

Caroline Rey-Salmon
Catherine Adamsbaum
Editors

Child Abuse

Diagnostic and Forensic
Considerations

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Caroline Rey-Salmon
Forensic Unit Hôtel Dieu Hospital
Paris, France

Catherine Adamsbaum
Pediatric Radiology Department
Hôpital de Bicêtre CHU Bicêtre AP-HP
Faculté de Médecine Paris Sud University
Le Kremlin Bicêtre, France

Translated by Nina Friedman and Anne Trager

Updated and translated from the French language edition: *Maltraitance chez l'enfant* by Caroline Rey-Salmon and Catherine Adamsbaum, © Lavoisier 2013. All Rights Reserved.

ISBN 978-3-319-65881-0 ISBN 978-3-319-65882-7 (eBook)
<https://doi.org/10.1007/978-3-319-65882-7>

Library of Congress Control Number: 2017958788

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Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword

This book had to be written—because of the content it brings and the perspectives it opens. It contains both knowledge and an example. It is, in both respects, profoundly useful.

First of all, it is the very type of book that every medical student should have read before starting his or her professional practice and that he or she should then keep at hand. With it, the slightest sign will attract his or her attention. The data in the book can then confirm the student's intuition and anxiety. The student will know what additional tests will be required, what emergency measures he or she will have to take to remove the child from immediate danger, and who to contact afterward.

The initiative of Doctors Caroline Rey-Salmon and Catherine Adamsbaum puts into perspective cross-curricular knowledge that can generate life-saving reflexes for the child.

The evocation, then, even purely medical and scientific, of the acts committed or likely to be committed on children immediately raises awareness: What society have we become where so many acts of this nature can still be committed?

If asked “what is the primary characteristic of our society today?” We would readily reply “disillusionment.” Is there no cause great enough to spark a need to take action and a passion to serve?

Have we forgotten the children?

Does the world still remember Aylan, that little child lying on a Greek beach in the position so typical of toddlers when they sleep, but plunged into a definitive and dreamless sleep while the murderous wave, now appeased, caressed his forehead in successive wavelets as if in a form of tragic and derisory request for forgiveness?

There are Aylans who die every day, not far away, at the ends of the earth, due to tragedies we hope will not attain us, but on the contrary, at our gate, without our knowing or seeing—perhaps simply because we do not know how to see them.

This book was written so that we learn to see them and, having discovered them, so that we know what to do.

It cannot be read without both shame and gratitude.

Shame, because this is what every human experiences at the discovery of one's own inhumanity. What is more abject than mistreating a child, wounding him, torturing him, physically or emotionally, killing him?

We would like to acknowledge, first of all, those doctors who overcome their emotions, doing what the vast majority of us would not imagine being able to

accomplish: receiving the victims, listening to them with care and the delicacy required by the state of terror and trauma in which the child is found, and at the same time using precision, objectivity, and mastery of a medical science that takes on a deeply human dimension. In this regard, we regret that this book does not include a chapter devoted to the frog—this toy, a mascot used by Dr. Rey-Salmon's team, is an example of a simple and effective way to make contact, which is always hard, with a child victim. When a girl shows on the frog the location of what she has experienced, she begins to express, communicate, and certainly exteriorize the horror suffered.

But unfortunately, more is needed. Too often, it is on the lifeless body of the child that we must look and perform an autopsy to know exactly why and under what circumstances the child lost her life.

And then we need to say it, to tell the judges how the drama unfolded.

It is also at this moment, when we bear witness to what the child has suffered, when we say what she had experienced through all the steps that are part of the procedure. It's in a certain way to give the floor to the child one last time—or perhaps even for the first time.

You really have to love the child to do that.

In all these dramas, there is one thing that is nearly constant. Once the revelation is made, we usually discover that it happened at our doorstep. How is it possible? How can we prevent such behaviors?

We believe that prevention in this area has two aspects: detection of situations of maltreatment and situations of risk.

Screening is in itself a preventive measure because it will have the effect of stopping the anonymity under which maltreatment is developing. It is also necessary to be able to decipher the signs and symptoms. Indeed, the child victim may be very young, perhaps only a few weeks or months old and unable to speak. Later, the child victim often blurs the tracks by protecting the abusers. So, the reality is undoubtedly discovered only by team action, when different specialties network and share the complementary nature of the different approaches.

But once the truth is discovered and the child treated or protected, the network must be extended. We must warn someone, but who? What service? At what moment?

In our opinion, another great merit of this book is that it calls on the non-physicians of the system in question to make an identical effort of transparency and decompartmentalization.

Decompartamentalization is here a master word. In this book, Doctors Caroline Rey-Salmon and Catherine Adamsbaum not only deal with the subject but also reveal its magnitude.

Indeed, although screening is a primary necessity, it nevertheless marks the lack of prevention in general. Prevention is not only about detecting the acts committed but also about the search for risk, that is to say, situations of risk, the discovery of which will make it possible to avoid the act becoming a reality. In many cases, going back in time to the causes of the tragedy reveals attitudes and behaviors after the fact

that could have been alerts had they been decoded. The reason they were missed is often the lack of communication.

This book, this joint work done by doctors, magistrates, and caregivers, men and women of good will, is an example of the approach we must all aim for.

Childhood in danger is above all childhood in pain. It deserves a complete reassessment of habits falsely considered as safe because they are the oldest. Justice must also do its part and look beyond the gates of its palaces.

It is rare for a child to suddenly become unhappy at the age of 10 years without having been unhappy at 5. It is rare that one is in revolt and violent at 10 without the roots of this behavior being in despair born perhaps even before the age of 5 and resulting from a situation of suffering. Bruises on the soul are more difficult to detect than those that mark the body. Often, the former precede the latter. Legislators should think about this and not pretend that filing a report is enough, nor should they hinder early education actions which can be successful.

In reality, acting as a network means sharing an interest, that of the child. This book is an example of the positive attitude to be adopted. Let us hope that the example is followed.

Yves Bot
Advocate General at the European Court of Justice,
Kirchberg, Luxembourg

Preface

The idea of this book comes from our deep wish to convey to younger generations our experience of child abuse. Maltreatment is unfortunately part of pediatric practice in all specialties. Our goal is to lift the denial that surrounds these situations throughout the world and to improve the knowledge of this public health issue, which is painful for everyone—for the young patients as well as for doctors and caregivers. Thus, the detection of subtle signs of abuse should make it possible to at least raise a suspicion of abuse, if not make the diagnosis of maltreatment with certainty, so as to protect the child as soon as possible from a fatal outcome or permanent sequelae that could result from repeated violence.

Our experience stems from our daily medical practice in pediatrics, forensics, and pediatric radiology and from our numerous discussions regarding infants and children possibly victims of abuse. This experience was then enriched by the many lessons learned through years of collaboration with judges, lawyers, investigators, and more generally all the actors of the legal world. Detailed statements from perpetrators of abuse have taught us a great deal about the mechanisms. They also taught us to be careful when dating traumatic events, which we know is often very difficult or impossible because the repetition of violence, whether it be physical or psychological, is unfortunately common.

The variety of topics covered and collaborators involved in this book illustrate the multidisciplinary approach needed when addressing abuse. Pediatricians, pediatric radiologists, neurologists, psychiatrists, pediatric surgeons, pathologists, forensic doctors, caregivers, etc. must work together and communicate with each other and also with social and judicial partners in order to achieve the quickest and most accurate assessment possible regarding the situation of the potentially abused child. The required cooperation between health providers and the justice system is exemplified in two chapters written by magistrates specifically involved in this area.

All of the teams contributing to this book are national or international references in the field of child, fetus, or adolescent abuse. We extend our deepest thanks to the authors and their colleagues for the confidence they have placed in this vast undertaking and for the time they were willing to devote to the writing and reading of these chapters.

This book has been updated and enriched since its French version was published in 2013 (*Maltraitance chez l'enfant*, Ed Lavoisier, Paris, France). We worked in the medical-legal unit of the Hôtel Dieu Hospital, Paris, and in the pediatric radiology

unit at Bicêtre Hospital, Faculté de Médecine Paris Sud University. We would like to thank all our colleagues and teams for the support they constantly provided throughout these long months of writing.

Yves Bot, presiding attorney general at the European Court of Justice, gave us the honor of writing the Preface of this book, illustrating the importance of communication across borders to better detect and therefore better prevent such violence. We express our sincere gratitude to him.

We also thank Professor Henri Nahum for his enthusiasm at the genesis of this project. And we express our appreciation to Lavoisier Editions and Fabienne Roulleaux and her team, especially Beatrice Brottier, who enabled the realization of this project.

We thank Pascale Zerbini for her effectiveness in preparing the manuscripts.

With this book, we wanted to address all aspects of child abuse, from the fetal period through adolescence, focusing on diagnostic elements, which are sometimes difficult to recognize or misleading, and on the differential diagnoses to consider. The book consists of general chapters, chapters dealing with organ damage, and chapters addressing specific issues, such as pathological lesions and postmortem imaging. Therapeutic approaches and main impacts are deliberately summarized. Some chapters are dedicated to epidemiological data, social data (domestic violence), and criminal data, which are key for any doctor involved in this context.

The book contains many illustrations, selected tables and practical examples, and key points summarized at the end of each chapter to enlighten the reader and highlight the fundamental ideas.

The bibliographies are deliberately short and focused mainly on books or basic articles.

This book is intended for any physician or caregiver interested in pediatrics, be they a student, a future specialist, or a practicing practitioner. Outside the medical community, any professional involved in situations of abuse may find answers to the questions that inevitably arise.

We hope that this book will meet readers' expectations and that it will spark the desire to go further and to pool knowledge from all disciplines, thus breaking down the walls between the involved professions for an improved response. Our goal is to protect children.

Paris, France

Caroline Rey-Salmon
Catherine Adamsbaum

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About the Editors

Doctor Caroline Rey-Salmon is a pediatrician and forensic scientist whose research especially focuses on child abuse, sexual and domestic violence. Having completed her degree in medicine at Paris 7 University in 1985, she is currently responsible for the forensic unit at Hôtel Dieu hospital, Assistance Publique de Paris (APHP). Further, Dr. Rey-Salmon is president of the “Center of Victimology for minors” a French association that promotes both the training of professionals and prevention of abuse in collaboration with judicial professionals, for more than 20 years.

Professor Catherine Adamsbaum is a pediatric radiologist and has been involved in the investigation of child abuse for more than 20 years. She received her degree in medicine from Paris 6 University in 1984. She served as General Secretary and later as President of the French Society of Pediatric Imaging (2003–2011). She currently chairs the department of pediatric radiology of Bicêtre Hospital, Assistance Publique de Paris (APHP), and is affiliated with Paris Sud University. In addition, Dr. Adamsbaum has co-chaired the taskforce on abuse of the European Society of Pediatric Radiology (ESPR) and she is currently Director of the National French Diploma program for child abuse.

Both authors are certified experts for the Court of Paris and the Supreme Court. They have developed valuable collaborations with other experts throughout the world in the field of child abuse. They authored a French-language book on child abuse in 2013 (Lavoisier Ed) that has since been awarded by the Prix Prescrire and is commonly used to train not only doctors, nurses, and medical students but also judges and prosecutors (Ecole de la Magistrature).

Working in collaboration with the National American Center on Shaken Baby Syndrome (NCSBS), they also co-organized the first international conference in Paris on shaken baby syndrome (2014).

List of Contributors

Catherine Adamsbaum Pediatric Radiology Department, CHU Bicêtre Assistance Publique Hôpitaux de Paris (APHP), Faculté de Médecine Paris Sud University, Le Kremlin Bicêtre, France

M. Balençon Cellule d'Accueil Spécialisé pour l'Enfance en Danger, CHU Rennes, Rennes Cedex, France

UMJ mineurs Hôtel Dieu-APHP, 1 place Parvis Notre Dame, 75181 Cedex 04 Paris, France

Sylvain Barbier Sainte Marie Magistrat, Paris, France

Marc Bellaïche Service de Gastro entérologie, Hôpital Robert Debré, Paris, France

T. Billette de Villemeur Neuropédiatrie, CHU Trousseau, Paris, France

Eleonore Blondiaux Service de Radiopédiatrie, CHU Trousseau, Paris, France

Ikram Bouacha Service d'exploration de la vision et neuro-ophtalmologie, Hôpital R. Salengro, CHRU Lille, Lille, France

Isabelle Bouvet-Drumare Service d'exploration de la vision et neuro-ophtalmologie, Hôpital R. Salengro, CHRU Lille, Lille, France

Sophie Cassier Faculté de Médecine Pierre et Marie Curie, Unité de chirurgie des Brûlés, Hôpital Trousseau, GH HUEP, AP-HP, Paris cedex 12, France

Kathia Chaumoitre Service d'Imagerie médicale, Hôpital Nord, Marseille, France

Claire Colmant Gynecology and Obstetrics, Kremlin Bicêtre Hospital, Le Kremlin Bicetre Cedex, France

Alexia Dabadie Service d'Imagerie Pédiatrique et Fœtale, Hôpital de la Timone Enfants, Marseille Cedex-5, France

Sabine Defoort-Dhellemmes Service d'exploration de la vision et neuro-ophtalmologie, Hôpital R. Salengro, CHRU Lille, Lille, France

Edouard Durand Child Protection Judge, Bobigny District Court, Bobigny, France

Ophélie Ferrant Unité Médico Judiciaire, Hôtel Dieu, Paris, France

Frédéric Gauthier Faculté de Médecine, Université Paris Sud, Orsay, France
Service de Chirurgie Pédiatrique, AP-HP, CHU Bicêtre, Le Kremlin Bicêtre Cedex, France

Guillaume Gorincour Service d'Imagerie Pédiatrique et Fœtale, Hôpital de la Timone Enfants, Marseille Cedex-5, France

Groupe de Recherche en Autopsie Virtuelle et Imagerie Thanatologique, Pôle d'Imagerie Médicale, Marseille, France

D. Haddad Service de chirurgie maxillo-faciale et plastique, Hôpital Necker-Enfants Malades, Paris, France

Faculté de Médecine Paris-Descartes, Université Paris 5, Paris, France

B. Husson Imagerie Pédiatrique, CHU Bicêtre, Le Kremlin Bicêtre, France

Jean-Luc Jouve Service d'Orthopédie infantile, Hôpital La Timone – Enfants, CHU Marseille, Aix-Marseille Université, Marseille, France

Camille Jung Service de Gastro entérologie, Hôpital Robert Debré, Paris, France

N. Kadlub Service de chirurgie maxillo-faciale et plastique, Hôpital Necker-Enfants Malades, Paris, France

Faculté de Médecine Paris-Descartes, Université Paris 5, Paris, France

A. Laurent Vannier Rééducation des Pathologies Neurologiques Acquises, Hôpitaux de St Maurice, St Maurice, France

Caroline Marks-Delesalle Service d'exploration de la vision et neuro-ophthalmologie, Hôpital R. Salengro, CHRU Lille, Lille, France

Marie Leray Psychopathologie de l'enfant et de l'adolescent, Hôpital Trousseau, Paris, France

Mireille Nathanson , Paris, France

Michel Panuel Service d'Imagerie Médicale, Hôpital Nord, CHU Marseille, Aix-Marseille Université, Marseille, France

Philippe Petit Service d'Imagerie Pédiatrique et Prénatale, Hôpital La Timone—Enfants, CHU Marseille, Aix-Marseille Université, Marseille, France

A. Picard Service de chirurgie maxillo-faciale et plastique, Hôpital Necker-Enfants Malades, Paris, France

Faculté de Médecine Paris-Descartes, Université Paris 5, Paris, France

Georges Picherot Child Abuse and Neglect Unit, Pediatrics Department, HME-CHU, Nantes, France

Marie-Dominique Piercecchi-Marti Service de Médecine Légale, Hôpital de la Timone, Marseille, France

M. Pierre Cellule d'Accueil Spécialisé pour l'Enfance en Danger, CHU Rennes, Rennes Cedex, France

Maryam Piram Pédiatrie Générale, CHU Bicêtre, Paris, France

Olivier Prodhomme Département de Radiologie Pédiatrique, Hôpital Arnaud de Villeneuve, Montpellier cedex 5, France

Maïa Proisy Service d'Imagerie Pédiatrique, CHU Rennes, Rennes, France

Caroline Rambaud Anatomie et Cytopathologie, Médecine Légale, CHU R Poincaré, Garches, France

Caroline Rey Salmon Unité Médico Judiciaire—Versailles, Paris, France

M. Roussey Cellule d'Accueil Spécialisé pour l'Enfance en Danger, CHU Rennes, Rennes Cedex, France

Marie-Victoire Sénat Gynecology and Obstetrics, Kremlin Bicêtre Hospital, Le Kremlin Bicetre Cedex, France

Isabelle Sec Medicolegal Department, Hôtel-Dieu, Paris, France

Vasili Smirnov Service d'exploration de la vision et neuro-ophtalmologie, Hôpital R. Salengro, CHRU Lille, Lille, France

Ikram Taleb-Arrada Département de Radiologie Pédiatrique, Hôpital Arnaud de Villeneuve, Montpellier cedex 5, France

Elise Thellier Gynecology and Obstetrics, Kremlin Bicêtre Hospital, Le Kremlin Bicetre Cedex, France

Barbara Tisseron Unité d'Accueil des Jeunes Victimes (UAJV) et Pédiatrie Adolescents, CH d'Orléans, Orléans, France

H. Touré Rééducation des Pathologies Neurologiques Acquises, Hôpitaux de St Maurice, St Maurice, France

Anne Tursz Cermes/Inserm U988—Site CNRS, Villejuif Cedex, France

Nathalie Vabres Child Abuse and Neglect Unit, Pediatrics Department, HME-CHU, Nantes, France

Patricia Vasseur UMJ Hôtel Dieu (APHP), Paris, France

M.P. Vazquez Service de chirurgie maxillo-faciale et plastique, Hôpital Necker-Enfants Malades, Paris, France

Faculté de Médecine Paris-Descartes, Université Paris 5, Paris, France

Corinne Veyrac Département de Radiologie Pédiatrique, Hôpital Arnaud de Villeneuve, Montpellier cedex 5, France

Matthieu Vinchon Service de neurochirurgie pédiatrique, Hôpital R. Salengro, CHRU Lille, Lille, France

Gilbert Vila Psychopathologie de l'enfant et de l'adolescent, Hôpital Trousseau, Paris, France

M. Zerah Neurochirurgie Pédiatrique, CHU Necker Enfants Malades, Paris, France

Caroline Rey-Salmon, Martine Balençon,
and Michel Roussey

“Among the facts so numerous and of such a diverse nature of which the medico-legal history of assault and battery is composed, there are some which form a quite separate group and which, hitherto left in the utmost obscurity, deserve for many reasons to be brought to light. I am referring to those acts described as abuse and ill-treatment, and more specifically of which children are victims of their parents, their masters, those who exercise more or less direct authority over them...”

—Ambroise TARDIEU, 1860.

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C. Rey-Salmon (✉)
Unité Médico Judiciaire—Hôtel Dieu, Paris, France
e-mail: caroline.rey@aphp.fr

M. Balençon • M. Roussey
Cellule d’Accueil Spécialisé pour l’Enfance en Danger—CHU Rennes,
16 Bd de Bulgarie, 35203 Rennes Cedex, France
e-mail: martine.balencon@chu-rennes.fr; michel.roussey@chu-rennes.fr

1.1 A Brief History of Abuse: The Place of Children in Society

Violence and neglect of children have always existed, in all latitudes, at all times, and many victims mark the history of our civilization. Recently, multiple fractures were found on the skeleton of an abused child, 2–3 years of age, from Ancient Egypt [1]. To obtain favors from the gods or to appease their anger, children were offered during ritual sacrifices. The case of the city of Sparta is well known, where fragile or handicapped children were thrown off the cliff of Mount Taygetus. Rome claimed the omnipotence of the *Pater familias* over his family who was solely responsible for all choices concerning the treatment and punishment of children. Others were walled alive in the foundations of the new cities to ensure their stability. Disabled or illegitimate newborns were abandoned in isolated places away from the cities to be devoured by wild beasts. Soranus, a physician at Ephesus around 200 BC, counselled parents on “How to recognize children worth raising.” Parents had the right of life and death over their children and little attention was given to the loss of a child.

Taking an ancient text as an example, in the Bible, Solomon wrote “He who spares his rod hates his son, but he who loves him disciplines him promptly” (Proverbs 13:24), which led undoubtedly to the saying, “Spare the rod, spoil the child.” Psalm 137:9 reads: “Happy is the one who seizes your infants and dashes them against the rocks.”

Plato, the fourth-century Greek philosopher, said: “the child should obey and for good, otherwise it will be rectified by threats and blows like a piece of wood ... Of wild animals, a child is the most difficult to take in hand: for insofar as he most of all has a spring of reasoning that has not yet been channeled, he becomes cunning and shrewd and the most hubristic of wild animals. The child must be tightly bound first of all when he leaves his mother and his nurses, he must be closely supervised by masters, whatever their function. He is also a slave whom every free man can chastise if some fault has been committed.” Aristotle, another Greek philosopher of the same time, recommended “we cannot learn without pain ... Of course, if the child is not behaving as he should, he must be reprimanded and punished.” But in the fourth-century AD, Oribasius, a Greek physician, and St. Augustine expressed their disapproval of corporal punishment of children, albeit with some nuances.

During the Middle Ages, the oppression of serfs under feudal regime, the poverty they were subjected to in order to survive, and cycles of famine and epidemics account for a multiplication of child abandonment and numerous infanticides, especially impacting girls, who were regarded as unnecessary mouths to feed. Infant mortality was commonplace in medieval society because there was no consciousness of the child’s particularity; children were considered adults in miniature. During the fifteenth century, it is estimated that 65% of children died before the age of 5, the mortality rate reaching 95% for children in foster care or entrusted to religious institutions [2].

In 1639, St. Vincent de Paul set about limiting infanticides and improving the survival of orphaned and abandoned children by opening the Children’s Hospital in Paris with the Sisters of Charity. The “tower” system was created, consisting of a hollow wooden cylinder, swiveling on itself and placed in a wall recess, where women could anonymously leave their children.

In the seventeenth century, the penal system applied in the same way to children and adults. A child guilty of theft could be imprisoned, sent to the galleys, or relegated to the penal colonies. A child's public execution served primarily as a deterrent to others.

The eighteenth century brought a change of perspective regarding childhood with fundamental innocence, Rousseau's "natural" child, and the fact that children are considered the wealth of the family, society, and its future.

This would not prevent the exploitation of children at work, which reached its peak at the time of the Industrial Revolution. Charles Dickens (1812–1870) remarkably described the condition of these young workers, often chained more than 12 h a day to their machine.

In the United States, slavery provided cheap labor for industrial growth, and the children of slaves were considered no more or less than livestock.

The twentieth century has, meanwhile, demonstrated its ability to exterminate children through several genocides. Today, children around the world are being brutalized, murdered, exploited, prostituted, hungered, raped, sold, circumcised, etc. However, great progress has been made in accepting the concept of child abuse and therefore of their recognition [3].

1.2 History of Medical Awareness of Ill-Treatment: A Long Denial

Maltreatment has long been ignored, due to several factors. Until relatively recent times, children were considered incomplete and inferior beings and were subjected to the unlimited rights of parental authority. Children were thus the exclusive "property" of the private family sphere. In the seventeenth century, under the influence of a moralizing trend encouraged by the church and state, and thanks to the concomitant decline in infant mortality, the family went nuclear, focusing the child, who now had a real potential of survival. This mutation linked to the educational process was accompanied by emotional overinvestment: the child became progressively the focus of attention.

The lack of recognition of abuse is also linked to other factors. Infantile diseases, particularly infectious diseases, had long been responsible for considerable mortality among children, and maltreatment occupied a relatively limited place numerically. In addition, denial was common, and it was extremely difficult for the social body to consider that parents were engaging in violence against their children. Doctors themselves, including pediatricians, refused to admit the reality of ill-treatment.

1.2.1 Pioneers: Tardieu

In the first book on pediatrics, *Practica Puerorum*, written in the year 900, a Persian physician, Rhazes, already attributed some children's hernia to beatings [4]. In the seventeenth century, an Italian pathologist Zacchias Paulus published a Latin work entitled *Quaestiones Medico-Legales*, which described the damage caused by rope

lashing and whipping from masters abusing their authority [5]. These practices were denounced by another English physician and philosopher, John Locke, in 1693, then in 1800 by James Parkinson, who is better known for the disease that bears his name than for his work in which he denounced severe punishment, and especially blows to the heads of young children, which could lead to hydrocephalus [6, 7].

But it is in France, and more particularly in forensics departments, that the pioneering work on abuse was carried out.

Ambroise Tardieu held the Chair of Forensic Medicine in Paris in 1860 when he published a long article entitled “Forensic study of abuse and poor treatment of children” [8]. Thirty-seven cases were reported, more than half of which are children under 5 years of age. The “Tardieu spots” or subpleural ecchymoses are described at autopsy after the homicide of an infant by mechanical asphyxiation. He warned his colleagues against the whimsical explanations made to try to explain children’s wounds. He mentioned certain aspects that he considers typical of lesions related to maltreatment: multiple and disseminated wounds, specific localizations (face, limbs, posterior part of the trunk), bruising of varied coloring, and multiple burns. Fractures of the skull with effusions of blood on the brain were the main causes of death [9]. The clinical descriptions are strikingly modern.

A prolific writer, Ambroise Tardieu, was interested in practically all aspects of child abuse, the tough working conditions in mines and factories, and the consequences on their physical and mental health (stunted growth and puberty, bodily deformities, metal poisoning, accidents, sexual abuse, and deep demoralization) [4]. He was also the first to study sexual abuse exhaustively with the analysis of 632 cases including 525 girls under 15 years of age [10]. One of his colleagues, also in forensics, in Rennes, Adolphe Toulmouche, had reported in 1853 the cases of four orphans whipped to death by their guardian and cases of 26 sexually abused children [11]. Conscious of his failure to convince his contemporaries, Ambroise Tardieu made a final attempt by reprinting his 1860 article in his last book published the year of his death in 1879 [12].

Still in the nineteenth century, but the United States this time, it is interesting to review the story of Mary Ellen Wilson told in 1874 by Jean Labbé [4]. Mary Ellen was an 11-year-old girl tormented by her nurse, with whom she had lived since the age of 18 months. Thanks to the intervention of missionaries, she was removed from this nurse, who was sentenced to 1 year of forced labor. For this to happen, it took the help of the lawyer of the Society for the Prevention of Cruelty to Animals, created in New York in 1866, after police and private charity organizations declared their powerlessness. It was as a result of this event that the New York Society for the Prevention of Cruelty to Children was established. Similar groups multiplied in the United States and then developed in England, France, Germany, and Italy. Their action was at the origin of the first laws allowing states to intervene in families.

Under the impetus of forensic pathologists, several pieces of legislation were drafted to try to ensure the protection of minors. It was a radical change in the vision of childhood, which until then belonged to the private family sphere. A first limit to the exorbitant rights of parents was instituted in France with the law of 24 July 1889 on the protection of children who are abused and morally abandoned.

The civil court thus had the power to deprive parents of their paternal power. Violence against children was punishable and prostitution of minors condemned. The criminal irresponsibility of minors under 13 was also affirmed by legislation prohibiting their imprisonment. However, the multiplicity of texts, giving competence to different jurisdictions, did not yet make it possible to effectively organize the protection of children in danger. Above all, society was not ready to raise the curtain of denial that surrounded adult brutality against children, and the pioneering works would soon fall into oblivion for many years.

1.2.2 The First Half of the Twentieth Century

During the first half of the twentieth century, pediatricians struggled to find medically acceptable explanations for the injuries they observed. Explanations included rickets, scurvy, constitutional bone fragility, syphilis, or “idiopathic” origins, all these hypotheses masking ignorance and persistent denial.

In 1929, French forensics doctor Pierre Parisot and pediatrician Louis Caussade published “Abuse against children” [13], which reported the analysis of 1937 cases of physical maltreatment. But this text, written in French, did not receive wide circulation and these authors had no more success than Tardieu.

Already suspected by Ambroise Paré, the traumatic origin of subdural hematoma was confirmed by Sherwood in 1930 [14], who described its association with long bone fractures. In particular, he described the observation of a 9-month-old girl with a fracture of the radius, subdural hematoma, retinal hemorrhage, and optic atrophy but did not provide any real explanation for the trauma. In 1939, neurosurgeons Ingraham and Heyl [15] assert the traumatic nature of infant subdural hematoma but do not go so far as to speak of inflicted trauma. In 1944, to explain the mechanism of subdural hematoma, Ingraham and Matson [16] mention a blow to the head or impact of any other nature unnoticed or kept secret by parents. The cause of the trauma was still not clearly stated.

In the 1940s, the development of new radiographic techniques allowed for a decisive shift in the recognition of child abuse. In 1946, John Caffey [17], one of the “fathers” of pediatric radiology, reported cases of six babies with a combination of subdural hematoma and long bone fractures; he was convinced of the traumatic origin of the lesions, even though it was not reported by the parents, but he did not dare to denounce them for fear of possible legal proceedings [4].

1.2.3 A Turning Point, the 1950: Silverman

In 1953, a student of John Caffey, Frederic Silverman, also a pediatric radiologist, described bone fractures with no traumatic history in children with radiologically normal bone structure [18]. It was the first time that a doctor dared to say that parents could voluntarily inflict serious injuries on their child [4]. Thanks to the pediatric imagery, abusive treatment finally came out of the shadows.

Paul Woolley and Williams Evans [19] in turn report, in 1955, 12 cases of fractures in young children that do not repeat when the children are removed from their family environment. In 1957, Caffey [20] reiterates his original article and insists on the unrecognized traumatic origin of fractures without traumatic context. In 1958, Fisher published the skeletal manifestations of parent-induced trauma in infants and children [21].

1.2.4 Another Decisive Turning Point, the 1960s: Kempe

But again, radiologists specializing in pediatrics have the greatest difficulty convincing their clinical colleagues of the reality of abuse. The man who truly brought child abuse into the awareness of the entire medical community was the Denver pediatrician Henry C. Kempe, who made a presentation at the annual meeting of the American Academy of Pediatrics in 1961, followed in 1962 by the publication with his friend Silverman and the child psychiatrist Brand F. Steele of the “battered child syndrome” [22]. They report 302 cases of child abuse victims in 71 US hospitals for 1 year and 447 additional cases from Crown prosecutors. They describe the characteristics of this syndrome like any other medical syndrome that medical students are used to learning. They write: “the battered child syndrome should be routinely considered in any child exhibiting not only bruises, fractures, or subdural hematoma but also when the size or type of injury is unrelated to the circumstances mentioned by the parents.” They go even further in suggesting other types of abuse: malnutrition, stunting, drug, or criminal intoxication. They also talk about the epidemiology of the problem: incidence of the syndrome in young children, severity of certain cases, frequency of recurrences, and sequelae. They also seek to “explain the reasons for medical repugnance,” i.e., physicians’ refusal to imagine parents abusing their children and their refusal to take an initiative with parents. They develop a maintenance technique, not for blame but to assess the underlying reasons for their psychological disturbance.

Combining a pediatrician, a radiologist, and a child psychiatrist, this article contains the seeds for many subjects of reflection that would be explored later. It was the starting point in the United States of a whole medical, psychiatric, and sociological literature. The article was accompanied by an editorial, in which the problem was considered serious enough to warrant mandatory reporting [23]. The first laws requiring the reporting of physical violence were voted in all American states within 5 years.

In 1965, a new category “child abuse” was listed in *Index Medicus*. In 1976, the International Society for Prevention of Child Abuse and Neglect (ISPCAN) was founded in the United States.

1.2.5 In France: Progressive Recognition—Neimann, Straus, and Manciaux

It took several years for the recognition of this syndrome to be accepted in France. The pediatric radiologists of the Children’s Hospital of Paris, Clément Fauré and Jacques Lefebvre [24], recount the difficulties they faced to get this diagnosis

accepted by their pediatric colleagues, who continued to believe the explanations of the parents and spoke of bone vulnerability probably of congenital origin [25]. In 1960, a case of subdural hematoma associated with fractures in an infant was published as if it was a rare case of an undetermined pathology [26].

The first work of importance recognizing abuse exerted on children comes from the team of Nathan Neimann in Nancy with a series of 79 cases between 1958 and 1965, in which only one had been diagnosed correctly by the referring physician. This series was published several times [27, 28]. Neimann had published an article in 1958 [29], before that of Kempe, but it was written in French, which explains the relatively modest international circulation. Next came Pierre Straus [30], which covered 46 cases from 1960 to 1967.

Together, Neimann and Straus made it possible to recognize the phenomenon of child abuse in France. These two teams are both associated in an article in 1968 [31] and later with Michel Manciaux, a student of Neimann, in a joint study carried out in 1972 and 1975 [32].

Subsequently, work and publications increased and awareness grew rapidly among health and social workers, followed by the public authorities (governmental campaign touching 50,000 abused children, talk about it, it is already acting) and then the general public. This was aided by a number of professional and voluntary associations, with notably the creation of the French Association for Information and Research on Child Abuse (Afirem) in 1979 by Pierre Straus [32].

1.2.6 Other Forms of Abuse Are so Pinpointed and Described

- *The so-called shaken baby syndrome*

Already in 200 BC, Soranus of Ephesus spoke very clearly the dangers of shaking a baby and recommended “not to entrust a newborn to women who are angry or have bad character because they can drop or shake dangerously.” In 1682, a doctor from Geneva, Bonnet, wrote about bruises on the head of infants that may have been responsible for intracranial hemorrhage: “this may be the fault of the nurse who drops child or throws him against some something hard” [33]. In 1823, a book of *Advice to Young Mothers Raising Children* written by a London grandmother states that “violent blows to the head can result in water production within the brain and how some parents expressed their anger toward a child by violently shaking can cause serious consequences” [4]. This corresponds to the hydrocephalus described by Parkinson in 1800 [7]. Modern medicine often explains with the scientific arguments that technological advances allow what those before us suspected.

The cerebral trauma in abused children was then described in children projected against a hard surface or that fell, associated with skin injuries and/or fractures.

Two German pathologists show evidence of subdural hematomas in infant deaths. In 1891, Dohle finds 14% subdural hematoma in 395 autopsies of children under 1 year, and in a series of 6000 autopsies of children under 2 years, in

1914, Kovitz finds 14% subdural hematoma in those aged 1–3 months, 10% in those aged 3–12 months, and 9% in the 1–2 years old.

Othmar Purtscher, an Austrian ophthalmologist, described in 1910 and published in 1912 [34] a paper on retinal hemorrhages in children who had their chests squeezed, sometimes leading to rib fractures and hypertension in the retina vessels. The term shaken baby was not used, but the description corresponds perfectly.

However, it is permissible to give SBS authorship to an English neurosurgeon, Norman Guthkelch, who in 1971 was the first to provide an explanation for subdural hematomas associated with fractures with no external signs of violence by invoking the causal mechanism of shaking the baby [35]. In 1972, John Caffey [36] would talk about the shaken baby syndrome and tell the story of a nurse who had admitted shaking a dozen children for 9 years to calm them down; two of them were dead. For one, at 11 weeks of age, she confessed that as the child refused to drink her bottle, she caught him by both arms and shook until his head was inert and he calmed down. The autopsy did not reveal fractures but uncovered a bilateral subdural hematoma [37].

- *Munchausen syndrome by proxy* described by Roy Meadow in 1977 [38] in which parents, most often the mother, are responsible for an alleged or provoked pathology.
- *Mental or emotional deficiencies* [39] including psychosocial dwarfism [40].
- *Sexual abuse* in children long to come to light because of the difficulty of representing this form of abuse [41].
- *Institutional violence* which the child psychiatrist Stanislas Tomkiewicz [42] denounced as “any act committed in or by an institution, or lack of action, which causes a child’s physical or psychological suffering and/or interferes with his further development.”

There is an increase in the number of publications that allow for the recognition of other forms of abuse: voluntary refusal of parental care for their children, violence between minors, harassment in school, sectarian education, fetal abuse, child soldier, child witness and victim of conjugal violence, ill-treatment linked to new information and communication technologies, and more.

Conclusion

This back and forth between Europe and the United States over a 100 years is illustrated by the names given to the various maltreatment syndromes. Thus, in France, although initially discovered by Ambroise Tardieu, the discovery of bone fractures of different ages caused by inflicted trauma was called “Silverman syndrome” to honor the famous pediatric radiologist, invited by pediatricians in Paris to give lectures. This term, which should be reserved for the observation of bone fractures of different ages, is sometimes misused in other maltreatment syndromes. At the same time, Frederic Silverman, for the sake of truth, suggested the use of the term “Ambroise Tardieu syndrome” [43] in American journals.

The problem of naming the different types of maltreatment persists, as evidenced by the multiplicity of terms used: abuse, non-accidental syndromes, inflicted injuries, abusive head trauma, shaken baby syndrome, etc.

However, very gradually, there has been a real mobilization of health professionals and the social body for the cause of children around the concept of abusive treatment of children and adolescents.

The concern to protect children became international in scope on 20 November 1989 with the adoption by the General Assembly of the United Nations of a convention on the rights of the child. This convention is an illustration of the collective awareness of the need for better protection of children throughout the world.

Historically, the denial of the phenomenon of child abuse has existed even in the medical world. It took the stubbornness of a few doctors on both sides of the Atlantic to acknowledge the existence of real pathologies caused by those close to the child. Even today, this denial exists among certain “family” doctors for whom it is difficult to identify children who are victims of abuse and neglect. It is often simpler to accept the story reported by the parents. This denial is factorial: actual ignorance of the phenomenon or inability to accept an inconvenient truth, especially if the family is known to the doctor. History makes it possible to become aware of the reality of the facts and justifies that it be taught to younger generations.

Key Points

- Violence and negligence against children have always existed still in a ubiquitous and timeless manner.
- The lack of recognition of abuse before the twentieth century was linked to high infant mortality and denial.
- Children were considered the exclusive “property” of parents subject to unrestricted parental authority until the twentieth century.
- In 1860, Ambroise Tardieu, a French forensic pathologist, published an article entitled “Medico-legal study of abuse and poor treatment of children.”
- The French law of 24 July 1889 on the protection of abused children gives the civil court the power to remove parental power.
- X-rays allowed the recognition of child abuse, thanks to major publications by the pediatric radiologists John Caffey and Frederic Silverman in the 1940s.
- Shaken baby syndrome was described by Caffey in 1972 and the Munchausen syndrome by proxy by Meadow in 1977.
- The notion of child maltreatment was introduced into the Act of 10 July 1989 in France.
- Child protection expanded internationally with the adoption by the General Assembly of the United Nations of a Convention of the Rights of the Child on 20 November 1989.

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Definitions and an Epidemiological Approach to the Frequency of Child Abuse

2

Anne Tursz

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In most countries, including France, the epidemiology of child abuse is nearly nonexistent, especially as concerns measuring the size of the problem. This difficulty in calculating frequency is largely linked to the absence of any real consensus on the definition of abuse, both internationally and nationally.

The most easily read definition for the public and the media, but also for health professionals, is the one describing abuse as a serious chronic illness with early onset, made up of a group of clearly identified pathologies: physical abuse, sexual violence, psychological abuse and negligence. In fact, the definition of child abuse should be broadened and include all situations in which the fundamental needs of infants and young children are not recognized. For example, we know that early and

A. Tursz

Cermes/Inserm U988—Site CNRS, 7 rue Guy Môquet, 94801 Villejuif Cedex, France

e-mail: tursz@vjf.cnrs.fr

massive emotional deprivation has a harmful effect on a child's development. Indeed, international scientific literature shows that long-term consequences of abuse are similar in all countries and emphasizes the seriousness of psychological violence, neglect and cases of emotional deprivation, even in the absence of physical abuse. Under-investigation, non-diagnosis, no reporting or dissimulation of child abuse lead to a major risk of repetition of violence.

What do we presently know about the extent, causes and consequences of child abuse? In fact, we know very little. In this chapter, we propose to consider the epidemiological approach to the frequency of child abuse in France as an example. Data from other countries show the rarity and even the absence of studies on child abuse in defined populations. For example, studies on abusive head trauma are based on data from limited and varied sources (forensic medicine, medical facilities, the press, etc.) [1].

Public authorities regularly make quasi-ritualistic statements on the seriousness of the problem and the necessity of reducing it, but there is no possibility of basing strategies of prevention, screening or care on reliable statistical and epidemiological data. In fact, for the wider public and even for some professionals, the principal source of information remains the media, and child abuse is reduced to the juxtaposition of anecdotal news items. These conceal a very real problem of society and public health and contribute to relieving parents that raise their children in a violent manner of any responsibility since they 'don't go that far'!

As with any pathology, the epidemiology of child abuse has three principal study objectives: calculate the frequency, identify risk factors and determine the long-term consequences. Reaching these objectives assumes in the first place that an agreed-upon definition of this pathology exists, which is far from being obvious. What are we talking about when we speak of child abuse?

2.1 Definitions

Until the law of March 5, 2007, reforming child protection¹ services, definitions used by the Decentralized Observatory of Social Action (ODAS) were the ones most used, and they are not obsolete [2]. Three groups of children are identified:

- 'Children at risk of abuse: any child living in conditions that endanger its health, safety, morality, education or care, without necessarily being abused
- Abused child: any child who is a victim of physical violence, sexual abuse, psychological violence or serious neglect with severe consequences for his or her physical and psychological development
- Child in danger: a category grouping together the two preceding ones'

¹ In France, child protection is decentralized at the level of the Department (basic territorial administrative unit) which is run by the General Council. Since the 2007 law, child protection activities are under the responsibility of the CRIP (Departmental Unit for Gathering Information of Concern), and statistical data are compiled by the Departmental Observatories for Child Protection (ODPE).

The definition used in articles recently published by the journal *Lancet*, which sets the average frequency of child abuse at 10% of children in several high-income countries [3], is as follows: ‘Any act of commission or omission by a parent or other caregiver that results in harm, potential for harm or threat of harm to a child. Harm does not need to be intended’ (p. 8). We can see that, compared with this definition, the French definition of ‘child abuse’ is very restrictive and that a child deemed ‘at risk’ is already a victim of a type of abuse. This is the point of view that prevailed in discussions of the National Committee on Child Protection during the preparation of the law of March 2007: the notion of danger took precedence over that of abuse.

The 2007 law [4] also introduced the notion of information préoccupante (IP) or ‘information of concern’, presently defined as ‘any information, including medical, which may lead to the fear that a child is in a situation of danger or in risk of danger, that it may be in need of assistance, and which should be communicated to the departmental unit for evaluation and follow-up’ [5]. While the IP does not define the abuse or danger, but should rather be seen as a professional tool for evaluating the seriousness of a situation—not to be confused with confirmed abuse, which must be reported to judicial authorities—it is clear nevertheless that this IP refers to a definition of danger.

In fact, there are several reasons to use a broad definition of abuse: (1) the international scientific literature shows that the effects of repeated humiliations (‘you’re worthless; you’re brainless; you’ll never amount to anything; etc.’) are often more harmful than blows in the long run, especially in terms of socialization [6]; (2) publications also point out the seriousness of neglect and isolated emotional deprivation, without physical abuse; and (3) homicide is not an extreme form of abuse, but rather abuse that’s gone wrong. When abusive parents are compared with parents who are perpetrators of filicide, they show common characteristics. A chronically beaten child goes suddenly from being a victim of abuse to being a victim of homicide. It can thus be stated without hesitation that, when it comes to maltreatment, there is no such thing as harmlessness, and a definition of abuse should be based on recognition of the needs of the child. It is well known that young children can only grow, develop and become socialized and responsible adults when their physical, affective and educational needs are met by those people that take care of them, generally their parents. Disregarding this rule thus constitutes a form of maltreatment, which is confirmed by the daily experience of those caring for children who are victims of abuse.

It is thus necessary to conceptualize child abuse using two complementary approaches: that of meeting (or not meeting) the basic needs of the child, which leads to reflections on primary prevention (the earliest possible screening for risk factors and recognition of danger before the advent of abuse itself), and that of a serious chronic disease, an approach that is more meaningful for medical professionals and the public.

The following text will specifically examine the evaluation of frequency, to the exclusion of the identification of risk factors and long-term consequences. Indeed, there is a real need to understand the statistical situation in France (method of gathering information, institutions involved) in order to consider the means needed to truly know the magnitude of the problem. On the other hand, risk factors and long-term consequences are not very different from one country to another and are the subject of a very rich scientific literature, most of which is in English.

2.2 The Estimation of Frequency

The obligation to maintain epidemiological data on abuse is over 20 years old, since it was the law of July 10, 1989, relative to the prevention of abuse to minors and the protection of children [7] that set up a departmental system of reporting abuse [and] entrusted the General Council with developing this ‘a permanent system to enable gathering information on abused minors’ using a criterion other than that of ‘danger’: that of ‘abuse’. As noted above, the law of March 5, 2007, expands the activities of children’s social services to minors and their families facing ‘difficulties that endanger the health, safety and morality of these minors or seriously jeopardize their education or their physical, affective, intellectual and social development’. Depending on what information source is consulted, reference is thus made either to danger or to abuse or to both, a point that will be systematically specified in what follows.

2.2.1 The Most Recent Official Figures Available

There are several public institutions responsible for compiling data on endangered or abused children [8]:

- Within the framework of decentralization and up until 2006, the Decentralized Observatory of Social Action (ODAS) managed statistics on children in danger. According to that organization, there were 98,000 children in danger in 2006, 19,000 of whom were abused [9].
- The tenth report of the National Observatory of Children in Danger (ONED) [10], dated May 2015, indicates that as of December 31, 2012, 284,050 children under 18 years of age benefited from at least one administrative or judicial measure, giving a rate of 1.95% for that age category (from 1 to 3.8%, depending on the Department).
- According to the National Observatory on Delinquency (OND), which has become the National Observatory on Delinquency and Penal Actions (ONDRP), statistics from the police and national gendarmerie noted 6038 cases of ‘abuse and abandonment of children under 15 years of age’ in 1996 and 17,889 cases in 2011 [11].

As concerns fatal abuse, in 2011 the ONDRP counted 58 cases of homicide of children under 15 years of age, and the CépiDc at Inserm² counted 41 cases.

Some of these figures give an idea of the seriousness of the problem. Thus, nearly 2% of the general population of minors less than 18 years old is cared for by social assistance for children (ASE), a worrying percentage. And what is to be said concerning figures for abused children identified in police statistics that have tripled between 1996 and 2011?

²CépiDc—Inserm: Center for the epidemiology of medical causes of death of the National Institute of Health and Medical Research. This is the Inserm service that ensures preparation of national mortality statistics.

However, all calculations of rates of abused children (depending on the data source) in the population at risk end up with figures of around 1 for 1000, very low rates and hardly realistic given what we know about abuse in other countries of comparable levels of development [3]. In addition, it is clear that the figures do not agree with each other, as can be seen immediately in figures of homicides according to their two official sources, with the figure from Inserm being lower than that from the OND/ONDRP for each year [11, 12].

2.2.2 The Lack of Consistency in the Data

This is clear from the figures in Table 2.1. It reports figures from 2002 since that is the last year for which a comparison between data sources can be made, as 2001–2002 was the last school year for which national figures are available.

Thus, we see much higher numbers proposed by the National Telephone Answering Service for Abused Children (Snatem, n° 119) than for any other information source, which is easily explained by the functioning of this service, whose anonymous calling system is responsible for numerous duplications, to which are added silent calls, prank calls or slanderous accusations. One can see as well that figures from within the same institution, Ministry of National Education, do not agree. Data for the second level of teaching are not the same depending on whether the report of abuse was made by a physician or by a social worker. In addition, there is no guarantee that the majority of cases are common to the two sources, medical and social. How can such disagreement be explained?

2.2.3 The Causes of Inconsistency

There are several causes and we can principally cite:

- Variable definitions (danger or abuse, etc.). Thus, referring to Table 2.1, National Education and the Snatem use those applied by ODAS; figures presented by the police and national gendarmerie refer to the penal offences of ‘violence, abuse

Table 2.1 Children in danger and abused: Number of cases according to information source in 2002 (school year 2001–2002 for data from Ministry of National Education)

Sources of information	Children in danger (N)	Abused children (N)
National education		
Physicians	44,980	16,103
<i>First level</i>	16,024	8340
<i>Second level</i>	28,956	7763
Social workers (second level)	14,947	6942
Snatem		31,913
ODAS	86,000	18,500
Police and national gendarmerie		27,109 ^a

^aThat is, 10,064 abused and abandoned children under 15 years of age, plus 17,045 cases of sexual violence of minors under 18 years of age

and abandonment of children under 15 years of age’ and ‘sexual violence on minors under 18 years of age’.

- Different units of observation according to the source: children (National Education), the complaint (the police), the telephone call (Snatem) and the report of abuse (ODAS).
- Different age categories: students at the first and second levels for National Education, minors under 18 years of age and young adults 18–21 years old for the Snatem and ODAS, and, for the police and the national gendarmerie, minors under 15 years of age for abuse and those under 18 years of age for sexual violence.
- Inclusion of diverse geographical zones. For the four sources listed in Table 2.1, in theory these are national data, but with non-negligible variations: all of the school districts for National Education (including overseas departments) calls to 119 in the national territory for the Snatem, 93 departments out of 100 for ODAS and metropolitan France for the police and national gendarmerie.

All these problems result both in the missing of cases and double counting, as well as in trends impossible to understand (real increase or decrease in the number of cases or changes in practice, notably in reporting abuse). The proposed rates appear in fact to be of debateable value and of uncertain variability. Thus, as concerns children in danger, rates go from 2.7 to 11.8 per 1000 depending on the departments, according to ODAS in 2006 [9]. Finally, only data that are relatively old and that have not been updated are available in France.

2.2.4 Attempts at Better Knowledge of Statistics

The National Observatory of Children in Danger (ONED) was created in 2004 with the specific mission of contributing ‘to collecting and analysing data and studies on abuse.... [...] to giving consistency to different data and information, to improving knowledge of phenomena of abuse’.

In its 2005 report [13], among the goals declared by ONED were ‘counting children in danger and analysing changes in that population’ and ‘constituting a data base enabling the construction of representative samples for more specific studies’.

Following the law of March 2007, the CRIP was created to better coordinate and centralize data. Problems of double counting and missed cases should thus be avoided since the courts are required to send a copy to the CRIP of reports of abuse made directly to the judicial system. Finally, the law reinforces the role of ONED in the national system of numerical data production by instituting the obligation of transmitting data produced by the departmental observatories of child protection (ODPE).

2.2.5 The Present Situation: A Decline in Knowledge About the Problem

In spite of the ambitious goals of ONED, in spite of legal requirements, we are presently confronted with a veritable desert as concerns statistics. Indeed, as we have

seen, the last national figures date from 2006 for ODAS and 2002 for National Education. As concerns ONED, it has not yet been able to fulfil its role as a statistical observatory, which requires laborious work of compilation and organization of statistical data received from all the pertinent sources. These include the CRIPs, ODPEs and general councils, the judicial sector and the health sector (notably hospitals and the C epiDc).

A large part of the seventh report of ONED in March 2012 [5] is devoted to results of a study on changes in IPs. There were no local or national figures on IPs in the report, but rather a very detailed reflection on the biases encountered. Thus, it is pointed out that 20% of departments count only a single IP for one sibling group. It also seems that the number of IPs increased between 2007 and 2010, mainly because of better visibility of the CRIP and the development of partnerships (62% of the causes for the increase). However, one cannot help but note that, for the time being, there are no statistical data that can be compared with those furnished up until 2006 by ODAS.

While there is information in the ONDRP report for 2011 [14] on changes between 2005 and 2010 on the number of minors implicated in violence towards others, on the other hand, it is more difficult to find data on minors as victims. This situation is not recent, and access to statistics on homicides of children since the 2007 report has become complicated, as is the case for statistics on sexual violence towards minors since the report of 2008.

The Office of Health, Social Action and Safety, in the General Directorate of School Teaching (DGESCO) in the Ministry of National Education produced a report entitled 'Educational, social and health policy in favour of students: Some statistical data, 2008–2009'. It is the most recent statistical document on the health of students. The results of the obligatory sixth year health check-up show that, among the pathologies identified, 8% were 'psychopathologies,' and abuse was not mentioned. In the chapter on child protection, it is noted that there were transmissions of an IP or a report of abuse for 31,866 children during the school year or a rate of 3.2‰ (from 1.7 to 5.2‰ depending on the school districts). Seventy-six percent of transmissions were to the president of the General Council. Selection bias is probable. Thus, the highest rates are noted in middle schools and Regional Centres for Adapted Learning (EREA), and the lowest are in preschools and elementary schools, which is surprising considering that abuse usually affects the youngest children [15]. Similarly, the overrepresentation of single-parent families may be explained by the fact that danger is looked for in them more often than in other families or even that they are considered as constituting a dangerous situation as such [16]. Thus, whether it concerns the EREA or single-parent families, one has the feeling that one finds what one looks for, based on stereotypes circulated as much by professionals as by the media!

This report for 2008–2009 cannot be found on the Ministry's site, nor can any statistical data on health, a situation that prevents comparison with much more detailed figures from the years prior to 2002. On the general site of the Ministry, as well as on Eduscol, a site intended for 'informing and accompanying education professionals', but also open to the general public, there is considerable information relative to the protection of children (practical advice for screening, numerous

references to laws and circulars as well as to articles in the Code of Education). However, it is not possible to obtain statistical data on children in danger and abused. This seems surprising since National Education is the main transmitter of information of concern, and one-third of IPs originates with the school sector. The only statistics' concern is academic results.

According to CépiDc data, child mortality from homicides appears to have decreased recently [12]. Thus, the average annual number of homicides has gone from 51 for the 2000–2006 period to 35 for the 2007–2013 period among children less than 15 years old. These figures are, respectively, 16 and 11 for the first year of life. Since the recommendations from the High Authority on Health (HAS) for managing unexpected deaths of an under-two infant [17] have not yet actually been evaluated by the 'national' study that took place in only 17 departments that volunteered—representing 38.5% of births in France [18]—their role in this decrease in infant homicides is not known. One fact remains constant, the overrepresentation of infants under 1 year old among those dying from homicide, and this is a long-standing phenomenon. In 1993, the last year for which specific statistics on infanticides³ are available, data from the police and national gendarmerie showed that these accounted for 3.8% of all homicides whereas under-one infants made up only 1.2% of the total population.

2.3 The Underestimation of Abuse

Several converging indices lead to the supposition there is an underestimation of the problem. For example, we can cite: the evident disinterest of the child protective services in the health sector as a potential source of information, the numerous selection biases mentioned in the figures shown above, the difficulty of ascertaining some types of abuse that are less visible than physical abuse (neglect, psychological violence) or hidden (violence in the upper social classes, etc.) and the imprecise border between 'ordinary educational violence' and abuse.

2.3.1 Is There Proof of This Underestimation?

The well-documented assertion that the constellation 'abuse-neglect' affects an average of one out of ten children, depending on the high-income country studied [3], gives an idea of the size of the underestimation. For reasons related to the availability of cases, this has been measured primarily for homicides [19, 20] and mainly for infanticides [21–23]. This measure was the principal objective of the retrospective study carried out in three French regions (Brittany, Greater Paris Region, Nord-Pas-de-Calais) by Unit 750 of Inserm,⁴ on 'suspicious deaths in under-one infants'

³ Infanticide: homicide of a child under 1 year of age.

⁴ Inserm U750/Cermes: Centre for research in medicine, science, health, mental health and society.

[15, 23]. During the study period of the research (1996–2000), there were, on average, 17 cases of infanticides per year nationally according to statistics from the CépiDc, but the results of the Inserm study lead to estimating this figure to be closer to 255 cases a year.

2.3.2 Causes of Underestimation Related to the Health System

2.3.2.1 The Limited Contribution of the Health System in Counting Cases of Abuse

All abused children go through the health system sooner or later, since parents are often forced to take them to emergency services or to a private practitioner. And yet, the system for assessing the number of children in danger and abused excludes the health sector, aside from consideration of reports of abuse sent by it. At present, no useful routine data come from this sector:

- There are no statistics relative to emergency service consultations.
- Nor any statistics in the private medical care sector.
- In case the child is hospitalized, the diagnosis can be found, thanks to data in the Hospital Information System (HIS), but these are in fact unusable. Indeed, only the nature of traumatic lesions is taken into account, not their accidental or intentional cause. WHO's International Classification of Disease codes X85–Y09 (assault) are not used since 'they have no effect on the value of the stay', the HIS data being used for determining what to charge for the act.
- Compilation, at the national level, of detailed data from National Education school health teams is no longer done.
- Certification of violent death is attributed to erroneous causes in a significant number of cases, as the Inserm study on infanticides has shown [15, 23].
- Improvement of mortality statistics is difficult because there is a lack of transfer of final results of scientific investigations from hospitals and forensic institutes to the CépiDc—Inserm.

2.3.2.2 No Diagnosis or Under-diagnosis

Failure to recognize abuse (fatal or not) may have various causes: a lack of competence and problems in training, insufficient investigations, no recourse to scientific publications and 'gaze aversion' [24].

The signs and symptoms of abuse and their risk factors, especially among young children, are not well known by all physicians. In France, nearly 80% of 3-year-old children are followed by general practitioners. At present, the latter hold a diploma in special studies (DES) in general medicine (MG) in which a real effort is made at theoretical training on the problem of child abuse. However, questions arise first of all concerning conditions surrounding practical training in paediatrics and, secondly, with regard to wide variation from one medical school to the next in the number of hours devoted to teaching on abuse, something which depends solely on teaching staff, who may find the topic highly interesting or on the contrary get rid of the chore as fast as possible.

If abuse is suspected, or even observed and asserted, another difficulty may be encountered before a rigorous diagnosis is established: the lack of expertise in paediatric forensic medicine in France. It is rare that specialists of adult forensic medicine have received specific training on the anatomy and physiology of the infant, notably as concerns the brain.

In the study on infanticides carried out by Inserm Unit 750, shortcomings in medical and forensic examinations were striking, both at the hospital level and at that of the judicial system. Thus, in cases where the final accepted diagnosis was sudden infant death syndrome, the rate of autopsy was only 51% in the hospital part of the study and 59% in the study among the courts. Furthermore, it is well known that some homicides leave no visible trace on the body of the victim, but in the same study, investigations appeared to be carried out less often when the clinical examination found no external traumatic lesions. This was highly statistically significant for cranial X-rays and brain scans in particular.

There is a lack of sharing of scientific knowledge among the various professionals concerned with children, and some medical ‘messages’ are clearly not communicated to professionals of child protective services, nor to those in the judicial system, for example, as concerns the impossibility of evoking ‘sudden unexpected death in infancy’ in the absence of any autopsy or as concerns the characteristics of lesions specific to so-called shaken baby syndrome (SBS).

The term ‘gaze aversion’ refers to the inability of a physician to imagine and accept a diagnosis of abuse [24]. This is an international and unchanging phenomenon. In 1962, the American paediatrician Henry Kempe published ‘The battered child syndrome’ in JAMA [25], an article that had considerable impact. He spent the rest of his career helping to develop legislation requiring the reporting of child abuse, which emerged in 1974. And in 1983, 1 year before his death, on observing his interns, Kempe felt that ‘the common denominator was the denial of child abuse by these fine young doctors who simply could not imagine the facts of life’ [26].

2.3.2.3 Not Reporting Abuse

Any analysis of the multiple causes for not reporting abuse should always be done while keeping in mind that there are two distinct professional contexts: that of the hospital physician (who can depend on social services, a hospital director, colleagues from various specialities, a psychologist, etc.) and that of the private practitioner (paediatrician or generalist) who works in the solitude of his or her office.

Physicians can choose not to report abuse for numerous and diverse reasons: fear of losing a client, empathy with the families, fear of prosecution for wrongful reporting, fear that child protective services fail and the inability to report abuse from within one’s own social class [27], which contributes to dissimulating very real child abuse in more well-off social classes. The illusion of control of the situation and the inability to relinquish the case are motivations found in hospital teams, who often consider that their multidisciplinary structure and the support of the hospital will allow them to resolve the child’s and family’s problems without outside help.

The adoption of the 2007 law is difficult for some physicians who find themselves faced with new structures, rules and definitions (IP, CRIP). At present, hospital physicians and private practitioners appear to choose to address themselves to either the CRIP or the court, based not on the urgency or seriousness of the case as intended but as a function of the quality of relationships already established with the director of the CRIP or the state prosecutor.

2.3.2.4 Problems of Arriving at a Consensus on Definitions (Abuse, Accident, Neglect?)

These play a role in evaluating the necessity of reporting abuse and, globally, in the recognition of abuse. The terms don't have the same meanings from one physician to another, or for physicians and the courts, and therefore don't lead to the same decisions being taken. Differences in interpretation principally concern SBS (always considered by some physicians as an 'accident') and situations exposing a child to a grave danger such as leaving a baby alone in a bath or with a large dog or a very young child left alone in a residence with stairs or an unprotected swimming pool. If the child suffers serious harm, or even dies, some will speak of 'a lack of supervision', others of an accident, but rarely of 'serious neglect', fatal or not.

2.3.2.5 Under-investigation, Non-diagnosis, No Reporting, and Dissimulation: Major Risks for Repetition

In the Inserm U. 750 study [15], 54% of infants who died from SBS were chronically abused. Out of 70 children with siblings, 11 had brothers or sisters who were victims of abuse and serious neglect and/or were followed by social services. Six had 11 brothers or sisters who died in a violent death.

2.4 In Conclusion: How Can We Improve Epidemiological Knowledge of Abuse and, Beyond That, of Danger?

The number of children in danger, or even abused, will be better known if there is an improvement in screening for risk of abuse and detection of abuse itself and if we succeed in creating a multi-institutional system for gathering statistical data. The necessary tools for these strategies exist and need to be strengthened. The fourth-month pregnancy consultation, written into the 2005–2007 Perinatal Plan and in the 'Perinatal Period Recommendations' for physicians from the High Authority on Health (HAS), is part of the 2007 law under the title 'systematic psychosocial consultation' (voluntary). Its aim is to screen for risk factors of child abuse and may give rise to home visits in the postnatal period, with the parents' consent. An initial evaluation of this practice, carried out in the context of the 2010 National Perinatal Study, showed that, unfortunately, only 21.4% of women said they attended it [28].

Screening for danger of child abuse rests primarily on school health check-ups, which are described in the 2007 law: a health check-up for children aged 3–4 years (recommended to be systematic, but not obligatory); obligatory consultations, at

no cost to families, at the 9th, 12th and 15th years during which a physical and psychological health check-up should be carried out. It should be noted however that the legal decree enabling these measures to be financed had not yet been issued as of the end of 2015. In addition, there has been a veritable unravelling of the school health system in the past few years, and it has become a moribund structure due to job cuts.

The role of all health-care professionals, especially general practitioners, in screening for risk factors and signs of child abuse, was defined in recommendations by the High Authority on Health in 2014 [29].

Finally, it is ONED's responsibility to ensure the creation of a statistical data base, born from the collaboration of all the actors involved, especially the health system.

Objectives such as these assume that public authorities reinvest in children as persons and as persons who deserve respect.

Key Points

- The definition of child abuse should be broadened and include the notion of a child in danger: at risk of abuse or abused.
- Homicide is not an extreme form of abuse; it's abuse that's gone wrong.
- The scientific literature emphasizes the seriousness of psychological violence, neglect and isolated emotional deprivation, in the absence of physical abuse.
- Risk factors and long-term consequences of abuse are similar in all countries.
- The combination 'abuse-neglect' affects one out of ten children in 'upper-income countries'.
- The situation concerning statistics in France leads to an underestimation of figures on child abuse.
- Under-investigation, non-diagnosis, no reporting or dissimulation of child abuse leads to a major risk of repetition of violence.
- In France, obtaining better epidemiological understanding of child abuse, necessary for developing public policies and their evaluation, depends on considerable improvement in the training of health professionals in recognizing situations dangerous to children as well as on the setting up of effective statistical tools for epidemiological surveillance that are able to process data (without misses or repetitions) provided by several sectors: health services, social sectors, schools, police, the justice system, etc.

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S.B.S. Marie

Magistrat, Paris, France

e-mail: Sylvain.Barbier-Sainte-Marie@justice.fr

3.1 Introduction

Dedicated to expertise, this chapter echoes the complexity of the subject, complexity that stems from the lack of uniformity of the status of the expert in the world. Depending on different legal and judicial systems, experts are subject to protean rules, involving multiple modes of intervention within the trial. The objective of the following paragraphs is therefore to extract the main axes that characterize each of the major judicial systems, without seeking to be exhaustive, and with the sole aim of better understanding the stakes.

First of all, describing the legal axes related to abuse presumes exploring the different judicial systems that have a direct impact on the protection of minors, criminal investigation, experts, and ultimately the trial.

Maltreatment of children can be diagnosed as more or less serious but in the most serious cases involves on one hand many medical specialties and, on the other hand, other disciplines. Among the latter, the law, through the referral of magistrates, prolongs the action taken by doctors. Indeed, when there is suspicion of abuse, a criminal procedure is opened and entrusted to the police, under the direction or not of a public prosecutor depending on the legal systems, and ultimately it is brought before a tribunal. At the same time as the criminal proceedings, civil proceedings for the protection of the child may be instituted.

3.2 The Main Principles

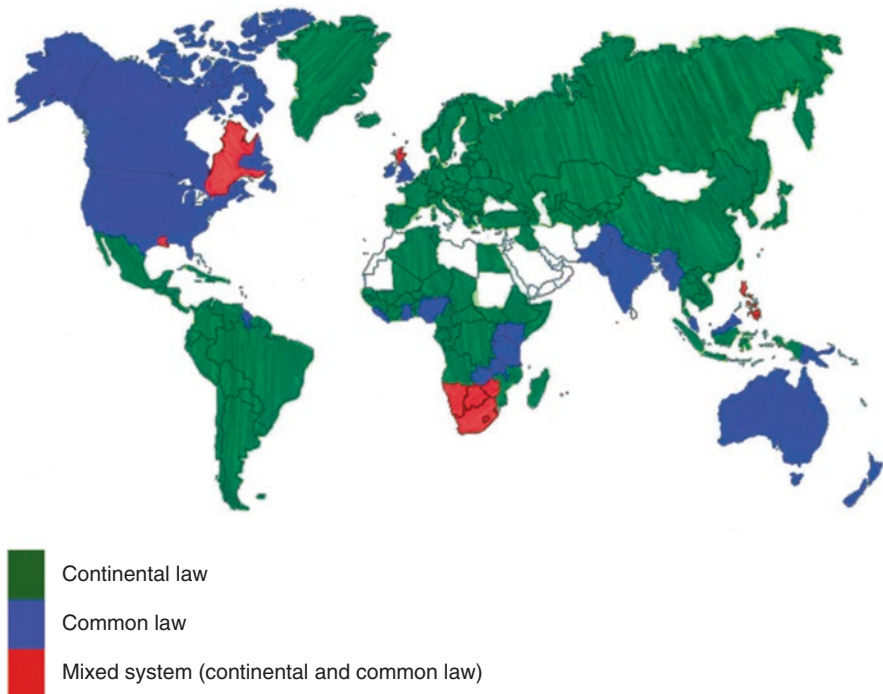
3.2.1 Historic

It is necessary to point out that there are two major legal systems in Europe, the brief history of which makes it possible to better understand their articulation and current application:

- The first is generally called “continental” or civil law derived from the Roman-Germanic legal tradition. It has its origins in the Ancient Roman *Corpus Juris Civilis*, compiled in the sixth century under the leadership of Emperor Justinian. It is often analyzed through the prism of the French legal system, for reasons related to the later Napoleonic Code, which irrigated many European and foreign systems, including Europe, Russia, much of Africa and Asia, Central America, and South America. Founded on the law and the search for “preestablished” evidence, this law is considered egalitarian, hierarchical, community oriented, and structured, thanks to the many codes that compose it.
- The second is the Anglo-Saxon or common law, which can be understood mainly through English law, from which it is derived. It originated in 1066, when William the Conqueror, Duke of Normandy, conquered England. Common law is characterized by a legal system guided by three fundamental principles: respect for the jurisprudence of the courts, recourse to the judge to decide only on points

of fact in the dispute, and the absolute supremacy of the law, which applies to any person or entity, public or private. The common law system has been adopted, and often amended, by other countries including the United States, Canada, Australia, New Zealand, and Ireland. Due to its jurisprudential nature, it is considered as more flexible than civil law, but some consider its protection to benefit mostly the most well-informed citizens. However, it should be noted that it is not always applied uniformly in countries which have adopted it. Thus, Scotland and Northern Ireland in the UK, Louisiana in the United States, and Québec in Canada use a “mixed” law, which combines common and civil law.

3.2.2 Legal Systems in the World



Some authors believe that through these two legal systems embody two types of civilization. From this perspective, the rigidity of the civil law system opposes the flexibility of common law. Globalization, allowing an exponential opening of markets and promoting the expansion of international trade, has led to a preponderance of common law in international contracts, at the same time that English has gradually emerged as the international language vehicle.

In the legal field, there are two major categories of proceedings, civil proceedings relating to child protection in the strict sense (educational assistance for the parents,

the child's placement) and criminal proceedings, which characterize the nature of the offense and the offender's punishment. In these proceedings, the parties or judges, depending on the judicial system, usually surround themselves with experts.

The expert is a technician in a defined specialty. He or she is called on to give an informed opinion about a situation, according to the terms of the mission entrusted to him or her. He or she produces the result of his research by formalizing his opinion in a document called an "expertise" and communicates it to the person who requested it within the designated time limit. Several expert opinions may be ordered within the same procedure, in particular when counter-expertise is demanded.

In addition, two types of expertise should be distinguished: civil expertise and criminal expertise, the latter being privileged in the area of child abuse, which is the subject of this book.

To promote the establishment of the truth, judges, as well as other magistrates and the involved parties, may well call upon, under conditions that vary in each country, *technicians to provide illumination in various fields of the art, science, and techniques they mastered not themselves* [1]. This expertise, which guarantees individuals a "right to proof," is framed by the procedure, both in civil and criminal matters [1]. Its system differs from one country to another, depending on the country's legal system.

A mode of administrating evidence, expertise is, above all, an investigative measure. The magistrate and the party may use it to clarify a matter, in general, when the judge does not have sufficient evidence to answer it or when a party to the trial must prove what it purports. While some see judicial expertise as a delegation of the magistrate's power, or even a practice that is part of a managerial management of justice [2], it can also be regarded as a modality among others for the magistrate to obtain technical information and for the administration of evidence.

The commission of an expert in a case falls to the decision of the parties or the judge, if they consider an expert opinion necessary for the resolution of the dispute. Recourse to the expert is, in general, subject to rules and conditions defined by law.

Traditionally, two procedural models are opposed:

- Within the so-called "inquisitorial" procedure, the judge directs the trial entirely. He himself must seek the truth, with the help of expertise that has been added to the case. This type of procedure characterizes civil law systems.
- On the other end of the spectrum, the "adversarial" procedure supposes that the parties master the essential elements of the trial. The role of the judge is reduced to that of a judge, arbitrating the claims of the parties. This type of procedure is generally that of common law systems.

These two procedural models belong to two quite different conceptions of the expert's intervention during the contentious phase. Although civil law is generally inquisitorial in nature and common law adversarial, the intervention of the expert

within each obeys set principles. However, these two procedures also encounter points of convergence.

In France, the status of judicial experts, defined in the Act of 29 June 1971, does not strictly constitute a professional status even if the title of judicial expert and its use are protected by law. In the French system, the legal expert, who exercises his profession outside his role as expert, is considered by 1971 State Council jurisprudence as an *occasional employee of the public justice system* (Conseil d'état Aragon decision of February 26, 1971, Appl. No. 77 459).

While it is important to distinguish between expertise in civil procedure and that provided in criminal proceedings, it is also necessary to adopt a comparative law perspective. In Europe, in the French-style continental or civil system, the technician is considered to be an "expert of the tribunal," whose task is defined by the judge and submitted to the said judge. Within the common law model, the expert has a status similar to that of a witness. In the first case, the expert is an agent of the court, lending *his eye and technical brain* [3], while in the second, the expert is that of the party who demanded the expert.

In criminal matters, the system of expertise is often different depending on whether the procedure is inquisitorial or adversarial. However, for Tony Moussa, Doctor of Law, *there is no purely adversarial or purely inquisitorial procedure* [4]. We must therefore update our way of analyzing expertise.

In France, for example, while the procedure is rather adversarial in civil matters, the judge has a greater role, since his task is not only to resolve the dispute between the parties but also to ensure that the trial runs smoothly (Art. 3) [5]. Finally, according to the same author, like civil procedure, but with differences in procedure and issues, *expertise has taken on a very important role in the modern criminal trial, bringing scientific progress into the quest for the truth, and following its evolutions, initially confined to forensics and anthropometric aspect, and then rapidly extending beyond these fields to psychiatry and psychology, graphology, and genetics* [4]. In criminal proceedings, the impartiality of the expert is questioned, depending on whether he is the expert of the tribunal (civil law system) or that of the parties (common law system) because the technical and scientific conclusions of his expertise have a growing importance in determining responsibilities and, therefore, in the outcome of the trial.

The European Commission for the Efficiency of Justice (CEPEJ) has identified three categories of experts, supervised by different legal regimes:

- *Technical* experts who make available to the court their scientific and technical knowledge on questions of fact (civil system)
- *Expert witnesses* who support the arguments of the parties (common law system) through their expertise in technical matters
- *Legal experts* who can be consulted by judges for their knowledge of the practices and rights in place in foreign countries [6]

While this classification is extremely useful, it should be qualified since the manner in which it is implemented varies greatly in common law and civil law contexts, as the following paragraphs will show.

3.3 Initiative and Designating an Expert

3.3.1 Primarily Shared Initiative

3.3.1.1 In Civil Law Countries

In civil proceedings, initiating recourse to expertise is shared among the parties and the court in the majority of European civil law countries (17 of the 27 member states [excluding Croatia]) [3]. This is the case in France, where Article 1315 of the Civil Code provides that *a person who demands the performance of an obligation must prove it. Conversely, a person who claims to be released from an obligation must prove the payment or the fact that caused the extinction of his obligation.* On the basis of this article, the parties bear the burden of proof and, therefore, the initiative of the expert opinion. The expertise is intended to compensate for a deficiency in the administration of the evidence. Under Article 263 of the Code of Civil Procedure, it can only be ordered when findings or consultations are not sufficient to enlighten the judge.

However, in some states, the expertise initiative remains an exclusive competence of the judge, as in Italy, Slovakia, and the Czech Republic. In these three countries, the judge controls the whole expertise process, even if the parties can intervene on an exceptional basis.

Finally, other states, such as Austria, Denmark, Sweden, Latvia, and Romania, make the initiative an exclusive prerogative of the parties. The judge, however, retains a role in the process of appointment and then in the choice of the expert, insofar as he can refuse this initiative or designate the expert of his choice.

In criminal proceedings, sharing initiative is also the norm in civil law countries.

Article 156 of the French Code of Criminal Procedure provides, for example, that *any investigating or trial court may order an expert opinion where a technical question arises, either upon the application of the public prosecutor, or of its own motion, or upon the application of the parties.*

Germany has a comparable procedure. If the judge considers that there is insufficient evidence, it is then for the judge to assess the use of an expert opinion, even if the parties may also request it.

Unlike in civil proceedings, the question of initiating recourse to an expert opinion does not always arise, because it can be made mandatory. In France, for example, the judge must order a pretrial medical assessment for a number of serious crimes, including murder, killings involving torture or barbarism, crimes involving minors, and sexual offenses (Articles 706-47 and 706-74-1 of the Code of Criminal Procedure) [7], the expert deciding on the appropriateness of care injunction against the perpetrator, in the context of socio-judicial monitoring. Finally, the judge can only resort to the expertise if it is necessary to resolve the dispute because of its technical nature.

3.3.1.2 In Common Law Countries

In *common law* countries, the expert is still considered the expert of the parties, both in civil and criminal proceedings. For that matter, the expert is referred to as an expert witness.

Since the proceedings are adversarial, it is for the parties to the proceedings to bring the evidence to the charge or to the defense. Consequently, the parties have the initiative of expert appraisal, since the latter contributes to support their demonstration.

However, in England, the judge may also take the initiative of expertise if it considers it necessary to have a single joint expert (and can encourage the parties to take on one, Article 35-15 of the *Civil Procedure Rules*) [8]. This innovation is the result of recent reforms of the expertise regime in England. Finally, there is a case where the judge can call on an expert to assist the court. The expert's role is to enlighten the judge and not to be a witness for the parties, who cannot cross-examine the expert [3]. These court assessors, prevalent in the maritime field, give *an inquisitorial tone to British procedure* [8, 9].

3.3.2 Primarily Legal Designation

Once the expertise has been initiated, it is advisable to look at who officially designates the competent expert. Whatever the legal system, accusatory or inquisitorial, the appointment of the expert is, in the majority of cases, jurisdictional.

3.3.2.1 In Continental Law Countries

In *civil proceedings*, in most civil law countries, the judge appoints the expert. The judge thus has a positive role in all European states, with the exception of Sweden, as he has the power to order and expertise if appears necessary to the manifestation of the truth. Negatively, the judge may also refuse the request for expert opinion formulated by the parties, except in cases where it is compulsory.

In *criminal proceedings*, the competence of appointing an expert reflects the organization of the procedure.

In civil law countries, the expertise is of great importance because, in most cases, *the expert report determines the outcome of the trial* [4], given the central role that the expert holds. Due to scientific conclusions, the expert often de facto determines responsibilities.

Where the judge is master of the procedure, as in France, it is the judge who has the primary competence of appointing an expert, even if the prosecutor can decide on *technical or scientific examinations* during the preliminary investigation, under the Article 77-1 of the Code of Criminal Procedure. The prosecutor can also order an expertise during the investigation stage, in accordance with Title XIX on procedures for sexual offenses and the protection of child victims (Articles 706-47-1 and 706-53-10 Code of Criminal Procedure) [7].

3.3.2.2 In Common Law Countries

In contrast, in common law countries, the expert, being one of the parties, is designated by them, both in civil procedure and criminal procedure.

However, the judge is not totally absent from the appointment procedure. In Scotland, for example, the judge may suggest to the parties that the court wishes to have the opinion of an expert and may also call on the expert after consultation and discussion with the parties. Similarly, in England and Wales, while the initiative and choice of the expert remain a prerogative of the parties, the judge validates the procedure. In any event, the expert remains the expert of the parties and not of the court [3].

While judges are more or less involved in expertise procedures, there are states where their role is totally absent. This is the case in Ireland, where, with the exception of personal injury, initiative, choice, and designation are reserved to the parties. This is also the case in the United States, where experts often enjoy the status of expert witness.

Thus, the initiative for expertise in Europe is mainly shared, both in civil and criminal proceedings. However, judges retain a leading role in appointing the expert but also in validating the proceedings initiated by the parties. While the difference between civil and common law countries is fundamental to understanding the expertise regime, we can observe that the rules are more nuanced.

3.4 The Choice of the Expert

Apart from the initiative to use expertise and the appointment of this expert, it is necessary to determine who chooses the expert and how.

3.4.1 Authority Over the Choice

While the majority of civil law countries include the parties in the appointment of the expert, there are two trends in the choice of the expert.

In half of European civil law countries (Germany, Austria, Belgium, Bulgaria, Estonia, Finland, France, Hungary, Italy, Slovakia, Russia, Greece, Lithuania, Luxembourg, the Netherlands, and Poland), the judge chooses the expert alone. However, he can make this choice after consulting the parties, whether compulsory or not, as is the case in Poland. In France, this consultation does not exist in criminal matters.

In the second half of civil law countries, the parties have a more active role in the selection of the expert, with the judge retaining only subsidiary jurisdiction (Denmark, Latvia, Portugal, Czech Republic, Norway) when the parties cannot agree on the name of the joint expert.

In common law countries such as the United States, Ireland (except for personal injury), England, and Wales, the choice of the expert is reserved for parties. However,

in England, where the court has previously asked the parties to resort to a single joint expert and that they have failed to agree, the judge chooses the expert from the list that the parties have preestablished.

In Québec and Scotland, which belong to countries with a “mixed” or bi-legal tradition, the choice of the expert is exclusively reserved to the parties if they have initiated the appointment. However, it should be recalled that the agreement of the judge remains binding in Great Britain.

3.4.2 The Modalities of the Choice

Whichever authority or person chooses the expert, it is rare that the choice is entirely unrestricted.

Indeed, in two-thirds of civil law states, the expert must be chosen from a preestablished list.

These lists may be national, regional, official, or professional. When experts are not directly selected by the courts, selection is often carried out by the Ministry of Justice.

In France, each court of appeal draws up a list of experts for a period of 5 years, and the court of cassation, for its part, draws up a national list of the most eminent national experts chosen from the lists of courts of appeal. Registration on this national list is 7 years, after which time experts must reapply.

While in some states, judges and parties cannot move away from the lists, in Austria, for example, most states grant more or less latitude vis-à-vis them, as the competent authority may sometimes choose from elsewhere. The existence of preestablished lists does not, however, prevent the judge from having to consult the parties in the specific choice of the expert in certain cases, even when listed, for example, in Denmark.

In some other states, the choice of the expert’s name is free and sovereign, whether the choice is made by the parties or the judge. In Belgium or Finland, there is no list, and the judge selects the expert based on competence, honesty, and reputation.

In common law countries, the parties have the sovereign choice of the expert, as in England, Ireland, Wales, and the United States. A nuance, however, exists in Scotland. While the choice of the expert by the parties or the judge remains free, a directory of experts is available to the authority of choice.

Finally, chance may be at the origin of the expert’s designation. In Romania, where the competence of the judge in the choice of the expert is subsidiary, the name of the expert is chosen by lot from a file containing experts who have undergone an examination organized by the Ministry of Justice. This is also the case in Malta. Where the parties have not been able to agree on the name of an expert, the expert shall be appointed by rotation in alphabetical order of a list established by the Ministry of Justice.

3.4.3 Nationality

As to the modalities of choice, we must raise the question of the expert's nationality. According to the final report of the Eurexpertise project, 3 states (Latvia, Lithuania, the Czech Republic) encourage that the expert be one of its nationals, 6 member states (Germany, Austria, Romania, Slovenia, Belgium, Greece) require the expert to be a national of a European Union country, and finally some countries (Bulgaria, the Czech Republic, Denmark, Estonia, France, Italy, Luxembourg, the Netherlands, Great Britain, Slovenia, Norway) accept non-EU experts. However, when the expert is of foreign nationality, he is often asked to reside and practice in the country of the jurisdiction that recruits him.

Article 57 of the Treaty on the Functioning of the European Union (TFEU) specifies that *Services shall be considered to be "services" within the meaning of the Treaties where they are normally provided for remuneration*. In this way, the expertise is linked to the services of the article above.

It can therefore only be subjected to restrictions under certain conditions. In the *Penarroja* judgment dated 17 May 2011, the Court of Justice of the European Union (CJEU), responding to several questions from the French Supreme Court, *ruled* that the decision to register a European Union national on a roster of experts had to take into account the qualifications and the recognition of his status as an expert in his state of origin.

3.5 Defining the Tasks

Once the expert has been appointed, the task remains to be accomplished.

The European Commission for the Efficiency of Justice (CEPEJ) classifies experts according to their task.

In civil law, where technical expert plays a key role, there are two trends:

- The first is that of countries like France, where the mission of the expert is strictly defined and monitored by the judge, both in civil and criminal proceedings.
- Under the second option, while the judge controls the expert's mission, the parties are not absent from its definition. For example, the German Code of Civil Procedure provides that *the court must direct the mission of the expert and can give instructions on manner and content of the mission* (Article 404 a, subparagraph 1) [10], but the requester, who bears the burden of proof, is actively involved in defining the expert's tasks.

In common law, the expert being committed by the parties, the latter determine the mission. Thus, the expert not only gives his technical perspective but is also allowed to express his opinion, contrary to the legal system in force in civil law countries. The use of an expert witness is obviously more developed in common law systems and northern Europe [11].

This principle, however, needs to be qualified in the case of England. While the mission is defined by the parties, according to the procedure for expert witnesses, the judge may also intervene at the request of the expert, to specify the questions to be answered and to define the technical field of his mission. The judge will then have to assess whether the intervention of the expert is necessary for the solution of the dispute. Finally, when the expert is shared by the different parties, the judge may give instructions to the expert without the need for the expert to make a request.

3.6 Ethics and Responsibility

The justice system cannot call on experts whose quality and specialization could be challenged. It is thus necessary to recall the essential role played by the rules of ethics and of responsibility, whose requirement has not ceased to increase in the last 10 years.

3.6.1 Ethics

3.6.1.1 The Rules

Many European states have established rules of ethics. In this respect, 20 member states of the European Union have provided for sanctions against experts in the event of breaches of their obligations.

Most experts swear before the judge or the court even when the expert is appointed and paid by the parties. This is the case in England, where an expert must declare respect for the truth and understanding of his duties [8, 12]. In Europe, eight member states require an oath at each assignment, and in nine other states, this oath is permanent. In France, employed by the public justice service, the expert takes an oath before the Court of Appeal of his domicile when he is entered on the list of experts.

Article 237 of the French Code of Civil Procedure provides that *the commissioned expert must fulfil his mission conscientiously, objectively and impartially*. In this respect, the ethical rules require the judicial expert to renounce his task when he acknowledges his lack of technical competence, on the basis of the principle of impartiality or the impossibility of completing the mission within the set time period. Moreover, a certain number of obligations are imposed on the expert when he accepts the mission: he is not the expert of the parties, he is independent of any doctrinal position, he must not make any legal assessment, and he should not reconcile the parties. (Articles 238 and 240 of the Civil Procedure Code, respectively, provide that *he must never express an opinion on a point of law*, and the judge *may not confer upon an expert a mission to reconcile the parties*.) [5] Moreover, he must respect the principle of contradiction and must personally carry out his mission.

In the absence of an oath (Bulgaria and Denmark), or legal provisions that make the interests of justice prevail over private interests, experts chosen by the parties are called “private” experts and not judicial experts [6].

3.6.1.2 Penalties

The existence of more or less established ethical rules in all European states allows disciplinary sanctions to be issued. In France, as in Denmark, the expert can be replaced. In Luxembourg, the expert may be sanctioned by the National Chamber of Experts if negligence in the exercise of its mission has been established. In some states, the expert may receive reduced fees or, as in France, be excluded from lists of experts. In Slovenia, the expert may also be fined if he files his report late, does not present it before the court, or refuses expertise without cause.

In England, experts being of the parties, their ethics have long been suspected, despite the existence of a number of jurisprudential rules. After the Woolf report issued in 1996, professional ethics of independence, objectivity, and transparency were codified by the Royal Institute of Chartered Surveyors in the Civil Procedure Rules. Although this code, in part 35, does not provide for sanctions in case of breach of ethics, professional organizations establish best practice guides and may take disciplinary action.

3.6.2 Civil and Criminal Responsibility

In most countries, the expert has some responsibility, either civil or criminal.

Among the civil law countries, 6 countries (Germany, Luxembourg, Slovenia, Slovakia, the Netherlands, the Czech Republic) limit it to civil liability, while Romania only has criminal responsibility, and some states practice both types (Austria, Belgium, Bulgaria, Estonia, France, Greece, Hungary, Italy, Latvia, Poland, Lithuania, Denmark, Sweden, Portugal).

Regarding liability, several states apply the common law. This is the case of France. The expert is then responsible for damages caused by his act, by negligence in performing the mission as in Luxembourg or recklessness, and must repair it. The error could be material or analytical or in the report writing, as in Bulgaria. However, proven misconduct does not automatically imply liability. One must then demonstrate harm caused by it. If this causal link is proven, the expert is required to repair the damage. Civil liability is subject to the payment of compensation or fines and often results in a reduction of the expert's remuneration.

As for criminal liability, it exists in most European states with civil law.

In France, the expert, like any citizen, is subject to standard criminal liability. However, the penal code provides for specific offenses with regard to the legal expert *directly related to the way the expert accomplishes his mission or takes advantage of it, is indiscreet, lying or corrupt* [4]. The expert is not only bound by professional secrecy but also by the confidentiality of investigations (Article 11 of the Code of Criminal Procedure) [7]. One can also be sentenced for forgery (Article 434-20 of the Criminal Code) and active or passive bribery (Articles 434-9, 435-7, and 435-9 of the Criminal Code), under the same conditions as a judge [7].

An important exception in the context of an expert's criminal responsibility in French law must be raised. If the expert is criminally responsible in the exercise of his mission, he enjoys immunity under Article 41 of the law of 29 July 1881 when

because of the importance of the expert's conclusions on the outcome of certain trials, including before the appeals courts, the expert could be under great pressure during the hearings and may develop arguments that sometimes seem excessive, and in these cases the law provides protection, provided that the defamatory facts are not foreign to the cause; and they relate to a party, provided that the libel was expressly reserved by the court in which the words were spoken or written [4].

In Poland, the willful violation of “sincerity” is liable to 3 years imprisonment. Austria also provides for a penalty for breach of confidentiality and professional secrecy. In Bulgaria, a false written or oral conclusion before a court can be punished, while Italy has created an offense for negligence in filing the report or in case of fraud.

In common law countries, only two countries, Ireland and Cyprus, provide experts with criminal and civil immunity [13].

In England, an expert's liability can be raised by the principal party. This may require the repair of damages due to negligence in fulfilling the mission having led to the loss of the trial. When the fault is proven, it is still necessary to establish a sufficient causal link between it and the damage resulting from the loss of the trial [9].

All countries do not require experts to justify having insurance covering the specific risk linked to this activity. Therefore, the guarantee of civil liability may appear illusory [13].

In English-speaking countries, criminal responsibility exists as perjury, as in England and the United States, or contempt of court as in Scotland.

In England, the 1911 Perjury Act provides that an expert witness, who lies knowingly in any court or during court proceedings, is guilty of perjury. He faces 2 years imprisonment and a fine (Article 1, Perjury Act, 1911) [14]. The expert is criminally liable vis-à-vis the court, and even though he is an expert of one of the parties, only the court and the Crown Prosecution Service can pursue him for perjury. Unlike civil law countries, the expert's criminal responsibility cannot be engaged on the violation of procedural rules.

3.7 Funding

Funding for expertise raises two issues, first, that of the amount of remuneration and, second, that of its origin.

3.7.1 Who Sets the Amount?

3.7.1.1 In Civil Law Countries

In civil proceedings, in 20 European countries, the provision is ordered by the judge and charged to the party that sought the expertise. The trial court determines the amount and expense of final pay. However, expert's compensation may have been previously set, either by Cabinet regulations, as is the case in Latvia and Poland, or under a statutory scheme established by the Ministry of Finance in the Czech Republic.

In criminal proceedings, the expert's compensation is generally set by the state or the judicial authority.

In France, a difference is made between set prices and non-set-priced expertise. Articles R116 to R122 of the Code of Criminal Procedure list all the types of expertise for which the price is fixed by law (commercial, medical, mechanical, interpretation, and translation). Experts who perform these missions are not eligible for other fees than those set by these texts. Conversely, expertise not mentioned in the texts are not priced. Experts are free to set their own fee but remain dependent on the judge's arbitration.

In Germany, the amount of the remuneration provided to experts in criminal proceedings, as in civil procedure, is subject to strict pricing under legislation. This is also the case in Italy, where set rates are the principle [15].

3.7.1.2 In Common Law Countries

In common law countries, in both civil procedure and criminal procedure, the expert can set his own fees and provisions, as in England and Wales. Compensation can also be negotiated, particularly in Scotland. In criminal proceedings in England, where the fees of expertise are freely determined, the court nevertheless has the power to limit expenses related to the expert and the amount of his fees. However, when the expertise is ordered by the Crown Prosecution Service, it directly determines the remuneration of the expert based on a scale.

3.7.2 Who Pays the Expertise?

In civil proceedings, in both civil and common law systems, the provision is the responsibility of the applicant, and the final costs are borne by the losing party.

In France, the judge designates the party supporting the provision, but when the latter is granted legal aid, *costs incurred by the investigative measures are advanced by the State* (Article 40, Act 91-647 of 10 July 1991 on legal aid). Similarly, regarding the final costs, while the expert's fees are often paid by the loser, this is not the case when legal aid has been granted. Additionally, the judge may, by reasoned decision, order the opposing party to pay all or part of the amount. Finally, exceptionally, certain costs related to the technical intervention under specific civil proceedings (educational assistance, tutelary procedures for the incompetent, and parental authority) are treated as legal costs.

In Italy, the losing party may be exempted from some of the experts' fees in labor law, social security proceedings, and guardianship cases. In other matters, the costs remain the responsibility of the parties. In other states, expertise is totally free, as is the case in Estonia, which finances expertise. In Lithuania, Poland, and Slovenia, the remuneration is paid by the applicant, unless the initiative is legal.

In criminal proceedings, expertise in civil law countries is often included in court costs. It is paid by the state. This is the case in France or Spain. However, some civil law states have the convicted person bear the cost of the criminal expertise.

As part of civil action cases, some states (France, Belgium) require a deposit which aims to avoid abusive constitutions. In Germany, all legal costs are charged to the guilty party. In Italy, the Treasury advances these costs and then turns to the convicted person for reimbursement.

In common law countries, the procedure is adversarial, and the losing party pays the costs incurred during the procedure. However, in England, expert fees may be paid by the Crown Prosecution Service, and part or all of the amount may be borne by the person sentenced in the judge's decision.

3.7.3 Victim Compensation: The Example of France

In France, a compensation commission for crime victims (CIVI) is responsible for conducting the actual compensation for damage suffered by the victims of a criminal offense, or their dependents, even if the perpetrator has not been identified. For minor victims, application for compensation must be made by the minor's legal representatives. This commission exists within each regional court. The deadline to enter demand is 3 years from the date of the crime.

There are two types of cases in which the victim is likely to bring an action for compensation before the CIVI:

- When the crime led to death, permanent incapacity, or total work incapacity lasting longer than 1 month
- In cases of rape, sexual assault, human trafficking, and sexual assault of a minor under 15 years

The purpose of the proceedings before the CIVI is to identify and establish the damages suffered by the victim, usually with expertise. It should be stressed that this procedure takes into account the developments of the damage. It provides financial, human, material, and logistical compensation for the harm suffered by the victim in his or her life, especially if help is needed at home. This procedure is particularly suitable in the context of children who have been victims of shaken baby syndrome, which, in the most severe cases, requires significant support in the medium to long term. The principle is full compensation for damages, with its parts being determined individually so that the financial support is optimal and covers all the damages. The compensatory process is long, and the CIVI may allocate provisions for the full amount. When the procedure leads to a support, the benefits are paid, under the principle of national solidarity, by a guarantee fund.

Conclusion

Expertise is an understudied area. Except the work of the European Commission for the Efficiency of Justice (CEPEJ), there is little comparative material.

From the above, it appears that the majority of European Union member states are using “technical experts,” and “expert witnesses” are reserved for common law countries. Only ten states appeal to “legal experts” as defined by the CEPEJ. Three quarters of the studied states and entities consider that courts should be in charge of the expert selection process. Experts are mainly selected based on the specific needs of each procedure [11], thus characterizing their specificity and extreme qualification. When experts are not recruited or appointed by the courts, it is usually the Ministry of Justice or the parties that do so.

When it comes to expertise, the traditional distinction between civil law and common law countries appears less and less clear, given the discussions initiated at the European level and the progressive reforms enacted in different states. Ultimately, this marks a drive to follow principles shared by the two legal systems to facilitate trade and improve cross-border judicial cooperation.

Key Points

- There are two major legal systems, civil law (the majority of European countries) and common law (England, Wales, Australia, Canada except Québec, the United States except Louisiana).
- In the civil law system, the judge generally appoints the expert, while in the common law system, it is generally the parties.
- Legal proceedings are divided into two main types, civil and criminal, each of which can call on experts as part of their procedure. In child abuse cases, an offense is committed by a perpetrator and thus is generally criminal in nature. There can also be civil proceedings related to child protection, for the child to be placed in foster care or for there to be mandatory family education.
- In the civil law system, the expert is a technical expert. He provides the judge with scientific or technical knowledge on a specific subject, as established by his defined mission. The expert’s objective is to enlighten the judge to facilitate decision making. In common law systems, the expert is an expert witness, whose role is to support the party’s argumentation. Additionally, one finds “legal experts” responsible for providing the judge with information about foreign laws when they pertain to the litigation.
- While there are no unified rules regarding expertise, Europe is currently considering the necessity of adopting overriding principles that could be respected in all the countries. This reflection results from the internationalization and intensification of legal relations among Europeans from different countries, be they private or professional.

Acknowledgment Acknowledgments to Mrs. Garance Jubert for her help researching this paper.

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Infllicted Cutaneous Lesions and Burns: The Skin

4

Barbara Tisseron, Maryam Piram,
and Caroline Rey-Salmon

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B. Tisseron (✉)

Unite d'Accueil des Jeunes Victimes (UAJV) CH d'Orléans France,
1, rue Porte Madeleine, 45000 Orléans, France
e-mail: barbara.tisseron@chr-orleans.fr

M. Piram

Pédiatrie Générale, CHU Bicêtre, Le Kremlin Bicêtre, Paris, France
e-mail: maryam.piram@aphp.fr

C. Rey-Salmon

UMJ, Hôtel Dieu, Paris, France
e-mail: caroline.rey@aphp.fr

4.1 Epidemiology—Definitions

The signs of abuse left on the skin of young victims—bruises and hematomas, in particular—gave rise to the name “battered child syndrome,” in a 1962 article by Dr. C. Henry Kempe [1]. They are the most well-known signs of abuse.

The United States health authorities define physical violence as any inflicted injury lasting more than 24 h [2], which is why some states require that all corporal punishment be reported to the legal authorities.

Skin lesions come in a wide variety and can involve any area of the skin [3].

While severe lesions are usually identified, minor bruising is often trivialized because it is not very painful, has little functional impact, and resolves quickly—sometimes in just a few days. It is nevertheless an excellent marker for abuse, and even the slightest bruising on the body of a young child who is not yet mobile requires a full evaluation. In practice, children who suffer severe forms of abuse like so-called shaken baby syndrome often have a history of bruises for which an accidental explanation was too readily accepted [4].

The presentation varies, and this chapter will deal only with the lesions seen most frequently in the abuse context, excluding gunshot and knife wounds. Alopecia is discussed in the chapter on cervicofacial, oral, and scalp lesions. There is a separate chapter devoted to burns.

4.2 Clinical

Abuse-related skin lesions can vary widely and be located in unusual places like the armpits and genitals. If a bruise or other suspicious skin lesion is found in a child who is not yet ambulatory or in an unusual location, a full clinical examination with the child completely undressed is warranted.

Lesions should be described in detail—primary and secondary lesions (erosions, ulcers, bullae, bruises, purpura, etc.), number, color, size, shape and location—and photographed or, if that is not possible, drawn on a detailed diagram. Recurring skin lesions or the presence of more than three lesions in the same area of the body should draw the clinician’s attention [5].

4.2.1 Contusions

A contusion is a post-traumatic lesion with no skin wound. It presents in the form of erythema, ecchymosis, hematoma, or purpura.

Erythema is redness of the skin due to dilation of the capillaries in the papillary dermis, which disappears on diascopy. The skin reddening is accompanied by a localized increase in skin temperature. It resolves rapidly and is nonspecific.

Post-traumatic ecchymosis reflects infiltration of the subcutaneous tissue by blood from the small capillaries ruptured by a direct blow or impact. Ecchymosis does not blanch on diascopy, because the red blood cells have leaked out of the vessels into the dermis. Ecchymoses are located at the point of impact but can migrate to underlying areas under the effect of gravity. Ecchymosis is subtle—or even

Fig. 4.1 Traumatic ecchymosis. Nine-year-old boy. Bouquet of bluish ecchymoses on the back of the forearm from being grabbed

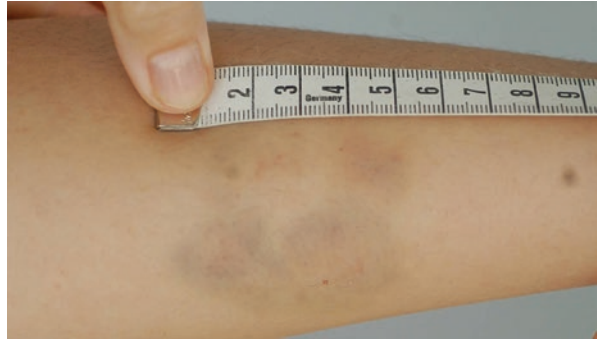


Fig. 4.2 Traumatic ecchymosis and erosions. Two-year-old boy. Bluish ecchymosis on the right cheek from being slapped and three small parchment-like erosions in front of the right auricle, from being scratched



Fig. 4.3 Traumatic ecchymoses. Seven-month-old boy. Several brownish ecchymoses on the left frontal, temporal, and parietal scalp from direct blows



absent—in people with anemia. Its extent varies with the severity of the blow and the vascularity of the area and the underlying anatomical plane (Figs. 4.1, 4.2, 4.3). Hence an abdominal injury—even a severe one—may leave no visible trace on the skin, though there are visceral injuries underneath (*cf.* chapter on visceral injuries).

Purpura is a red, hemorrhagic spot that does not blanch on diascopy due to the presence of extravasated blood in the dermis. When caused by trauma it is macular and may appear petechial; it consists of punctiform pinhead-sized elements. It can appear ecchymotic when it forms an irregularly shaped, purplish-blue sheet, or streak-like in the case of linear lesions caused by friction or pinching of the skin.

A hematoma is a collection of blood in a newly formed cavity. It reflects the rupture of vessels larger than capillaries. The blood then separates the muscle fascicles. Hematomas take longer to resolve than ecchymosis (Figs. 4.4–4.6).

Ecchymosis is a commonplace finding in everyday pediatric practice. The main difficulty is distinguishing ecchymosis caused by ordinary activity or accident from that due to abuse [6].

To make that assessment, consider the child's age and degree of mobility, the site of the ecchymosis, and the lesion's appearance.

In outpatient practice, it is not unusual to find recent skin lesions in children older than 9 months without chronic illnesses. There is no gender difference. Lesions are more common between the ages of 5 and 9 years and less common after age 10 years [7]. Lesions on the bony prominences—shins, knees, elbows, forearms, scalp, and forehead—suggest accidental trauma [8]. Contusions are more common during warm weather, when children are playing outside.



Fig. 4.4 Hematoma. Fourteen-year-old girl. Purplish hematoma on the right upper arm from a blow with a motorcycle helmet

Fig. 4.5 Hematoma. Thirteen-year-old girl. Multicolored hematoma on the upper third of the right outer thigh from a series of kicks

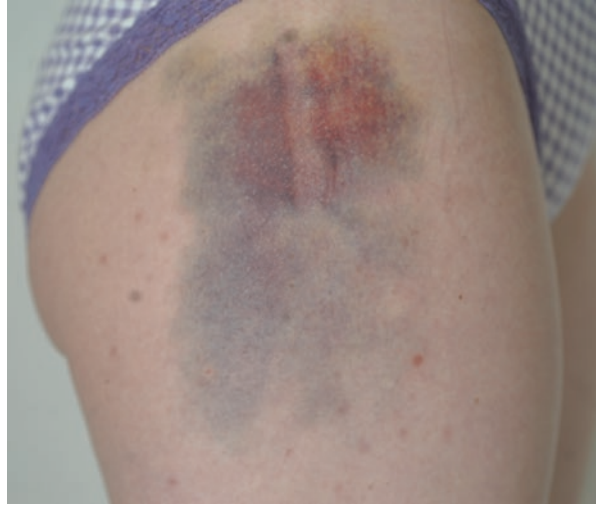


Fig. 4.6 Hematoma. Fifteen-year-old boy. Red hematoma at the top of the left shoulder from being pressed with a shoe while the patient was on the ground



However, any bruising on a non-ambulatory infant under the age of 9 months without a perfectly congruent explanation always warrants a medical workup to look for fractures and head injuries. In particular, lesions on the ears (Fig. 4.7), neck, face (except the forehead) (Fig. 4.8), buttocks (Fig. 4.9), trunk (Fig. 4.10), external genitals, feet, and hands are highly suspicious for inflicted injury [5, 9].

The ecchymosis may take the shape of the injuring object. A blow from a stick or broom handle produces a rectangular area on the skin with a pale central area bordered by two parallel lines of ecchymosis, due to the blow pushing the blood away from the point of impact and toward the edges (Fig. 4.11). Blows with a cable

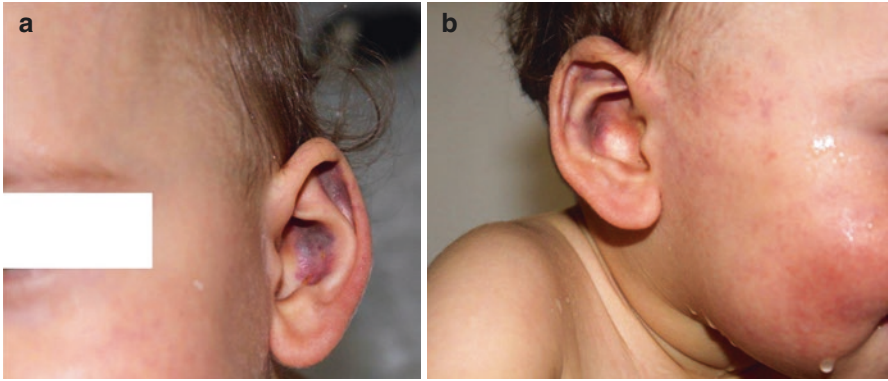


Fig. 4.7 a and b: Suspiciously located ecchymoses. Eight-month-old boy suspended by his ears. (a) Left auricle. (b) Right auricle



Fig. 4.8 Suspiciously located ecchymoses. Three-year-old boy. Brownish ecchymoses with finger-shaped prints and chin erosions from being gripped during force-feeding. Note the brownish ecchymosis on his left elbow



Fig. 4.9 Suspicious ecchymoses. Ten-year-old boy. Loop-shaped ecchymoses on the buttocks from being struck with a television cable

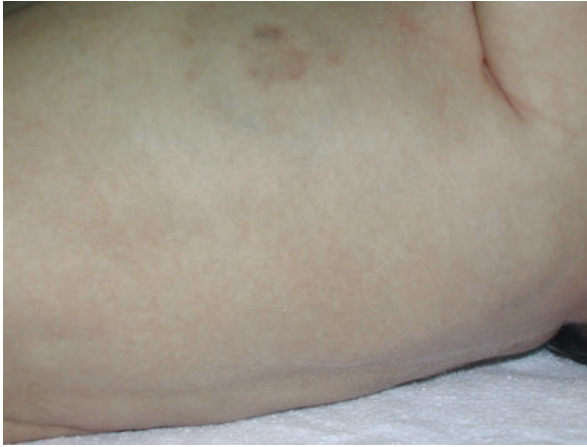


Fig. 4.10 Ecchymoses on the trunk. Four-month-old boy with diffuse, deep subdural hematomas. Ecchymosis on the left side of the chest reproducing the thumbprint of his father, who shook him violently



Fig. 4.11 Suspiciously shaped ecchymoses. Thirteen-year-old boy. Linear ecchymoses separated by a clear center from being struck with a broom handle

or electrical wire cause loop-shaped ecchymoses (Fig. 4.12). An imprint of the abuser's fingers can sometimes be seen right on the skin, when a blow is delivered with the flat of the hand (Fig. 4.13) or, if the victim is grabbed, in the place where he was grabbed (Fig. 4.14). Being able to recognize these appearances is fundamental to quickly identifying abuse.

It is very important to document the explanations given by the child's caretakers and compare them to the medical and medicolegal findings [10]. The reader might find it helpful to consult the chapter on the diagnostic process.

Fig. 4.12 Suggestive-shaped ecchymosis. Twelve-year-old boy. Large greenish ecchymotic patch within which an ecchymotic loop can be seen, from being struck with an electrical cable



Fig. 4.13 Suggestive-shaped ecchymosis. Sixteen-year-old boy. Ecchymosis in the shape of the perpetrator's hand on the front of the thigh



Fig. 4.14 Suggestive-shaped ecchymoses. Seventeen-year-old girl. Red ecchymosis on the inside of each thigh from being gripped during sexual assault



Fig. 4.15 Erosion. Nine-year-old boy. Parchment-like neck abrasion from attempted strangulation



4.2.2 Wounds

An abrasion or erosion is a superficial loss of skin or mucous membrane, limited to the epidermis (in the case of skin), which heals without leaving a scar. It can be caused by a relatively superficial injury (scratch, shallow bite) or skin friction. Such lesions bleed little and form a scab as they heal, taking on a yellowish, parchment-like appearance (Figs. 4.15 and 4.16). An ulcer is a deeper loss of skin or mucous membrane, involving the epidermis and the dermis (in the case of skin), which leaves a scar when it heals (Fig. 4.17).

A simple wound is a break in the skin or mucous membrane with no adjacent lesion. It can be superficial or deep. It is caused by a sharp instrument (Fig. 4.18).

A laceration refers to a contusion with a break in the tissues. It is caused by a blunt object and occurs in places where a blow strikes an area with underlying bone—for example, the scalp or supraorbital ridge. A deep bite can also cause a laceration. If a bite is very recent, the visible bite marks on the child's skin should be swabbed in an attempt to collect a sample of the perpetrator's saliva. The swab should be returned to its sleeve and stored in the freezer for possible use by the legal authorities and later identification by DNA profiling.

Circular furrows at the wrists and ankles are caused by restraints (Fig. 4.19).

Fig. 4.16 Erosion.
Fourteen-year-old girl.
Three-centimeter-long skin
erosion on the left upper
back from being scratched



Fig. 4.17 Ulceration.
Seventeen-year-old boy.
Thigh ulcer from a blow
with a metal rod

Fig. 4.18 Simple wound. Nine-year-old boy. Scar from an unsutured, clean-cut blade wound on the back of the left forearm



4.2.3 Hair Tourniquet Syndrome

Hair tourniquet syndrome was first described in 1612, when lesions caused by a hair strangulating a penis were observed [11]. Since then it has been described numerous times in the literature. The syndrome denotes any hair or fiber wound tightly around an appendage (fingers, toes, penis, clitoris, labia majora, or labia minora), usually in a child under age 2 years (Fig. 4.20). It can be bilateral and involve several fingers or toes [12, 13]. The constricted appendage responds with edema, ischemia, and ultimately necrosis, which can result in mutilation. The literature is divided as to whether the etiology of this syndrome is deliberate or accidental, and an isolated finding of hair tourniquet syndrome is not generally enough to distinguish between

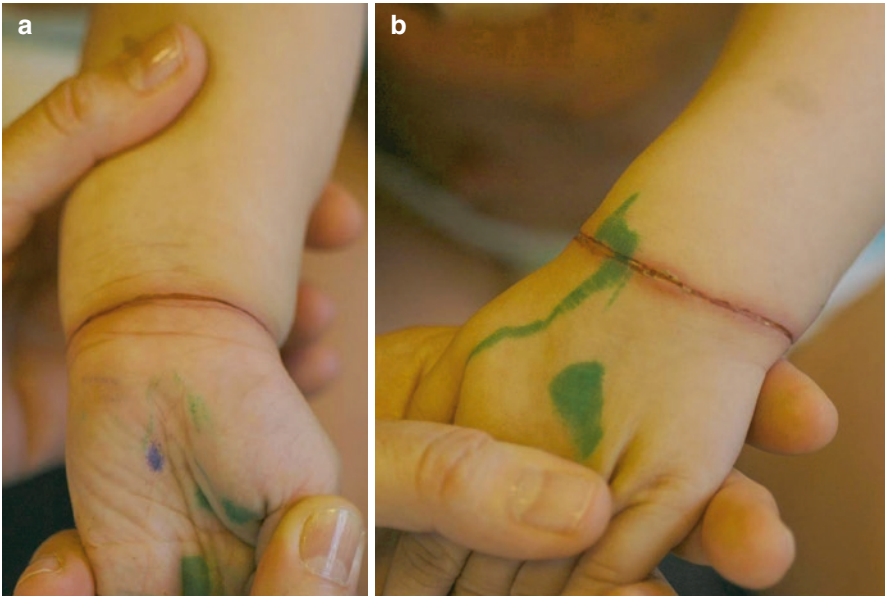


Fig. 4.19 a and b: Ligature wound. Fifteen-month-old girl. (a) Furrow on the left wrist due to ligature. (b) Circular shape of the furrow

Fig. 4.20 Hair tourniquet syndrome. Five-month-old infant. Inflamed appearance of the right second toe after a hair was removed



them [14, 15]. The resulting ischemia is painful and may cause crying or unusual irritability [16]. Any child old enough to point out an abnormality on his body and express pain should be asked about inflicted injury, especially if there are other traumatic injuries (Fig. 4.21).

Fig. 4.21 Hair tourniquet syndrome. Four-year-old boy. Circular furrow at the root of the penis from binding. Punishment injury (enuresis)



Fig. 4.22 Human bite. Four-month-old girl. Circular arc of bruises on the right forearm from a bite



4.2.4 Bites

Any bite mark is suspicious and warrants a complete, meticulous skin examination immediately. Parents or babysitters often claim the child was bitten by a sibling or by another child minded by the same babysitter. It is therefore important to describe the shape of the bite—round or oval—and the diameter of the mark, in an attempt to determine whether it is a child or adult bite. If possible, photograph the lesion against a ruler to provide an objective reference for later discussion. Adult bite marks can be distinguished from those of children by an intercanine distance greater than 3 cm. In some cases, the family blames the bite on a pet. Human bites are generally superficial, while animal bites are much deeper (Fig. 4.22).

4.3 Imaging

Any suspicious skin lesion in a young child warrants a full workup including a complete skeletal survey, ophthalmoscopy, and brain imaging. This is especially important for young children, because it can reveal subclinical skeletal or head injuries (*cf.* corresponding chapters). This workup should also be considered for older children with numerous skin lesions or skin lesions in unusual places, and/or if the family's explanations are vague.

4.4 Dating

Ecchymosis lasts a few days, its color changing as the hemoglobin breaks down. After the initial edema, ecchymosis appears. It starts out red or black and then turns purplish, before becoming brownish and then yellowish. Resorption begins in the periphery; the more extensive the initial ecchymosis, the longer it takes to resorb.

Dating ecchymosis based on clinical findings is inaccurate and analyzing the color of the lesion is subjective and difficult. There are many factors at work, including lesion's depth, location and blood supply, the time since the event, the force of the impact, and the child's skin pigmentation. Hence, same-age ecchymoses can be different colors, and it is usually impossible to determine whether skin lesions are, or are not, of different ages [17]. Postmortem dating of ecchymoses is discussed in a separate chapter.

4.5 Differential Diagnosis

There are two parts to the differential diagnosis of skin lesions; the first involves determining whether the lesions observed were caused by trauma, and the second involves determining whether traumatic injuries are accidental or inflicted.

While most of the differential diagnoses are clinical, there are some conditions that can mimic abuse, underlining the need for additional diagnostic testing. Even when skin lesions exhibit the characteristics of inflicted injury, it is essential to make certain that the child's coagulation is normal. Hence any child with ecchymotic lesions should have a coagulation workup, including a complete blood count, peripheral blood smear, partial thromboplastin time, and in some cases, after discussion by the medical team, additional tests such as von Willebrand factor, factors II, VII, VIII, IX, X, and XIII, and bleeding time [18].

4.5.1 Differential Diagnosis of Traumatic Lesions

4.5.1.1 Mongolian Spots

Mongolian spots are caused by the migration of deep dermal spindle cell melanocytes toward the skin surface. They generally disappear on their own during childhood but occasionally persist into adulthood. They are congenital spots found frequently in African, Asian, Hispanic, and Mediterranean populations with

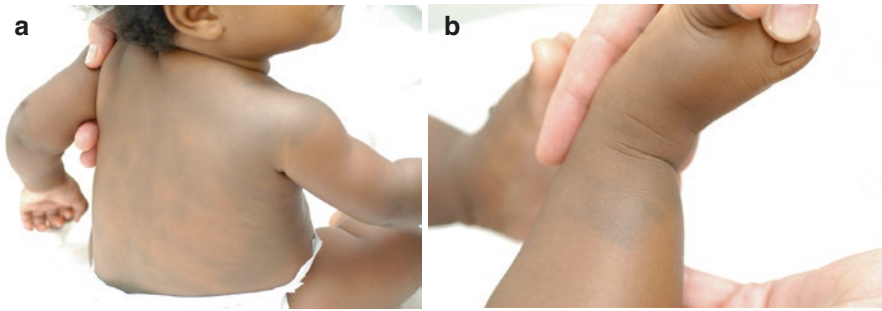


Fig. 4.23 a and b: Diffuse Mongolian spots. Four-month-old girl. (a) Back and shoulders. (b) Right foot

pigmented skin and in multiracial children. These irregular spots vary in size and are slate gray-blue in color (Fig. 4.23). While they are typically located in the lumbosacral region, on the buttocks, and in the intergluteal cleft, they are occasionally found on the upper and lower extremities, sides, and shoulders. Because they may be interrupted, superimposed, multiple, or distributed over the back, they can occasionally cause problems with diagnosis. When questioned, parents immediately explain that they are “birthmarks.” The proof is that the color of the spots will be the same when the child is seen back a week later. This is a strictly clinical diagnosis for which no additional testing is required [19].

4.5.1.2 Idiopathic (or Immune) Thrombocytopenic Purpura (ITP)

Idiopathic thrombocytopenic purpura (ITP) is an autoimmune bleeding disorder characterized by isolated thrombocytopenia with a platelet count below 150,000/L that cannot be explained by another condition. ITP is related to the presence of antiplatelet autoantibodies, which results in platelet destruction by mononuclear phagocytes, mainly in the spleen, and to an immune-related deficit in bone marrow platelet production. Clinical manifestations occur when the platelet count drops below 30,000/L. Though the child’s general health remains good, there are dermatologic signs of bleeding such as petechial purpura or ecchymosis and/or mucosal signs of bleeding such as epistaxis or hemorrhagic bullae in the mouth. The clinical presentation is often suggestive, and the diagnosis is confirmed by a complete blood count and peripheral blood smear. The cytopenia is isolated, with no involvement of the other cell types. Severe internal bleeding such as hematuria or gastrointestinal and cerebrospinal bleeding is rare, occurring only when the platelet count drops below 10,000/L. When the purpura is very ecchymotic, it can resemble a contusion, but the multiple petechiae that invariably accompany it point to the correct diagnosis.

4.5.1.3 IgA Vasculitis (Henoch-Schönlein Purpura)

IgA vasculitis (formerly called Henoch-Schönlein purpura) is a systemic vasculitis of the small vessels. It is characterized by the classical triad consisting of palpable purpura joint symptoms (arthralgia or arthritis) and abdominal involvement (abdominal pain, gastrointestinal bleeding and acute intussusception). It is frequently accompanied by edema of the extremities and may be complicated by orchitis and kidney

Fig. 4.24 IgA vasculitis. Nine-year-old boy. Purpuric lesions on the feet



involvement (hematuria, proteinuria, nephrotic syndrome, renal failure, and hypertension). The child's general health remains good, and there is no bleeding disorder or thrombocytopenia. It is an infiltrated purpura that can take the form of petechiae, papules, or ecchymotic patches (Fig. 4.24). The gravity-dependent lesions occur primarily on the lower extremities and buttocks but are sometimes found on the upper extremities (elbows) and, on rare occasions, the face and trunk. Involvement is fairly symmetrical and increases in the standing position. The lesions regress on their own within a few weeks. Though there is usually a single episode, it can recur. The diagnosis is clinical and leaves little room for suspicion of abuse.

4.5.1.4 **Cạo gió**

Cạo gió, a Vietnamese term meaning “scrape the wind,” or *gua sha*, a Chinese term meaning “scrape the fever” or more generally “scrape the disease to allow it to escape through the skin,” is an ancient medical treatment. It is sometimes called “spooning” or “coining” by English speakers; occasionally the French name “tribo-effleurage” is also used. The practice is very common in Asia, especially Vietnam, where Chinese medicine—an alternative to western medicine—has deep roots. It consists of applying oil to the skin and then firmly rubbing the skin of the back or neck several times, usually along the ribs and spine, with a coin until blood appears beneath the skin. The

technique is used mainly as a treatment for fever or pain but also as a remedy for cough, rhinitis, nausea, and abdominal pain. The diagnosis is strictly clinical.

4.5.1.5 Blood Cancers

There are immediate differences in the clinical presentation of a child with a blood cancer, who will be in poor general health and—in addition to petechial and ecchymotic purpurial lesions suggestive of thrombocytopenia—will have mucocutaneous pallor suggestive of anemia. There may also be prolonged fever, bone pain, mucosal bleeding, and leukemic infiltration with lymphadenopathy and hepatosplenomegaly. The CBC and peripheral blood smear show pancytopenia, usually with blast cells in the blood. The diagnosis is confirmed by bone marrow examination and staging.

4.5.1.6 Constitutional Abnormalities of Hemostasis

Here it is mainly a question of ruling out hemophilia and von Willebrand disease. Subcutaneous hematomas, often combined with ecchymosis, are common and may arouse suspicion of maltreatment. Look for a family or personal history of bleeding problems, bruising “easily” at the least impact, gingival bleeding, epistaxis, hematuria, or prolonged, abundant menstrual periods. The history provided by the parents and clinical examination aid in the diagnosis, with laboratory confirmation by coagulation testing.

4.5.1.7 Ehlers-Danlos Syndrome

Ehlers-Danlos syndrome refers to a heterogeneous group of hereditary connective tissue disorders. It is characterized by joint hypermobility (predisposing to trauma), vascular fragility (causing frequent, sometimes spontaneous, bruising), and numerous scars, which can mimic the signs of abuse. However, velvety skin texture, chronic fatigue, generalized pain, and neurocognitive or dysautonomic manifestations, as well as family history, help guide the diagnosis [20].

4.5.2 Differential Diagnosis of Abuse

4.5.2.1 Accidental Ecchymosis

Factors to consider in determining whether ecchymosis is accidental were discussed above, in the section on contusions. The analysis is based on the child’s age, the location of the ecchymosis, and the context; in accidental injuries there are no inconsistencies between the history and medical findings.

4.5.2.2 Self-Inflicted Ecchymosis

Perpetrators frequently allege that the ecchymosis was caused by falls or self-inflicted blows in the context of a child’s behavioral, or even psychiatric, disorder—particularly when the child is very young and unable to explain the circumstances himself. This is where multidisciplinary assessment is essential—especially since disability is a risk factor for abuse. Determine whether there are any inconsistencies between the observed injuries—location, appearance, outline of the shape of a blunt object, etc.—and the family’s explanations.

Fig. 4.25 Self-inflicted wounds. Fourteen-year-old right-handed boy. Cutter wounds and cigarette burns on the distal end of the left upper extremity



4.5.2.3 Self-Inflicted Wounds

When they are extremely tense, some adolescents cut themselves with a sharp object to make themselves bleed and calm themselves down. This is known as “cutting.” Such self-inflicted wounds are located on the front of the body, particularly on the upper extremities and the front of the thighs. The wounds are made with the dominant hand, which explains why they are unilateral or grossly asymmetric on the upper extremities (Fig. 4.25). They are diagnosed based on the teenager’s account.

4.6 Treatment Principles and Sequelae

Contusions (erythema, ecchymosis, and hematomas) and bites resolve on their own, with the skin returning to its original state. No treatment is needed, aside from analgesics, if necessary, and a topical antiseptic for bites.

Some wounds require exploration, debridement, and suturing. Except for erosions and abrasions, which involve only the epidermis, wounds may leave scars in exposed areas, causing social problems for the child.

The treatment for hair tourniquet syndrome is removal of the fibers or hair in question. In many cases, this procedure must be performed under general anesthesia.

Key Points

- While skin lesions are an excellent marker for abuse, they can be short-lived, especially in young children.
- The non-accidental nature of ecchymosis can be determined based on an analysis of the child’s age, the location of the bruise, and the circumstances reported by the family.
- Even the slightest ecchymosis on an infant under the age of 9 months warrants a complete evaluation, including a clinical examination of the completely undressed child, a skeletal survey, brain imaging, and ophthalmoscopy.
- This workup should also be done for older children if they have numerous or recurring skin lesions or skin lesions in unusual places, and/or if the family’s explanations are vague.

- In an abuse context, skin lesions may be found in unusual places (armpits, genitals, etc.). They should always be described in great detail (type, coloring, size, and location) and photographed.
- Any bite mark in a child is suspicious and warrants an exhaustive skin examination.
- Clinical dating of ecchymosis is imprecise, and it is usually impossible to determine whether skin lesions are, or are not, of different ages.
- In a context of ecchymoses or hematoma, it is essential to verify that the child's clotting is normal.

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Inlicted Cutaneous Lesions and Burns: Abuse-Related Burns

5

Sophie Cassier and Marie-Paule Vazquez

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S. Cassier

Faculté de Médecine Pierre et Marie Curie, Unité de Chirurgie des Brûlés, Hôpital Trousseau,
GH HUEP, AP-HP, 26, rue du Dr Arnold Netter, 75571, Paris Cedex 12, France

e-mail: sophie.cassier@aphp.fr

M.-P. Vazquez (✉)

Service de Chirurgie Maxillo-Faciale et chirurgie Plastique, Faculté de Médecine
Paris-Descartes, Université Paris 5, Hôpital Necker-Enfants Malades, 149 rue de Sèvres,
Paris, France

e-mail: marie-paule.vazquez@aphp.fr

5.1 Introduction

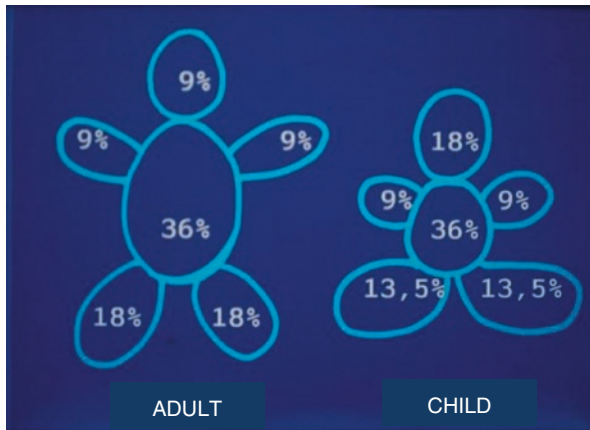
Intentional burns are most likely underestimated because it can be difficult to prove that a burn was deliberate [1]. They are one of the most common causes of death due to child abuse and are the most painful injuries that can be inflicted [2–4]. The percentage of children admitted to burn centers as a result of abuse ranges from 1% to 35%, depending on the country being studied [5]. Burns are found in 5–20% of physical abuse cases and disproportionately affect children ages 1–3 years [6, 7]. Intentional burns cause greater morbidity and mortality than accidental burns. Inflicted burns result in longer hospital stays, more surgeries, and a higher rate of infectious complications due to delays in seeking treatment [1, 8]. All confirmed cases of neglect-related burns should be reported.

5.2 Clinical Aspects

The depth of a burn has prognostic value, because the deeper the burn, the higher the risk of sequelae. It is also important for treatment—in particular, in terms of the indication for skin grafting. Determining the burn depth is difficult in the initial phase, because the polymorphous appearance—with several coexisting degrees—is often misleading. The depth should be reassessed daily, and judgment about it or about whether surgery will be needed should not be rushed. Burns can be staged by degrees. First-degree burns are areas of painful, sunburn-like erythema caused by damage to the epidermis, which nevertheless retains its ability to regenerate. Second-degree burns are characterized by blistering and are classified as either superficial—typically characterized by a pink or red background, blisters, and severe pain—or deep, in which there is variable blistering, a whitish background that turns brownish-red due to intra- and subdermal hemolysis and more moderate pain (unless there is secondary infection). What differentiates these two stages is the depth of the damage to the dermis, which determines whether or not the skin can regenerate on its own and thus whether skin grafts are needed. Distinguishing between superficial and deep second-degree burns in the acute phase is difficult. The burn is described as intermediate second-degree, with a more precise diagnosis becoming possible based on its course over the next 4–10 days. A third-degree burn is a deep burn that destroys the entire skin layer, resulting in a stiff white, brownish, or black appearance.

Apart from the depth of the burn, which should be reevaluated later, the examination should determine the child's age, the conditions and circumstances of the burn, the area of the burn, its precise location(s), its exact characteristics—whether it has sharp borders, is circumferential, etc.—and any signs pointing to the causative mechanism. An accurate diagram of the initial injuries, supplemented by medical photographs, is essential. Practitioners also need to look for other injuries and evidence of neglect or abuse and attempt to reconstruct the circumstances of the event. There are specific methods used to estimate and calculate the percent of total body surface area (TBSA) involved—especially in very young children, for

Table 5.1 Burn size: Wallace rule of nines



Body part	Area involved
<i>Wallace rule of nines—table for adults</i>	
Head and neck	9%
Anterior trunk	18%
Posterior trunk	18%
Each leg	18% (x2)
Each arm	9% (x2)
Perineum	1%
Total	100%
<i>Wallace rule of nines—table adapted for children</i>	
Head and neck	18%
Anterior trunk	18%
Posterior trunk	18%
Each leg	13.5% (x2)
Each arm	9% (x2)
Perineum	1%
Total	100%

whom the Lund and Browder chart is preferred over the Wallace rule of nines (Tables 5.1 and 5.2). The depth of the burn is directly proportional to the temperature and nature of the agent causing the burn and to the duration of exposure (Table 5.3). Children have thinner skin than adults, which explains why they suffer more serious injury under similar burn conditions. Certain burn locations are suggestive of abuse. Accidental burns are more likely to involve the lower face, neck, front of the trunk, and/or upper extremities (Fig. 5.1), while intentional burns usually involve the lower half of the trunk, perineum, lower extremities, hands, and face [6] (Figs. 5.2 and 5.3).

Table 5.2 Burn area: Lund and Browder chart

Location	Age (years)				
	0–1	1–4	5–9	10–15	Adult
Head	19	17	13	10	7
Neck	2	2	2	2	2
Posterior trunk	13	13	13	13	13
Anterior trunk	13	13	13	13	13
Right buttock	2.5	2.5	2.5	2.5	2.5
Left buttock	2.5	2.5	2.5	2.5	2.5
Perineum	1	1	1	1	1
Right forearm	4	4	4	4	4
Left forearm	4	4	4	4	4
Right upper arm	3	3	3	3	3
Left upper arm	3	3	3	3	3
Right hand	2.5	2.5	2.5	2.5	2.5
Left hand	2.5	2.5	2.5	2.5	2.5
Right thigh	5.5	6.5	8.5	8.5	9.5
Left thigh	5.5	6.5	8.5	8.5	9.5
Right lower leg	5	6	5.5	6	7
Left lower leg	5	6	5.5	6	7
Right foot	3.5	3.5	3.5	3.5	3.5
Left foot	3.5	3.5	3.5	3.5	3.5
					Total

Table 5.3 Burn depth

Depth	Skin involvement	Initial clinical lesions
First-degree	Epidermis	Pain Erythema Edema
Superficial second-degree	Epidermis Superficial dermis	Pain Pale pink color Clear blisters Exudative Positive diascopy
Deep second-degree	Epidermis Deep dermis	Hypoesthesia Deep red color + petechiae Serosanguinous blisters Positive diascopy
Third-degree	Epidermis Dermis Hypodermis Adnexa	Numb White, brown, or black eschar Non-exudative Negative diascopy

Fig. 5.1 Accidental scald from a hot liquid. Twenty-four-month-old child. Injury to the lower part of the face and the chest



Fig. 5.2 Deliberate burn to the foot by forced immersion. Fifteen-month-old child. "Stocking" burn that required emergency escharotomy



Fig. 5.3 Intentional scald of the buttocks. Eighteen-month-old girl. Uniform lesion with clearly demarcated borders and no splash marks



5.2.1 Forced Immersion

Forced immersion in scalding bath or sink water is the most common method for deliberately burning a child [5]. Forced immersion leaves several telltale signs. When immersion occurs with the child immobilized, the scald is generally symmetrical, and there is a sharp demarcation between injured and healthy skin (Fig. 5.3), unlike in accidental immersion, where a scattering of peripheral lesions of varying depths evidence the child's efforts to limit contact with the scalding substance [9]. Intentional scalds are uniform in depth and usually involve the perineum and/or lower extremities [5–7, 10]. It is important to keep in mind, however, that a very young child may be frozen with fear and suffer deep, symmetrical scalds without any sign of splashing. If a child is held in the scalding water with his legs bent, the scalding will be uniform and symmetrical, but the lower extremity joint creases will be spared [5, 6, 11, 12]. A deep glove- or stocking-pattern burn should also raise suspicion that the child's hand or foot was intentionally immersed in scalding water (Fig. 5.2). Deliberate scalds of the child's buttocks are usually uniform, with sharp borders and no splash marks (Fig. 5.3). They can also be halo-shaped, due to the child being forced to sit against the cooler bottom of the bathtub [7].

5.2.2 Burns Inflicted with Hot Objects

Intentional burns due to contact with a hot object usually leave a readily identifiable imprint and are deep. The classic example is the imprint of an iron (see Fig. 10.8 in the Chap. 10), a curling iron, or a hot cloth on the face. This kind of burn on an unexposed area is highly suspicious for abuse. Burns from accidental contact are not as deep because the withdrawal reflex limits the contact time with the hot object. Cigarette burns are round, sharply demarcated, measure 7–8 mm in diameter, and—because the burn is not as deep peripherally—have a deeper base with slightly elevated edges [6, 13] (Fig. 5.4). They are typically third-degree burns that heal slowly, usually leaving a scar with a depigmented center surrounded by a hyperpigmented halo. Accidental cigarette burns, on the other hand, are single, more superficial, less well-demarcated, and usually heal without a scar.

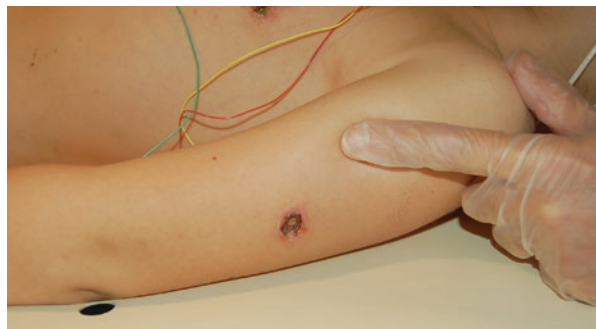


Fig. 5.4 Intentional cigarette burns. Six-year-old child. Round, well-demarcated, centimeter-sized lesions with a deep base and slightly elevated borders

5.2.3 Electrical Burns

Intentional electrical burns are very rare and much harder to identify as deliberate because their clinical presentation closely resembles that of accidental burns. They can cause cardiac arrhythmias and tetanic muscle spasms and should be considered whenever there is an unexplained loss of consciousness. Electrical burns can range from a simple erythematous papule to a deep necrotic lesion, depending on the type of voltage and duration of contact [7]. The lesions are usually small and punctiform, corresponding to the electrical current's entry and exit points. Multiple electrical burns or different age scars should alert the clinician to the possibility of abuse.

5.3 Imaging

The only imaging needed when an intentional burn is suspected is investigation for other abuse-related trauma, particularly skeletal and head injuries. Medical photographs are very helpful at every stage—for diagnosis, to document progress, and as legal evidence. In some cases, old and recent family or school photos can also help with diagnosis, dating and identifying recurring abuse.

5.4 Differential Diagnosis

There are a number of conditions to consider in the differential diagnosis of intentional burns, including accidental burns and certain ritual and self-treatment practices [6, 13]. Several skin conditions can also be mistaken for burns at various stages of healing.

5.4.1 First-Degree Burns

Conditions that can be mistaken for first-degree burns include certain types of cellulitis, allergic contact dermatitis, drug rashes, solar dermatitis, insect bites, and phytophotodermatitis. With contact dermatitis, an inflammatory, pruritic erythema is seen hours or days after exposure to a particular agent. The history is fundamental to determining the etiology behind the clinical presentation. Phytophotodermatitis is a contact dermatitis caused by certain plants from the Apiaceae (celery) and Rutaceae (lemon, bergamot) families. It presents as patches of erythematous epidermolysis that can be mistaken for a superficial burn. The pattern of the lesions corresponds to the points of contact with the plant responsible for the condition. Children who ingest the causative agent may exhibit lesions around their mouths.

5.4.2 Second-Degree Burns

Conditions that can look like a second-degree burn include dermatitis herpetiformis and skin infections (staphylococcal, in particular), epidermolysis bullosa, bullous

impetigo, Stevens-Johnson syndrome, and pemphigus. The Nikolsky sign can be used to differentiate a bullous condition from a burn; it can be observed by exerting tangential pressure or rubbing the skin at the base of a lesion. If pressure or rubbing causes the skin to exfoliate, the sign is positive. A positive Nikolsky sign is found in epidermolysis bullosa and staphylococcal scalded skin syndrome (SSSS), which is a response to a staph infection. While SSSS can resemble a superficial second-degree burn, the child will have a fever and be generally ill. The disease usually starts with erythema, which is followed by blistering and desquamation. It mainly affects infants, young children, and children with depressed immune systems or renal failure and can be fatal. Epidermolysis bullosa is a group of bullous diseases in which blisters and erosions form either spontaneously or after very minor trauma. There are both congenital and acquired forms. In children, it is mainly the congenital forms that cause sloughing of large areas of the skin and mucous membrane, beginning in the neonatal period or shortly thereafter. The Nikolsky sign and family history are positive. A skin biopsy can be performed if there are difficulties with the diagnosis. The Nikolsky sign is negative in bullous pemphigoid and dermatitis herpetiformis. Dermatitis herpetiformis presents as symmetrical patches of pruritic vesiculopapular eruptions on the trunk or extremities. Diagnosis is based on the pattern of the lesions and their pruritic nature. If in doubt, a biopsy of the lesions showing immunoglobulin A at the dermis-epidermis junction confirms the diagnosis. Bullous impetigo is an infectious dermatitis due to streptococcus and/or *Staphylococcus aureus* that presents as flaccid bullae or vesicles filled with a clear fluid and surrounded by a ring of inflammation. These pruritic lesions develop into round erosions that can resemble cigarette burns. A similar picture is seen with ecthyma, which presents as ulcerated lesions with a blackish crust and a predilection for the lower extremities. In both of the foregoing cases, the lesions—unlike cigarette burns—heal rapidly with appropriate antibiotic therapy and, except for ecthyma, without leaving a scar.

5.4.3 Deep and Third-Degree Burns

Third-degree burns may be found with a rare condition known as congenital insensitivity to pain (CIP) and can be mistaken for intentional burns. CIP is a hereditary neuropathy characterized by an inability to feel physical pain but preserved sense of touch and proprioception. The diagnosis is based on a careful clinical history and physical examination, supplemented by genetic testing. In most reported cases, the condition is due to autosomal recessive transmission of a SCN9A gene mutation.

5.4.4 Other Pitfalls

Some rituals and cultural practices can also cause burns and be mistaken for abuse [13]. Applying hot objects (cupping glasses, silver coins, etc.) or particular plant-based ointments to the skin to treat certain illnesses can cause burns, though they are

usually not very deep. Although there is no intention to injure the child, such practices warrant a medical/psychosocial assessment to stop them from happening again.

5.5 Dating

Unlike ecchymoses, it is possible to say that burns are different ages and hence highly suspicious for abuse. First-degree burns usually heal within a week without scarring, while superficial second-degree burns heal in 10 days to 2 weeks, leaving a scar that is discolored in the early phase and then can fade. Cigarette burns usually leave round scars that are depigmented in the center and hyperpigmented in the periphery. Deep second-degree and third-degree burns take several weeks or months to heal or become chronic. If seen late, they can present as necrotic, often infected, wounds.

5.6 Treatment Principles

Burns are treated with a combination of surgery and resuscitation, depending on the severity (extent and depth), the child's age, and the type of burn. There are well-defined criteria for hospitalizing a child with burns. If there is the slightest suspicion that the family is responsible, the child should be hospitalized regardless of the severity of the burn, if possible in an intensive care unit, which is a more secure setting. Practitioners can refer to the current recommendations to justify hospitalization (Table 5.4).

Medical care should address four factors: plasma loss, hypothermia, infection, and pain. The child's vital signs should be stabilized, and he should be started on an appropriate combination of sedatives and analgesics. Any child with burns over more than 10% of his total body surface area should receive IV fluids. Plasma loss will depend on the size of the burn; the formula is 2 ml/kg/%TBSA in the first 8 h. While initial pain control is essential, local treatments, mobilization, and physical therapy also cause pain. It is important to know how to go from moderate sedation to deep general anesthesia, depending on the burn.

Surgical care involves a combination of topical treatment and potential surgery, with the latter deferred for between 4 and 10 days. Treatment is done on an inpatient

Table 5.4 Criteria for hospitalizing a burned child

Area \geq 5% children $<$ 1 year
Area \geq 10% children \geq 1 year
Functional locations: face, hands, feet, or perineum
Electrical burn
Circumferential burn
Chemical burn
Associated traumatic injuries
Suspected neglect or abuse
Underlying medical condition

basis with sedation or, if necessary, general anesthesia and involves exposing the burns to air under an infrared lamp, repeated spraying with dilute antiseptic (chlorhexidine), and daily antiseptic baths. These treatments minimize the risk of infection. If healing is not obtained after 8–10 days of treatment, excision followed by autologous skin grafting is indicated. The only indication for urgent surgery is a deep circumferential burn requiring escharotomy—incisions through the epidermis and dermis—which should be performed by a surgeon within the first 6 h.

5.7 Sequelae

The deeper the burn, the greater the risk of scarring. Without the appropriate measures, scars from deep burns tend to become hypertrophic, even keloid. The younger the child, the greater the risk of scar contracture and deformation with growth—particularly on the limbs, face, and neck. Two years of adjuvant treatments such as scar massage, hydrotherapy with a fine, high-pressure (“filiform”) shower, sun protection, and compressive garments are needed after deep burns to prevent functional and cosmetic sequelae due to scarring. Secondary surgery will depend on the sequelae and the psychological context but should wait at least 2–3 years after the burn, unless there are functional problems (eyelids, corner of the mouth, joints, or hands).

Key Points

- Intentional burns are underestimated, because it is often difficult to prove that a burn was deliberate.
- Burns are one of the most common causes of death due to child abuse and are the most painful inflicted injuries.
- The examiner should describe the exact characteristics of the burn, along with any signs pointing to the mechanism. An accurate diagram of the initial injuries is essential, supplemented by medical photographs.
- Intentional burns usually involve the lower half of the trunk, perineum, lower extremities, hands, and face.
- Forced immersion in scalding water is the most common mechanism, often resulting in symmetrical burns with a sharp line of demarcation.
- Intentional burns due to contact with a hot object are deep, and the shape of the object can often be discerned.
- The differential diagnosis of intentional burns includes a number of conditions, among them accidental burns and certain ritual and self-treatment practices.
- The presence of multiple burns at different stages of healing is highly suspicious for abuse.
- Treatment involves a combination of surgery and resuscitation, depending on the type of burn and the child’s age.
- If there is the slightest suspicion that the family is responsible, the child should be hospitalized, regardless of the severity of the burn.

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Michel Panuel, Kathia Chaumoitre, Philippe Petit,
and Jean-Luc Jouve

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M. Panuel (✉) • K. Chaumoitre
Service d'Imagerie Médicale, Hôpital Nord, CHU Marseille, Aix-Marseille Université,
Marseille, France
e-mail: Michel.PANUEL@ap-hm.fr; Kathia.CHAUMOITRE@ap-hm.fr

P. Petit
Service d'Imagerie Pédiatrique et Prénatale, Hôpital La Timone—Enfants, CHU Marseille,
Aix-Marseille Université, Marseille, France
e-mail: Philippe.Petit@ap-hm.fr

J.-L. Jouve
Service d'Orthopédie Infantile, Hôpital La Timone—Enfants, CHU Marseille,
Aix-Marseille Université, Marseille, France
e-mail: jean-luc.jouve@ap-hm.fr

Skeletal injuries are common and were part of the first radiological and clinical descriptions of child abuse. The ability to recognize them is key to diagnosis. They are varied, some are specific for abuse, and they are not life-threatening. In most cases the functional prognosis is good.

6.1 Clinical Presentation

Skeletal injuries in abused children can have a variety of clinical presentations. While an obvious orthopedic problem may dominate the clinical picture, skeletal injuries are more commonly discovered during a radiology workup motivated by a primarily neurological clinical picture, other suggestive clinical signs (bruises, skin abnormalities, etc.), or sudden infant death. There are typically few clinical signs of underlying bone lesions, and there is little or no correlation between the presence of bruising and that of fractures [1–3].

The radiological workup plays a crucial role; comparing the clinical history to the injuries found is essential. Any inconsistencies may be further evidence in support of the diagnosis.

6.2 Mechanisms

6.2.1 Properties of the Immature Skeleton

The anatomical particularities and biomechanical properties of the immature skeleton are responsible for the particular presentation of accidental and non-accidental injuries. In infants, the cortical (compact) bone of the diaphysis is richly vascularized and more porous than that in older children and adolescents, making it more resilient to deformation. During the first two years of life, the metaphysis is characterized by thin compact bone and predominant spongy (cancellous) bone, within which are found the primary spongiosa, in direct contact with the growth plate, and the more mature secondary spongiosa, which is the main cancellous component of the metaphysis. The primary spongiosa is the weakest area in infants [2, 3]. The growth plate and, more broadly, the entire chondro-epiphysis are also fragile (Fig. 6.1).

The immature periosteum is also distinctive, being thick, sturdy, richly vascularized, and only weakly attached to the diaphyseal cortical bone beneath it. In contrast, it is firmly anchored in the metaphyseal region and at the perichondral ring surrounding the growth plate. Note that in young children, the bony and cartilaginous components of the skeleton are weaker than the adjacent fibrous structures (periosteum, joint capsule, tendons, and ligaments).

6.2.2 Mechanisms of Injury

In the abuse context, skeletal injuries vary with the child's age, the nature of the trauma, and the anatomical region involved. The injury might be caused by a direct

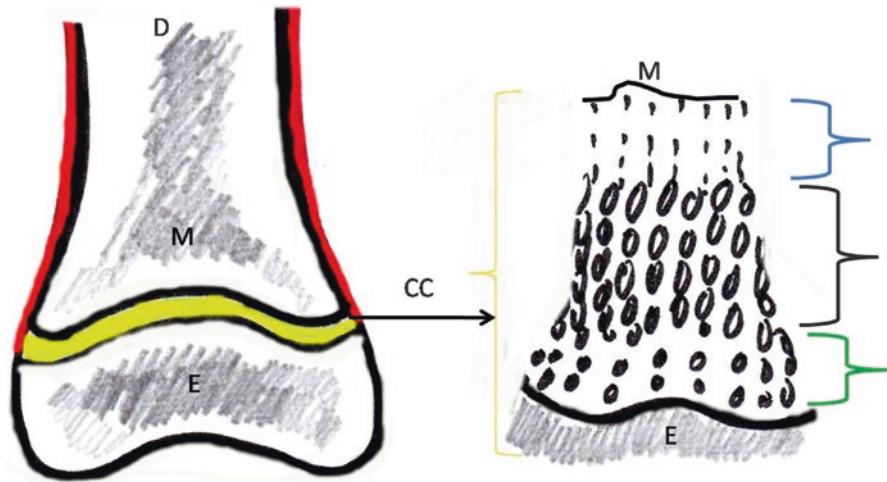


Fig. 6.1 Diagram of the growth plate (CC, yellow). E: epiphysis, still cartilaginous and covered with articular cartilage; M: metaphysis; D: diaphysis. The periosteum (red) covers the compact bone of the diaphysis up to the metaphysis, to which it is firmly anchored. The growth plate has several histologically distinct zones; they are, from the epiphyseal side (E) to the metaphyseal side (M), the resting zone (at the bottom of the diagram, green brace); the proliferation and maturation zone (black brace); and the zone of provisional calcification, apposed to the metaphysis, which is where the transformation to bone takes place (primary and secondary spongiosa) and the area of greatest weakness (blue brace)

blow, similar or even identical to that observed in an accidental context; it might also be due to torsional (limbs), traction (limbs), shearing (limbs), or compressive (ribs and spine) forces.

While there are a number of different mechanisms for skeletal injuries in the “shaken baby” context (and some children exhibit more than one kind), what they all have in common is violence: ribs crushed by the abuser’s hands, spinal compression injuries caused by the back-and-forth movements of the skull and trunk, limbs injured by wild swinging, and injuries to the skull or other bones by direct blows.

Repeated attacks will cause different-age lesions, and a new injury can occur in previously injured areas, hence the emphasis on the role of recurring microtrauma in metaphyseal cancellous bone. The abnormalities that are encountered will be detailed in the section devoted to radiological aspects below.

In addition to traumatic injuries, bones can also exhibit the consequences of malnutrition or repeated stress.

6.3 Imaging

Quite often, imaging provides information critical to diagnosis and management. Whatever the circumstances of clinical suspicion motivating the search for skeletal injuries, the imaging workup and report must be impeccable, because the imaging documents are usually a fundamental part of the legal case [4].

6.3.1 Modalities

6.3.1.1 Radiology

The American College of Radiology (ACR) and the Royal College of Radiology (RCR) have issued recommendations for radiologic exploration of children with suspected non-accidental injury [5, 6] (Table 6.1). The recommended workup varies according to age and clinical context.

Before age 2 years, a full skeletal survey is mandatory. After age 5 years, a full skeletal survey is unnecessary, and the images should involve the areas of clinical suspicion. Between ages 2 and 5 years, the choice should be made on a case-by-case basis.

A single whole-body radiograph (“babygram”) should not be performed; images should be centered and properly collimated. For the knees and ankles, obtain orthogonal views between them and in the metaphyseal region under consideration (Figs. 6.2 and 6.3). The full skeletal survey should ideally be performed during regular working hours in the presence of an experienced radiologist who will verify the quality, order additional exposures, if needed, and take appropriate analgesic measures on the child’s behalf.

The published recommendations differ in a few details, for example, oblique views of the rib cage, routine lateral views of the elbows and wrists, and an additional

Table 6.1 Recommendations for skeletal survey in children under the age of 2 years. NB: The recommendations for head and abdominal imaging are not included in this table. A radiologist proficient in pediatric imaging should validate image quality

<i>Initial workup</i>	
Routine views	Skull, frontal and lateral (unless 3D CT head views) Cervical spine, frontal, and lateral Chest, frontal, and lateral (ribcage, spine, and shoulder girdle) Lumbosacral spine and pelvis, frontal Lumbosacral spine, lateral Limbs (by separate, collimated images) Right and left upper arms, frontal Right and left forearms, frontal Hands, frontal Thighs, frontal Lower legs, frontal Feet, frontal
Widely advised additional views ^a	Lateral view centered on the knees and ankles; the younger the child, the more important this is Oblique views of the ribcage
<i>If initial workup is equivocal or normal with a high index of suspicion clinically</i>	
Repeat radiological workup	New complete skeletal survey, as above, after approximately 10 days with the child in a safe environment
OR	Bone scan
<i>All siblings under age 3 years living in the same conditions as the index case should have the same imaging workup</i>	

^aThese views should be done routinely

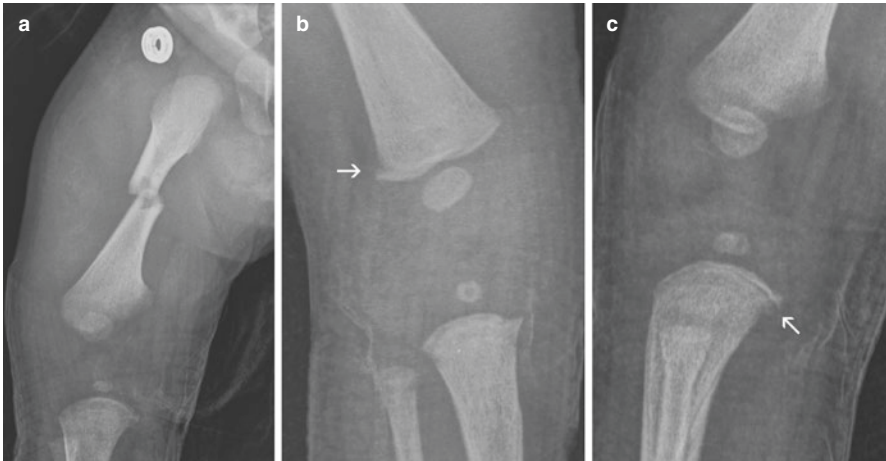


Fig. 6.2 Five-week-old infant admitted for loss of right lower extremity function. (a) transverse fracture of the femur, soft traction device causing spurious artifacts. (b) image orthogonal to the femoral metaphysis demonstrating a metaphyseal bucket handle injury (*horizontal arrow*). (c) image orthogonal to the tibial metaphysis demonstrating the same type of injury to the tibia (*oblique arrow*). The rest of the workup revealed multiple fractures that had been missed on the clinical exam (ribs and forearm)

head image on the squamous part of the occipital bone. In any case, the emphasis is on high-quality skeletal survey and interpretation; any excesses or shortcomings could have serious negative consequences for the child or his family [4, 7].

There are three possible scenarios after the first radiological assessment: an appearance typical of non-accidental trauma on one or more bones, no visible injuries, or an equivocal or doubtful situation. For the latter two cases, when the clinical picture is highly suggestive, there are two suggested options: perform a bone scan or repeat the X-rays 10 days to 2 weeks later (the rib cage, at a minimum, without repeating the head exposures), provided the child's safety can be ensured (Figs. 6.4 and 6.5). The new images may show injuries in the repair phase, like callus formation on fractures that had initially gone unnoticed [2, 8]; they may also show new lesions and help with the differential diagnosis (e.g., normal variants or bone dysplasia) and with dating the injuries. Conversely, if there are no signs of repair after 10 days or so, traumatic bone lesions can be ruled out. When a child is hospitalized urgently with severe neurological problems requiring intensive care, the full skeletal survey may have to wait, obviating the need to repeat it.

The radiology report should be precise, indicate whether the study is technically satisfactory or new images are needed, describe any abnormalities, clearly mention any suspicion of non-accidental injury if such is the case, and rule out the main alternatives in the differential diagnosis. The radiologist should also communicate his diagnostic suspicions or certainty to the clinician treating the child as soon as possible [4]. The radiologist can also determine right away whether or not there are different-age lesions (*cf.* section on dating below).

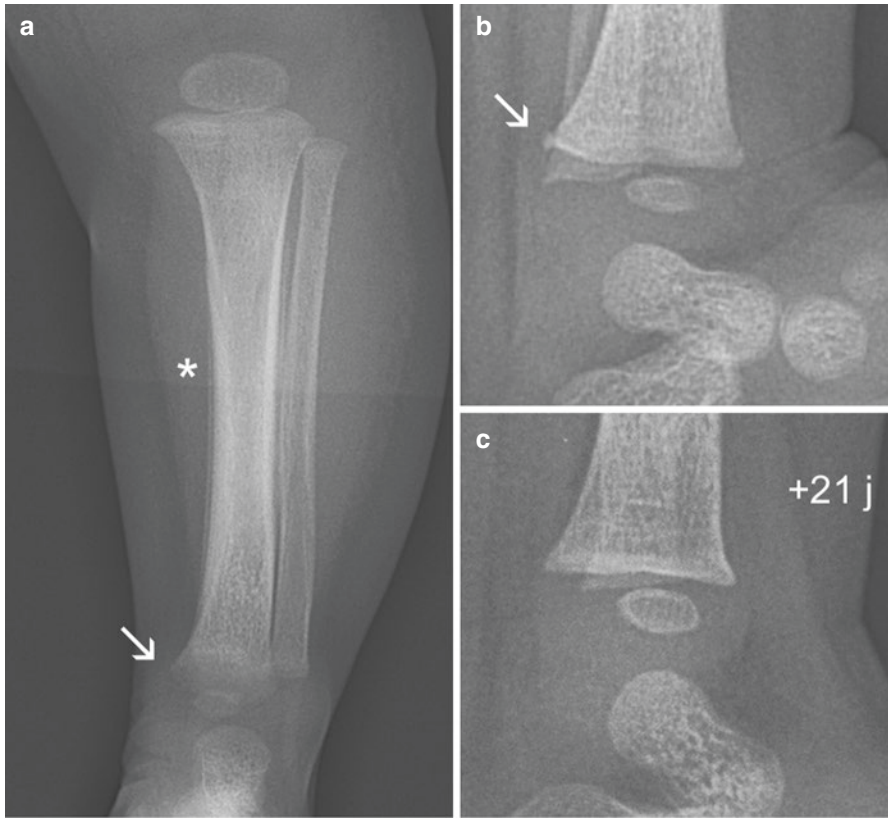


Fig. 6.3 Eight-month-old infant with multiple fractures. (a) frontal view of the left lower leg during the initial workup, sclerosis and subtle bowing of the tibial shaft together with circumferential periosteal new bone formation (*asterisk*); the distal metaphysis appears normal (*arrow*). (b) spot film of the ankle, corner fracture of the tibial metaphysis (*arrow*). (c) image taken 21 days later; the metaphyseal lesion can no longer be seen

6.3.1.2 Bone Scan

Bone scans are very sensitive in detecting rib fractures, non-displaced shaft fractures, and periosteal separations and remodeling. However, their ability to detect subtle metaphyseal injuries is very poor, due to physiological increased uptake in the metaphysis and growth plate; skull fractures and very recent or consolidated fractures may also go unnoticed (Fig. 6.6). In addition, dating fractures with bone scan is tricky. There is no consensus on its indications in this context. Bone scans can be done instead of a second skeletal survey in doubtful cases, for the ribs in particular. The level of ionizing radiation exposure is, however, higher than that delivered by a selective skeletal survey [1].

6.3.1.3 Other Imaging Modalities

Ultrasound can be used to reveal occult fractures, epiphyseal separations, and juxtacortical collections like hematomas, but there is no scientific proof of its actual

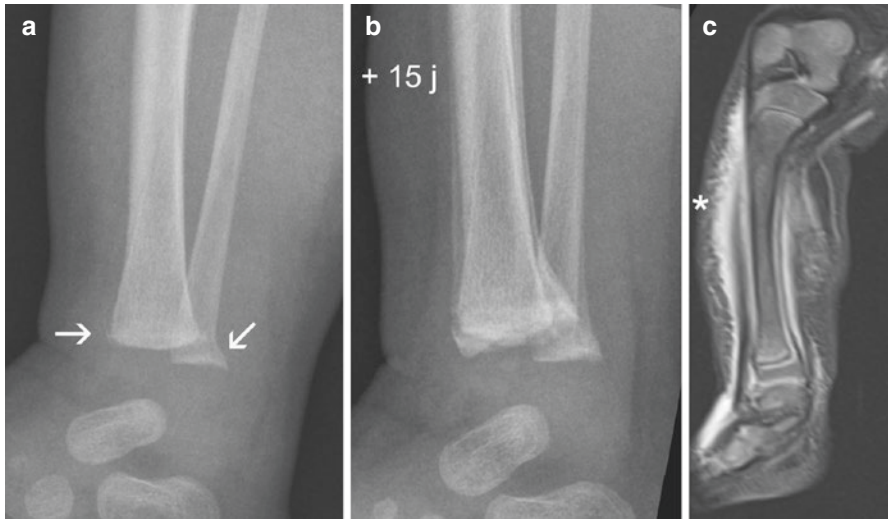


Fig. 6.4 Two-month-old infant with loss of right lower extremity function of unknown etiology. (a) Corner fracture of the tibial metaphysis (*horizontal arrow*) and bowing fracture of the fibular metaphysis (*oblique arrow*), subtle on the initial workup, seen more easily on the follow-up X-ray 2 weeks later (b), at which time there was also thick periosteal new bone formation. STIR sequence MRI (c), longitudinal section of the tibia (detail from the whole-body MRI) contemporaneous with the initial workup confirms the metaphyseal fracture and illustrates subcutaneous abnormalities (*asterisk*)

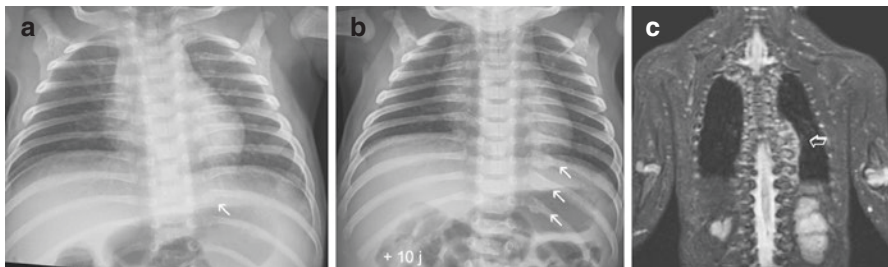


Fig. 6.5 One-month-old infant with lower extremity fractures. (a) initial chest X-ray, probable posterior fracture of the left tenth rib (*arrow*). (b) chest X-ray, day 10, several calluses can be seen (*arrows*). (c) MRI, 3D STIR sequence with MIP reconstruction, day 2, performed during a brain MRI, hematoma in contact with rib fractures (*hollow arrow*)

value. The same is true for computed tomography, which in live children is used in only a few specific cases—namely, multiple trauma and suspected spinal injury. Nevertheless, emergency CT done for neurological reasons should include an analysis of the cranial vault using the 3D imaging options, which can be a good substitute for plain films.

Whole-body STIR-MRI has emerged as an option for detecting musculoskeletal injuries in abuse cases; other potential advantages are the fact that it does not use ionizing radiation and can be coupled with brain MRI. One publication, however, has shown that it has low sensitivity for diagnosing rib fractures and metaphyseal

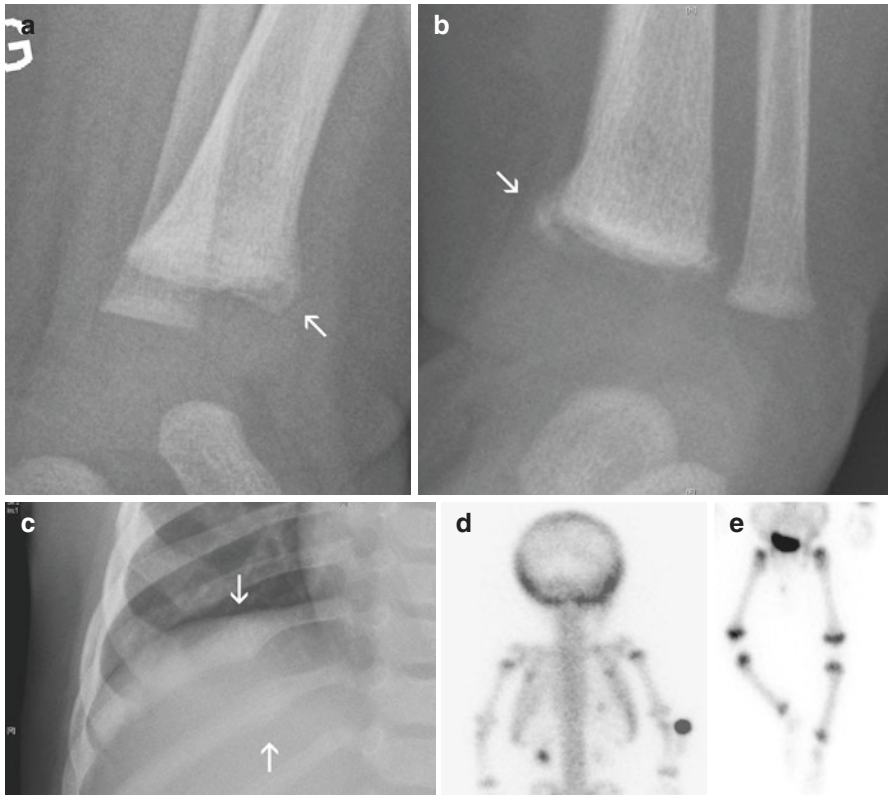


Fig. 6.6 Four-month-old infant with a subdural hematoma. (a, b) corner avulsion injury of the distal tibial metaphysis (*oblique white arrows*). (c) posterior calluses on the right ninth and tenth ribs. (d) bone scan, posterior view, a single costal lesion can be seen. (e) bone scan, anterior view, the metaphyseal lesion in the left tibia is not recognized

lesions and so cannot be used in place of the standard skeletal survey. It can, however, provide additional information on soft tissue injuries when the diagnosis is still unclear after skeletal survey [9] (Figs. 6.4 and 6.5).

6.3.1.4 Sibling Skeletal Survey

The recommendations include a skeletal survey of all siblings under age 2 or 3 years in cases of proven non-accidental injury (Table 6.1) [4].

For cases of non-accidental injury of a child in day care, that might be extended to other young children.

6.3.1.5 Postmortem Studies

A high-quality skeletal survey appears to be essential autopsy practice for infants who die inexplicably or unexpectedly [3, 10]. Here again, localized images are more effective for analyzing subtle traumatic lesions. While, like the skeletal survey, whole-body CT can be done postmortem in uncertain cases, its value has not yet



Fig. 6.7 Postmortem CT scan of a 16-month-old infant, global view of the skeleton, and coronal reconstruction of the right tibia. No visible lesions, but the sensitivity of this type of exploration has yet to be demonstrated. Image courtesy of G. Gorincour

been determined, especially since postmortem CT is still difficult at most sites [11] (Fig. 6.7). The reader might also like to consult the chapter on postmortem imaging for details regarding the technical aspects and current recommendations.

6.3.2 Bone Lesions

All types of fractures have been reported in the abuse context. Some injuries, however, are highly suggestive of—even pathognomonic for—inflicted injury; these include metaphyseal lesions and posterior rib fractures (Table 6.2). Often, multiple bones are involved, and repeated attacks explain the presence of different-age lesions (Figs. 6.8 and 6.9).

Table 6.2 Specific skeletal lesions from non-accidental injury [1, 2, 7, 20]

Corner or bucket handle metaphyseal injury (classic metaphyseal lesion)
Thoracic compression fracture especially posterior rib fracture
Spinous process fracture
Multiple fractures including bilateral fractures
Different-age fractures
Epiphyseal separation
Compression vertebral fracture
Finger or toe fracture
Complex skull fracture

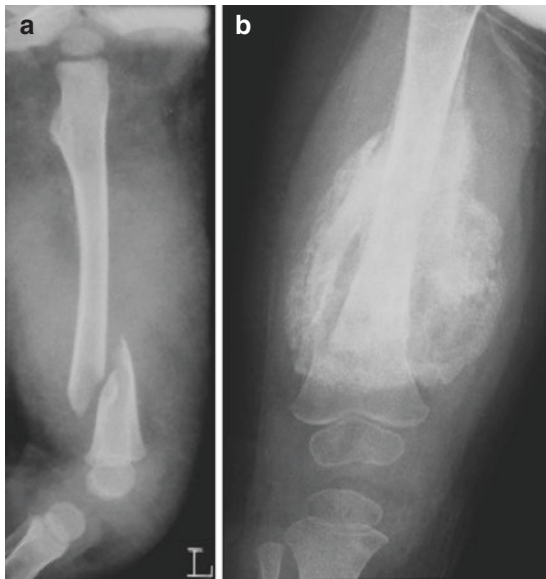


Fig. 6.8 Twelve-month-old infant, already walking. Emergency visit due to episode of functional loss. Oblique fracture of the distal third of the left femur (a); right femoral fracture at the same level shows an exuberant callus, different-age injury (b). The initial hypothesis of osteogenesis imperfecta was refuted by the rest of the clinical exam and the abuser’s admissions

6.3.2.1 Metaphyseal Lesions (Figs. 6.2, 6.3, 6.4, 6.6, 6.9, 6.10, and 6.11)

Initially described by J. Caffey and subsequently named “classic metaphyseal lesions (CML)” by Kleinman et al. [2, 12], these particular fractures are observed in 30–50% of abused children under the age of 18 months and are highly specific to non-accidental injuries. Because they affect the fragile primary spongiosa, they are not seen after age 2. Most CMLs are caused by direct torsional movements during intentional injury but have also been described in shaken baby syndrome when the child is repeatedly shaken or grabbed violently, in particular by the shoulders or upper extremities. They are never caused by a fall. There is a predilection for the distal femoral, proximal and distal tibial, and proximal humeral metaphyses. There



Fig. 6.9 Three-month-old infant with a subdural hematoma. Consolidated untreated fractures of the left humerus (supracondylar) (a); right femur (proximal third) (b); and left tibia and fibula (junction of the middle and distal thirds) (c). These fractures appear contemporaneous. Classical metaphyseal lesion of the proximal left tibia (c, *arrow*), probably more recent

may be no clinical signs with these metaphyseal avulsion fractures, making the skeletal survey essential to the diagnosis. The radiological appearance varies with the size of the lesion and the projection. It might be a “corner” fracture or have a “bucket handle” appearance. Displacement can be minor or, in rare cases, more pronounced; if the latter, there may also be a periosteal separation (Figs. 6.4 and 6.10). This type of injury is one of the limitations of the bone scan, where it might be masked by physiological uptake in the growth plate and metaphyseal region immediately adjacent to the fracture (Fig. 6.6). Over the natural course of these lesions, the adjacent growth plate extends toward the metaphysis in the form of a radiolucent zone that is sometimes difficult to appreciate. It is impossible to date this continually changing phenomenon. Diagnosing it retrospectively is also very difficult.

Some metaphyseal injuries typically found in accidental trauma may also be seen in child abuse cases; these include the so-called “buckle”—or “torus”—fractures and epiphyseal fracture-separations (Fig. 6.4).

6.3.2.2 Rib Fractures

Rib fractures are common in the abuse context (up to 25% of cases, depending on the series [1, 13]), especially in children under the age of 1 year. They are generally multiple, on adjacent ribs, often bilateral, and sometimes symmetrical; in most

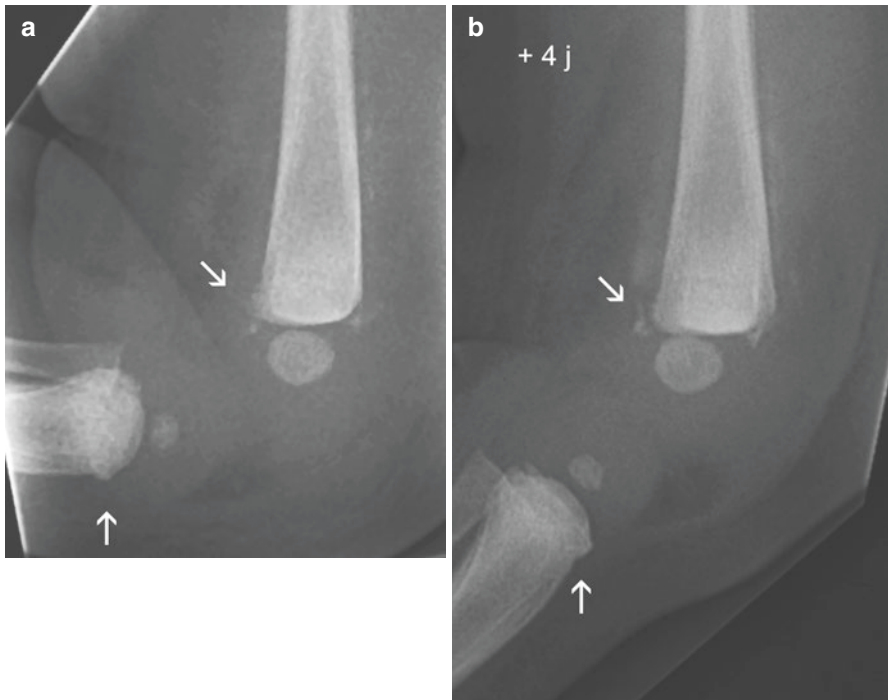


Fig. 6.10 Three-month-old infant admitted to the emergency department for loss of left lower extremity function. (a) initial X-ray, corner fracture of the distal femoral metaphysis (*oblique arrow*), irregularity, and sclerosis of the proximal tibial metaphysis (*vertical arrow*). (b) after discharge against medical advice, the child was brought back to the emergency department 4 days later; the injuries are more obvious (*arrows*)

cases they are asymptomatic. They most often involve the sixth to eleventh ribs. In infants, a fractured first rib is specific for abuse. A single rib may have multiple fractures of different ages. Rib fractures are caused by the abuser crushing the rib cage with one or both hands and can be located posteriorly, laterally, or at the anterior chondrocostal junction. Most typical and indicative of abuse is an incomplete fracture of the posterior portion of the rib, where it pivots against the transverse process of the vertebral body. Radiological diagnosis on the frontal and oblique views can be difficult when there is no displacement and is often only made secondarily, after a callus has formed (Figs. 6.5 and 6.6). That, and the high specificity of the injury, justifies a bone scan or follow-up X-rays if there are no other elements allowing a firm diagnosis.

6.3.2.3 Diaphyseal (Shaft) Fractures of the Long Bones

Long bone shaft fractures have low specificity for non-accidental trauma. However, they are very unlikely to happen accidentally in an infant who is not yet walking (Figs. 6.8, 6.9, 6.11, and 6.12). They occur most often in the humerus, followed by the femur. The prevalence in abuse cases is approximately 20% [13–15]. Humeral

Fig. 6.11 Transverse femoral shaft fracture combined with a circumferential metaphyseal lesion (*arrow*) highly suspicious for non-accidental injury in a 14-month-old girl



shaft fractures are usually spiral or oblique. In children older than 2 years, a transverse fracture in the middle third of the two forearm bones suggests a defensive injury in a context of inflicted trauma when the history is implausible or the injury is recurrent, as the child uses his forearm to try to protect himself (Fig. 6.13). In the femur and tibia, shaft fractures can be spiral, oblique, or transverse, and none of these types is specific to non-accidental injury [2, 3, 16]. Incomplete shaft fractures such as the so-called bowing fractures may also be observed. Those fractures result in posttraumatic curvature of the diaphysis due to microfractures that are invisible on radiography, like a bent reed. Those often involve the fibula and ulna.

6.3.2.4 Periosteal New Bone Formation

Periosteal new bone formation (periosteal reaction) is a normal repair response for traumatic cortical lesions and is found in a variety of other conditions. In the context of non-accidental injury, it may signal a repair response or be due to a large detachment of the periosteum with no associated fracture, becoming a massively calcifying subperiosteal hematoma that increases in size with repeated injury (Figs. 6.3, 6.4, 6.9 and 6.10). Such hematomas must be differentiated from the exuberant calluses that can form with non-immobilized fractures (Fig. 6.8), but making that distinction can be difficult, given that both types of injuries may be present.

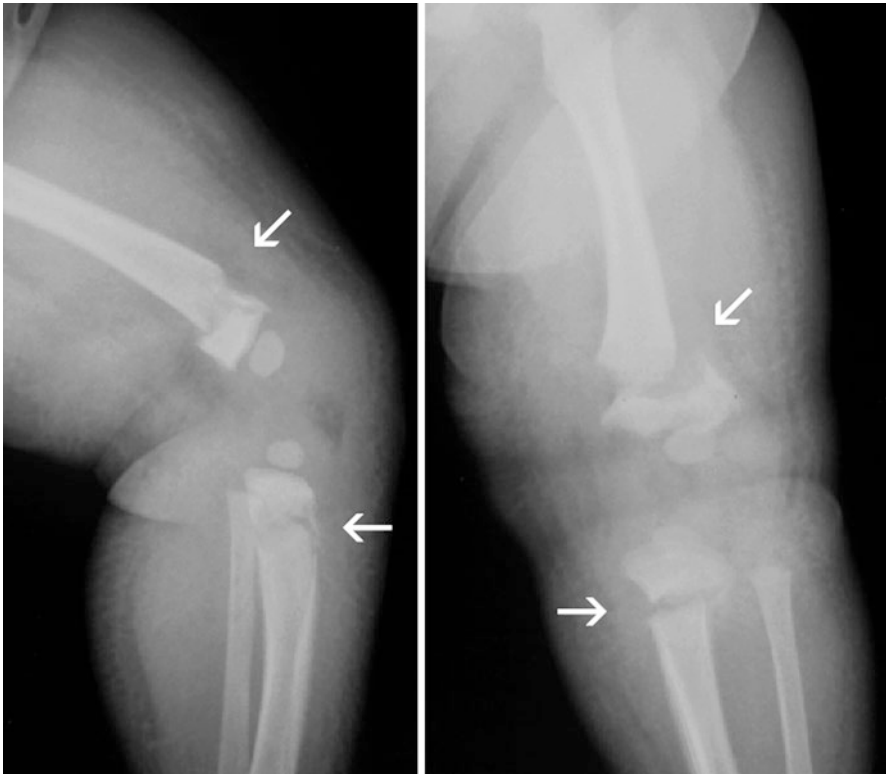


Fig. 6.12 Three-month-old infant sent to the emergency department for loss of left lower extremity function. Transverse fractures at the metaphyseal-diaphyseal junction of the distal femur (*oblique arrows*) and the proximal tibia (*horizontal arrows*). Inconsistencies in the parents' claim of a fall from the changing table prompted a radiographic workup showing posterior fractures in several ribs, confirming the diagnosis of non-accidental injury

6.3.2.5 Injuries of the Spine, Shoulder, and Pelvic Girdles

Spinal fractures are very rare in young children, and in the absence of a plausible clinical history of major trauma, such findings should arouse suspicion of abuse. They usually take the form of thoracic and lumbar vertebral compression fractures, due to the compressive force generated by violently shaking a baby back and forth or slamming the child's buttocks down onto a hard surface (Fig. 6.14). Those same mechanisms can also tear the interspinous ligaments, which later calcify or fracture the neurocentral synchondrosis, which can lead to true lumbar spondylolisthesis, in which the vertebral body seems to "wander into the abdomen." Thanks to the vertebral body reconstruction process, compression fractures can be seen for several months (Fig. 6.14). Spinal fractures require a full spine MRI to look for a spinal cord contusion or even a cut. These are discussed in another chapter.

Clavicle fractures are very rare before the age of 2 years outside the obstetric context. They account for less than 3% of abuse-related injuries [13]. Acromial avulsion fractures are also the exception but are highly suggestive of abuse.



Fig. 6.13 Different-age fractures in the forearm bones of a 26-month-old boy in a case of admitted abuse: non-displaced transverse fracture in the proximal third of the radius (*black arrows*), “greenstick” fracture at the junction of the middle and distal thirds of the radius and bowing fracture at the same level in the ulna with thick periosteal new bone formation (*white arrows*)

Pelvic fractures are very rare in this context and in infants are caused by violent blows, crushing, or sexual abuse (Fig. 6.15).

6.3.2.6 Skull Fractures

Before age 2 years, skull fractures are found in an estimated 20–30% of abuse cases [2, 3, 13]. There is no correlation between a possible skull fracture and underlying brain injuries, which are dealt with in a separate chapter. Skull fractures are caused by a direct blow, and their appearance will depend on the area of contact and the force of the impact. Several studies have shown that skull fractures are very rare (less than 3%) in falls from a height of less than 1.80 m [3]. Though no form of skull fracture is specific for non-accidental injury, multiple fractures, fractures which extend beyond the sutures, and bilateral fractures are more common in the

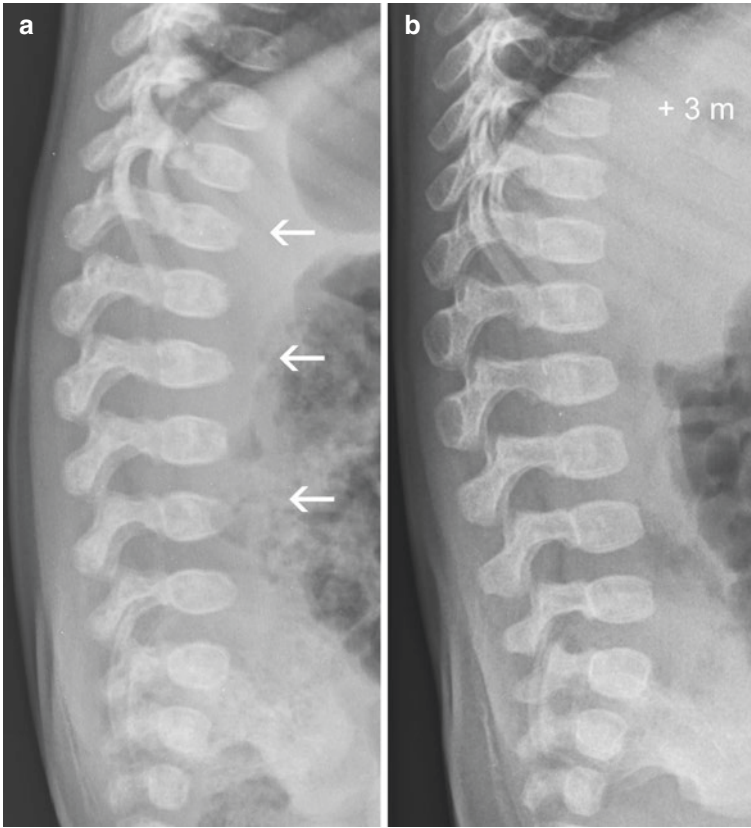


Fig. 6.14 Shaken baby. (a) initial lateral spine X-ray; T11, L1, and L3 compression fractures (*arrows*); (b) X-ray 3 months later, the injuries are still visible but more subtle



Fig. 6.15 Pelvic injury with fractures of the superior pubic rami (*arrows*) in a context of non-accidental injury of a 6-week-old infant presenting with a femoral fracture, as well (*asterisk*)

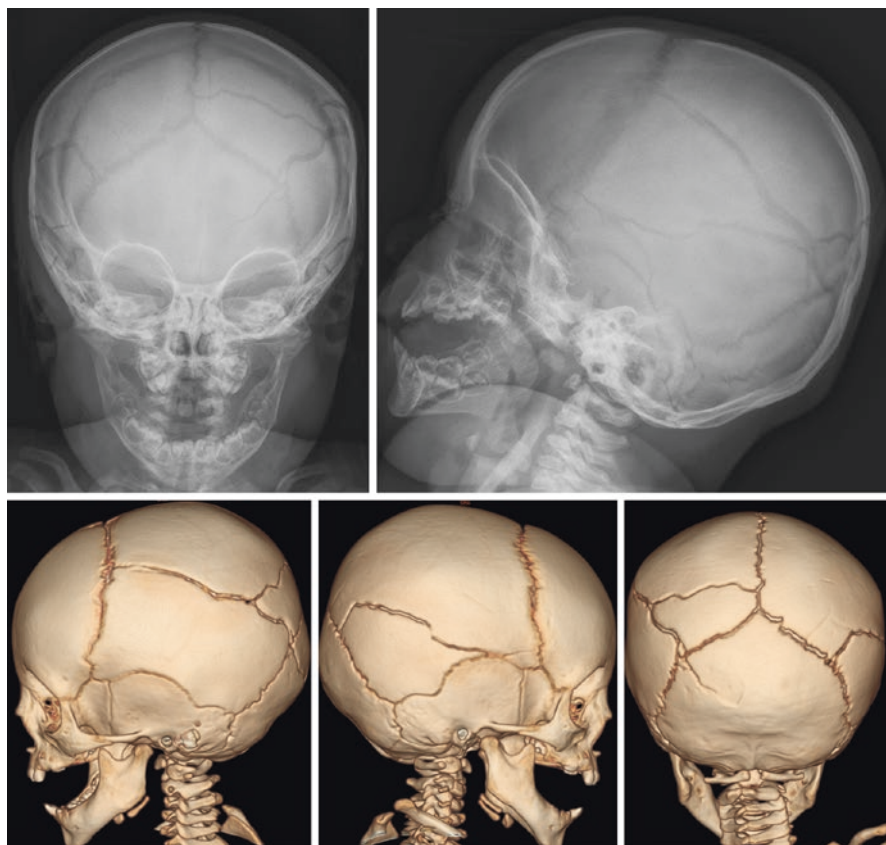


Fig. 6.16 Multiple skull fractures in a context of non-accidental injury. The CT surface views show the fracture lines as well as plain X-rays

non-accidental context. Since swelling of the adjacent soft tissue is not always found, its absence does not necessarily mean that a lesion is not recent. A skull X-ray is classically indicated (at least two views, frontal and lateral)—however it may be replaced with CT including 3D reconstructions of excellent quality; the fracture line is linear or branching, has clear, but not sclerotic, margins, and there may be a pronounced (>3 mm) diastasis. Though it used to be standard to say that CT did not show fracture lines, in fact routine volume CT readily allows 3D reconstruction with very good visualization of the cranial vault, the sutures and intrasutural bones (so-called wormian bones), and any fracture lines (Fig. 6.16). However a fracture without scalp swelling may be difficult to differentiate from a normal variant. Bone scan, however, has very poor sensitivity in detecting skull fractures.

6.3.2.7 Other Fractures

While limb fractures are quite rare, fractures of the phalanges, carpal bones, or tarsal bones before walking age is suspicious, as are fractures of the facial bones, despite the high frequency of facial soft tissue injuries.

Unless there is a known history of severe trauma, a fractured sternum in a young child is highly suggestive of abuse [16].

6.3.2.8 Mineralization and Maturation

The analysis of the radiographic documents should also evaluate bone mineralization and maturation, looking for obvious demineralization and/or delayed bone age. Note, however, that bone mass assessment on plain X-ray is relatively subjective and that bone age is variable. In addition, bone density measurement is difficult in this age group regardless of method, whether quantitative computed tomography (QCT) or dual-energy X-ray absorptiometry (DXA), and there are no validated reference ranges for infants and young children [1, 17, 18].

6.4 Dating

Dating bone lesions is an important, yet uncertain, part of the imaging process, especially in the context of non-accidental injury [1–3]. First, one must be familiar with the radiographic particularities of the natural repair process. The younger the child, the faster the fracture heals; as an example, an obstetrical humeral shaft fracture knits in 4 weeks, while in an 8-year-old, a fracture in the same location takes 10 weeks to consolidate. In cases of inflicted injury, the healing process may be disrupted by a lack of immobilization or by repeated injury. It is important to keep in mind that dating is not an exact science and that the time period during which a phenomenon can be seen is variable (Table 6.3).

Several anatomical and radiological phenomena occur. There are immediate changes in the soft tissues adjacent to the affected bone after the injury, including disappearance of the fat pads and swelling. Note that most limb fractures are not accompanied by subcutaneous hematomas, either at the time of the injury or afterward. Periosteal new bone formation is usually visible by the end of the first week (or even sooner in healthy newborns) and by the third week at the latest (Figs. 6.3, 6.4, 6.8, 6.9, 6.10, and 6.13). For shaft fractures, the fracture line is initially clear, and then its margins begin to progressively fade on day 10. Callus formation comes next, its speed depending on the child's age. Fracture site remodeling is highly variable, depending on the age and type of fracture. The foregoing does not apply to either skull fractures or metaphyseal injuries, which have a different repair process

Table 6.3 Dating post-fracture repair phenomena in children [1, 2]

Radiologic change	Early	Peak	Late
Resolution of soft tissue changes (varies with type of injury)	From 2 days	1 week	Less than 3 weeks
Periosteal new bone formation	From 4 days	10 days	Less than 3 weeks
Loss of fracture margin definition	From 10 days	3d week	–
Evidence of callus	From 14 days	4th week	6th weeks or more
Remodeling	3 months	1 year	Until the growth plate closes

than shaft fractures. The important thing is to confirm, if such is the case, that the injuries observed occurred at different times and to distinguish between acute, recent, and old injuries. The key is to identify the so-called “different-age” lesions, which are not just a major diagnostic clue but also indicate that inflicted injuries are recurrent and thus that the child is at high risk of death.

6.5 Differential Diagnosis

Differential diagnosis is another key step. Some situations pose real problems and can lead to either overdiagnosis of abuse or failure to recognize true traumatic injuries. There is also the possibility of mixed pathologies, e.g., malnutrition with vitamin deficiencies, congenital or acquired bone fragility, and abuse.

The differential diagnosis will depend on the anatomical region in question. Repeated accidental injury might be a possibility in some cases but never before a child can walk.

6.5.1 Metaphyseal Lesions

6.5.1.1 Normal Variants

There are a number of developmental metaphyseal variants that can be mistaken for traumatic lesions. If in doubt, a follow-up X-ray 2 weeks later is key, since with developmental variants, the image will look exactly the same as it did initially. The main imaging pitfalls are metaphyseal beaks, metaphyseal spurs, and metaphyseal “step-off” [12, 19].

Harris lines, or growth arrest lines, appear as fine linear opacities on the long bone metaphyses, perpendicular to the long axis of the bone, or as one or more fine curvilinear opacities that follow the shape of short bones. They have no specificity; when they are discovered at the time of the first episode—prior to any immobilization, e.g.,—they may be suggestive of malnutrition.

6.5.1.2 Metaphyseal Dysplasia

Metaphyseal chondrodysplasia, Schmid type, and corner fracture-type spondylo-metaphyseal dysplasia can mimic a traumatic metaphyseal corner fracture. The rest of the radiological assessment will clarify the diagnosis in most cases. While other dysplasias with metaphyseal involvement may be mistaken for abuse, they usually affect all of the metaphyses, though certain metaphyses predominate (Fig. 6.17).

6.5.1.3 Metabolic Disorders

Vitamin D deficiency or X-linked vitamin D-resistant rickets is readily identified based on the symmetry of the irregular growth plate thickening. Menkes disease (an X-linked copper metabolism disorder) or copper deficiency in premature infants can cause metaphyseal spurs or fragmentation. Premature infants can have other deficiencies with occasionally misleading bone manifestations (Fig. 6.18).

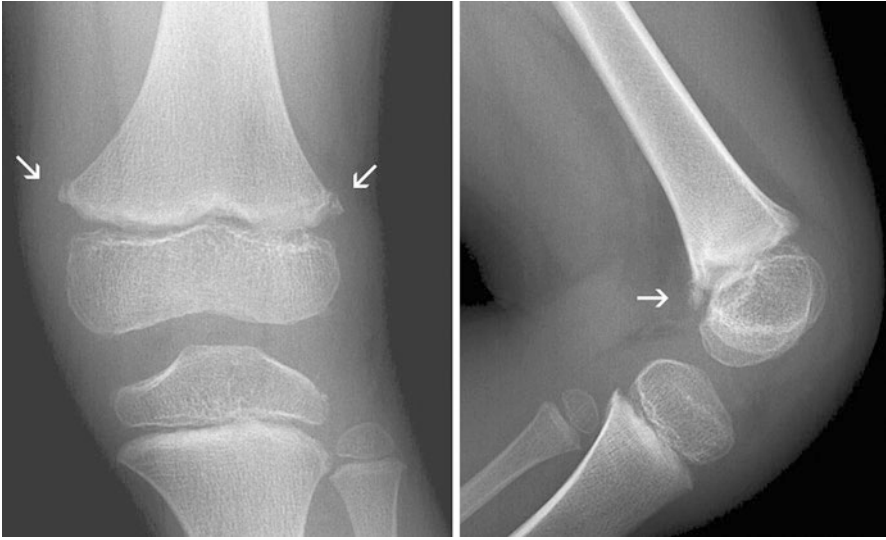


Fig. 6.17 Distal femoral metaphyseal fragmentation in a 4-year-old boy (*arrows*). The child's age, the clinical context, and the rest of the radiological workup pointed to spondylometaphyseal dysplasia, rather than trauma. Image courtesy of L. Mainard

6.5.1.4 Infectious Diseases

Though now relatively rare, congenital syphilis can cause symmetrical abnormalities on the medial side of the proximal tibial metaphysis, as well as periosteal separation. Nonspecific osteomyelitis can also lead to metaphyseal fragmentation, sometimes multifocal; the laboratory workup helps establish the diagnosis.

6.5.1.5 Neurological Lesions

Congenital insensitivity to pain and mobility loss of neurologic origin may be accompanied by metaphyseal or epiphyseal lesions and subperiosteal hemorrhage, which may in some situations be mistaken for non-accidental injury or overly-vigorous physical therapy treatment—e.g., manipulation for a foot deformity (e.g., club foot).

6.5.2 Diaphyseal Lesions

6.5.2.1 Periosteal New Bone Formation

Periosteal new bone formation can be a normal variant during the first 6 months of life (in the femur and tibia); in such cases it is symmetric, fine, and continuous (Fig. 6.19). The same appearance can be seen in some premature infants (Fig. 6.18). An infection, a neuroblastoma metastasis, and a leukemic bone lesion may also have that appearance, though more localized. Periosteal thickening is also found in a variety of other conditions, such as Caffey disease or infantile cortical hyperostosis and hypervitaminosis A. Scurvy can cause large subperiosteal hematomas.

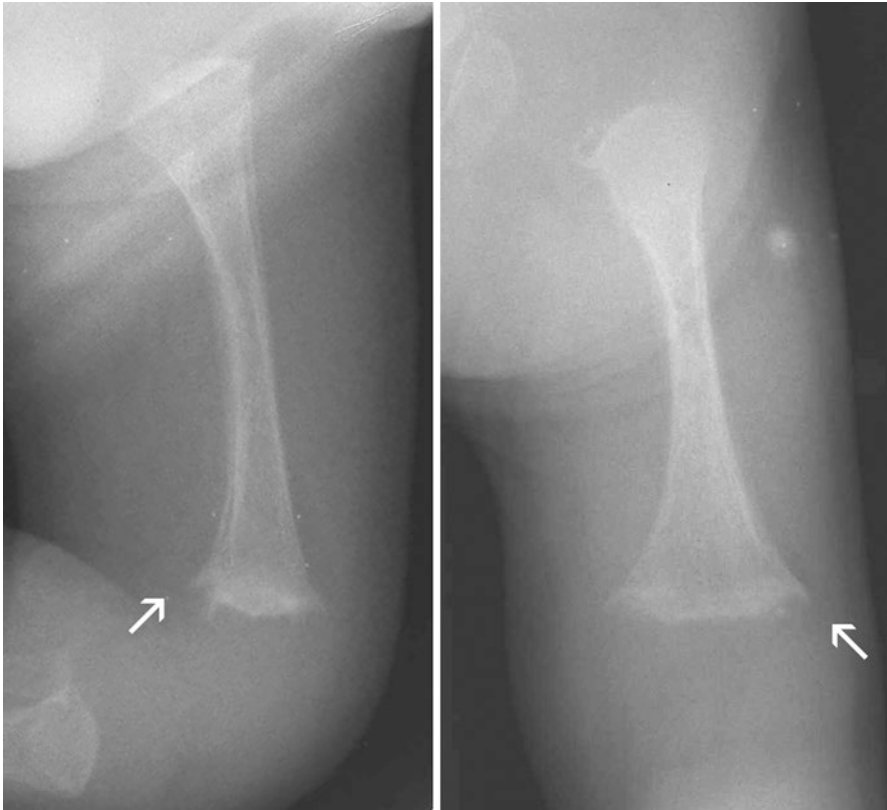


Fig. 6.18 Osteopathy of prematurity: metaphyseal beaks and irregularities (*arrows*) with periosteal new bone formation. Image courtesy of C. Adamsbaum

6.5.2.2 Osteogenesis Imperfecta

The main differential diagnosis for shaft fractures is osteogenesis imperfecta, primarily types I and IV. Type I, the most common, is an autosomal dominant condition characterized by osteoporosis, multiple wormian bones, bluish sclera, and a family history. Type IV, on the other hand, is less common. While it is also autosomal dominant and features wormian bones, there is no family history and osteoporosis may not be apparent in infants, thus posing a real diagnostic problem. As a result, it is very important to look for wormian bones in any infant with one or more long bone fractures where non-accidental injury is suspected. Occipital bone imaging using a Towne view or 3D reconstruction of the cranial vault in search of intrasutural bones in the lambdoid suture is thus essential. To have any significance, wormian bones must be numerous (more than a dozen, roughly); they are also found in conditions other than osteogenesis imperfecta, such as congenital myxedema (which is rare) or cleidocranial dysplasia. A fundamental point in the differential



Fig. 6.19 Thick, symmetrical periosteal new bone formation at the medial surface of both tibias in a 20-day-old newborn with no history of trauma, considered a normal variant. Note that the projection is inappropriate for exploring the distal metaphyses

diagnosis is that with osteogenesis imperfecta, metaphyseal lesions are the exception and are never the only finding [20]. The clinical and radiological picture known as “temporary brittle bone disease,” described in the 1990s, has been completely debunked and should no longer be included in the differential diagnosis of any finding suggestive of non-accidental injury [1, 21].

Though DXA or QCT may be performed for suspected osteoporosis, there are no validated reference ranges for infants and young children [1, 17, 18].

6.5.3 Rib Fractures

Rib fractures can also be caused by accidental injury (though mainly in older children), birth trauma, external cardiac massage, and even, in rare cases, by vigorous chest physical therapy for bronchiolitis in infants. We must stress, however, that in these cases the injuries do not involve the posterior rib [1, 4, 8].

6.5.4 Vertebral Compression Fractures

Traumatic spinal lesions are rare in the abuse context and are usually not an isolated finding. Hence, differential diagnosis is not an issue (as Langerhans histiocytosis, storage disease, or normal variant).

6.5.5 Birth Trauma

Obstetrical fractures usually occur during difficult deliveries of high-birthweight infants, breech presentations and, more rarely, premature infants; they can even occur during cesarean section. The clavicle, humeral shaft, and femoral shaft are the most common fracture sites. The same type of metaphyseal fractures as those found in non-accidental trauma has been described after difficult delivery of the extremities (Fig. 6.20). Although



Fig. 6.20 Five-day-old newborn, obstructed labor due to breech presentation, loss of function, metaphyseal avulsion with bucket handle injury to the tibia (*oblique arrow*), and periosteal new bone formation extending to the diaphysis (*horizontal arrow*). While this appearance is similar to that seen in non-accidental injuries, the specific context and dating of the injuries help avoid confusion

most cases are diagnosed clinically, some are diagnosed radiologically from an X-ray done for some other reason. An important point in the differential diagnosis with non-accidental injury is that a callus is always present by day 11 and is visible in most cases by day 7 [1].

6.6 Treatment Principles

Once non-accidental injury is suspected, the child must be hospitalized immediately. Treatment is generally simple, as there is little or no fracture displacement. The treatment in most situations is orthopedic, using a plaster cast or axial traction. Traction is often preferred because it keeps the child in the hospital setting while medical, social, and legal steps are being taken. Osteosynthesis may be used for some injuries in children over 2 years—lateral condyle fracture of the elbow, for example. One possible pitfall is initiating inappropriate treatment after failing to diagnose subtle adjacent injuries in the initial workup,—e.g., placing a child in traction for a fractured femur when there are underlying metaphyseal injuries (Fig. 6.2).

In addition to treating the skeletal injuries, this period should also be used to look for and treat injuries in other systems. Initially, the most important part of treatment is preventing further injury. Hospitalization protects the child from potential early recurrence. This is essential and should be done if at all possible with the parents' cooperation. Things are easier when a treatment option like traction keeps the child hospitalized without value judgments regarding the circumstances of the injury. Remember that this is a potentially life-threatening condition.

The initial inpatient period has great diagnostic value, as well. The lack of new bone lesions while the child is protected is an important argument in favor of abuse and against osteogenesis imperfecta. It is also very valuable later, for medicolegal purposes.

6.7 Sequelae

What is distinctive about abuse-related skeletal injuries is that the functional prognosis is usually good, and the younger the victim, the better the prognosis. Remodeling is rapid for shaft fractures and large periosteal separations (Fig. 6.21). Metaphyseal avulsion fractures heal without sequelae; in some cases a radiolucent area can temporarily be seen protruding into the metaphysis, giving the growth plate a tortuous appearance [12]. Premature fusion of the growth plate is very rare and is the result of a true Salter-Harris fracture. Vertebral compression fractures can be radiologically apparent for several months (Fig. 6.14). Lastly, aside from any associated brain injuries, skull fractures can in rare cases develop into a leptomeningeal cyst. Formerly called “growing fractures,” leptomeningeal cysts correspond to the

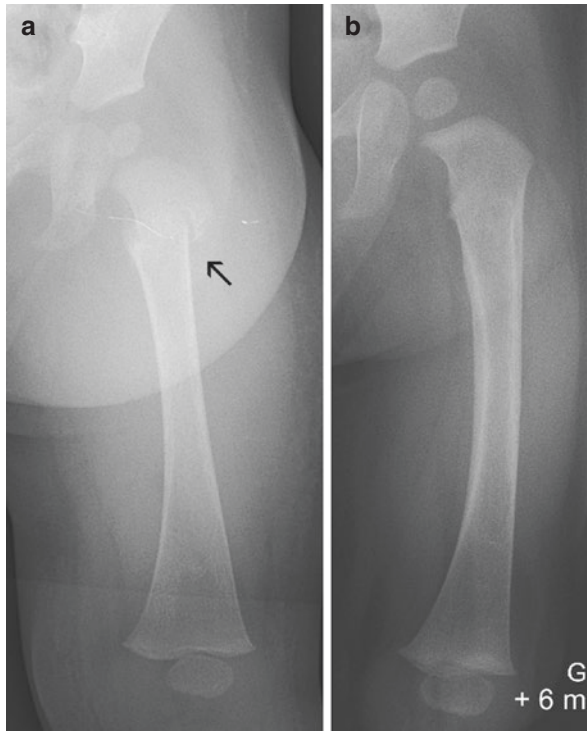


Fig. 6.21 (a) Subtrochanteric fracture in an 8-month-old infant in a context of non-accidental injury (*arrow*). (b) Follow-up 6 months later shows flawless remodeling of the trochanteric region

persistence of a wide fracture line with blurred margins, through which a dural hernia containing cerebrospinal fluid—and sometimes brain tissue—protrudes. Treatment is neurosurgical.

Key Points

- In an abuse context, skeletal injuries are most likely in infants.
- The imaging workup must be impeccable and contain the specific images recommended by several learned societies.
- In questionable cases it is helpful to repeat some of the images 2 weeks later or perform a bone scan.
- Metaphyseal “corner” or “bucket handle” fractures and posterior rib fractures are highly specific, even pathognomonic, for abuse.
- Other common injuries are nonspecific; these include shaft fractures, periosteal new bone formation, and skull fractures.
- The presence of multiple injuries is suggestive of abuse.

- Dating with imaging is imprecise; it is much more important to be able to say that the lesions are of different ages.
- The functional prognosis for skeletal injuries is good, as a general rule.
- Osteogenesis imperfecta should be considered in the differential diagnosis, although in practice it is easily ruled out in most cases.

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Non-accidental Injuries of the Brain and Spinal Cord

7

C. Adamsbaum, T. Billette de Villemeur, B. Husson,
A. Laurent Vannier, H. Touré, and M. Zerah

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C. Adamsbaum, M.D. (✉) • B. Husson, M.D.
Imagerie Pédiatrique—CHU Bicêtre, 78 rue du Général Leclerc, 94270
Le Kremlin Bicêtre, France
e-mail: adamsbaum.catherine@gmail.com; catherine.adamsbaum@aphp.fr;
beatrice.husson@aphp.fr

T. Billette de Villemeur, M.D.
Neuropédiatrie—CHU Trousseau, Paris, France
e-mail: thierry.billette@aphp.fr

A. Laurent Vannier, M.D. • H. Touré, M.D.
Rééducation des Pathologies Neurologiques Acquises, Hôpitaux de St Maurice,
St Maurice, France
e-mail: a.laurentvannier@gmail.com; h.toure@hopitaux-st-maurice.fr

M. Zerah, M.D.
Neurochirurgie Pédiatrique—CHU Necker Enfants Malades, Paris, France
e-mail: michel.zerah@aphp.fr

Non-accidental brain injury, or abusive head trauma, is a specific form of abuse generally suspected when an infant with acute neurological symptoms is found to have both subdural and retinal hemorrhages. Though it is frequently caused by violent shaking, in 2009 the American Academy of Pediatrics recommended replacing the appellation “shaken baby syndrome” (SBS) with “abusive head trauma” (AHT), to include other mechanisms such as head impact, slapping, and strangulation [1]. The incidence of AHT is estimated to be 20–30 cases per 100,000 infants under age 1 year [2, 3]. These lesions are determined to be traumatic after considering, and then ruling out, the few possible alternatives [4]. In most cases the circumstances of the injury are not described by either the perpetrator or any witnesses or admitted at the time of diagnosis [5]. Typically, the family’s or caretaker’s account of how the injury occurred varies from one person to another, is inconsistent, and—most importantly—is incompatible with the medical findings. Shaking is ultimately determined to be the only possible explanation after a rigorous diagnostic process based on reliable diagnostic criteria. The seriousness of AHT and its neurological sequelae and the high risk of potentially fatal recurrence make rapid diagnosis essential.

7.1 Clinical Presentation

There are a variety of clinical presentations [3, 6]:

1. *An apparent life-threatening event (ALTE)* in infancy consists of impaired consciousness either alone or combined with:
 - Autonomic dysfunction such as bradycardia, pallor, vomiting, or apnea
 - Seizures
 - Signs of increased intracranial pressure such as a bulging fontanelle, moaning, hypertension, and vomiting or signs of brain herniation
 - Neuromotor problems such as mono- or hemiparesis

The description of the event is a key element in pointing the diagnosis toward non-accidental injury. The account of the circumstances by the adult looking after the child when the ALTE occurred is often nonexistent, changeable, inconsistent, and/or at odds with the medical findings [7, 8]. The event is usually described as a sudden, unexpected, and unexplained change in the child’s level of consciousness [9–12]. Some report an accidental fall, but a minor one—such as a fall from a sofa—that is inconsistent with the medical findings. Usually there are no other witnesses to provide additional information.

Any child with an ALTE of unclear origin should undergo brain CT and fundus exam as soon as possible to look for intracranial and intraocular bleeding. The fundus exam—ideally done as quickly as possible by a pediatric ophthalmologist—looks for bleeding in the fundus, which can be either uni- or bilateral. The appearance is described in detail in Chap. “Retinal hemorrhages”.

When unexplained ALTE is accompanied by intracranial hemorrhage on unenhanced brain CT and retinal hemorrhage, abusive head trauma is highly likely [8]. That hypothesis should be buttressed by looking for other signs of abuse using the usual diagnostic strategy and ruling out possible alternatives [13]. A skeletal survey

should be done to look for injuries—especially metaphyseal avulsion fractures and rib fractures—that the clinical exam missed. Multiple, unexplained, untreated, and/or different-age fractures are further strong evidence of abuse. Readers can find a detailed description in Chap. “Skeletal injuries” but should keep in mind that fractures are present in only about a third of cases [5].

2. *If the child dies after an ALTE*, his injuries must be investigated by brain CT, skeletal survey, fundus exam, and neuropathological examination of the brain, spinal cord, and eyes. Interested readers are referred to Chap. “Post Mortem Imaging” for more information.
3. *Some signs and symptoms can be nonspecific and/or transient* such as pallor, vomiting, poor feeding, behavioral changes, and hypotonia (floppy baby). In particular, vomiting may have been incorrectly ascribed to gastroenteritis, but there will be no history of diarrhea.

Discovery of AHT may also begin with a “sentinel” lesion such as an unexplained fracture, bruises in a non-ambulatory child, or a lesion in the mouth.

4. *For progressive macrocrania* in an infant whose head circumference curve changed abruptly a few months earlier, brain imaging (CT or MRI) should be done quickly to look for a chronic subdural hematoma. A study of the head circumference curve may show a change in the curve when the infant was a few months old after initially smooth growth. This is critically important, because a sudden acceleration in head growth can be used to date the occurrence of the subdural hematoma [14]. The parents are then asked whether they remember any unexplained, transient neurological or behavioral episodes from that time that might suggest trauma and whether there were any changes in child care arrangements during that period. Remember that brain CT or MRI must be done to look for a subdural hematoma whenever there is suspicion that a young child has been abused, even if there are no apparent neurological symptoms [15, 16]. Should any old intracranial lesions like parenchymal scars or old subdural hematoma be discovered, the child should receive the same etiological workup and differential diagnosis as in the acute phase.

Like all abuse-related syndromes, AHT is vastly underdiagnosed. This is due to a number of factors. Because there are no specific markers that prove AHT, the diagnosis is based on a set of convergent evidence. While this is not unusual in medicine, the medicolegal repercussions of abuse tend to inhibit the objective diagnostic process. Evoking, formulating, and confirming this kind of diagnosis is always—consciously or not—hampered by nonmedical considerations. The potentially tragic consequences of a diagnostic error—whether of omission or commission—place an enormous weight on the medical process. Shaking often happens in a moment of exasperation with an infant who is crying or is crying in a way that the perpetrator cannot tolerate [17, 18]. Given the immediate, often very severe and undoubtedly unexpected effect of shaking on the child, the perpetrator naturally tends to minimize its force, duration, and frequency [19, 20]. This is especially important because the episode that causes the severe signs may not be the first but one of a series of previous shaking incidents that did not cause such worrisome signs as episodes of unexplained vomiting [5, 21]. Lastly, how the perpetrator and the medical and paramedical

teams perceive the medicolegal import of the diagnosis substantially affects the exchange of information between the child's family and the doctors.

The diagnostic criteria, once multiple and complex, have been simplified—in particular, with the French 2011 public hearing guidelines for professionals [8]. Which have been updated in July 2017 (https://www.has-sante.fr/portail/jcms/c_2794425/fr/syndrome-du-bebe-secoue-outraumatisme-cranien-non-accidentel-par-secouement). Here, as elsewhere, the diagnostic process must be methodical and rigorous. Doctors should make sure they can answer the following three questions:

1. Is the child's neurological condition traumatic in origin?
2. Is the context of onset or discovery described by the family consistent with the child's problems, or was it abuse?
3. Has every alternative diagnosis compatible with all of the child's problems and injuries been ruled out [13]?

The clinical and paraclinical findings that help answer these questions and confirm that the child's condition is consistent with AHT fall within the scope of several medical specialties: pediatrics, pediatric neurology, neurosurgery, radiology, ophthalmology, and, in some cases, forensic medicine and neuropathology [22]. In other words, diagnosing AHT requires a multidisciplinary approach.

The diagnosis of abusive head trauma is based on the presence of intracranial and ocular injuries. However, none of the characteristic AHT-related injuries (subdural hematoma, brain injury, or retinal hemorrhage) are essential to the diagnosis, and none are pathognomonic. Retinal hemorrhages are best screened for by an ophthalmologist. The fundus examination should be done as soon as possible after the acute episode—ideally within 24 h (see Chap. “Retinal hemorrhages”).

Beyond the initial acute episode, subdural hemorrhages may have disappeared completely; ocular hemorrhages generally regress rapidly, and brain injuries may leave gliosis and focal or diffuse brain atrophy and porencephalic cavities.

When the initial episode is isolated and does not cause major brain injury, recovery is possible with no identifiable neurological sequelae. This can make diagnosis difficult, and a thorough analysis of the entire context (clinical findings, findings from the interview, etc.) will be needed to establish that the lesions were caused by non-accidental trauma.

All possible non-traumatic causes must be ruled out using the clinical and/or ancillary findings; these include bleeding disorders, vascular malformations, and hereditary and metabolic disorders [13] (see below).

Nevertheless, finding an abnormality on ancillary testing does not in itself rule out abusive head trauma, unless the alternative diagnosis explains every single one of the child's problems. In fact, children with chronic diseases are more likely to be abused. Recognizing such accompanying conditions can be difficult.

The features of abuse must be carefully looked for. These include:

- A history and/or description of the circumstances in which problems began that cannot explain the intracranial injuries observed [8]

- Multiple previous outpatient visits or hospitalizations
- Unexplained fractures (rib fractures or metaphyseal avulsion fractures, in particular) discovered on X-ray [23]
- Skin lesions that are unexplained, multiple, untreated, or suspicious by virtue of their appearance or location

Abusive head trauma may not involve any of these types of injuries.

7.2 Mechanisms

Non-accidental brain injuries are due primarily to violent shaking, hence the classic appellation “shaken baby syndrome” or SBS [24]. Several clinical and postmortem studies have reported subdural hematomas due to shaking without impact [5, 8, 20]. The name “abusive head trauma” proposed recently by the American Academy of Pediatrics (AAP) is intended to include all of the other mechanisms that can be associated with shaking, such as impact against a soft or hard surface, slapping, and strangulation [25, 26].

The AAP defines the force of shaking needed to cause the intracranial and retinal hemorrhages found in SBS as follows: *shaking [...] so violent that individuals observing it would recognize it as dangerous and likely to kill the child* [25].

Diagnosis is difficult, because confessions are rarely obtained during outpatient visits or hospital stays [5, 20], the symptoms are nonspecific, and the child’s body may not show any bruising.

We should begin by clarifying that everyday trauma like that from a fall or simply “playing”—one of the most common mechanisms alleged by perpetrators—cannot cause the injuries seen in abuse cases [8, 27, 28]. It has been established that a short fall, resuscitation, and play cannot cause a multifocal subdural hematoma or profuse retinal hemorrhages. There have been no reported cases of children under age 1 year with both a subdural hematoma and retinal hemorrhage after a short (<1.5 m) fall [8].

Data on the mechanisms that produce brain injuries in abuse come from biomechanical studies and statements by abusers during judicial investigations [5, 20, 29]. The acts described are always extremely violent, frequently accompanied by screaming, even howling, and have absolutely nothing to do with playing. In more than half of the cases, the violence was repeated ten or so times, on average, and that frequency is probably underestimated [5]. Most likely, death is not necessarily due to an extreme form of abuse, but rather to abuse “gone wrong.” In many cases, other kinds of violence preceded the shaking episode, which is why early identification of the signs—such as bruising on an infant too young to walk, especially when it is on the child’s face or trunk—is so crucial [30].

While it is not the doctor’s job to identify the perpetrator or reconstruct the events, it is helpful to medical and paramedical professionals to understand how violent these acts are. Here are several excerpts from legal statements by perpetrators of the violence causing SBS (see also [5]):

“I was angry; I grabbed her and pulled her out of the rocker. I shook her, holding her by the waist. I don’t know for how long, maybe several minutes. I was beside

myself. She pitched backward and was having trouble breathing. I stopped shaking her. I held her against me; her breathing was really weak.”

“I picked her up; I wasn’t holding her head and gave her one or two shakes, up and down, more after hitting the bar of the crib... I admit picking my daughter up violently, shaking her and hitting her head against the crib... I should add that after I shook her, she stopped crying.”

“I threw him onto his bed hard. I was really on edge; I couldn’t stand his loud crying. I picked him under the arms and threw him onto the mattress; his head bounced on the mattress.”

“She kept crying. I shook her. I picked her up under the armpits and shook her. I shook her three or four times like that; I put her back on the bed because she wasn’t talking anymore...”

“I shook him hard and his head went back and forth and then all of a sudden he stopped crying. I put him in his chair and he looked like he was sleeping, his eyes were closed...”

“I picked her up and shook her really hard... She calmed down, and I went to put her back in bed...that was the first and last time at that point...”

“I was holding my daughter with both hands under her arms... Her head went back and forth when I did that; it lasted a few seconds...maybe a minute... It was to make her stop crying; I was exasperated.”

These excerpts confirm not just the violence of the acts but also that they were repeated, sometimes daily, for several weeks, or months.

These statements also help us understand the “logic” behind repeated shaking, which is explained by the “apparent calm” that is quickly induced by the shaking [5]. That “calm” is actually the initial post-shaking symptoms (decreased alertness, hypotonia, impaired consciousness, etc.), that occur very shortly, if not immediately, after the shaking stops. This vicious cycle highlights the danger to the child and the absolute necessity of reporting potential abuse as soon as the first warning signs, like an unexplained chest bruise on an infant [30], are recognized.

The repetitive nature of the violence helps explain why dating brain injuries is so difficult; this will be discussed later in this chapter. During shaking, the perpetrator grasps the child by the sides or under the arms, which explains why there are often bruises where the fingers press on the chest and in the armpit region. Similarly, recent rib fractures are caused by forceful compression of the rib cage and are often located in the posterior portion of the ribs due to lateral compression. Anterior fractures are also seen but are harder to recognize due to the cartilaginous nature of the anterior portion of the ribs.

The perpetrator is always an adult in the child’s circle (father or stepfather, babysitter, mother, etc.). While perpetrators are believed to be more often male, that needs to be taken with some caution [31]. It is important to add that children do not have the strength needed to inflict such injuries until they reach adolescent age and size.

Why is shaking so pathogenic? Infants and young children are very different than adults in that their neck muscles are weak, their heads are relatively heavy, and their brains are relatively dense due to the myelination process. During the first 2 years of life—and the first few months, in particular—the brain is rich in water and poor in the constituents of myelin (lipids and cholesterol). The brain is mobile within the

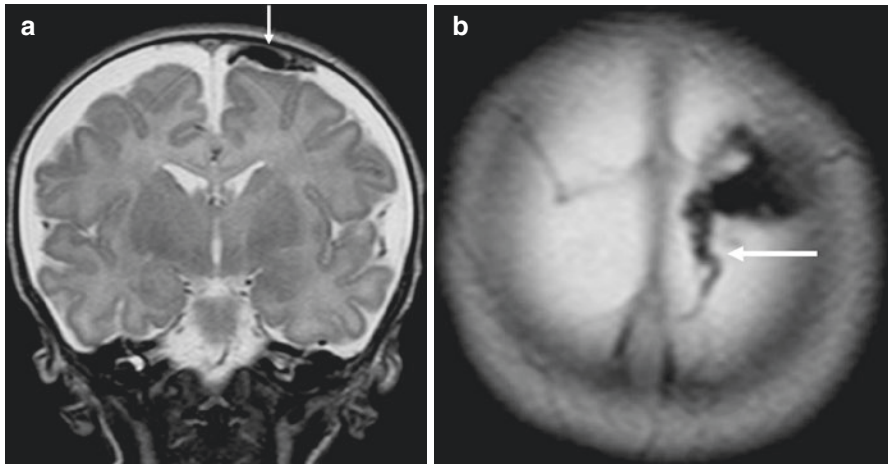


Fig. 7.1 AHT. Thrombosis secondary to a venous rupture/tear. One-month-old baby. MRI, T2-weighted sequence, coronal image (a), and axial image passing through the convexity (b). Voluminous clot at the vertex, on the left (a, arrow), marking the thrombosis caused by tearing of a bridging vein during shaking (b, arrow)

skull, which is itself plastic and deformable in young children. As a result, SBS typically affects infants younger than 8 months, held by an adult under the arms or by the chest and brutally shaken with sharp “back-and-forth” acceleration-deceleration movements of the head. This ruptures the bridging veins that stretch between the cortex and the superior sagittal sinus as the brain makes abrupt anteroposterior movements within the skull; the falx cerebri protects the brain from lateral movements. Those bridging vein ruptures lead to subpial hemorrhage, increasing the likelihood of cortical hypoxia and epileptic seizures, and diffuse, sheetlike subarachnoid and subdural hemorrhages. Rupture of the bridging veins explains the nearly invariable predominance of clots at the surface of the brain. Venous thrombosis secondary to the ruptures can be demonstrated on autopsy or in vivo, on CT or MRI, by the tubular shape of the clots at the vertex [32–36] (Fig. 7.1). The anatomical data indicate a variable number of bridging veins; their average caliber is inversely related to their number, which might account for individual variations in the response to trauma [37]. In addition, a subdural collection is more likely in young children due to their highly vascularized dura mater and cranial vault. These intracranial hemorrhagic lesions are reportedly far more common in boys, who account for at least two thirds of cases [5, 38]. The cause of this male predominance is still hotly debated, and none of the proposed explanations have yet been proven. The hypotheses put forward cite psychological factors, as families have different expectations with regard to girls and boys. Another explanation that has now been rejected is that boys’ larger subarachnoid spaces might facilitate subdural bleeding by favoring bridging vein rupture during shaking; this has not, however, been observed in daily practice among children with enlarged subarachnoid spaces [8]. On the contrary, enlarged subarachnoid spaces may protect the brain by dampening its movements within the skull during shaking [39].

Associated parenchymal lesions include contusions, which are often frontobasal or temporal due to the hemispheres hitting the bony walls. In reality, they are usually anoxic-ischemic injuries whose origin is not clear-cut. These injuries may be the result of parenchymal compression by subdural hematomas, of status epilepticus-induced edema, or of cardiac arrest-related anoxia due to brainstem injury; these mechanisms can occur in a variety of combinations.

If there was impact against a hard surface, there may be multiple complex, star-shaped, wide skull fractures, but these by themselves have no neurological consequences.

Injuries to the spinal cord and its coverings (epidural hematoma) are possible but more rarely reported [40–42]. These are probably underestimated, because they are masked by the neurological signs from brain injuries and are not routinely looked for [43]. The spinal column is hyperelastic in young children—and even more so in infants—due to its significant cartilaginous component and ligamentous hyperlaxity. Thus bone lesions are rare in hyperflexion or hyperextension injuries, while the spinal cord, which cannot stretch, is more vulnerable to such forces. This is the classic SCIWORA (Spinal Cord Injury Without Radiographic Abnormalities), which can only be demonstrated by spine MRI. The upper cervical spine is particularly vulnerable due to its anatomical and physiological characteristics in young children; their facet joints are more horizontal, their neck muscles are too weak, and their heads are relatively heavy before the age of 8 years. Injuries to the cervical cord are seen primarily in very young infants—age 5 months, on average—exhibiting decreased alertness and respiratory distress. Thoracolumbar injuries are seen in older children—age 13½ months, on average—exhibiting signs that are immediately more suggestive, such as spine deformities or focal neurological signs.

The mechanisms responsible for spinal cord injuries, as reported by perpetrators, include extremely violent shaking such as manual “whiplash” maneuvers, throwing the child down in a sitting position causing hyperflexion or forced hyperflexion or hyperextension [43]. The cord can be injured in a variety of ways during spine trauma: by shearing, by compression from posterior wall recession or epidural hematoma, by contusion, by being stretched due to dislocation, or by a direct blow.

7.3 Imaging

Very often, brain imaging allows diagnosis of SBS. While the clinical presentation is variable and nonspecific, a lack of clarity in the reported circumstances and a changing, discordant history are key diagnostic elements. This chapter will only detail imaging of the brain and spine. Skeletal and visceral injuries, which may accompany the brain lesions described here, are discussed in their own chapters.

7.3.1 Brain CT

Brain CT should be the first examination done, on an urgent basis, at the slightest suspicious symptom, whatever the child’s age [44]. CT scans are readily accessible in an emergency, rapid to perform, and require no sedation or intravenous contrast agent.

CT is an excellent modality for detecting acute or subacute subarachnoid, subdural, and intraparenchymal hemorrhages. Extradural hematomas are rare in the

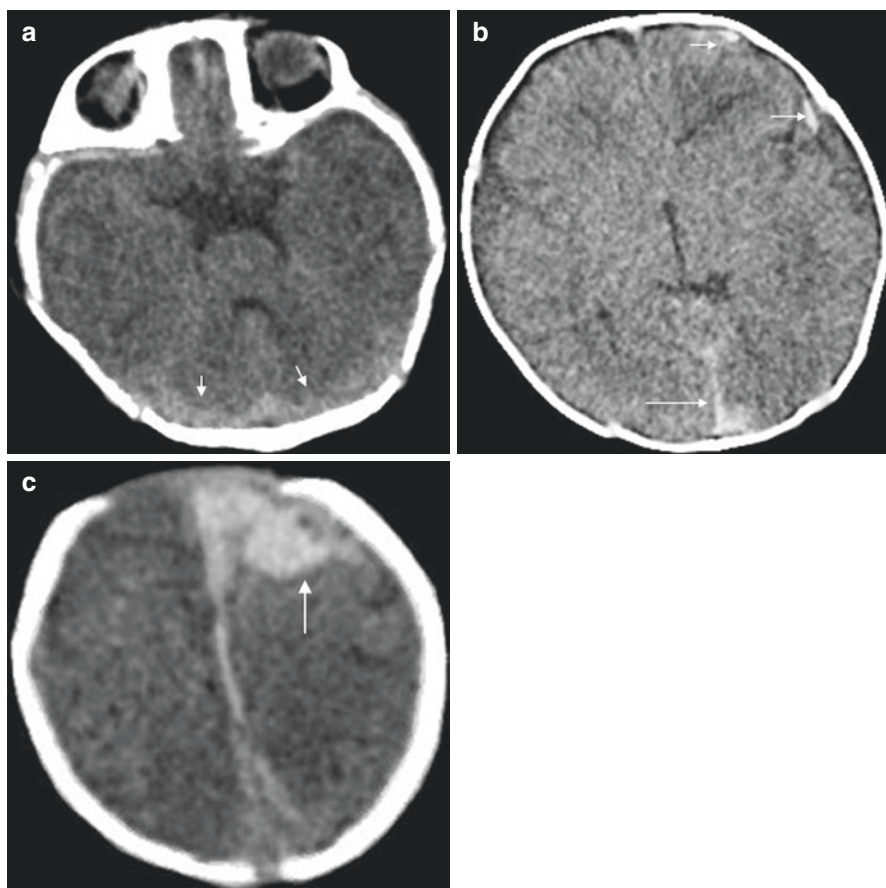


Fig. 7.2 AHT. Characteristic multifocal subdural hematomas. One-month-old baby with right upper extremity clonus, hypotonia, and pallor (same patient is in Fig. 7.1). Initial brain CT: diffuse subdural hematomas (*arrows*) marked by hyperdensity of the tentorium cerebelli (**a**), the interhemispheric space (**b**), and the left frontoparietal zone (**b**), with highly suggestive predominance at the vertex (**c**). Parenchymal hypodensity due to hypoxia-ischemia in the left hemisphere

non-accidental context. In the vast majority of cases, the initial CT establishes the diagnosis by showing the characteristic multifocal, sheetlike, unilateral or bilateral subdural hematomas at a number of pericerebral and/or deep cerebral sites such as the interhemispheric space, the tentorium cerebelli (Fig. 7.2) [8, 45, 46], and/or the retroclival space [47]. Hyperdensities representing falx cerebri or tentorium cerebelli hemorrhages are highly suggestive of SBS. Similarly, a preponderance of hyperdensities at the vertex is also highly suggestive, as it reflects rupture/tearing of the bridging veins by violent acceleration-deceleration movements of the brain within the skull (see Sect. 7.2) (Fig. 7.3). In some cases, post-rupture bridging vein thrombosis can be visualized directly in the form of tube-shaped hyperdensities at the top of the brain [32, 34, 35]. The visible subdural hematomas vary in density and size; those in lateral locations are often of mixed density [48, 49]. CT can also show cerebral edema or hypodensities in the white matter, cortex, and basal ganglia due to anoxic-ischemic injuries, though the latter are far better explored with MRI (Fig. 7.4).

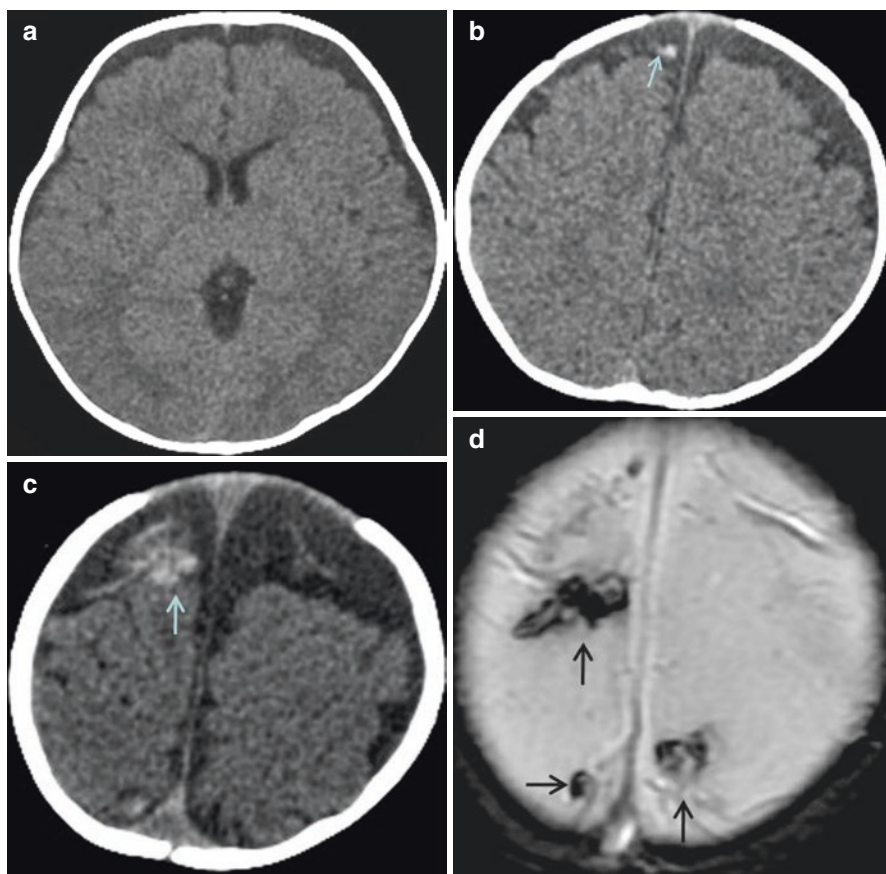
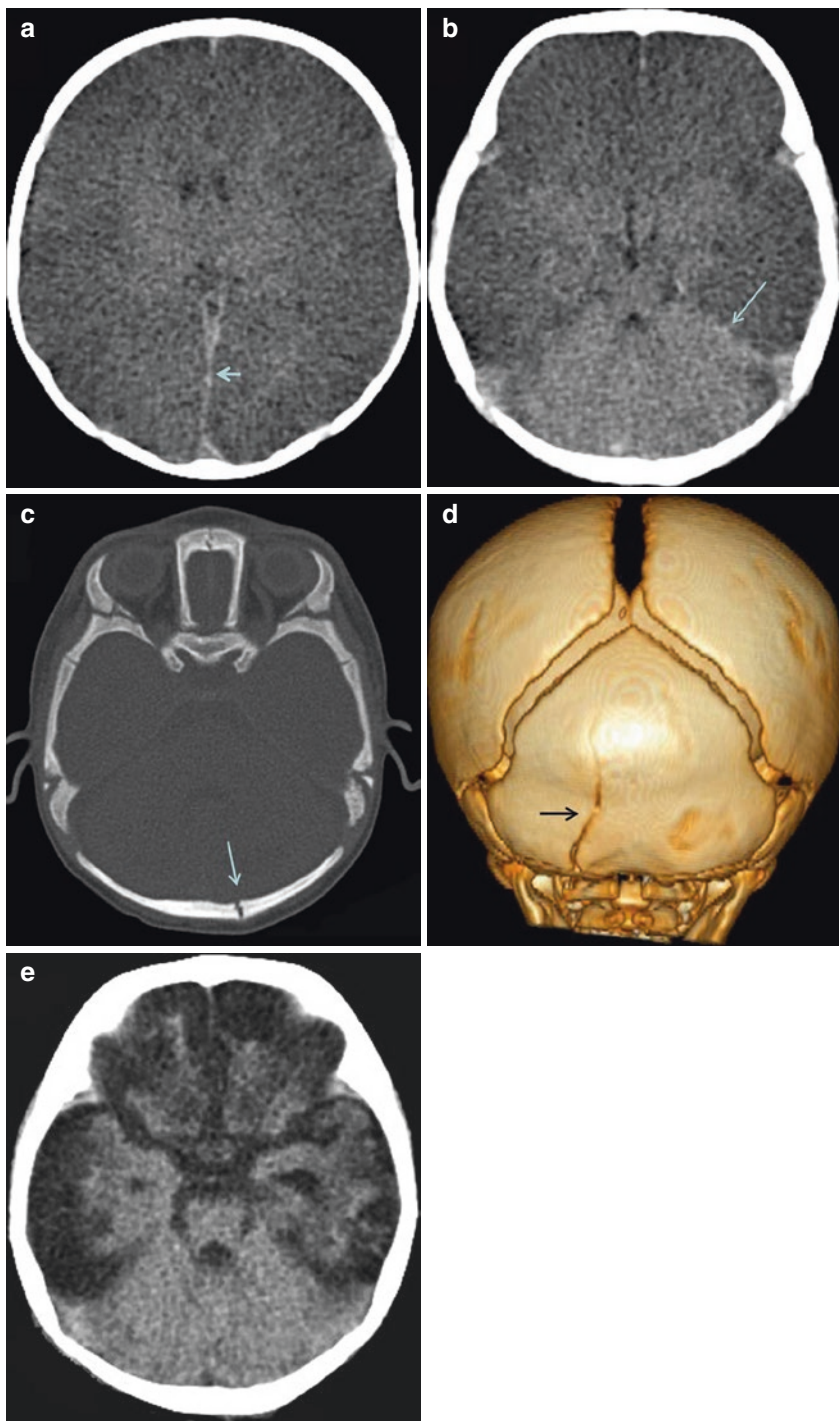


Fig. 7.3 AHT. Characteristic predominance of hemorrhage at the vertex. Four-month-old boy seen for loss of consciousness. CT scan (**a–c**) and T2*-weighted MRI (**d**). Hypodense bifrontal subdural effusion. Tubular and round hyperdensities at the vertex (**b, c arrows**), corresponding to rupture/tearing of the bridging veins, confirmed on MRI (**d, arrows**)

Fig. 7.4 AHT. Parenchymal abnormalities on CT. Four-month-old abused baby, brought to the emergency department for hypotonia and crying. Numerous bruises and metaphyseal fractures. Initial CT scan (**a–d**) and 3 months later (**e**). The brain window images (**a** and **b**) show overall white matter hypodensity, while the cerebellar density is preserved (**b**). Ventricular effacement due to cerebral edema. Thin film of hyperdense subdural hematoma between the hemispheres and at the tentorium cerebelli (**arrows**). Bone window (**c**) and 3D reconstruction of the skull in posterior view (**d**): linear left occipital fracture with no scalp swelling (**arrows**) and sutural diastasis due to significantly elevated intracranial pressure. Changes at 3 weeks (**e**): Major cerebral atrophy sparing the cerebellum



CT can be used to determine whether neurosurgical decompression is indicated. It is more sensitive than MRI in detecting craniofacial fractures, which are readily analyzed by 3D reconstruction using a bone window. CT can also be used to identify scalp swelling, which is evidence of recent impact (Figs. 7.4 and 7.5).

Skull fractures are an indicator of a direct blow. They have no specific appearance, but—like multiple fractures—fractures that cross sutures and bilateral fractures are suspicious for non-accidental injury, as are wide fractures. While not always easy, it is important to distinguish fractures from normal variants like accessory sutures and wormian bones [50]. For more information on this topic, see also Chap. “Skeletal injuries”.

One feature of wide skull fractures is their potential, though rare, for progression to a leptomeningeal cyst—also known as a “growing skull fracture.” This occurs when the leptomeninges, or even cerebral tissue, herniate through a wide fracture line that fails to close on its own. Aside from this very specific case, there is no correlation between the existence of a skull fracture and that of underlying brain injury.

Lastly, if there is clinical suspicion of AHT and the initial scan is questionable, it is important to repeat the CT scan 12–24 h later, because cerebral edema can initially mask a thin film of subdural hematoma (Fig. 7.6). Likewise, if there is a small-volume hematoma, it is not unusual to see a significant expansion in the hematoma a few days later. A brain MRI, which should be done as soon as the child’s condition permits, is also helpful, especially if there is doubt about the diagnosis [8].

7.3.2 Brain MRI

The diagnostic value of brain MRI as a complement to CT lies in its ability to confirm signs of bleeding within a small subdural collection, demonstrate bridging vein rupture at the convexity (the so-called “lollipop” and “tadpole” signs [34, 36]), and show contusions, which are often frontal and/or temporal (Figs. 7.7 and 7.8) [32, 34–36, 51]. Brain MRI can only be done later, after abusive head trauma is positively diagnosed by CT scan. Ideally performed within the first 10 days, brain MRI can be difficult to do if the child is in intensive care. The value of MRI must be weighed against the clinical condition of the infant who in some cases cannot be moved.

MRI’s primary role is prognostic; it can be used to assess parenchymal injuries, which will in large part determine the prognosis [51]. Those injuries can be broken down into five basic types, which often occur in combination [52]. The most common abnormalities are hypoxic-ischemic injuries that can involve both cerebral hemispheres. In the acute phase, they are accompanied by edema, and this brain swelling can minimize or mask subdural hematomas. Major hypoxic-ischemic injuries (Type 1) involve the cerebral cortex, the basal ganglia, and the white matter and/or the junction between the cerebral white and gray matter (Fig. 7.9). There can also be secondary involvement of the pyramidal tracts in the brainstem via Wallerian

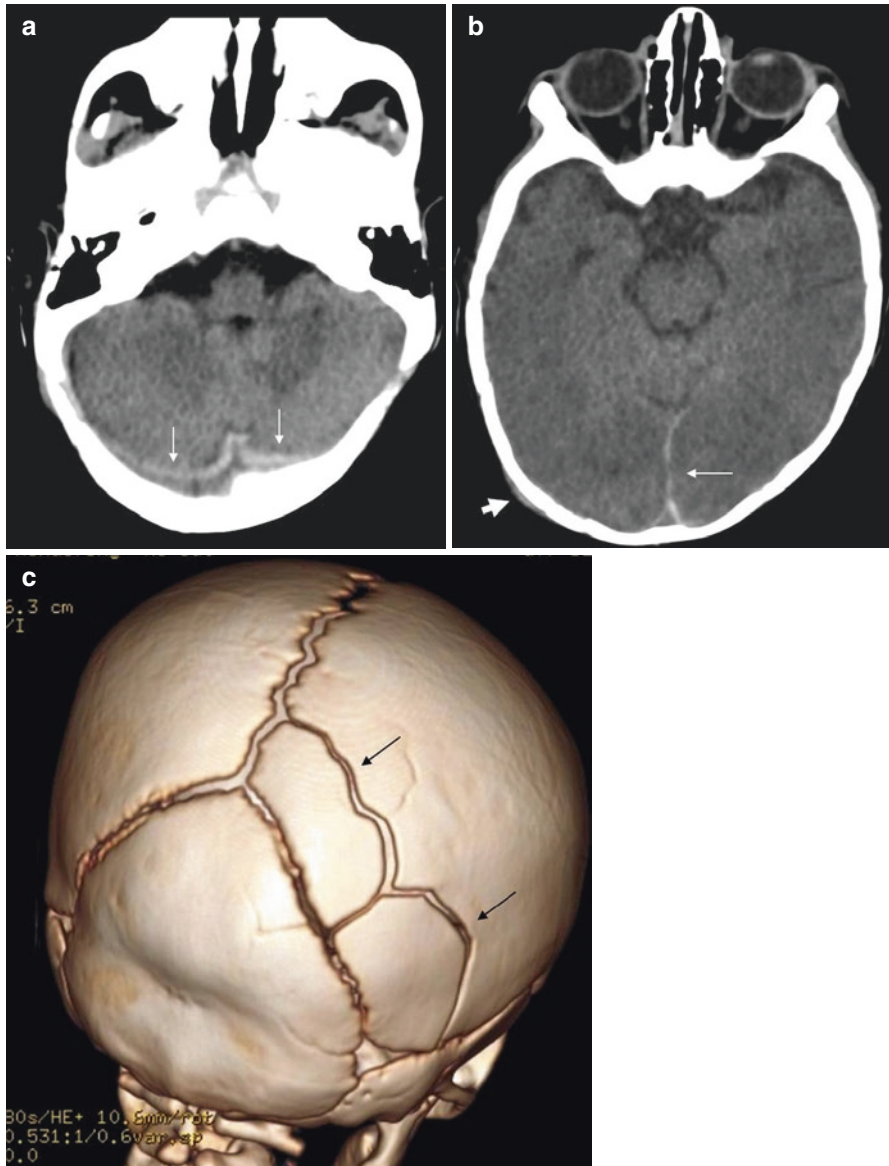


Fig. 7.5 Shaking with impact. Four-month-old infant seen for crying and vomiting, with intense pallor. Brain CT, brain window images (a–c), and 3D reconstruction of the skull in right posterior view (c). Subdural hematoma at the tentorium cerebelli (a, arrows) and in the interhemispheric space (b, thin arrow). Wide right posterior parietal fracture line (arrows), which must be distinguished from a physiological suture. Scalp swelling directly above the fracture, evidence that the fracture is recent (b, thick arrow)

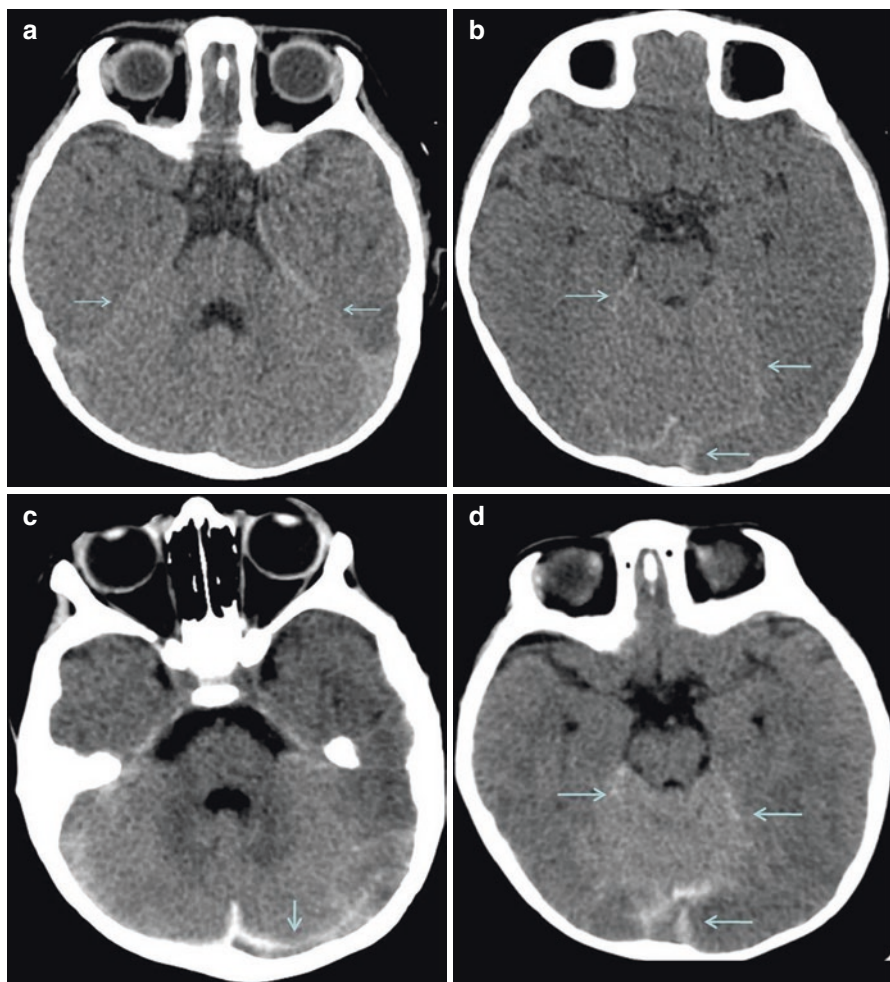


Fig. 7.6 AHT. Value of repeating the CT scan after 24 h. Eleven-month-old boy seen for ALTE with impaired consciousness, hypotonia, and facial bruising. Initial CT scan (**a** and **b**) and 24 h later (**c** and **d**): subtle hyperdensities corresponding to subdural hematomas at the tentorium cerebelli and in the interhemispheric space (*arrows*). CT scan 24 h later: the hyperdensities are now obvious (**c** and **d**, *arrows*)

(anterograde) degeneration (Fig. 7.8). In Type 2, the hypoxic-ischemic injuries are limited to the border zones (watershed areas), particularly in the parasagittal regions, between the territories of the anterior and middle cerebral arteries ventrally and the middle and posterior cerebral arteries dorsally (Fig. 7.10). More rarely, these infarctions can also involve the cerebellum. Type 3 is a venous infarction that typically occurs unilaterally in the parieto-occipital region, and often at the convexity, near a bridging vein rupture (Fig. 7.11). Types 4 and 5 are less common. These correspond to focal axonal injuries in the white matter—in the corpus callosum, in particular

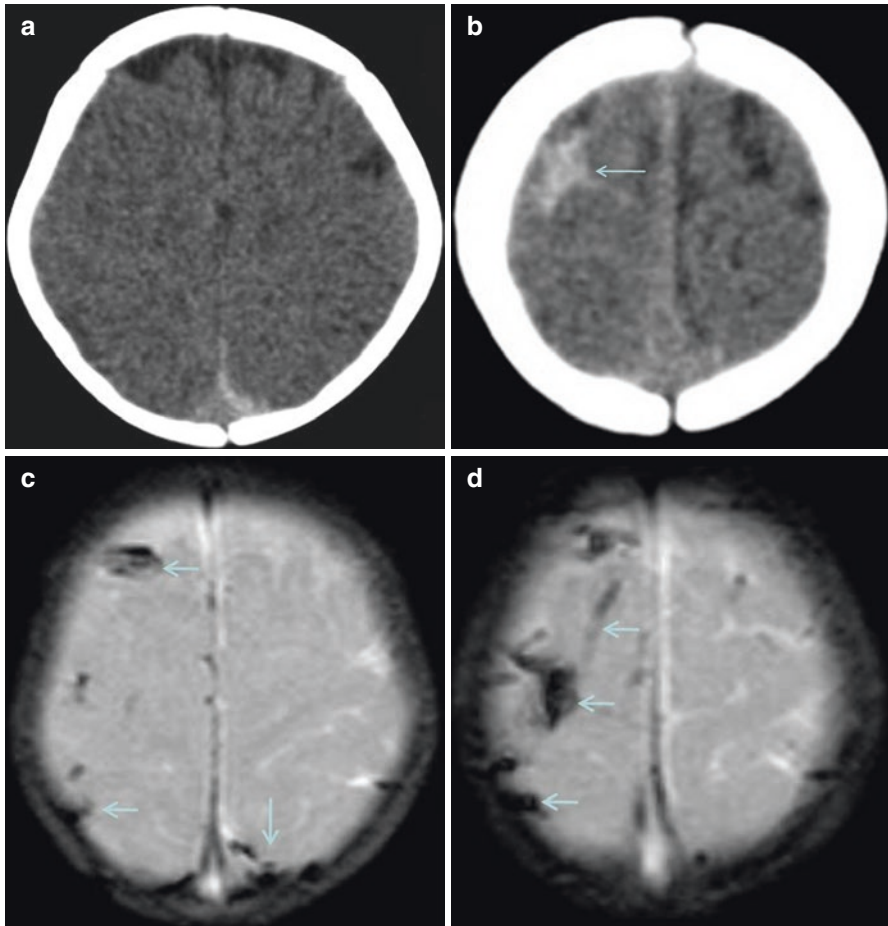


Fig. 7.7 AHT. Bridging vein rupture. Complementarity of CT and MRI. Four-month-old boy in cardiac arrest. CT (**a** and **b**): subtle hyperdensities (*arrows*) and effacement of the sulci due to cerebral edema. MRI 2 days later, T2*-weighted sequence (**c** and **d**): tubular and round structures with very low signal intensity indicating characteristic bridging vein rupture/thromboses (*arrows*)

(Type 4)—and to direct contusions with lacerations, often frontotemporal, due to the brain hitting the bony walls of the skull (Type 5) (Fig. 7.8) [53].

MRI is better than CT for analyzing the parenchyma of the cerebrum, cerebellum, brainstem, and spinal cord, especially for prognostic purposes. The minimum study should include T1- and T2-weighted spin echo sequences, T2-weighted gradient echo (or susceptibility-weighted) sequences, which are very sensitive to hemosiderin deposits, and diffusion-weighted sequences, which are very sensitive for early detection of anoxic-ischemic areas. Also, diffusion sequences can be used to identify areas of cytotoxic edema with diffusion restriction, which is predictive of irreversible injury (Figs. 7.9 and 7.10) [51].

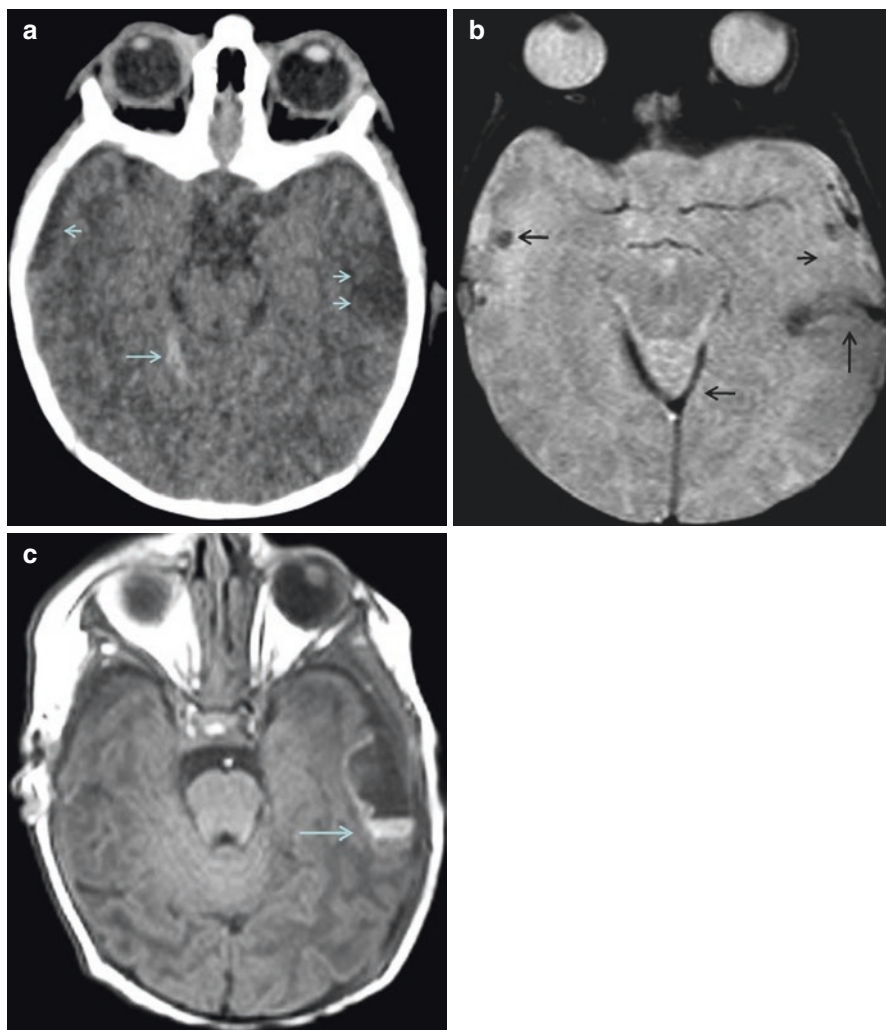


Fig. 7.8 Shaking with slaps. Bitemporal contusions. Six-week-old infant, vomiting and apathy. Bruising on the left cheek. CT (a): Hyperdensity of the right wing of the tentorium cerebelli (arrows) and bitemporal hypodensity, more prominent the left. MRI done the same day, axial T2*-(b) and T1-weighted (c) images: Confirmation of the subdural hemorrhage at the tentorium cerebelli and in the posterior interhemispheric space, with low signal intensity (b, arrows) and signs of intraparenchymal hemosiderin bitemporally, indicating hemorrhagic contusions (arrows). Fluid level in a left temporal cavity (c, arrow)

Other sequences can also be useful; for example, sagittal STIR sequences can show muscle and ligament injuries in the neck [36, 40–42, 54]. MR angiography (MRA) can be used in the differential diagnosis to rule out vascular malformations without intravenous contrast agent. Though intravenous contrast is not used routinely, in some cases it can help show venous thrombosis.

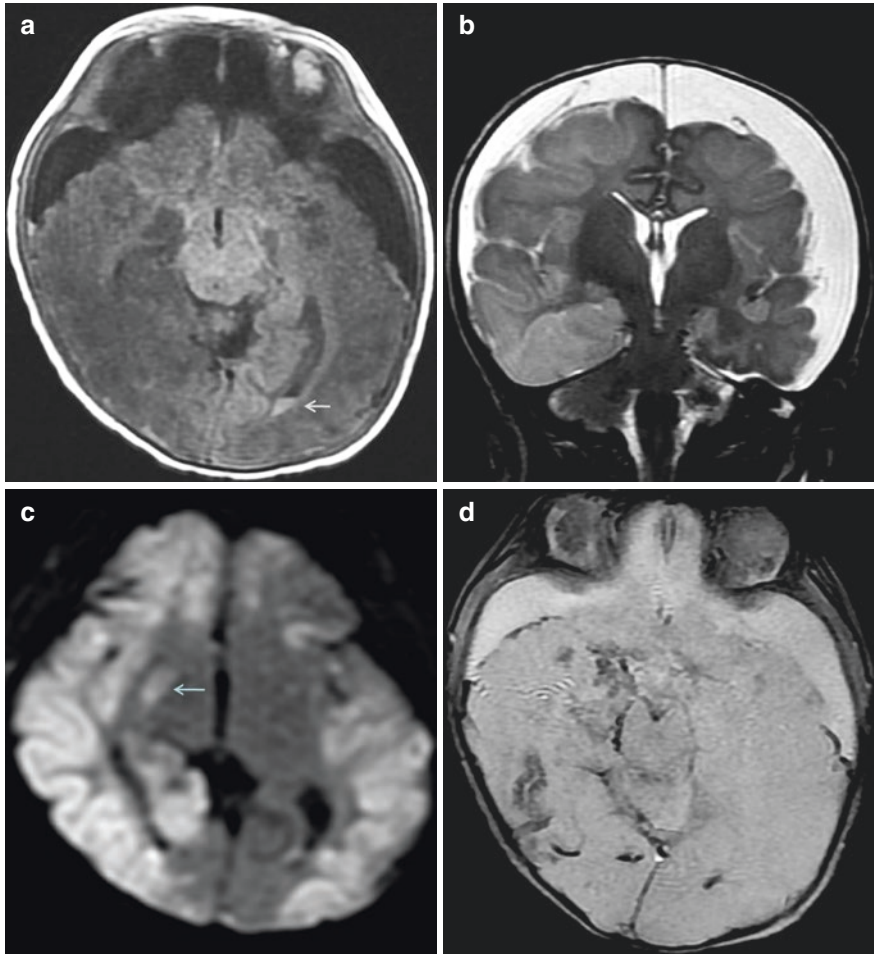


Fig. 7.9 AHT. Diffuse anoxic-ischemic injuries on MRI. Seven-week-old girl seen for vomiting and refusal to eat (no brain images available) and then for seizures 3 weeks later. MRI, axial T1-weighted (**a**), coronal T2-weighted (**b**), axial diffusion-weighted (**c**), and T2*-weighted (**d** and **e**) images. Large, old-looking, compressive bilateral subdural hematoma, hypointense on the T1-weighted image. Temporo-occipital loss of gray-white matter differentiation, especially on the right (**a**, *arrow*). Blood fluid level (high signal intensity) in the occipital horn of the left lateral ventricle (**a**, *arrow*). Diffuse hyperintensity with swelling of the cerebral cortex, visible especially on the right on the T2-weighted image (**b**), and bilaterally on the diffusion-weighted image (**c**). Hyperintense right basal ganglia on the diffusion-weighted image (*arrow*). A large number of hemorrhagic areas, frankly hypointense on the T2*-weighted image (**d**), in the cerebral sulci and the subdural collections, with rupture of bridging veins at the top of the brain (**e**, *arrows*)

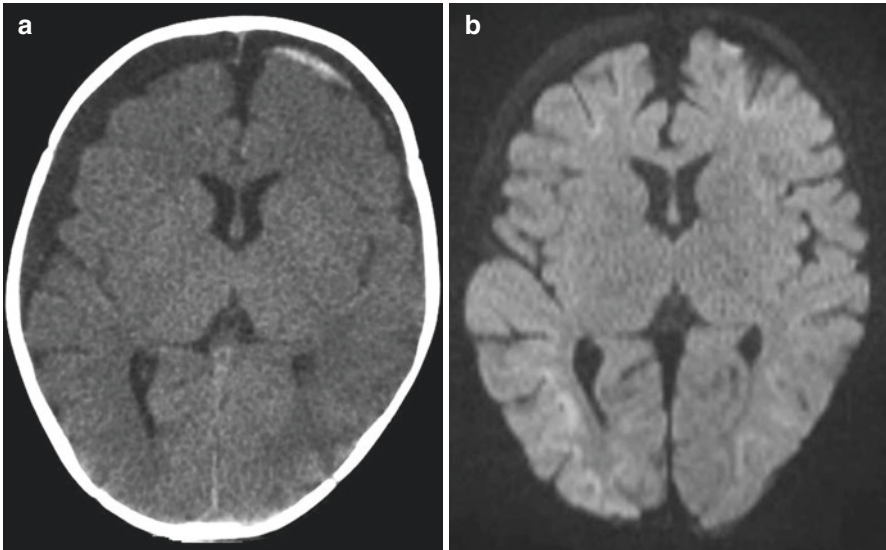
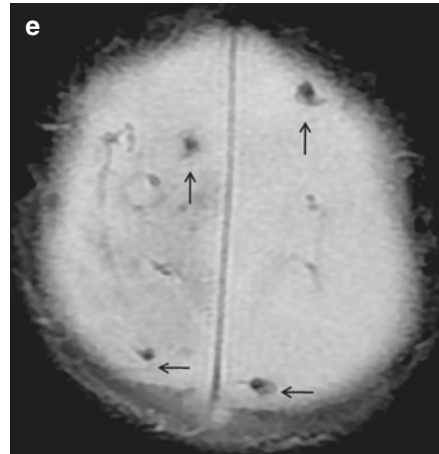
Fig. 7.9 (continued)

Fig. 7.10 AHT. Diffuse anoxic-ischemic injuries. Comparison between CT and MRI. Four-month-old infant presenting with vomiting over the preceding several days and then seizures. Right hemiparesis on clinical examination. CT (a), axial diffusion-weighted (b and c), coronal T2-weighted (d), and axial T2*-weighted (e) MRI images. The CT scan (a) shows a diffuse frontal subdural hematoma, hypodense on the right and of mixed density on the left. The MRI (b–e) shows diffuse anoxic-ischemic injury at the gray-white matter junction marked by high signal intensity on the diffusion-weighted images (b and c, arrows) and confirms the diffuse subdural hematomas, marked by frank hypointensity on the T2- (d) and T2*-weighted (e, arrows) images, with clots or thrombosed bridging veins at the vertex (d, arrows)

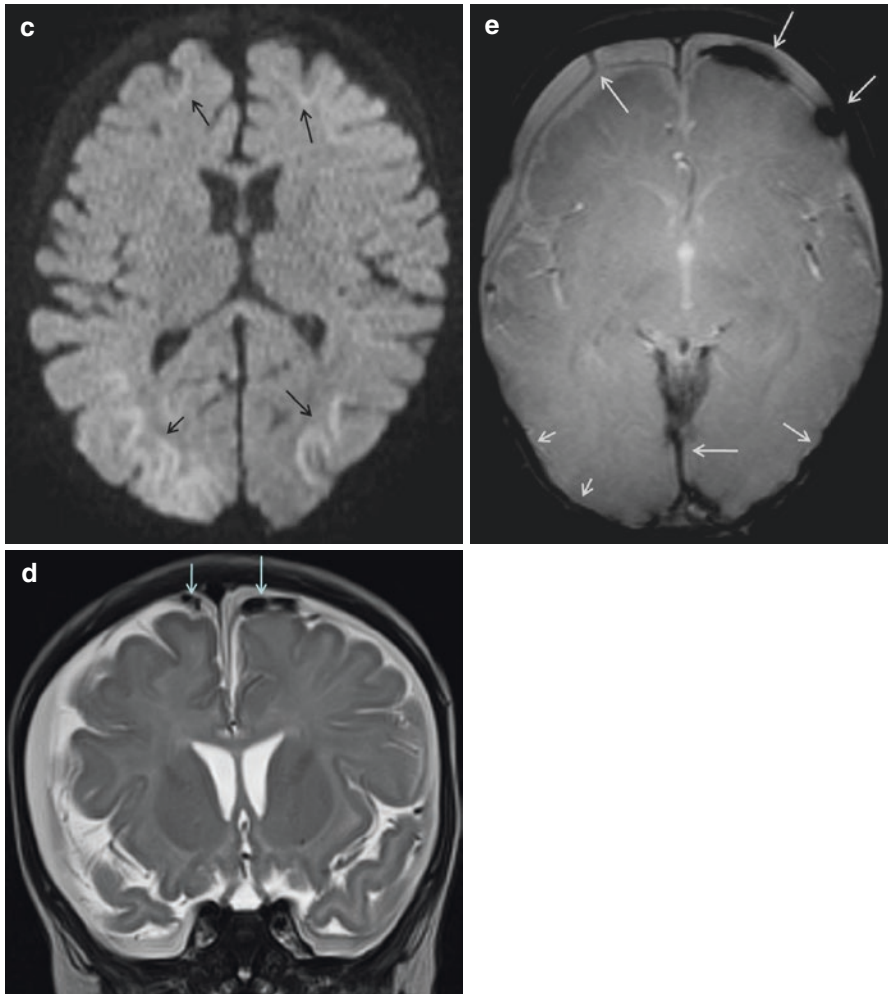


Fig. 7.10 (continued)

MRI is thus used as a complement to CT when the injuries are typical. A high clinical index of suspicion with a normal or questionable CT scan is a rapid indication for MRI.

MRI can also be used as a first-line modality to look for subclinical subacute and chronic injuries in asymptomatic children (for instance, the siblings of a known case). Its excellent sensitivity in detecting parenchymal scarring makes it the gold standard in such cases.

7.3.3 Transfontanellar Ultrasound (TFU)

TFU plays a very marginal role in suspected SBS. While it is done in certain cases—as a second-line modality after CT—to help determine the subdural or subarachnoid location of a collection, this is rarely necessary in practice. As a reminder, TFU is of little or no help in finding small-volume subdural hematomas, particularly when they are located in the longitudinal fissure or tentorium cerebelli. TFU cannot be used by itself for suspected SBS; it must be followed by CT.

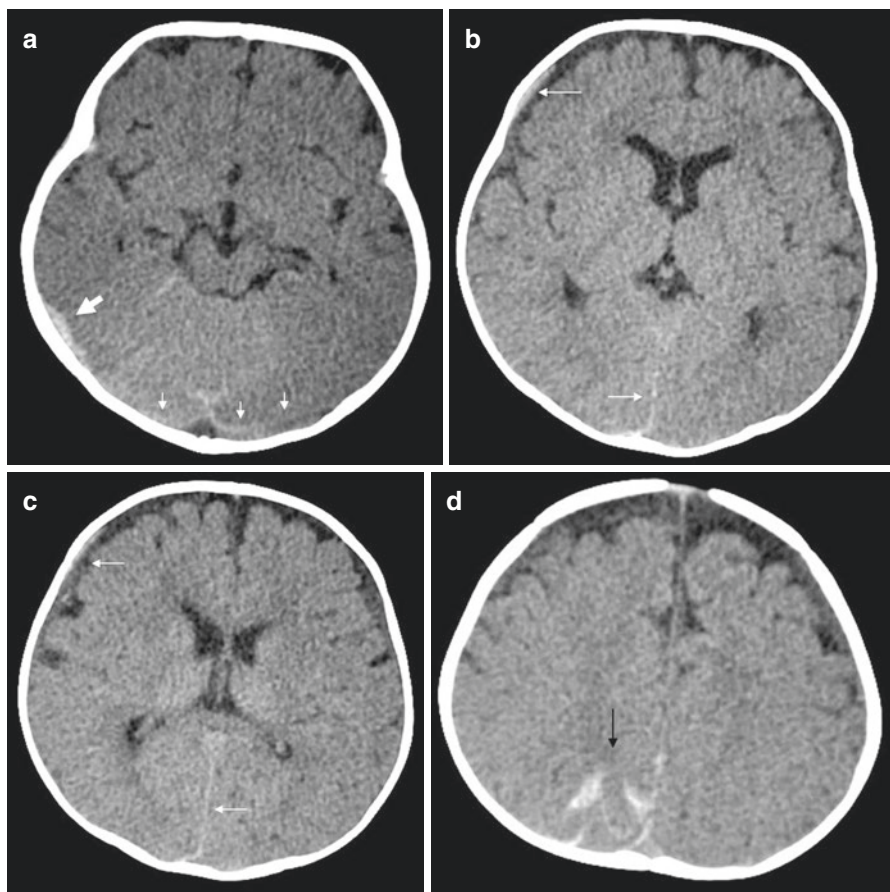


Fig. 7.11 AHT. Venous infarct and multiple subdural hematomas. Initial CT (a–d); MRI 2 days later (e–f) and MRI 1 month later (g). Six-month-old infant in cardiac arrest. Brain CT (a–d): Diffuse subdural hematomas (arrows) marked by hyperdensity of the tentorium cerebelli (a) and the interhemispheric space (b and c) and subarachnoid hemorrhage at the vertex on the right, where the hyperdensity lines the sulci (d). MRI, axial T1-weighted (e) and coronal T2-weighted (f) images: confirmation of the subarachnoid hemorrhage on the right (e), with abnormal hyperintensity of the underlying cortex, most likely corresponding to a hemorrhagic venous infarct (f). Progression to cerebral atrophy, most prominent in the right parietal lobe (g)

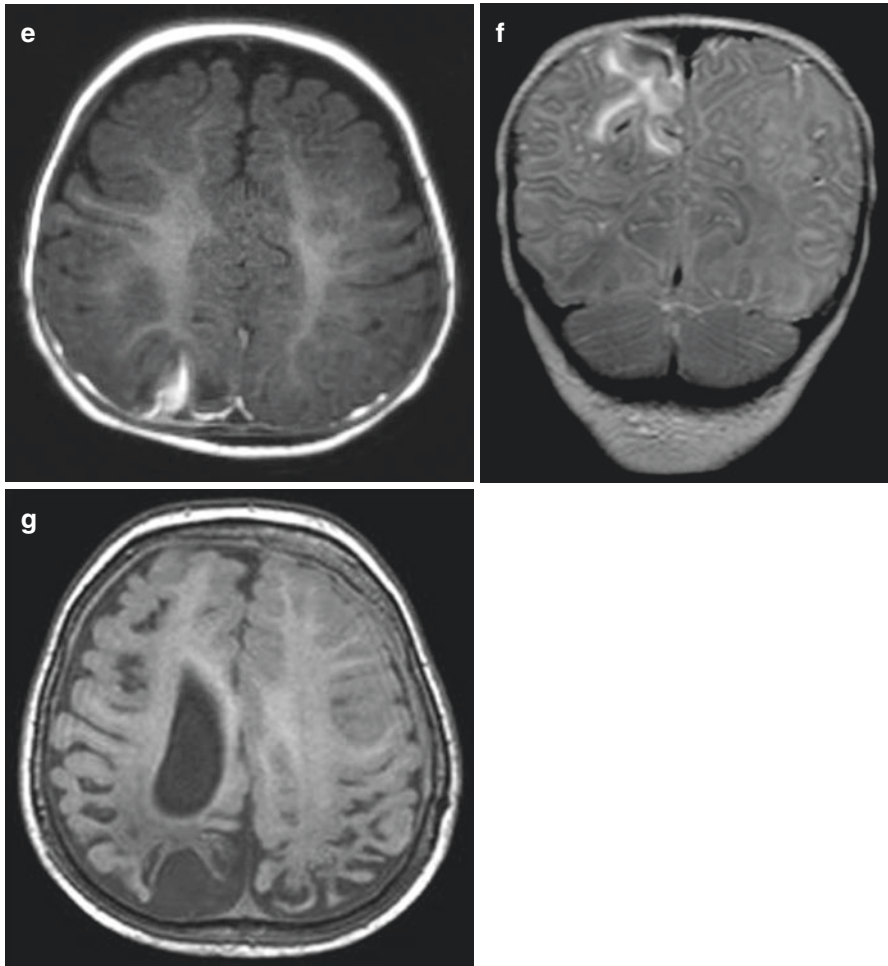


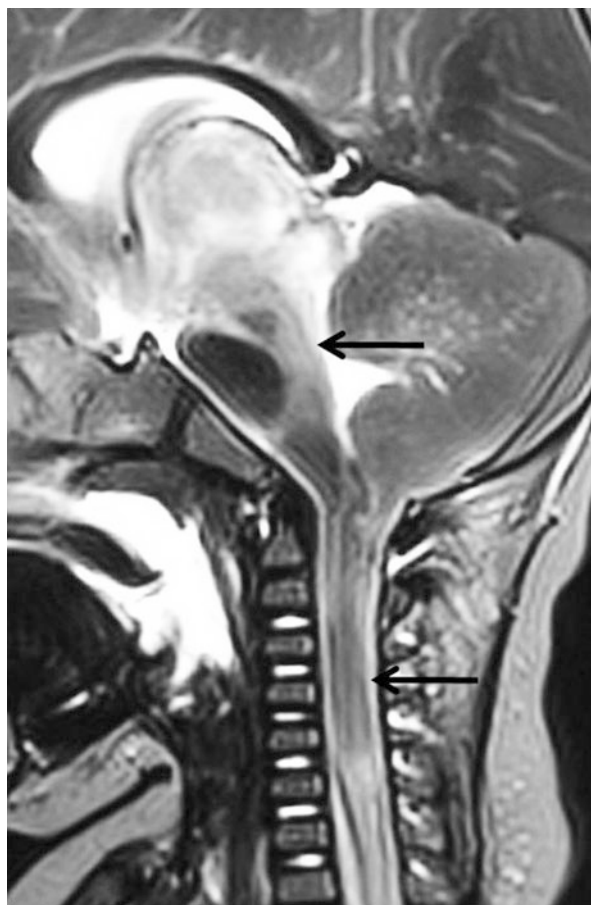
Fig. 7.11 (continued)

7.3.4 Spine MRI

The frequency of spinal cord injuries in non-accidental trauma is underestimated. Yet it is easy enough to explore the cervical spine when brain MRI is done, to look for injuries to the cord and cervical soft tissue [36, 40, 41, 54]. An MRI of the entire cord should be done whenever there is a spine injury (fracture, dislocation, etc.) or clinical suspicion of spinal cord injury. Exploration of the cord is also advised in cases where the neurological picture is questionable or not fully explained by the brain injuries.

Cervical cord injury occurs mainly in young infants (age 5 months, on average), and a variety of traumatic lesions can be seen, including contusions, epidural hematomas, a severed cord, etc. (Fig. 7.12). Cervical cord injuries are

Fig. 7.12 AHT with spinal cord injury. Nine-month-old infant, cardiac arrest. MRI, sagittal T2-weighted image. Contusion of the brainstem and spinal cord, heterogeneous and hyperintense (arrows)



produced by flexion-extension movements of the neck during violent shaking (whiplash injury).

Spinal subdural hemorrhage is reported in over 60% of children with abusive head trauma, while rarely observed in accidental trauma [40]. Spinal subdural hemorrhage is not usually accompanied by cord or spine injuries, and the causal mechanism is still being debated. The most likely hypothesis is tracking of intracranial subdural hemorrhage into the spinal compartment due to gravity, though direct damage to vessels within the dural compartment cannot be ruled out [40].

As a reminder, vertebral injury is often absent thanks to the particular elasticity of the spine in this age group, which helps absorb even large mechanical forces—unlike the cord, which does not stretch. Vertebral fractures can, however, occur in the abuse context (see Chap. “Skeletal injuries”) and require a full spine MRI.

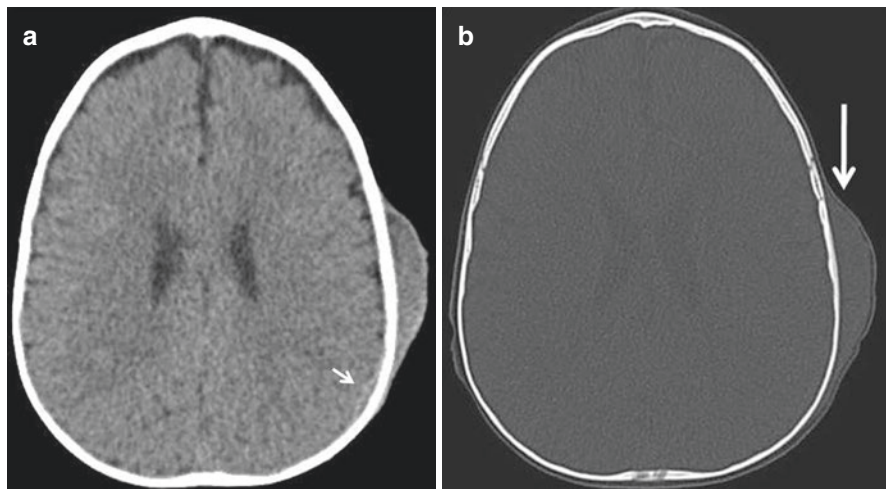


Fig. 7.13 Differential diagnosis of SBS: accidental trauma due to a fall from a changing table onto a stone floor. CT (**a** and **b**). Thin localized film of subdural or extradural hematoma (*arrow, a*). Voluminous swelling of the overlying scalp (*arrow, b*)

7.4 Differential Diagnosis

Diagnosing SBS requires systematically ruling out a number of other conditions [4, 13]. Most—like bleeding disorders, meningitis, hypernatremic dehydration, and metabolic disorders like glutaric acidemia type 1 and abnormalities of copper metabolism—are easy to rule out based on clinical and/or laboratory findings [8, 26, 55]. Remember, however, that children with these abnormalities can also be shaking victims.

Vascular malformations, while possible, are rare. They might be suspected when there is a localized subarachnoid hemorrhage and are easily confirmed by MR angiography.

Accidental injury is generally easy to rule out; with non-accidental trauma, the reported history is changeable or absent, while commonplace injuries like falls from a sofa, for example, never causes the diffuse, deep subdural hematoma characteristic of SBS (Fig. 7.13) [8]. This is especially important to remember, because this is the mechanism often alleged by perpetrators. Yet the study by Chadwick [28, 56] found no deaths due to falls of between 1 and 3 m and only one death out of more than a hundred cases of children who fell more than 3 m. Only major trauma with sharp deceleration—such as from a high-speed car accident or a fall from a great height from defenestration—can cause diffuse subdural hematomas, but in those cases the context is obvious, and there are generally signs of major impact [8, 26]. In contrast, a multifocal subdural hematoma and profuse retinal hemorrhages cannot be caused by a low-height fall, resuscitation, or play [8].

Childbirth can cause diffuse, same-age subdural hematomas accompanied by subarachnoid and retinal hemorrhages; these are often asymptomatic and posterior.

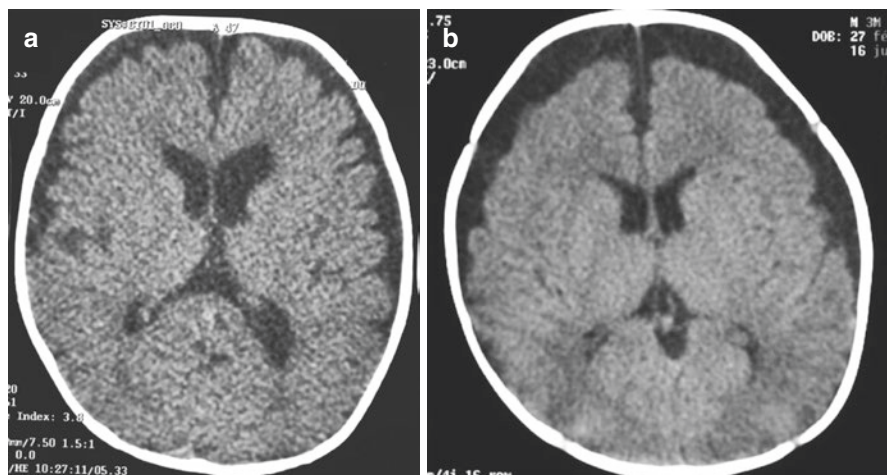


Fig. 7.14 Benign enlargement of the subarachnoid spaces (a) versus old subdural hematoma (b). CT in two different 6-month-old children. (a) Normal variant: pericerebral fluid effusion seeps into the cerebral sulci, which are enlarged. Moderately dilated ventricles. Context of familial macrocrania. (b) Old subdural hematoma due to SBS: the pericerebral fluid effusion is compressing the sulci. The child presented with vomiting of 2-week duration

If there are symptoms, they appear within a few hours of birth and progress of a piece, with no asymptomatic interval. Those obstetrical hemorrhages disappear most often in less than 3 weeks. Thus the only period in which SBS can be difficult or impossible to diagnose is the perinatal period, in the very first days of life—hence the importance of detailing the child’s clinical status during the pregnancy and after birth.

The hypothesis that benign enlargement of the subarachnoid spaces is a risk factor for subdural hematoma was widely debated and ultimately disproven [8].

One must distinguish between two situations:

- The first is the enlargement of the subarachnoid spaces commonly seen in infants due to temporary immaturity of the CSF reabsorption system. This entity has no clinical signs, aside from macrocrania—which is often the reason for the consultation and for which there is often a similar family history. Here the macrocrania progresses steadily, as evidenced by the smooth shape of the head circumference curve. Imaging shows moderate overall enlargement of all of the sulci, which have a fluid-type density or signal intensity. The ventricles may also be moderately dilated (Fig. 7.14). It is highly unlikely that this kind of subarachnoid space enlargement facilitates bridging vein rupture during shaking, since infants explored radiologically for simple enlargement of the pericerebral space, who often have a family history of macrocrania and no other symptoms, never show bridging vein rupture. Some authors have even demonstrated that, on the contrary, the fluid layer may have a beneficial dampening effect by reducing the brain’s mobility within the skull during shaking [39].

- The second is subarachnoid space enlargement due to an old subdural hematoma, where the bleeding is causing a temporary reabsorption problem. The head circumference curve in this case is very telling, showing a frank increase in head circumference in the weeks preceding the brain imaging. The first hypothesis should be chronic subdural hematoma, especially if the child had episodes of vomiting unaccompanied by diarrhea or fever—often erroneously attributed to gastroenteritis—in the previous weeks. While fundus examination is very important, it is often normal in this context, where the bleeding is already old. All previous brain images should be carefully analyzed looking subtle signs of bleeding that may have been missed. If there are no previous images, a brain MRI should be done to look for old subdural bleeding that does not have a purely fluid appearance, in contrast to the subarachnoid spaces, which have the same signal intensity as cerebrospinal fluid. All of these findings should then be correlated with the child’s head circumference curve and detailed clinical history, because many of these cases are actually shaken babies whose diagnosis was initially missed [14].

7.5 Dating

Imaging-based dating is inaccurate and of little use at the time of diagnosis for brain injuries. Overly restrictive dating can, however, create problems for the subsequent legal process [14].

Generally speaking, the CT appearance of hemorrhage depends on many factors, including the hematocrit, the hemoglobin level, and the degree of clot retraction, which in turn depends on the rapidity of the bleeding [57]. Theoretically, on CT, non-coagulated blood is isodense with the brain parenchyma, while coagulated blood is hyperdense. That hyperdensity persists for about a week, gradually becoming isodense and then hypodense. So as a rule of thumb, hyperdensity reflects bleeding that is a few hours to about a week old. Conversely, a hypodense subdural hematoma indicates an old bleed—usually more than 2 weeks old. There are a number of pitfalls with this, however. In anemic patients, acute bleeding is isodense; disseminated intravascular coagulation can delay the formation of a hyperdense clot; and a mixed appearance with a combination of hyper- and hypodense areas may reflect an acute hematoma. On the other hand, while old subdural hematomas are generally hypodense, in some cases they are heterogeneous. For example, an old subdural hematoma can spontaneously re-bleed due to an inflammatory membrane, becoming heterogeneous (Fig. 7.15).

In practice, the hematomas in SBS are often of heterogeneous—or “mixed”—density. In the specific context of abuse, where the violence is often recurrent, dating is even more uncertain.

MRI contributes only minimally in dating hematomas. It is more sensitive than CT in detecting membranes within a subdural hematoma; such membranes are an indication that the hematoma is at least 2 weeks old [57]. On the other hand, it can demonstrate acute parenchymal lesions generally less than a week old based on

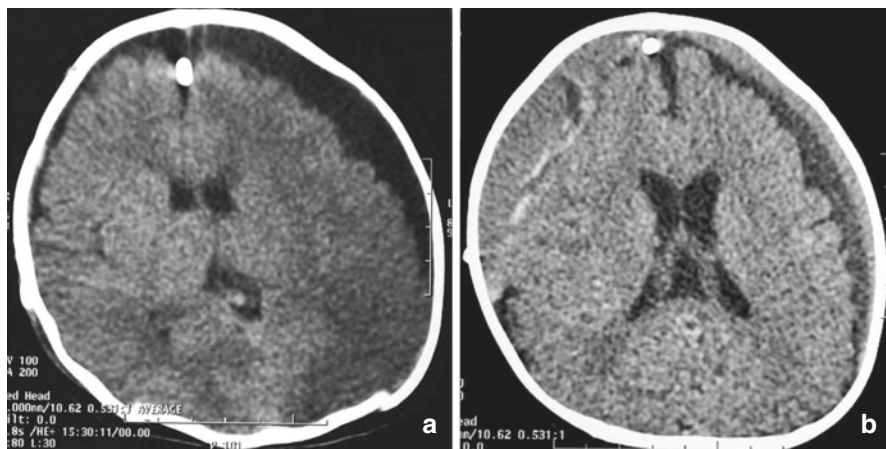


Fig. 7.15 AHT. Spontaneous re-bleed of an old bilateral subdural hematoma. CT scans 2 months apart (**a** and **b**). (**a**) Old bilateral subdural hematoma, larger on the left, with a shunt valve in a 5-month-old child hospitalized for SBS. (**b**) Spontaneous reorganization of the hematomas 2 months later, with the child still in a hospital setting. No new clinical symptom was present. The subdural hematomas have increased in size, especially on the right, and their density changed, becoming heterogeneous

diffusion abnormalities. In contrast, as a rule of thumb, parenchymal atrophy, localized glial scars, and porencephaly indicate lesions that are more than 3 weeks old.

So, like with skeletal injuries, the presence of different-age lesions is a key finding on the imaging report. They must be in different locations, since a subdural hematoma can re-bleed spontaneously in its capsule. For instance, the combination of a hypodense anterior bifrontal subdural hematoma indicating bleeding that is old (usually more than 2 weeks old) and a hyperdense hematoma of the tentorium cerebelli suggests at least two episodes of violence [14] (Fig. 7.16). Similarly, the presence of both an “old”-looking hypodense subdural hematoma with membranes and acute parenchymal injuries on diffusion-weighted images also indicates different-age injuries.

In the brain, like in the skeleton, the existence of different-age lesions is critical because it indicates at least two episodes of violence. Hence it is possible to both formally rule out the accident often alleged by the perpetrator and determine that there is a high risk of further violence. We should add that when there are different-age lesions, it is impossible to determine, using imaging, exactly how many episodes of violence have occurred—only that there have been at least two. This is especially important to remember, given that perpetrators often report regular, sometimes daily, episodes of shaking over a period of several weeks for the unfortunate purpose of “calming the child” (cf. Sect. 7.2) [5].

The inaccuracy of dating lesions by imaging—like dating ocular lesions by ophthalmology—makes clinical data all the more important. While careful analysis of the child’s behavior based on the family’s statements can yield a lot of information, such statements are only available when there is a forensic investigation [14]. The public hearing [8] in France studied the time between injury and the onset of

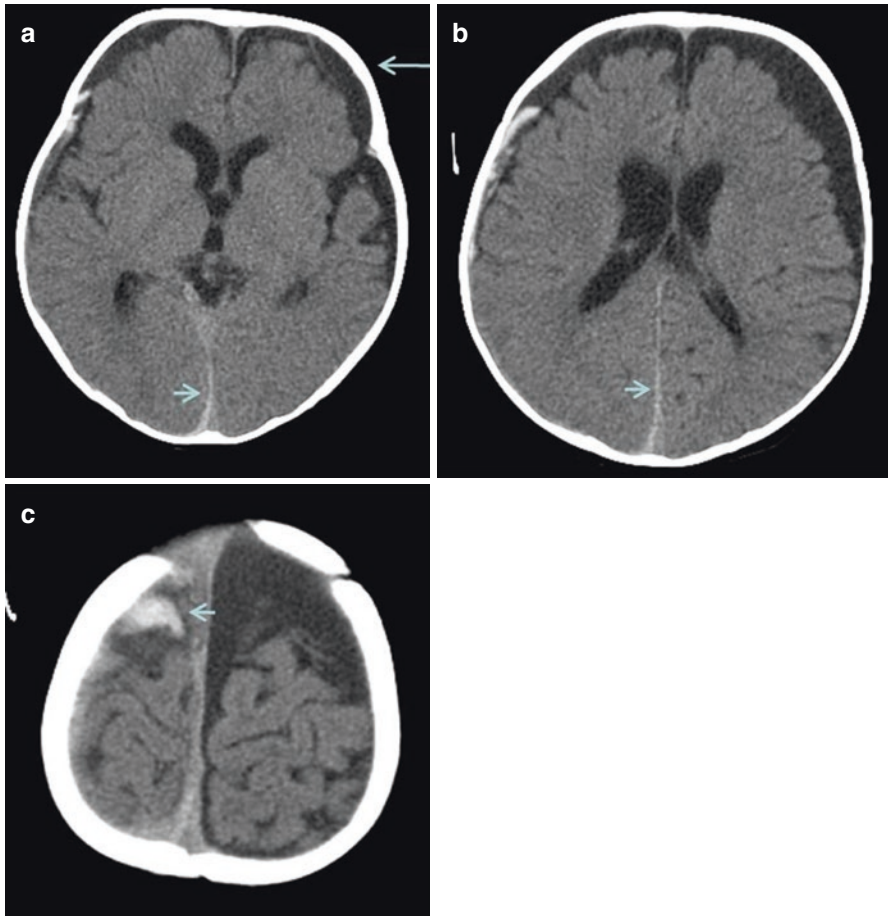


Fig. 7.16 AHT. Different-age subdural hematomas. Six-month-old girl hospitalized for malaise, pallor, and impaired consciousness. Brain CT at admission (a–c): subdural collections of different densities in distinctly different locations. Old hypodense left frontotemporal subdural hematoma: more than 2 weeks old (a, arrow). Coexisting hyperdensities in the interhemispheric space and at the vertex on the right (a–c, short arrows). These hyperdensities indicate recent bleeding, less than a week old. The heterogeneous appearance of the right subdural hematoma cannot be used for dating (spontaneous reorganization possible)

symptoms and concluded, based on the literature, that symptoms begin immediately after injury. In the interval between violent shaking and emergency medical intervention, the child's condition is not "normal," and this change in behavior can be ascertained from what the family and/or the caretaker says during the legal process. The child behaves differently than he did before when playing, feeding, sleeping, etc. [19, 20, 29, 58, 59]. This is corroborated by the fact that injuries are immediately symptomatic in accidental trauma, as well.

7.6 Treatment Principles

All young children with suspected SBS or subdural hematoma must be hospitalized for diagnosis, treatment, and protection. Depending on their clinical condition and imaging results, they are initially admitted to either pediatrics, if the injuries are moderate and well-tolerated, or to the pediatric intensive care or neurosurgery unit, if the clinical signs are severe (epilepsy or impaired consciousness). An SBS victim is a traumatic brain injury patient and should be managed accordingly. Treatment has three objectives: to preserve the vital functions, to control epilepsy, and to treat subdural hematoma and/or increased intracranial pressure:

- Maintaining the vital functions—in particular, in cases of impaired consciousness—is based on nonspecific intensive care.
- Controlling epilepsy and preventing status epilepticus, particularly, is critical, because this is one of the most dreaded complications in young children. Epilepsy can be an initial finding or occur secondarily after admission. Epilepsy prevention should be routine but is especially important if the child is very young and if imaging shows signs of recent bleeding—subpial bleeding, in particular. Other treatments (e.g., hydantoins) should be considered in cases of repeated seizures or status epilepticus. This treatment requires regular electroencephalographic (EEG) monitoring.
- Increased intracranial pressure and subdural hematomas are best managed in a neurosurgical setting or in close proximity to a neurosurgery department. Intracranial pressure control is tailored to the child's clinical signs, imaging, and transcranial Doppler. The most severe forms may require intubation, ventilation, and osmotherapy. Voluminous subdural hematomas may require evacuation, for which there a number of techniques. Subdural tapping at the lateral angle of the anterior fontanelle is a simple procedure that can be performed under local anesthetic and repeated if necessary. Basically an emergency procedure, it is rarely a permanent solution. The other treatments are neurosurgical. For recent hematomas containing fresh blood, an external drain or subdural-subgaleal shunt is placed. In some cases, this can completely eliminate the hematoma. More often, however, it is a temporary procedure that allows the collection to liquefy. Once the hematoma fluid becomes clear and less protein-rich, the standard treatment is placement of a subdural-peritoneal shunt. This involves running a valveless catheter from the subdural space to the peritoneum. A unilateral shunt is sufficient and effective even for bilateral effusions. This internal shunt is temporary; it is removed in a few weeks, after verifying by CT that the hematoma has resolved.

7.7 Sequelae

SBS has serious and frequent sequelae, justifying any and all measures to prevent shaking or its recurrence (Figs. 7.4, 7.9, and 7.11) [60].

7.7.1 Frequency

The frequency of these sequelae is underestimated because the frequency of the syndrome itself is underestimated (see Chap. “Definitions and an Epidemiological Approach to the Frequency of Child Abuse”) and because the sequelae often go unrecognized.

The frequency of abusive head trauma is underestimated because it is not always diagnosed:

- The most serious cases, resulting in death, may be incorrectly attributed to a natural cause, as the report from France’s Mission de Recherche Droit and Justice (Law and Justice Research Mission) shows. That report found that, according to hospital records, 45% of unexpected infant deaths had no autopsy and 40% were classified as sudden infant death (SIDS), that is, a natural death, by the public prosecutor without autopsy.
- The least serious cases are not hospitalized. Hence there is no CT, MRI, or fundus examination and no initial diagnosis, though there is a risk of learning and attention problems and epilepsy later.
- Also, even if the child is hospitalized, his symptoms may be wrongly attributed to other causes such as a fall or resuscitation [56, 59]. The time to diagnosis generally increases with younger child age, parents who are Caucasian, and parents who live together [6].

Lastly, if a subtle subdural in the tentorium cerebelli, for example, is missed, the initial CT scan may be considered normal, hence the importance of interpretation by a radiologist trained in pediatric imaging [6].

The frequency of sequelae is underestimated because they often go unrecognized; there are various reasons for this:

- The Kennard Principle [61], which posits that children have a better long-term prognosis after brain injury than adults, is still firmly rooted in some people’s minds, making professionals and parents less alert to the possibility of sequelae. Yet there are two clearly identified negative prognostic factors that invalidate the Kennard Principle: when the child is very young (often less than 1 year), which is a constant in AHT, and when the injuries are diffuse, which is common in AHT [62, 63].
- The nature of the sequelae, their delayed onset, and the gradual nature of neuro-cognitive skill acquisition in young children can make sequelae difficult to evaluate.
- As with all traumatic brain injuries (particularly in children), the physical lesions often regress completely. Hence the child appears normal or subnormal, although there are deleterious cognitive and behavioral sequelae. This “invisible” disability can be deceptive, wrongly suggesting that there are no sequelae.
- In addition, unlike immediate sequelae, others due to a learning deficit do not appear until later, at the age at which the child would normally be expected to

acquire new skills. Executive functions take a long time to develop, and some are not mature until late puberty. Hence, after a severe brain injury, some problems are not apparent until the child reaches the age where that function is supposed to be operational [62]. Yet almost none of the studies on post-SBS outcomes have much long-term data, and so late-onset sequelae are not assessed.

- Because children—unlike adults—cannot be compared to what they were before traumatic brain injuries, but only to what they would have become, parents and professionals have no basis of comparison that would allow them to deduce, with any certainty, what might be blamed on the brain injury.
- Lastly, parents—whether the perpetrators or not—often want to “move on” and fail to get their children long-term follow-up.

7.7.2 Description and Distinctive Features

This chapter is not going to deal with the initial mortality rate, which ranges from 10 to 40%, depending on the series. The reader is referred to Chap. “Definitions and epidemiological approach to the frequency of child abuse”.

7.7.2.1 Distinctive Features of the Sequelae

Sequelae are common and severe, due to the young age of the child at the time of the brain injury and the often diffuse nature of the parenchymal injuries in AHT/SBS. Those injuries are exacerbated by multiple, often coexisting factors in AHT:

- Delay in seeking care:
Aside from sudden acute episodes prompting an immediate call for help, parents often wait to take the child to the hospital, doing so only after several days or even weeks of vomiting, sleep problems, etc.
- Delayed diagnosis, once the child is hospitalized:
As stated several times in this chapter, the adult accompanying the child never mentions shaking at the outset. If that person is the perpetrator, he does not admit it [5], and if not, he does not know what happened. This delays the diagnosis and thus the brain CT. In addition, even if his neurological status allows it, the child is too young to say what happened. Lastly, the child often shows no, or only subtle, external signs of violence such as bruises on the face, axillae, or trunk.
- The delay in getting the specialized care required by a serious traumatic brain injury, whatever the causal mechanism. It is important to limit secondary brain injury initially and then to provide long-term follow-up aimed at limiting the consequences of the initial brain injuries.
- Repeated shaking [5]. Recurrent traumatic brain injury has also been identified as a negative prognostic factor.

7.7.2.2 Description of the Sequelae

There are various possible sequelae, and they can occur in combination. Cognitive sequelae are marked by learning deficits, intellectual impairment, and/or a lack of

cognitive flexibility. Behavioral sequelae include attention deficit, loss of inhibition, slowness, and fatigability. Motor sequelae may include simple unilateral or bilateral hemiplegia. Sensory sequelae (uni- or bilateral peripheral and cortical blindness) and epilepsy are also possible [60]. A review of the literature on abusive head trauma outcome, covering 489 cases in all, shows a median mortality rate of 21.6% and a morbidity rate (depending on study recruitment method) ranging from 59 to 100%, with a mean of 74%. In other words, only one child out of four was sequela-free. There is a significant association between the outcome and the initial Glasgow Coma Scale score, the presence of large retinal hemorrhages, the presence of a skull fracture, and the extent of parenchymal injuries found in the first 3 months [64].

Studies reporting the long-term outcome are rare [10, 64–66]. Bonnier et al. [64] reported the outcome for 13 children followed for an average of 7 years (range, 5–13 years). That study clearly showed extremely wide variation in the time until signs appeared, with arrested brain growth taking 4 months, pyramidal tract involvement from 6 to 12 months, epilepsy taking 2 years, and cognitive and behavioral problems not appearing for 3–6 years. Only one child was still considered normal after 7 years of follow-up.

Benyayer et al. [65] published a study in 2000 on the outcome of 28 patients under age 2 years who had been hospitalized in a rehabilitation unit. The median age at the time of diagnosis was 4 months, 22 days (range, 1–10 months). While none of the children had a neurological history, a third reportedly had sleep and eating problems. The initial clinical picture was characterized by severe signs, with coma in more than half of the cases, inaugural seizures or status epilepticus (lasting from 2 h to 4 days) in more than 70% of the children, and uni- or bilateral hemiplegia in 80% of them. All of the children had subdural hematomas, and 80% had retinal hemorrhages, which were usually bilateral. Some also had skull fractures, sometimes multiple, or fractures of the appendicular skeleton, and a third also had bruises. After an average follow-up of 18 months (range, 6–43 months), the children ranged in age from 1 to 4 years (median 2 years), and none had died. More than half of the children had a motor deficit; 11 had hemiplegia, 6 bilaterally, and 6 reduced muscle tone and/or motor neglect. Contrary to what was expected for their age, six were unable to hold up their heads, six others were unable to hold themselves up in a sitting position, and ten were not walking. Half of the children failed to obey simple orders, and more than a third had a visual impairment, four of them blindness. Half of the children still suffered from epilepsy, usually with flexor spasms appearing 1–7 months after the initial episode. More than two thirds of the children were receiving antiepileptic treatment, and it involved double or triple therapy for more than half. The outcome for 12 of the 28 children was catastrophic with major sequelae; initial status epilepticus followed by flexor spasms appears to predict a very poor outcome. None of the children could be assessed for developmental quotient. Finally, 9 of the 28 children had moderate sequelae, and for seven children, the outcome seemed favorable. All of the children had a break in their head circumference curve (evidence of brain atrophy), with an average loss of 2.2 standard deviations (SD). The loss was -0.5 SD for those who seemed sequela-free and -4.4 SD for those with major sequelae; the maximum loss was -8 SD. The children with the largest losses had multiple disabilities.

Barlow et al. [67] reported on a prospective longitudinal study on an initial cohort of 55 SBS victims from 1980 to 1999, 6 of whom had died. Twenty-five children were followed for an average of 5 years. More than 50% of the children were lost to follow-up, due mainly to the families' refusal to participate in the study. Sixty-eight percent of the children had sequelae: 36% had severe difficulties and were totally dependent, 16% had moderate difficulties, and 16% had difficulties that were considered minor. The sequelae included a motor deficit in 60% of cases, visual problems in nearly half of the patients (16% had cortical blindness), epilepsy in 20% of cases, language disorders in 64% of cases, and behavior abnormalities in 52% of cases, appearing at 2–3 years of age. The severity of the deficits was correlated with the severity of the initial trauma.

Mireau [68] analyzed the outcomes for 404 children hospitalized in a neurosurgery unit for SBS. Seventy were evaluated after an average of 4 years using a five-level clinical assessment scale. Progressive worsening of the problems was noted. Only 30% of the children who were followed appeared asymptomatic, 30% showed a mild delay, and 40% had severe neurological problems.

Talvik et al. [69] reported similar results in their prospective study on the outcomes for 26 shaken baby syndrome victims from 1997 to 2003. The 22 surviving children were followed for an average of 4 years and 6 months. Only 9% of the children had no long-term sequelae. The other 20 children had a variety of problems, and 13% were severely disabled.

Stipanovic [70] studied the cognitive skills of 11 AHT victims compared to 11 paired controls, 6 years after their injury. Children capable of undergoing a neuropsychological assessment were included, while those with severe neurosensory disorders were excluded. Despite that, the cognitive skills of the SBS victims were significantly lower than those of the controls in terms of IQ, working memory, and executive functions (lack of both organizational skills and inhibition). In addition, 7 out of 11 children were still receiving rehabilitation despite how long it had been since their injury.

In conclusion, severe traumatic brain injury in childhood, regardless of the mechanism, has a significant and long-lasting impact. These sequelae affect social and occupational integration, prevent the development of autonomy, and often perpetuate dependence on others. Hence everything possible should be done to prevent shaking, and if shaking has already occurred, diagnosis is essential to preventing its recurrence. Long-term clinical follow-up is also essential to detecting “invisible” sequelae and tailoring the treatment in a way that minimizes the long-term consequences.

Key Points

- Most abusive head trauma takes the form of shaken baby syndrome (SBS), which primarily affects infants younger than 8 months of age.
- The sequelae of shaking are serious and frequent, and repeated shaking can be fatal, which makes rapid diagnosis and immediate child protection essential.

- There are a variety of acute and delayed clinical presentations; they include neurological distress (coma, vomiting, seizures, and hemiplegia), unexplained death, macrocrania, and sequelae.
- SBS is difficult to diagnose, because the shaking is not reported. A changing or inconsistent history is a key element. The main mechanism of SBS is violent shaking, followed in some cases by impact. Always look for bruising where fingers may have pressed and for rib fractures; these are invaluable for the diagnosis. In young children, shaking causes bridging vein rupture at the vertex, which in turn causes the characteristic multifocal, diffuse, sheetlike subdural hematomas in both deep (interhemispheric space and tentorium cerebelli) and superficial locations.
- Emergency brain CT is used to diagnosis SBS. Any young child with a subdural hematoma should be hospitalized immediately for both treatment and protection.
- MRI is useful for analyzing the brain parenchyma. Brain damage is more often due to anoxia-ischemia than to a traumatic contusion. Those hypoxic-ischemic injuries determine the prognosis with AHT.
- The differential diagnosis involves very few candidate conditions, and they are in general easy to rule out after a rigorous diagnostic process. They include accidental injury, bleeding disorders, meningitis, metabolic disorders, vascular malformations, and benign enlargement of subarachnoid spaces.
- CT and MRI are not accurate for dating intracranial injuries. The key element is the presence of different-age injuries at different locations, indicating at least two episodes of violence. Dating is possible clinically, during the forensic investigation.

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Corinne Veyrac, Frédéric Gauthier, Ikram Taleb-Arrada,
and Olivier Prodhomme

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C. Veyrac • I. Taleb-Arrada • O. Prodhomme (✉)
Département de Radiologie Pédiatrique, Hôpital Arnaud de Villeneuve,
371 Avenue du Doyen Gaston Giraud, 34295 Montpellier Cedex 5, France
e-mail: i-talebarrada@chu-montpellier.fr; o-prodhomme@chu-montpellier.fr

F. Gauthier (✉)
Faculté de Médecine, Université Paris Sud, Orsay, France

AP-HP, CHU Bicêtre, Service de Chirurgie Pédiatrique, 78 rue du Gal Leclerc, 94275
Le Kremlin Bicêtre Cedex, France
e-mail: frederic.gauthier@aphp.fr

Thoracic/abdominal injury is a rare but particularly severe complication of child abuse [1]. It is the second leading cause of death in abused children, after traumatic brain injury.

While the prevalence of abdominal injuries in abused children is difficult to determine from the literature, most teams agree that between 8 and 11.4% of children hospitalized for physical abuse have abdominal visceral injuries [2, 3]. In addition, in a recent series from the United States, a quarter of the abdominal injuries in children under the age of 1 year were non-accidental [2, 4–6].

The frequency of thoracic visceral injuries is uncertain, because the literature on thoracic injuries includes rib fractures, which are common in abuse cases—especially when children are shaken.

8.1 Characteristic Features of Inflicted Abdominal Injuries

There are a number of characteristics that distinguish abuse-related thoracic and abdominal injuries from accidental ones [7]. It is important to be familiar with those characteristics, as their presence should raise suspicion of abuse and prompt a systematic search for other evidence that confirms the diagnosis. The child's life depends on it.

8.1.1 The Child's Age

Although non-accidental abdominal injuries can occur at any age, they are much more common before age of 3 years. The average age is approximately 3 years, as opposed to 9 years for traffic accidents and roughly 10 years for falls [4, 5]. In Barnes's series [4], sixteen out of twenty children were younger than 5 years. In Wood's series [6], seven out of thirteen children were younger than 3 years. Thus before age of five, a child with an abdominal injury is more likely to have been abused than injured accidentally [2, 8]. The same is true for thoracic injuries.

8.1.2 The Clinical Context

As with all abused children, there is often a more than 12-h delay in seeking care [6, 9]. That feature is fairly nonspecific (65%), however, and is also seen in children injured in low-velocity accidents (household and bicycle accidents and low-height falls) [6].

For abused children, the tendency to delay care results in a more complex clinical situation, a poorer general condition, and a higher frequency of infectious complications at the time of diagnosis. That is one possible explanation for why the prognosis for visceral injuries is worse in abused children than in children hurt in an accident.

Certain aspects of the medical history are more common among abused children than among children hurt in accidents [2]; these are prematurity, disability, and siblings with a similar history. It is important to be familiar with this context in order to suspect abuse and look for diagnostic evidence such as clinical or radiographic signs of previous injuries, which are present in more than half of cases. General signs such as malnutrition may also be noted.

The reported history of the events that led to the injury is very often discordant with the lesions observed. In some cases no trauma is reported, or the history might be inconsistent, varying according to who is speaking or incompatible with the child's age or with that of his brothers or sisters, if they are being blamed for the injuries—e.g., blaming a child falling off the bed, or a sibling stepping on or rolling over on him while he's asleep, for a gastrointestinal perforation. When children are injured in accidents, on the other hand, the context is very clear; 70% of injuries are due to traffic accidents and 20% to falls from great heights.

8.1.3 Severity of Abdominal Injuries

Abused children suffer more severe abdominal injuries than children injured in accidents, as evidenced by the higher severity score and the number and duration of hospitalizations [2, 3, 10]. They need surgery more frequently and have a higher mortality rate [3, 11], making abdominal injury the second leading cause of death in abused children [4, 6].

8.1.4 Organs Involved

Solid organs are injured more frequently than hollow organs, though the gastrointestinal tract is involved far more often in non-accidental than in accidental injury [3, 4, 11]. This might be explained by the fact that for a young child's, thin, unmuscle abdominal wall transmits all of the force concentrated in a punch or kick to the abdominal organs, which are compressed and crushed against the spine. Ledbetter's series [12] speaks volumes, reporting that 11 out of 17 (64%) abused children had hollow organ injuries, compared to only 11 out of 139 (8%) children injured in accidents. The other series [4, 13] also report a high frequency of gastrointestinal tract injuries in non-accidental versus accidental injury contexts. In the series reported by Wood [6], a hollow organ is injured in 6 out of 13 abused children (46%), as compared to 10 out of 77 children hurt in high-velocity accidents (13%) and 5 out of 31 hurt in low-velocity accidents (16%). The risk of gastrointestinal damage for an abused child is reportedly twice as high as after an accident with abdominal impact and five times higher than after a fall [4].

Roaten [13] reported on 24 patients in whom injuries were distributed as follows: 23 solid organ lesions in 17 children (8 livers, 5 spleens, 4 pancreases, 4 adrenal glands, and 2 kidneys) and 14 hollow organ lesions (1 stomach, 6 duodena, and 7 jejunum and ilea). In the series by Price [14] consisting of 23 patients who had died from abuse-related abdominal injuries, the lesions observed were liver lacerations (52%) and damage to the small intestine (30%), the pancreas (15%), the mesentery (33%), the adrenal glands (6%), and the major vessels (3%).

In the chest, the most common organ damage is pulmonary contusion.

Among the solid organ lesions, pancreatic injury—in cases where there has been no traffic accident or direct blow to the epigastrium by bicycle handlebars—is strongly associated with abuse [5, 15]. The liver is damaged more often than the spleen or kidneys, no doubt due to its large size in children.

8.1.5 Associated Injuries

Abdominal injury is frequently (in 85–92% of cases) associated with other traumatic lesions.

Those lesions may be:

- Superficial, at or some distance away from the site of the abdominal injury: bruises, abrasions, burns, bites, frenulum of tongue tears, and genital injuries.
- Deep: traumatic brain injury, rib fractures, pneumothorax, metaphyseal corner fractures of the limbs, penetrating wounds, etc.

Thoracic injuries are seen much more frequently with abdominal injuries after non-accidental compared to accidental trauma (38% vs. 17%).

Because they provide highly presumptive, if not definitive, evidence of abuse, these features are fundamentally important and must always be looked for and investigated—though they may be absent.

In summary, typical abuse-related abdominal injuries are found in children under age 3 years, are serious, involve both hollow and solid organs, are often associated with other traumatic injuries (especially thoracic ones), and are part of a particular clinical context, after a questionable account of the injury, with previous patient or family history of trauma [7].

8.2 Clinical Presentation

The clinical presentation can vary significantly depending on the severity of the injury and the organ involved.

In cases of severe trauma, the symptoms can be glaringly obvious and serious (hypovolemic shock). They can point straight to an injury in the abdomen (acute abdomen with progressively increasing pain, distention, and guarding or muscle contractions) or chest (dyspnea and hemoptysis). In other cases they can be misleading or nonspecific (neurological, sepsis, or a severe deterioration in general condition).

With moderate or minor injury, the clinical signs are often insidious or delayed; these may include vomiting, anorexia, weight loss, anemia, a palpable abdominal mass, dysphagia, or fever. These signs can be missed, misinterpreted, or attributed to something other than trauma, especially when no history of trauma has been reported. These children are in grave danger, since there is a high risk of recurrence and repeated abuse is correlated with increased mortality.

Sometimes, an obvious extra-abdominal lesion—perhaps head trauma (potentially life-threatening) or a skeletal injury—captures all the attention, and the abdominal or thoracic symptoms are missed. Whenever abuse is suspected or confirmed, proper diagnostic procedure requires looking for visceral injury.

It is therefore important to identify superficial lesions, whose existence points straight to abuse: bruises, abrasions, cuts, burns, and bites [16]. Some sites are especially suggestive of abuse, including the head, mouth, extremities, genitals, anus, buttocks, torso, and back (cf. chapter on inflicted lesions and burn: the skin). The lack of any lesions on the abdominal wall in no way rules out the possibility of an internal abdominal injury—even a serious one [4].

Lastly, there are two possible situations. In some cases the injury is diagnosed but the problem is tying it to abuse, and in other cases the abuse is obvious and the problem is detecting intra-abdominal organ damage as quickly as possible.

8.3 Mechanisms

The mechanisms of abuse-related abdominal injury are fairly stereotypical and due to direct blows or to compression against an unyielding surface—e.g., someone intentionally punching or kicking a child who is lying on the ground or a mattress. That explains the frequency of injuries to the posterior organs like the pancreas and duodenum, which are compressed or sectioned between the area of pressure and the spinal column. All of the solid and hollow organs can be damaged. Thoracic injuries can also be caused by direct blows or violent and prolonged compression.

This is why it is so important to look for bruising of the trunk where the pressure was exerted and for fractured ribs [16] (see also chapter on inflicted lesions and burn: the skin and skeletal injuries).

8.4 Imaging

The following is a sequential description of the various imaging-related aspects of abdominal and thoracic injuries, though the lesions are very often found in combination (Fig. 8.1). The initial diagnostic workup should be exhaustive, to both ensure appropriate management and detect abuse [11].

8.4.1 Hepatic Injuries

The most frequently injured intra-abdominal solid organ in abused children is the liver. Unlike with accidental injuries, the left lobe is most vulnerable, as it is compressed against the spine by direct blows to the epigastrium [15] (Fig. 8.2).

Injuries include lacerations, parenchymal contusions, and subcapsular hematomas. Both vascular complications (pseudoaneurysm and hemobilia) and biliary complications (biloma and biliary peritonitis) have been reported.

There are no particular differences in imaging appearance between lesions caused by non-accidental and accidental trauma [17]. Hemoperitoneum is a variable finding.

Computed tomography is the modality of choice for early diagnosis. Lesions appear hypodense and do not enhance with IV contrast. Lacerations are linear, band-like, branching, and transhepatic (Fig. 8.3). Contusions are poorly demarcated intraparenchymal areas (Fig. 8.1). Subcapsular hematomas are collections that compress the underlying parenchyma from the outside in. While circumferential periportal hypodensities may be observed, they are nonspecific and have been described in non-traumatic contexts [17].

Ultrasound, with routine use of color Doppler, can also reveal early-stage liver lesions in the form of hyperechoic patches (Fig. 8.3). The teams unanimously endorse its use for monitoring [18]. Indeed, management of hepatic injuries is

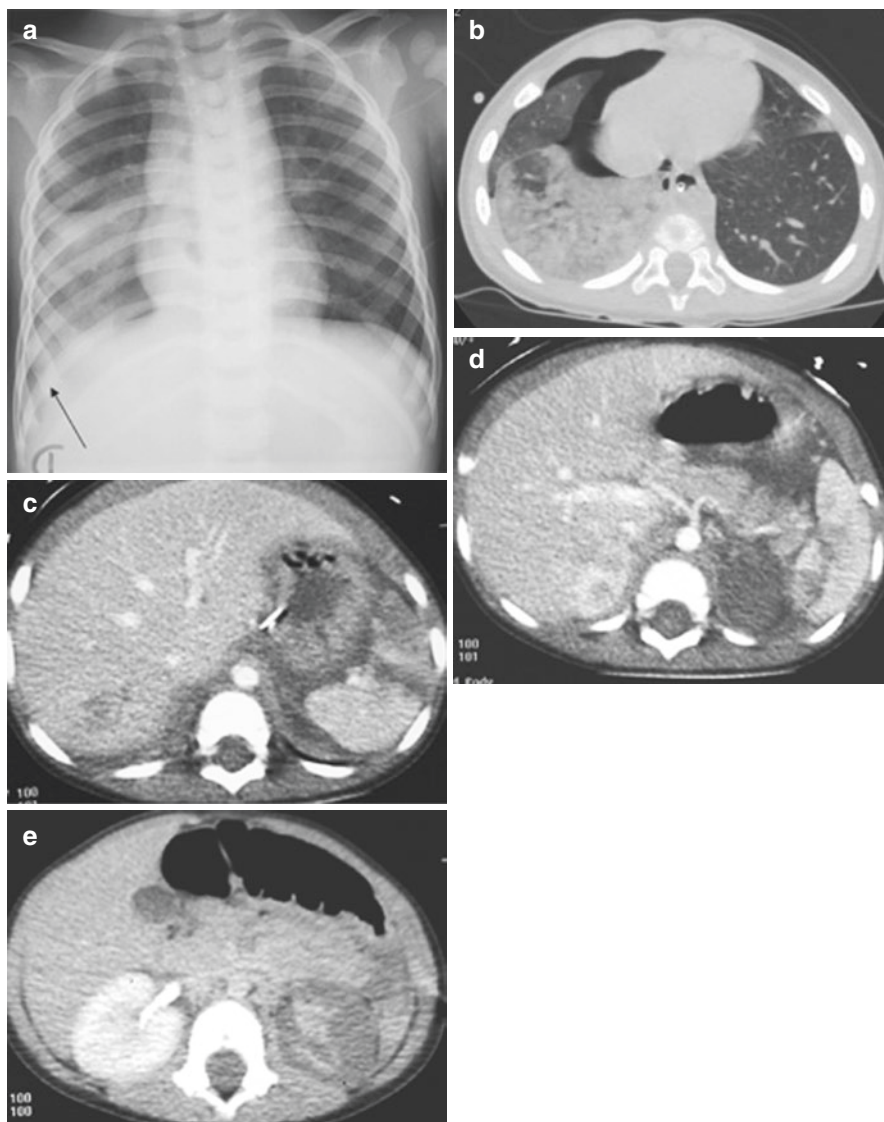


Fig. 8.1 Thoracic/abdominal injury 18-month-old boy, skin lesions on the thighs, umbilical region, and anterior chest wall. **(a)** Chest X-ray: large right lung base opacity, right retrocardiac air, anterior fracture of the right seventh rib (*arrow*). **(b)** Chest CT: right posterobasal pulmonary contusion and pneumothorax. **(c, d, and e)** Contrast-enhanced abdominal CT. Hepatic contusion in segment 7, ruptured spleen, free intraperitoneal fluid (**c**); left renal hilum injury (non-enhancement of the kidney) and pancreatic fracture (**d** and **e**). The injuries were attributed to two violent blows, one on the right (from the end of a broom) and the other on the left (from a punch). From the files of Dr. C. Adamsbaum (Le Kremlin Bicêtre)

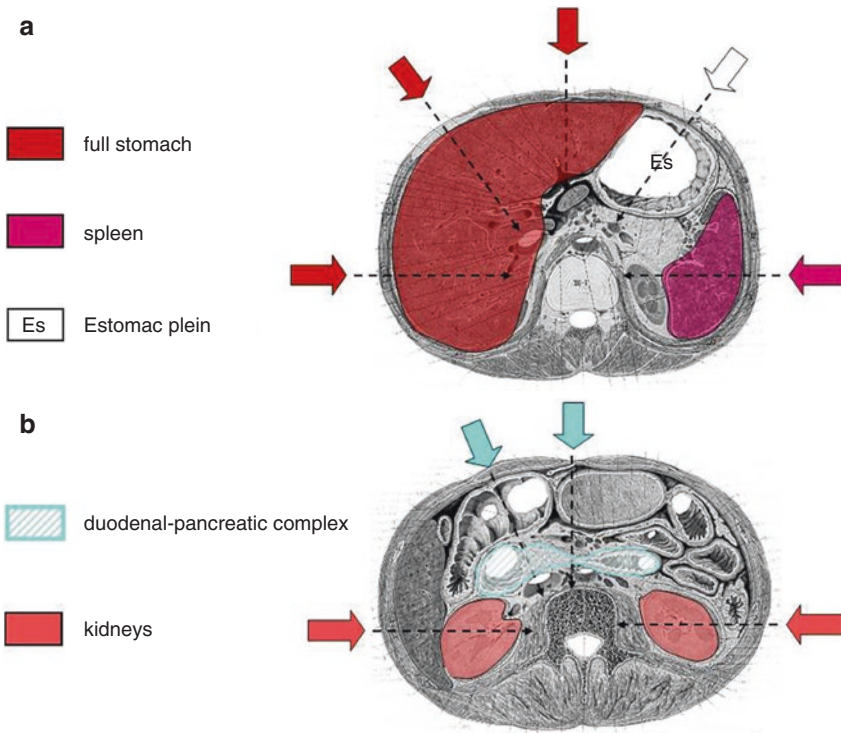


Fig. 8.2 Axial sections of the trunk (from Pernkopf, *Anatomie Humaine*) showing how anterior and lateral compression of the trunk against an unyielding surface can cause contusions and fractures of the liver, spleen, and full stomach (a), or of the kidneys and duodenal-pancreatic complex (b)

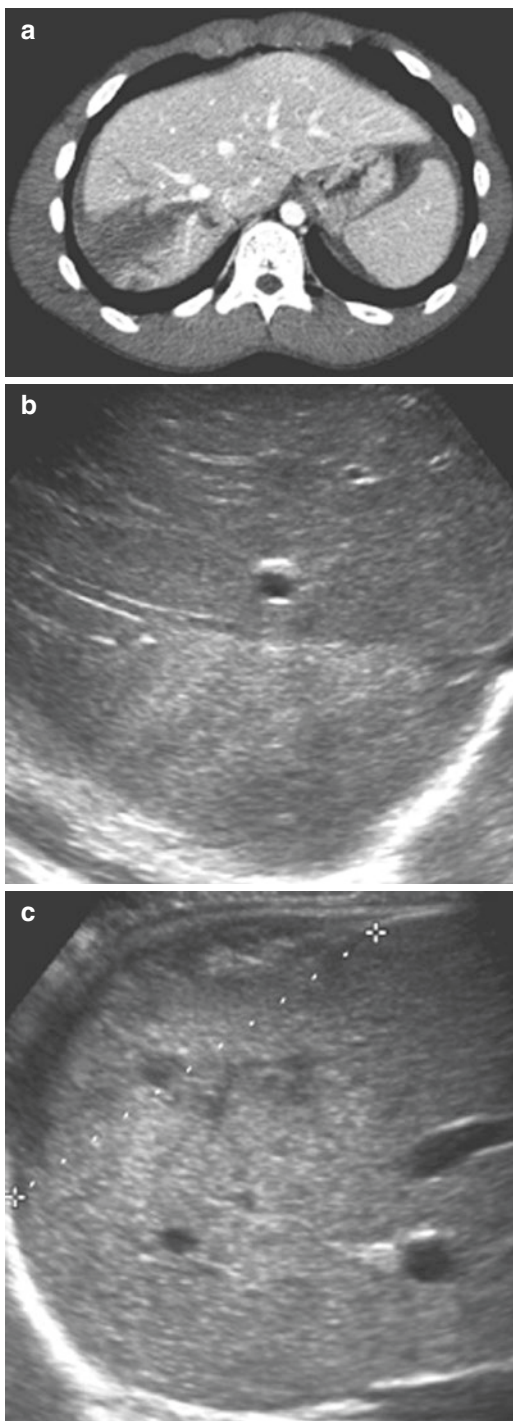
overwhelmingly non-operative, with only one to 3% of children requiring emergency surgery, all traumatic etiologies combined. Hence monitoring is important, especially when the initial severity of the lesion is such that progression or complications—and thus the potential need for secondary intervention—are unlikely. Though vascular or biliary complications can occur at any time, they are most likely 2 weeks to 3 months after injury.

The lesions become progressively more heterogeneous over time (Fig. 8.3), with irregularly shaped areas of liquefaction. Subcapsular collections also liquefy. The lesions will eventually shrink and usually disappear. That process can take anywhere from a few days to several months, depending on the type, size, and severity of the lesion. In the series of 45 liver injuries reported by Bulas [18], mild lesions had disappeared 1 week to 3 months after injury, moderate lesions had disappeared within 6 months in 80% of children, and severe lesions had disappeared within 9–15 months in 30% of children post-injury. So it is impossible to accurately date injuries with imaging alone.

8.4.2 GI Tract Injuries

As mentioned previously, gastrointestinal tract injuries are far more common with abuse than with accidental trauma. Abuse should always be suspected when a child

Fig. 8.3 Liver laceration.
(a) Contrast-enhanced CT. Very hypodense segment 7 lesion with ruptured capsule and small subcapsular detachment.
(b) Ultrasound at admission, clearly showing a large area of parenchymal hyperechogenicity.
(c) Ultrasound on day 7, the parenchymal lesion appears heterogeneous and is accompanied by a small liquefied subcapsular hematoma



under age 5 years presents with GI tract injury [4, 11, 19]. Similarly, GI injury should be suspected in any abused child with abdominal trauma. Alongside the seat-belt and handlebar injuries, intentional blows are the cause of 19% of GI tract injuries [9]. Lastly, gastrointestinal perforation is seen more often after intentional injuries than after traffic accidents.

The most frequently involved organs are the duodenum and the proximal jejunum [1, 20], which lie next to the pancreas just ventral to the spine (Fig. 8.2). Stomach and colon injuries are less common [15]. Hematomas and perforations can be seen, often in combination with mesenteric injury.

8.4.2.1 Intramural Hematomas

Intramural hematomas, which result from a partial thickness tear in the gastrointestinal wall, are found primarily in the second and third parts of the duodenum, the latter being held in place by the ligament of Treitz and crushed against the spinal column by direct blows to the epigastrium. In the proximal jejunum, hematomas tend to develop on the antimesenteric side. Because they are subserosal, they can be very large (Fig. 8.4).

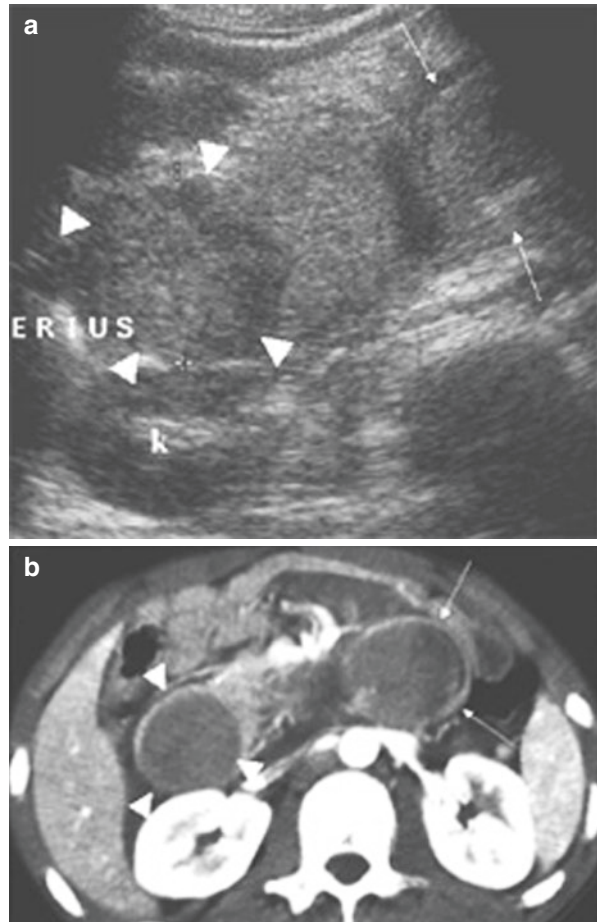


Fig. 8.4 Duodenal hematoma. On day 1, large duodenal mass, echogenic on ultrasound (**a**), hypodense on CT (**b**). Second part of duodenum (*arrow heads*). Fourth part of duodenum (*long arrows*)

On ultrasound [21], hematomas are lesions in the bowel wall; there is sometimes wall thickening with or without loss of the gastrointestinal folds, and there is sometimes an echogenic or hypoechoic mass (Figs. 8.4a and 8.5a) that is hypovascular on Doppler. Peristalsis is reduced or absent. The bowel lumen is narrowed, in contrast to more or less obvious dilation upstream.

On CT [22], intramural hematomas appear as significant localized eccentric bowel wall thickening that does not enhance after intravenous contrast, or as a well-demarcated intramural mass with a “coiled spring” appearance of the mucosal folds and obstruction of the lumen (Figs. 8.4b and 8.6). A mesenteric hematoma and free intraperitoneal fluid may also be present.

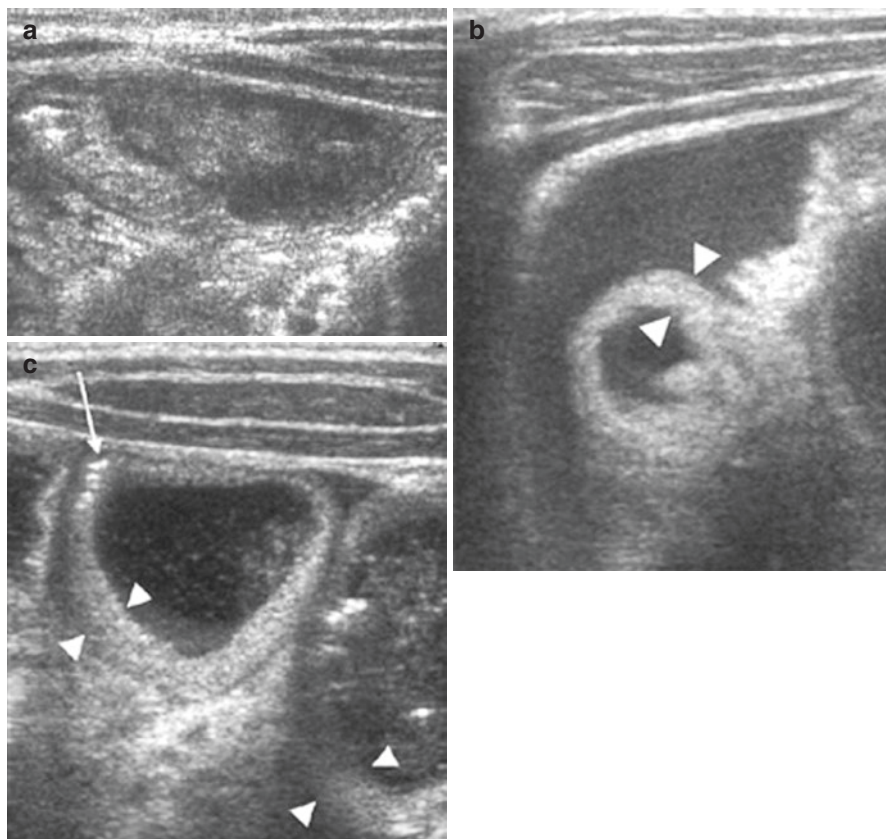


Fig. 8.5 Gastrointestinal tract perforation. Two-and-a-half-year-old boy referred for vomiting and fever, with no history of trauma. Multiple bruises and abdominal guarding on clinical examination. (a) In the left upper quadrant, hypoechoic lesion in the wall of a jejunal loop whose folds are visible and slightly thickened: intramural hematoma. (b and c) In the right flank, subtly echogenic free intraperitoneal fluid and thickened, de-stratified, immobile loops (*arrow heads*), with intramural pneumatosis (*long arrow*). These features suggested GI tract perforation and ischemia, requiring immediate surgery: 50-cm ileal infarction due to a mesenteric shearing injury. Confirmed abuse. Used with permission from *Pediatr Radiol* [32]

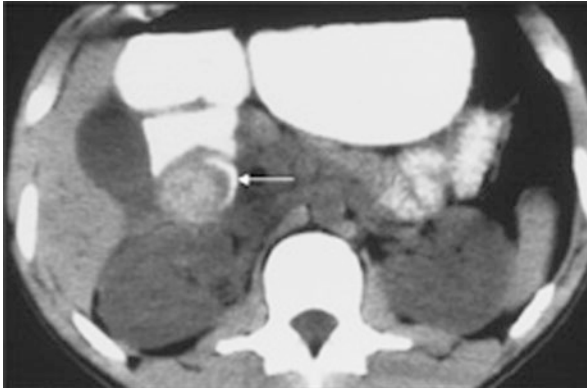


Fig. 8.6 Duodenal hematoma. Three-and-a-half-year-old boy, kicked in the abdomen, vomiting. CT after oral contrast, no IV injection. Hypodense mass in the lateral wall of the second part of duodenum: intramural hematoma. The lumen is compressed, reduced to a lunar crescent (*arrow*), and the GI tract proximal to the injury is extremely dilated. From the files of M. Raissaki (Heraklion). Used with permission from *Pediatr Radiol* [32]

The vast majority of cases are managed conservatively—medically—and monitored both clinically (until signs of bowel obstruction disappear) and with imaging. Sonographically, the course is characterized by a rapid change in the hematoma's features: its echogenicity declines toward liquefaction, it shrinks, the obstruction disappears, and peristalsis resumes. That process takes from 3 days to a month, depending on the initial size of the lesion [21].

8.4.2.2 Gastrointestinal Perforations

Gastrointestinal perforations, which result from a full-thickness tear in the bowel wall, primarily involve the mid-small intestine (60% jejunum, 10% ileum [20]), which is not fixed in the peritoneal cavity. However, ruptures can also occur in the duodenum [20], especially in the retroperitoneal portion, that is, the third part of duodenum [23]. Such lesions are severe, potentially fatal, particularly since the clinical signs often appear late, after peritonitis or sepsis has set in.

Combined with clinical exam, CT is the only reliable modality for early diagnosis. The only specific sign is the presence of extraluminal gas (Fig. 8.7), sometimes in the form of easily recognized pneumoperitoneum and sometimes as small intraperitoneal bubbles in contact with the intestine, in the mesentery, or in the right anterior pararenal space (in cases of retroperitoneal duodenal perforation). Systematic, thorough CT examination to look for these signs is the rule, though they are found in only a third to a half of children [17, 22, 24]. That is why it is important to look for other diagnostic signs, namely, focal bowel wall thickening (in contrast with adjacent normal GI tract), which usually shows hyperenhancement, and infiltration of the mesenteric fat, especially if there is free intraperitoneal fluid. These small signs may be the only imaging evidence suggesting GI perforation and thus the need for emergency surgery. It is especially important to look for them very carefully whenever free intraperitoneal fluid is the only finding and is unexplained

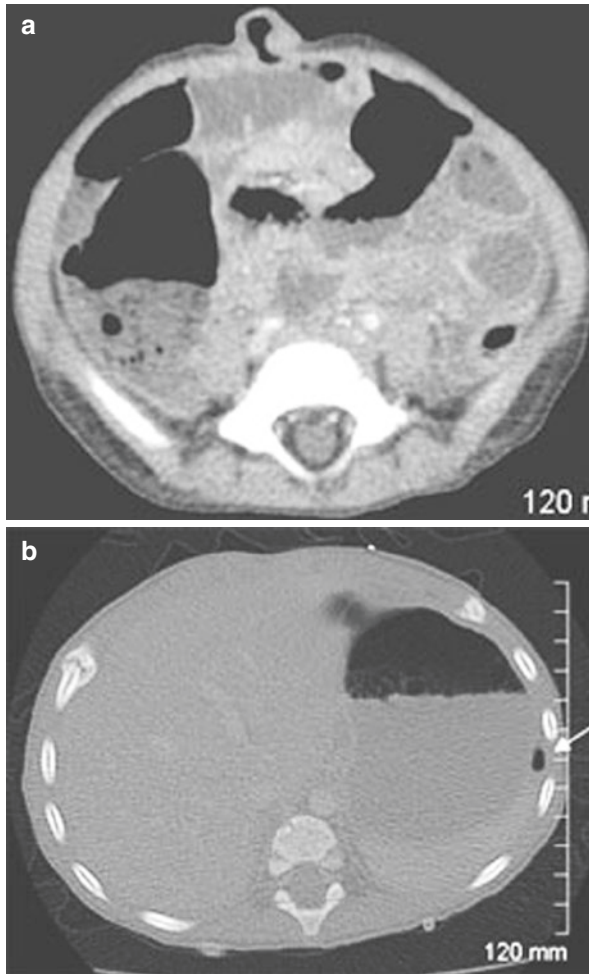


Fig. 8.7 Jejunal perforation. Twenty-two-month-old boy, referred for vomiting with no known history. Ultrasound showed free intraperitoneal fluid and fluid-filled, moderately-dilated loops of intestine. The CT scan shows pneumoperitoneum in the umbilicus (**a**). Use of a wide window width (**b**) shows other extraluminal bubbles (*arrow*). Note the rib fracture on the right. Immediate surgery: jejunal perforation. From the files of Dr. C. Baunin (Toulouse)

by a solid organ lesion or pelvic fracture. Any delay in the diagnosis worsens the survival prognosis.

8.4.2.3 Shock Bowel or CT Hypotension Complex

It is important to recognize this entity, because it warrants resuscitation rather than surgery. CT hypotension complex is seen in young children resuscitated for hypovolemic shock, who appear stable enough to undergo imaging but then suddenly decompensate—often with severe neurologic damage. It carries a very high risk of death

(85%). The CT signs are characteristic [22]; the entire GI tract is dilated and fluid-filled, and there is increased contrast enhancement of the bowel wall and a reduction in caliber of the aorta and inferior vena cava, which show hyperenhancement, as do the mesentery and kidneys. More variable signs include hypoperfusion of the spleen and pancreas; intense enhancement of the adrenal glands, pancreas, and superior mesenteric vessels; diffuse bowel wall thickening; persistent enhancement of the ureters; and free intra- and retroperitoneal fluid. Often there are other traumatic injuries—intracranial (89%) and intra-abdominal (48%) lesions, in particular [22]. Key to the diagnosis is the generalized nature of the GI abnormalities and associated signs, in contrast to the more localized signs seen with traumatic injury to the GI tract itself [17, 22].

8.4.2.4 Mesenteric Injuries

Direct blows and inflicted deceleration injuries (child thrown against a hard surface) can tear the small peripheral vessels or rupture the superior mesenteric vessels [15, 20, 22]. On CT, fluid collections in the mesenteric root, surrounding and separating the major mesenteric vessels, and hyperdense mesenteric infiltration may be due to intramesenteric bleeding or an inflammatory response to intrinsic GI tract lesions [17]. Isolated mesenteric lesions do not necessarily warrant surgery.

8.4.2.5 Telltale Scarring

In some situations, abdominal injury goes unnoticed. The GI tract can heal on its own, sometimes completely, other times leaving behind posts ischemic fibrotic scarring. The latter, caused by mesenteric injury or direct impact to the small intestine, can subsequently result in obstruction [25]. The first test ordered will likely be ultrasound, which will show not only peristaltic dilation of an obstructed, fluid-filled GI tract but also actual stenosis in the form of a fixed, non-stratified, non-hyperemic thickening of a variable-length bowel segment [21]. The abuse diagnosis is very difficult—in some cases, possible only by surgery (which shows intestinal stenosis and the associated mesenteric lesion) and the pathology examination of the resected bowel segment.

8.4.2.6 Specific Features of Gastric and Bowel Lesions

The stomach is injured in less than 1% of abused children [15]. Greater curvature ruptures have been described, characterized by massive pneumoperitoneum, as have gastric antral hematomas and pneumatosis [26]. Acute gastric dilation has also been reported; the mechanism is purely functional, occurring after a copious meal following a period of severe deprivation, suggesting a superior mesenteric artery syndrome-type mechanism.

Large bowel injuries are extremely rare, although perforations and intramural hematomas have been described in the transverse colon. Rectal injuries—perforation, in particular—tend to be due to sexual abuse (cf. chapter on sexual abuse).

8.4.3 Pancreatic Injuries

Abuse should be considered whenever a young child not involved in a road accident presents with a pancreatic injury, since a third of the cases of traumatic

pancreatitis are reportedly non-accidental in origin [8, 11]. Pancreatic injury represents approximately 10–20% of traumatic abdominal injuries in abused children [13]. This includes fractures (lacerations), transections, and pancreatitis, with or without secondary pseudocysts. Injury is caused by a direct blow to the epigastrium, where the pancreas crosses the midline in front of the vertebral column, which explains why the damage often occurs at the junction between the head and body of the pancreas, as well as its classic association with duodenal injury.

Though the CT scan is negative in a third of cases, it remains the diagnostic modality of choice. Fractures appear as linear parenchymal hypodensities. In transection, the pancreatic fragments are completely separated (Fig. 8.8)—something that is often difficult to appreciate on the early exam [17]. The most common sign on computed tomography is the presence of peripancreatic fluid (50%), particularly in the anterior pararenal space, the lesser sac, and the lesser omentum (Fig. 8.1). Other signs include a more or less diffuse enlargement of the pancreas itself, infiltration of the peripancreatic or mesenteric fat, thickening of Gerota's fascia, and free intraperitoneal fluid, which are signs of post-trauma pancreatitis. Note that the pancreas may appear normal. The best indicator in that case is peripancreatic fluid in the absence of other visceral involvement, though that sign is nonspecific [17].

While ultrasound is generally not sensitive enough for early diagnosis of traumatic pancreatic injuries, it is very effective in detecting post-traumatic complications, such as extrapancreatic fluid collections, which are very common. They resolve on their own in 50–63% of cases [17, 27] and develop into pseudocysts in the other patients. The pseudocysts resolve on their own in half of cases, warranting routine monitoring with ultrasound.

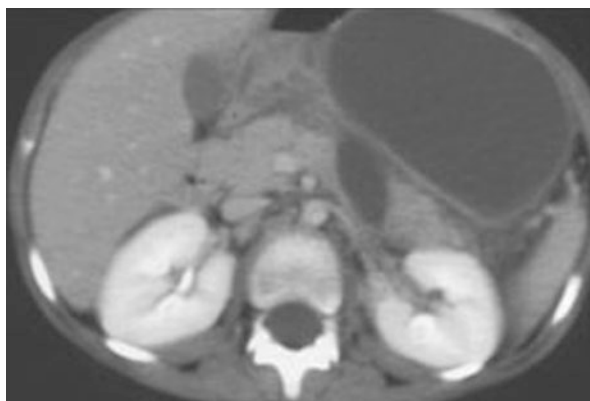


Fig. 8.8 No history of trauma. Three-year-old boy. Contrast-enhanced CT. Transection through the body of the pancreas with infiltration of the peripancreatic fat, an intrapancreatic collection, and a large pre-pancreatic pseudocyst. From the files of M. Raissaki (Heraklion, Greece). Used with permission from *Pediatr Radiol* [32]

8.4.4 Splenic Injuries

Injuries to the spleen are less common in abused children than in children injured in accidents [15]. With the more routine use of imaging, however, they now rank second, after liver injuries [4]. They include parenchymal contusions, fractures (lacerations), and subcapsular and intraparenchymal hematomas.

In the early stage, parenchymal lesions appear hyperechoic (Fig. 8.9) and hypovascular on ultrasound and as non-enhancing hypodensities on contrast CT. Subcapsular hematomas compress the underlying parenchyma. They are accompanied by hemoperitoneum in more than 75% of cases [17, 28], though it can be subtle, localized, and parasplenic. Pseudoaneurysms are rare and easy to diagnose with CT—and with ultrasound, as well, provided Doppler is a routine part of the initial exam.

Monitored sonographically, these lesions take a standard course, becoming progressively more hypoechoic, heterogeneous, and liquefied. They shrink (Fig. 8.9), revascularize, and eventually disappear completely. There is occasionally a residual scar in the form of an indentation on the periphery of the spleen or, more rarely, a linear band of intraparenchymal echogenicity [28]. The duration of such lesions is extremely variable, ranging from a few weeks to a year, making accurate dating impossible [28].

8.4.5 Adrenal Gland Injuries

The adrenal region should be analyzed carefully with any abdominal trauma, particularly if abuse is confirmed or suspected. Adrenal gland hematomas have indeed

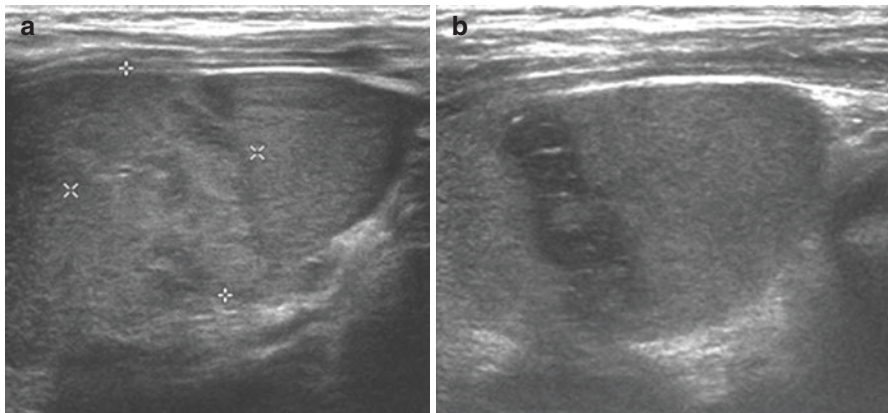


Fig. 8.9 Ruptured spleen. (a) Ultrasound at admission. Large heterogeneous echogenic area traversing the spleen, with a small amount of subsplenic free fluid. (b) Follow-up ultrasound on day 11. The lesion is transparenchymal, very hypoechoic, and partially liquefied. Its borders with the adjacent healthy parenchyma are clearly defined

been described in the abuse context [29]. As with accidental trauma, the right adrenal gland is more likely to be injured than the left, either by direct compression, elevated venous pressure, or tearing of the small adrenal vessels. Such injuries are usually accompanied by other abdominal visceral and/or skeletal injuries.

CT is the diagnostic modality of choice. It shows a rounded hypodensity in the central part of the gland, separating its two limbs, with perirenal fat stranding and, in some cases, free retroperitoneal fluid. This lesion must be differentiated from a primary adrenal mass. MRI can be used to complete the investigation [7]. Treatment is nonsurgical.

8.4.6 Genitourinary Tract Injuries

Genitourinary tract injuries are relatively rare in abused children (8% of visceral injuries, according to Roaten [13]), if we exclude sexual abuse, which is covered in a separate chapter. They have the same characteristics as accidental pediatric GU tract injuries. Fractures (Fig. 8.10) and parenchymal contusions—with or without subcapsular or perirenal hematoma—are caused by direct impact, while vascular lesions (Fig. 8.1) and excretory tract lesions tend to be caused by deceleration-type mechanisms. Doppler ultrasound can be used to detect perirenal collections and most parenchymal lesions and to make sure the kidney is vascularized. If the Doppler is abnormal, CT—including late phase images—is done to exhaustively document the lesions.

Abused children can suffer acute renal failure due to massive intramuscular bleeding with rhabdomyolysis and myoglobinuria. Dark-colored urine points to the possibility of myoglobinuria, which is confirmed by a test strip that is positive for blood in the absence of red blood cells. Other causes of acute renal failure—toxic etiologies (drugs and medications), in particular—should be considered; these may also be non-accidental.

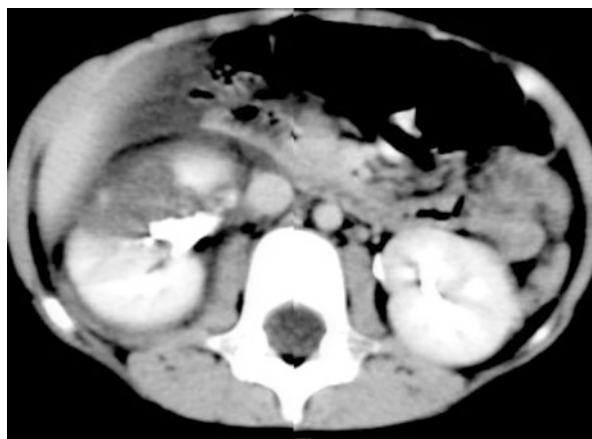


Fig. 8.10 Ruptured right kidney due to a kick to the flank. From the files of M. Raissaki (Heraklion, Greece). Used with permission from *Pediatr Radiol* [32]

Ruptures of the urinary bladder are rare. Intraperitoneal bladder rupture can be caused by a direct blow to a full bladder [25, 30] and requires immediate surgical repair. It presents as an acute abdomen, gross hematuria, renal failure, and free intraperitoneal fluid. Extraperitoneal bladder ruptures are caused by pelvic fractures and are treated non-operatively. The differential diagnosis is therefore important and relies on CT, which demonstrates extravasation of the contrast agent and shows its location with respect to the bladder and rectosigmoid [17].

Urethral and genital lesions are caused by sexual abuse and are beyond the scope of this chapter. It should be noted that a scrotal hematoma may simply be the extension of a hemoperitoneum through the processus vaginalis.

8.4.7 Free Intraperitoneal Fluid

Free intraperitoneal fluid is typical, but not inevitable, in cases of intra-abdominal solid organ injury. In the absence of any solid organ, pelvic, major vessel, or bladder injury, it points to a possible gastrointestinal, mesenteric, or pancreatic lesion. Abundant hemoperitoneum is not a sign of active bleeding but may simply reflect the fact that imaging was done more than 24 h after injury. On the other hand, ultrasound in young children frequently shows a small amount of anechoic free intraperitoneal fluid in the absence of trauma.

Chylous ascites is possible in the abuse context [31, 32]. Usually accompanied by other signs of abuse, it is caused by direct injury to the mesenteric lymphatics or to abrupt hyperextension. It can be totally isolated or associated with other intra-abdominal lesions—pancreatic lesions, in particular. It is diagnosed by paracentesis. It responds to medical treatment with a protein-rich, low-fat diet containing medium-chain triglycerides.

Other possible causes are congenital, obstructive, and iatrogenic (history of surgery) [31].

8.4.8 Thoracic Injuries

These can involve the lung parenchyma, the mediastinum, or the diaphragm. The possibility of occult cardiac injury with elevated troponin I in the context of non-accidental trauma has recently been reported [33].

8.4.8.1 The Lung Parenchyma

Pulmonary contusions are the most common form of injury. On CT [34] these appear as confluent or nodular amorphous or crescent-shaped opacities that are usually posterior and peripheral—though not anatomically distributed (Fig. 8.1)—and spare a subpleural area of normally aerated parenchyma. Though chest radiography is less sensitive for diagnosing pulmonary contusions (early ones, in particular), their rapid resolution (in less than a week) renders routine use of diagnostic CT controversial [34].

Pulmonary lacerations are much less common and can result in pneumatocele or pneumothorax, depending on whether they are central or peripheral, respectively.

Asymptomatic thoracic injuries may not be diagnosed until an infectious complication develops, and the patient presents with pneumonia. By then it is difficult to tie the pathology to a traumatic event.

8.4.8.2 The Pleura

Pleural effusion can be bloody, serous (in some cases just a reaction to an intra-abdominal injury), or even chylous [35]. Ultrasound is useful because it distinguishes pleural from parenchymal involvement and shows the amount of fluid and whether it is purely anechoic or slightly echoic (chylous or hemorrhagic).

Pneumothorax is detected using plain chest X-ray.

8.4.8.3 The Mediastinum

Pneumomediastinum can be secondary to tracheal, bronchial, or esophageal rupture or be caused by a sudden, excessive increase in alveolar pressure (Fig. 8.11).

Tracheal and bronchial lesions are rare. They are caused by a sudden large increase in airway pressure against a closed glottis or severe anteroposterior compression of the chest. A combination of pneumomediastinum, pneumothorax, and subcutaneous emphysema is usually found.

Esophageal ruptures are often diagnosed late, when the patient presents with mediastinitis or a mediastinal abscess secondary to a retropharyngeal abscess. In a literature review by Morzaria [36], perforation occurred in the thoracic esophagus in four cases, the cervical esophagus in eight cases, and the hypopharynx in ten cases. The initial mechanism of injury in 70% of cases was forced ingestion of a foreign body, and the average patient age was 19 months. In the absence of a pre-existing condition such as operated esophageal atresia or a previous endoluminal procedure, esophageal perforation in a child that young should always raise suspicion of abuse. The diagnosis is suggested by dyspnea, dysphagia, cyanosis, fever, pain, and possibly neck swelling and subcutaneous emphysema. It is

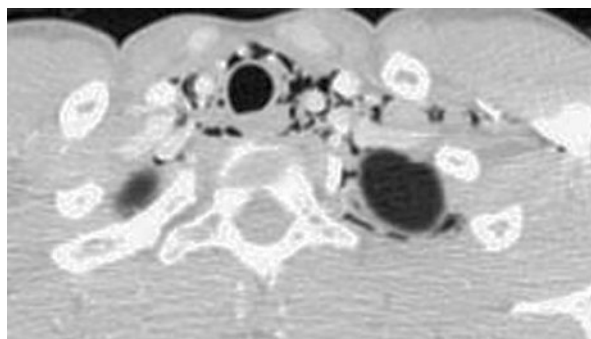


Fig. 8.11 Thoracic trauma, 13 years old, violent kick to the chest. Chest pain. CT: pneumomediastinum and subcutaneous emphysema due to elevated alveolar pressure

confirmed by CT, barium swallow, or, especially, endoscopy. It is usually treated medically.

Lesions of the aortic isthmus are unusual and obviously very severe.

The heart is well protected by the flexible rib cage and by the lungs. Myocardial contusions can, however, occur due to compression of the heart between the sternum and the spine and can readily cause arrhythmias. Diagnosis is very difficult and relies on an assortment of different types of evidence (clinical, EKG, enzyme levels, echocardiography, etc.). Cases of sudden cardiac arrest have also been reported, in which a violent blow to the precordial region caused acute ventricular arrhythmia without any injury to the heart muscle itself [37].

8.4.8.4 The Diaphragm

Diaphragmatic ruptures are rare, but when they do occur they are usually left posterolateral. They should be suspected whenever a hemidiaphragm is elevated and its contour cannot be traced, because herniation of the abdominal organs is often absent. These signs are hard to detect radiologically when there is a lung opacity or pleural effusion. CT may show discontinuity and/or focal thickening in the diaphragm.

8.5 Distinguishing Between Accident and Abuse

When abuse is not immediately obvious, accidental injury is the principal differential diagnosis. It is crucial to analyze the reported circumstances of the injury and assess whether or not they are consistent with the injuries observed; the child's personal and family history (siblings, in particular); the comprehensive clinical examination with testing, analysis, and photos of skin lesions; and the search for other injuries—especially skeletal and brain injuries. We know that a ruptured spleen or gastrointestinal hematoma can be caused by a simple fall against a bench or sidewalk and that pancreatic fracture is a classic result of a bicycle handlebar injury. A fall down the stairs, however, will not cause a perforated bowel.

Although bleeding disorders cannot by themselves explain a visceral lesion, they should always be tested for.

8.6 Dating

Dating visceral injuries is much harder and less accurate than skeletal injuries—even when comparing clinical data to imaging data, in some cases. A ruptured organ generally becomes symptomatic very quickly, with immediate pain, pallor, intense thirst, and then shock (when there is heavy bleeding); some of the symptoms of a perforated bowel or pancreatic injury develop more gradually (sometimes over the course of a day), with signs of generalized or localized peritonitis and infection. Solid organ and mesenteric contusions may be asymptomatic for a

long time, discovered only when sequelae occur. Whatever their location, hematomas start out as dense, hyperechoic clots that liquefy in a few days, becoming hypoechoic and fluid-like in density. If surgery is to be performed, we recommend documenting superficial and deep lesions photographically and keeping them in the medical record, so that they can be examined later by an expert to supplement the operative report.

When diagnosing abuse, it is particularly important to identify the repetitive nature of attacks; this means finding evidence of different-age injuries. This is impossible—or at least extremely difficult—for visceral injuries, though a liquefying hepatic, splenic, or gastrointestinal injury is most likely semi-recent, whereas gastrointestinal, or on rare occasions biliary, stenosis and total or segmental renal atrophy with hypertension suggest an older injury. That is one reason why the rest of the workup—the skeletal workup, in particular—is so important (cf. chapter on skeletal injuries).

8.7 Treatment Principles

As with any pediatric injury, assessing the hemodynamic situation is the number one priority. With their low blood volume, infants and small children are at risk of circulatory collapse from even a small blood loss. Resuscitation, fluid replacement, and—at the very minimum—venous line placement should be done prior to imaging.

The clinical exam looks for signs of multiple trauma, neurological problems, injuries to the extremities, and skin lesions. The clinician attempts to determine the mechanism of thoracic or abdominal injury.

The initial imaging workup consists of plain radiographs of the chest and abdomen, including the pelvis and spine. The goal is to detect fractures (ribs, clavicles, pelvis, etc.), pneumothorax, lung opacities, or intra- or retroperitoneal free air in the abdomen, which is an indication for immediate surgery.

Computed tomography is considered the gold standard for accurate evaluation of thoracic and abdominal injuries. Ultrasound may, however, be of major value in the initial workup. It does not use ionizing radiation, is available in all emergency and pediatric facilities, and can be performed at the patient's bedside. It should be meticulous, investigate the entire abdominal cavity, utilize both curved array and high-frequency linear transducers, and always include a color Doppler analysis. It is the most reliable technique for detecting even small amounts of free intraperitoneal fluid or pleural effusion. It is capable of demonstrating lesions in the liver, spleen, and in many cases, the GI tract. It does have some limitations, in particular when there is a penetrating wound or wound dressing, or severe abdominal distention from gas that masks the entire mid-abdominal region. It is much less sensitive than CT for diagnosing pancreatic, gastrointestinal, and mesenteric lesions; as we have seen, those are the target organs in the child abuse context. Another major disadvantage in the abuse context is that the

documentation it produces is often not objective enough for legal purposes. Despite all that, ultrasound is indicated as the first-line modality, especially when a severe abdominal injury is unlikely. It can then be supplemented by CT if abnormal or if the results are inconsistent with clinical findings. Ultrasound is also the basic modality for medium- and long-term monitoring of known lesions. Ultrasound is also the modality of choice in depicting visceral lesions in the context of suspected child abuse (cutaneous, head, and/or skeletal findings) without abdominal symptoms.

CT is the second-line modality if there is strong suspicion of severe thoracic injury, the abdominal ultrasound is abnormal or unreliable, a pancreatic or gastrointestinal injury is suspected, the hemodynamic situation inexplicably deteriorates despite appropriate resuscitation, or there are signs of hemorrhage (e.g., falling hemoglobin) with no visible external bleeding. Because the abdomen and chest CT always includes intravenous contrast to detect active bleeding, determine if there is solid organ damage, and study the GI tract, head CT should be done first. Delayed-phase images should be added if there is urinary tract involvement.

It is important to use different windows when reading—the bone and pulmonary windows, in particular—to better detect not just bone lesions but small amounts of free air, as well.

Other techniques might also be useful, such as barium meals for diagnosing and monitoring intramural hematomas or for suspected esophageal perforation.

Independent of imaging, some teams have recommended routine screening because thoracic and abdominal injuries that were totally inapparent clinically have been reported in abused children. That screening includes measuring transaminase levels (to detect hepatic injury) and blood amylase and lipase levels (to detect pancreatic or gastrointestinal injury) and testing for hematuria and blood in the stools [38]. Using a threshold of 80 IU/l, Lindberg [39] reported that transaminase levels had 77% sensitivity and 82% specificity in detecting hepatic injuries (the injuries were occult in 26% of patients in his series). While the indication for an imaging workup is not based on these arguments alone, they may be useful if the initial workup is normal. Lastly, most children with microscopic hematuria do not have a urinary tract injury; a urinary tract injury is less common than injury to another organ in cases of microscopic hematuria, and hematuria is a very poor indicator of abdominal injury [17].

The pediatric workup is not, of course, limited to evaluating thoracic and abdominal injuries; the child should receive a comprehensive workup (cf. chapter on diagnostic strategies and recommendations) [20, 40].

Lastly, we have seen that—excluding intra-abdominal GI perforations and active vascular lesions (relatively rare)—most thoracic and abdominal injuries benefit from medical treatment. That warrants a detailed analysis of the injuries at the time of diagnosis and monitoring them during treatment with ultrasound. The frequency of the examinations will depend on the organ involved, the severity of the initial injury, and the child's clinical progress.

8.8 Sequelae

Secondary complications are detected by continuing to monitor after the event; once everything seems normal, the interval between follow-ups can be gradually increased. Long-term clinical and imaging follow-up is needed, because some ischemic injuries (to the mesentery, intestines and kidneys) and those due to a ruptured canal or duct (the esophagus, bronchi, bile and pancreatic ducts, and urethra) can have delayed sequelae (e.g., stenosis of the canal/duct, or pancreatic pseudocyst) and remain clinically silent for months, or even years.

Monitoring during the high-risk period should include laboratory testing; if there is an abnormal result confirmed by two consecutive tests closely spaced in time, imaging-based monitoring should be resumed.

Even in nonsurgical cases, if there has been significant abdominal injury—and especially if there was diffuse free fluid—the child's family should be informed that there is a risk of adhesive bowel obstruction and that they should consult a surgeon within hours if the child is vomiting and/or in severe pain, to prevent short-bowel syndrome due to a delay in diagnosing an extensive volvulus.

We will not detail here the specific methods for monitoring and treating the sequelae of each type of injury, which are well known to physicians and surgeons who specialize in the various systems and organs in children and adolescents (ENT, pulmonology, hepatology, gastroenterology, nephrology/urology, gynecology, etc.). The child's regular pediatrician should ask for their opinion and assistance—the rarer the lesion, the less they should hesitate to do so.

Despite the pediatric surgery rule of using non-operative conservative treatment whenever possible, excising an organ is sometimes necessary to save a child's life and will mean specific lifelong follow-up. Examples include asplenia after total splenectomy and reduced nephron mass (despite compensatory hypertrophy in young victims) after nephrectomy or renal atrophy.

In conclusion, thoracic and abdominal injuries cause serious disease and are associated with high morbidity and mortality. Imaging plays an important role in the initial assessment, subsequent monitoring of the injuries identified in that assessment, and the medicolegal discussion. Computed tomography is the mainstay of diagnosis; the indication for it will depend on the clinical data, standard radiography, and, in many cases, the ultrasound results. Ultrasound can reliably be used for monitoring during treatment. The radiologist also has a duty to suspect abuse whenever the circumstances are not clearly accidental, the child is younger than 3 years, there is gastrointestinal tract and/or pancreatic involvement, the reported circumstances are inconsistent with the injuries found, there was a delay in seeking medical help, similar events have been reported with siblings, and skin lesions are noted. In those cases it is imperative to confirm the abuse diagnosis by looking for other injuries—skeletal and neurological, in particular—because the child's life is at risk.

Key Points

- Thoracic/abdominal injury is a rare but severe complication of child abuse, since it is the second leading cause of death, after traumatic brain injury.
- The main hallmarks of inflicted abdominal injury are young age (often less than 3 years), delay in seeking care, and inconsistencies between the reported history and the observed injuries.
- Abdominal injuries are more severe in abused children than in children injured in accidents.
- While any abdominal organ, solid or hollow, can be injured in inflicted abdominal trauma, solid organ injuries are more common.
- When there is no history of traffic or handlebar accident, pancreatic injury is strongly suggestive of abuse.
- Thoracic involvement is possible with abuse, marked primarily by pulmonary contusion.

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Sabine Defoort-Dhellemmes, Isabelle Bouvet-Drumare,
Caroline Marks-Delesalle, Ikram Bouacha, Vasili Smirnov,
and Matthieu Vinchon

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S. Defoort-Dhellemmes (✉) • I. Bouvet-Drumare • C. Marks-Delesalle • I. Bouacha
V. Smirnov
Service d'exploration de la vision et neuro-ophtalmologie, Hôpital R. Salengro, CHRU Lille,
Lille, France
e-mail: Sabine.DEFOORT@chru-lille.fr; isabelle.drumare@chru-lille.fr; caroline.delesalle@chru-lille.fr; ikram.bouacha@chru-lille.fr; vasili.smirnov@chru-lille.fr

M. Vinchon
Service de neurochirurgie pédiatrique, Hôpital R. Salengro, CHRU Lille, Lille, France
e-mail: matthieu.vinchon@chru-lille.fr

In children with intracranial hemorrhage, retinal hemorrhages (RHs) are a major red flag for non-accidental injury (NAI) and especially shaken baby syndrome (SBS) [1]. RHs are not, however, either necessary or sufficient for the diagnosis, as they are absent in about a quarter of NAI cases and can occur in other situations such as traffic accidents, birth trauma, and certain systemic illnesses.

When a child suffers an apparent life-threatening event at home witnessed only by his caretaker, we must be able to determine whether retinal hemorrhages are traumatic in origin and if so, whether that trauma was accidental or intentional. There are several questions here, which have been the subject of numerous articles and heated debates:

- Can cardiopulmonary resuscitation cause visible retinal hemorrhages?
- Can retinal hemorrhages be caused by status epilepticus or by hypoxic brain injury associated with severe head trauma?
- What is the mechanism responsible for retinal bleeding and how much force is needed to cause such bleeding? Is very intense shaking or violent trauma necessary to cause these hemorrhages, or can they be caused by low-height falls or during play [2–4]?

In any child with traumatic brain injury (TBI), accurately describing and photographing RHs for forensic purposes is essential [5–7]. The diagnosis of shaken baby syndrome will rely more on the characteristics of the retinal hemorrhages (their size, their location within the layers of the retina, and whether they extend to the peripheral fundus) than on the fact of their existence.

9.1 Types of Retinal Hemorrhages [3, 8–10]

While any type of retinal hemorrhage can be found with pediatric traumatic brain injury, some types are more suggestive of—or even quasi-pathognomonic for—SBS. The fundus should therefore be examined as soon as possible, after pupil dilation, by an ophthalmologist or, failing that, by pediatric intensive care staff. RHs should be documented photographically with a handheld digital fundus camera.

Retinal hemorrhages are described according to:

- Whether they are unilateral or bilateral
- Their appearance (size and shape), which will depend on their location in the posterior pole (peripapillary, macular, or along the vascular arcades) or in the peripheral fundus (mid-periphery or extending to the far periphery, to the ora serrata) (Fig. 9.1)
- Their location within the layers of the retina (preretinal, superficial or deep intraretinal, or subretinal) (Fig. 9.2)

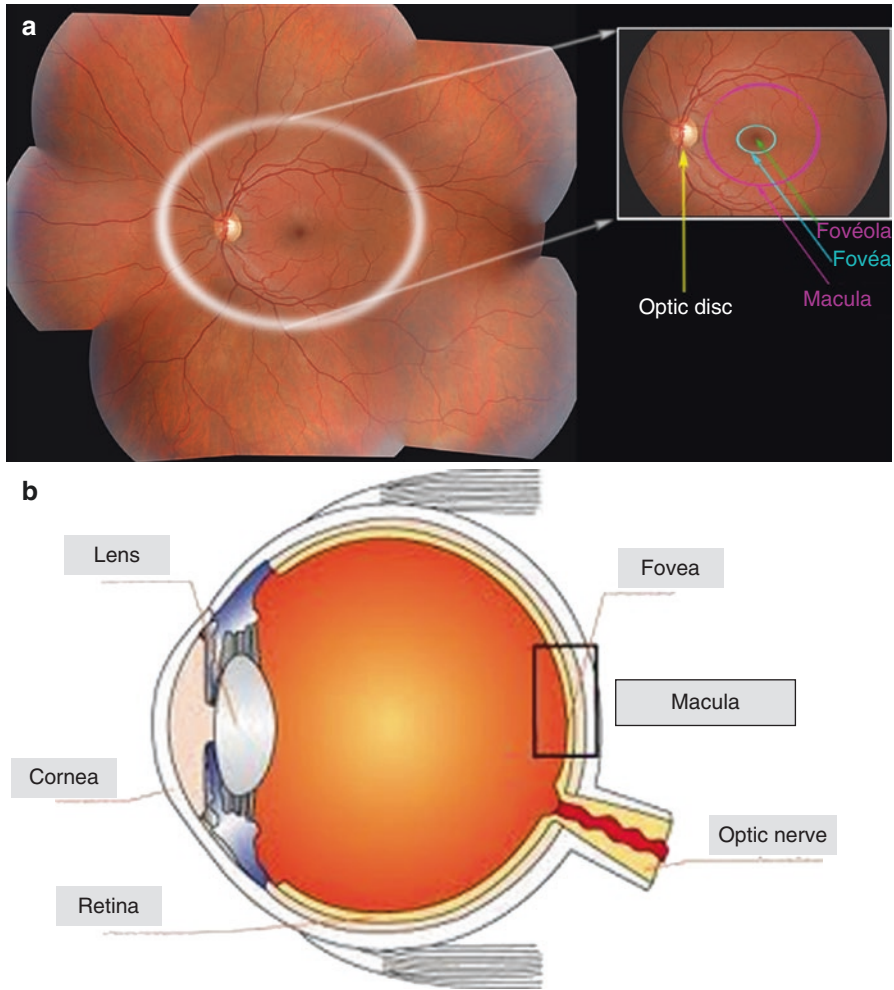


Fig. 9.1 Normal eye. (a) Normal ocular fundus. (b) Schematic of the normal eye

9.1.1 Preretinal or Subhyaloid Hemorrhages and Hemorrhagic Retinoschisis (Fig. 9.3a)

Preretinal hemorrhages are located between the internal limiting membrane (ILM) and the vitreous. It can be difficult to tell the difference on fundus examination between preretinal subhyaloid hemorrhages and hemorrhages that actually lie beneath the ILM (or even within the superficial layers of the retina) but bulge forward into the vitreous. As some histological and optical coherence tomography (OCT) studies have shown, some or all so-called “preretinal”

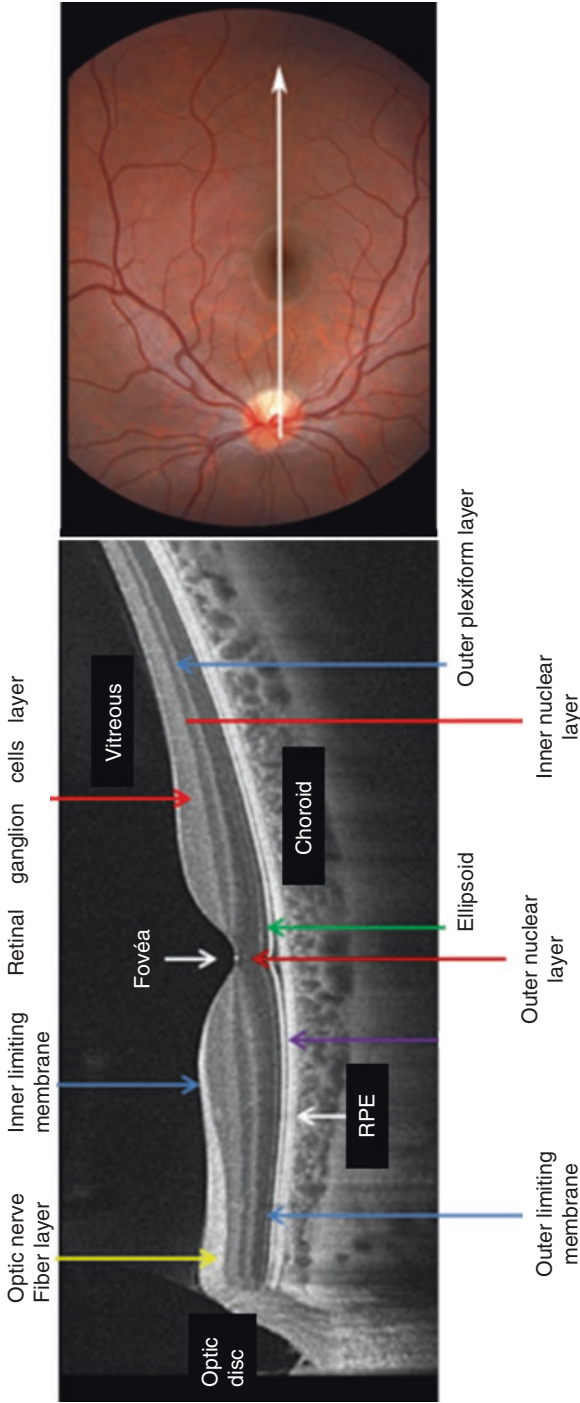


Fig. 9.2 Possible locations for retinal hemorrhage. Cross section of the retina by optical coherence tomography (OCT). Preretinal hemorrhages are located between the internal limiting membrane and the vitreous; superficial intraretinal hemorrhages are between the nerve fiber layer and the ganglion cell layer; deep intraretinal hemorrhages are in the outer plexiform layer and outer and inner nuclear layers; and subretinal hemorrhages are between the photoreceptor (PR) outer segment and the retinal pigment epithelium (RPE)

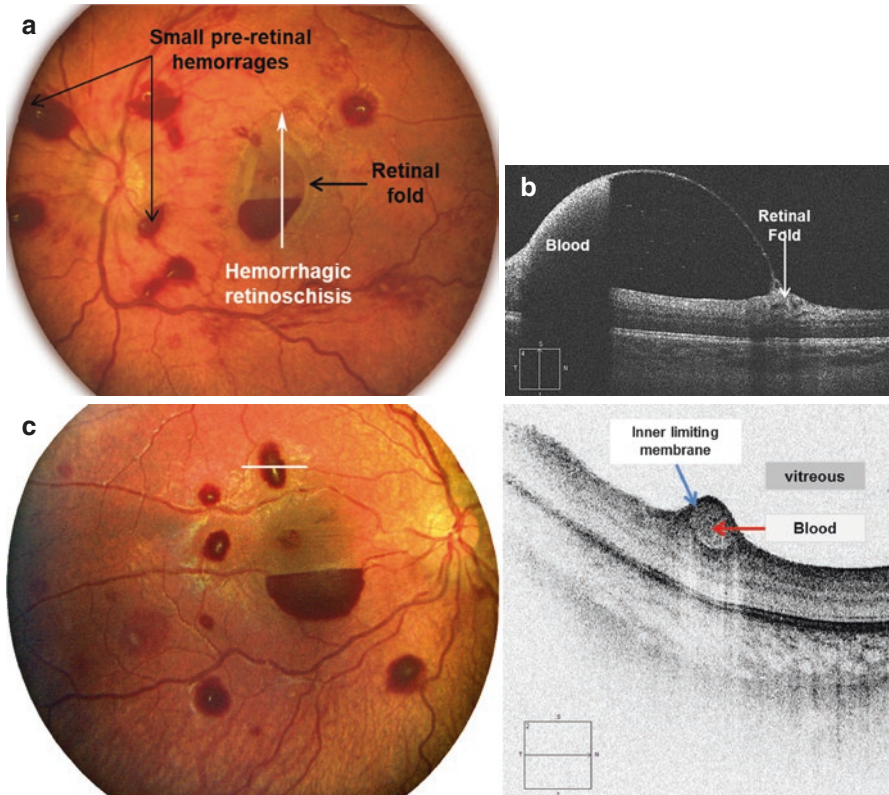


Fig. 9.3 Preretinal hemorrhages and hemorrhagic retinoschisis. (a) Photo of the posterior pole of the eye: Small preretinal hemorrhages, less than one disc diameter in size. Hemorrhagic retinoschisis with blood settling in a “pigeon’s nest” pattern due to gravity (baby in upright position). Circular retinal fold. (b) OCT cross section of hemorrhagic retinoschisis: Circular retinal fold outlining the retinoschisis, due to the RH pushing forward, causing the vitreous to pull on the retina where it is still attached. (c) OCT cross section (negative) of what was labeled a small “preretinal” hemorrhage, revealing that the hemorrhage is actually beneath the internal limiting membrane, perhaps even in the nerve fiber layer (between the internal limiting membrane and the ganglion cell layer). In children, OCT is done on a moving eye and hence is not as accurate as in adults

hemorrhages are in fact located beneath the ILM [10–13]. Preretinal hemorrhages come in two forms:

1. Large dome-shaped hemorrhages, which can obscure the underlying retinal features. They usually occur singly and accompanied by other types of preretinal hemorrhage, but there can also be more than one, of different sizes.

It is more clinically obvious that a preretinal hemorrhage lies beneath the ILM when it takes the form of a pseudocyst that is denser in the center (with the child lying down); this is called *hemorrhagic retinoschisis* [14]. The blood settles there, becoming a fluid level that varies with the child’s position. The retinoschi-

sis is sometimes edged with a whitish, *arcuate retinal fold* that is easier to see as the hemorrhage regresses, and on optical coherence tomography (Fig. 9.3b). Very large hemorrhages can take 1–3 months to resolve and leave sequelae such as epiretinal membranes and macular holes.

2. Small dome-shaped hemorrhages, which are less than one disc diameter in size, bright red, and bulge forward into the vitreous (Fig. 9.3c).

9.1.2 Intraretinal Hemorrhages

There are two types of intraretinal hemorrhage:

1. Superficial intraretinal hemorrhages are located in the posterior pole of the eye and follow the path of the nerve fibers, which explains their linear, or “splinter,” shape near the optic nerve head, their “flame” shape along the retinal vessels, and brush-like appearance beyond that. They resolve very rapidly, sometimes in less than 24 h—hence the importance of performing a fundus exam and taking photos when the child is admitted to the emergency room (Fig. 9.4).
2. Deep intraretinal hemorrhages are dark red and have a “dot” or “blot” shape with sharp borders (Fig. 9.5).

9.1.3 Subretinal Hemorrhages

Subretinal hemorrhages are located between the photoreceptors and the retinal pigment epithelium (RPE).

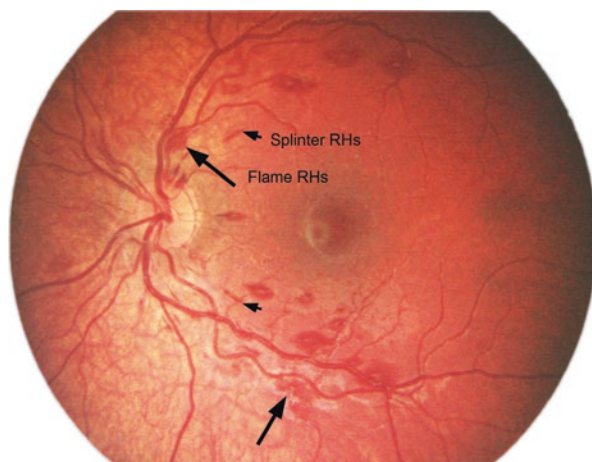


Fig. 9.4 Superficial intraretinal hemorrhages. Flame-shaped (*long arrows*) and linear, or splinter (*short arrows*), hemorrhages

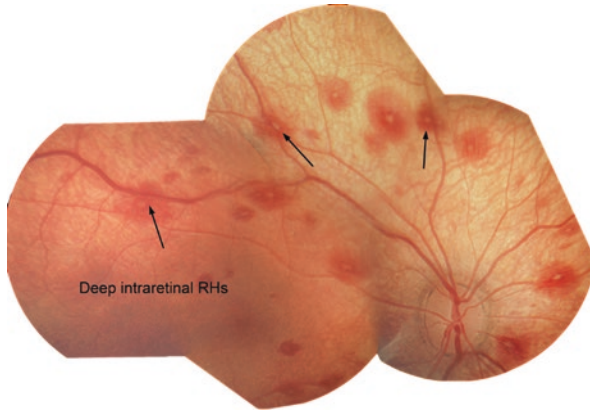


Fig. 9.5 Deep intraretinal hemorrhages. “Dot-and-blot” hemorrhages. The intraretinal location is obvious when a retinal vessel crosses over the hemorrhages. Some have a white dot in the center

9.1.4 Special Case of White-Centered Hemorrhages (Roth’s Spots)

Some preretinal and intraretinal hemorrhages have a white center that should not be mistaken for the light reflex from the internal limiting membrane. The location of the light reflex changes with the angle of illumination and can often be seen at the top of hemorrhages that bulge into the vitreous.

9.1.5 Other Possible Fundus Lesions

- Vitreous hemorrhage, obscuring all or part of the fundus, is caused by the rupture of large hemorrhages (Fig. 9.6).
- Choroidal hemorrhage.
- Papilledema due to increased intracranial pressure, which occurs in 10% of TBIs.
- Dilated retinal veins, caused by venous hypertension.
- Optic atrophy, which occurs late and is evidence of injury to the pregeniculate visual pathway.

9.1.6 Intraorbital Hemorrhages

Intraorbital hemorrhages are scleral hemorrhages or hemorrhages of the optic nerve sheath, extraocular muscles, or orbital fat; they are identified in postmortem pathology studies.

9.1.7 Classification of Hemorrhages

Retinal hemorrhages have been classified into three types [15–17]:

- *Type 1*: Intraretinal hemorrhages, flame-shaped or dot-and-blot hemorrhages, located in the posterior pole (Fig. 9.7).

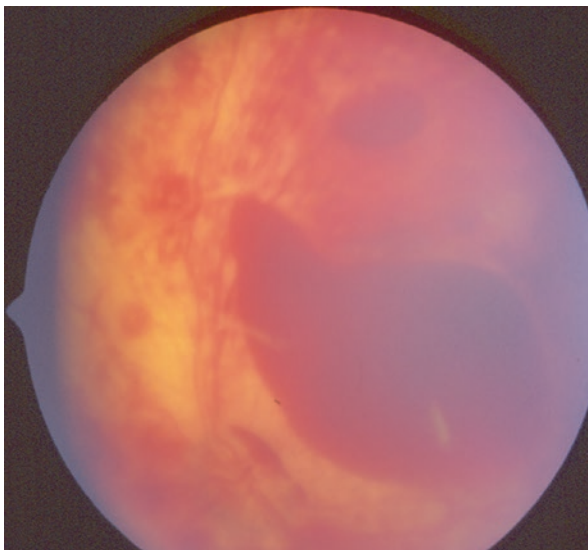


Fig. 9.6 Vitreous hemorrhage. Fundus is obscured and looks blurred

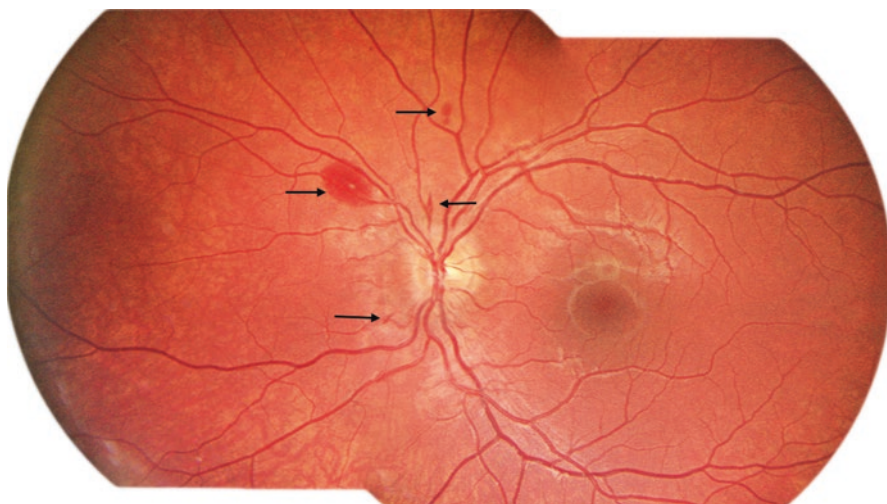


Fig. 9.7 Type 1 retinal hemorrhages (*arrows*)

- *Type 2*: Preretinal dome-shaped hemorrhages, which are small (no more than one disc diameter) and located in the posterior pole, around the optic nerve head, along the vascular arcades, or in the mid-periphery. These hemorrhages can be isolated or accompanied by Type 1 hemorrhages (Fig. 9.8).
- *Type 3*: Multiple hemorrhages of any type (intra-, pre-, or subretinal), scattered throughout the retina to the periphery and accompanied by a large unilateral or bilateral premacular hemorrhage or hemorrhagic retinoschisis. Type 3 is subdivided into Types 3a—when the hemorrhages are countable (Fig. 9.3)—and

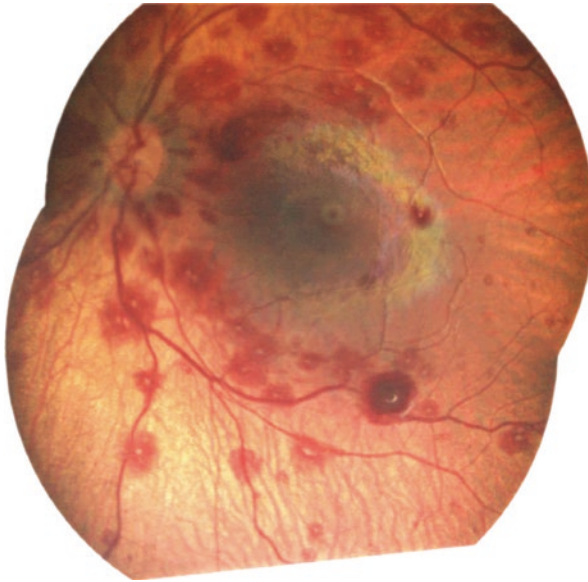


Fig. 9.8 Type 2 retinal hemorrhages

3b, when profuse hemorrhages line the entire retina and are too numerous to count (Fig. 9.9a–c).

We originally chose this classification system because at the time there was no internationally recognized system. Several protocols for documenting retinal hemorrhages have since been validated, however. A number of studies have shown very good intra- and interobserver correlation in interpreting a series of photos (taken with a RetCam® or Kowa®) illustrating hemorrhage characteristics: their distribution over the retinal surface, which is divided into a variable number of zones; the number of hemorrhages in each zone; their depth in the retina; and the presence of hemorrhagic retinoschisis, retinal fold, or vitreous hemorrhage (Fig. 9.9d, e) [19–22].

9.2 Pathophysiological Hypotheses

There have been several mechanisms proposed to explain retinal hemorrhage in children with traumatic brain injuries.

1. The most widely accepted mechanism is *vitreous traction on the retina* due to the successive violent rotational acceleration-deceleration head movements produced by violent shaking, with or without head impact. Because a child's vitreous is denser than that of adults and is tightly attached to the internal limiting membrane, this causes shear between the ILM and the retinal layers beneath it. The result is a tearing of the retinal capillaries and thus retinal hemorrhages, creating one or more areas of retinoschisis and, in some cases, a traction fold.

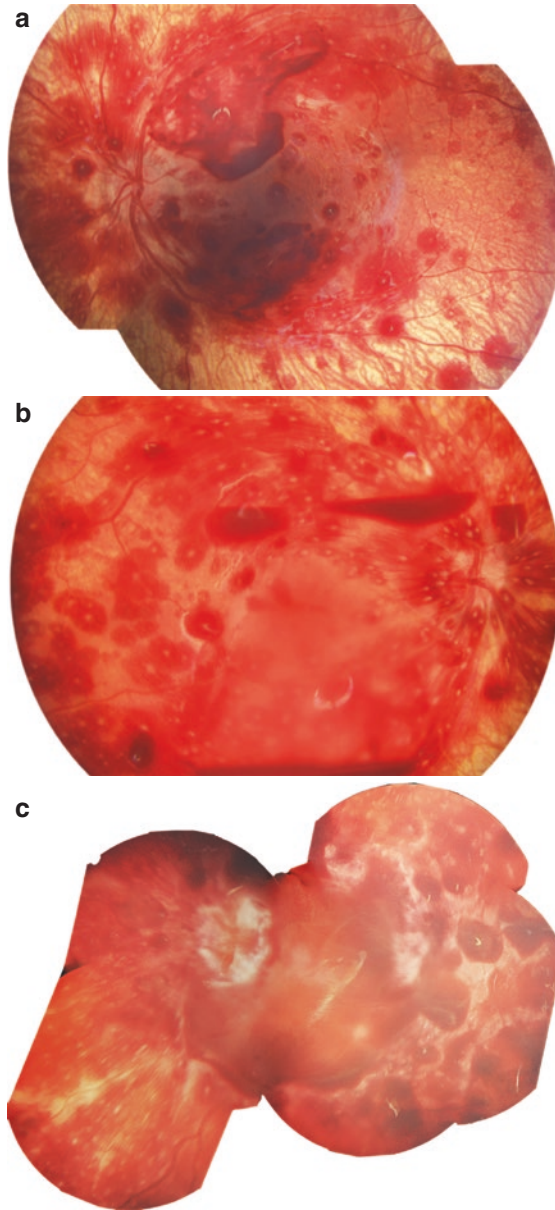


Fig. 9.9 Collecting data from the fundus exam. (a–c) Type 3b retinal hemorrhages. (d) Zones of the retina as defined by Fleck [12]. *Zone D*: a three-disc diameter circle centered on the center of the optic nerve head. *Zone M*: An eight-disc diameter circle, whose center is on a line bisecting the retinal vascular arcade and the optic disc and joining the tangential point of contact between *zones D* and *M*. *Zone P*: Peripheral retina beyond *Zone M*. (e) Fleck Zones *D* and *M* are called *A* and *B* by Tandon [18], who divides *Zone P* into *Zone C*, whose outer limit passes by the vortex veins, and *Zone D*, which extends beyond that zone to the ora serrata. Some of the landmarks defining these zones are difficult to identify when there are profuse retinal hemorrhages covering nearly the entire retina, but in that case the score is automatically the maximum

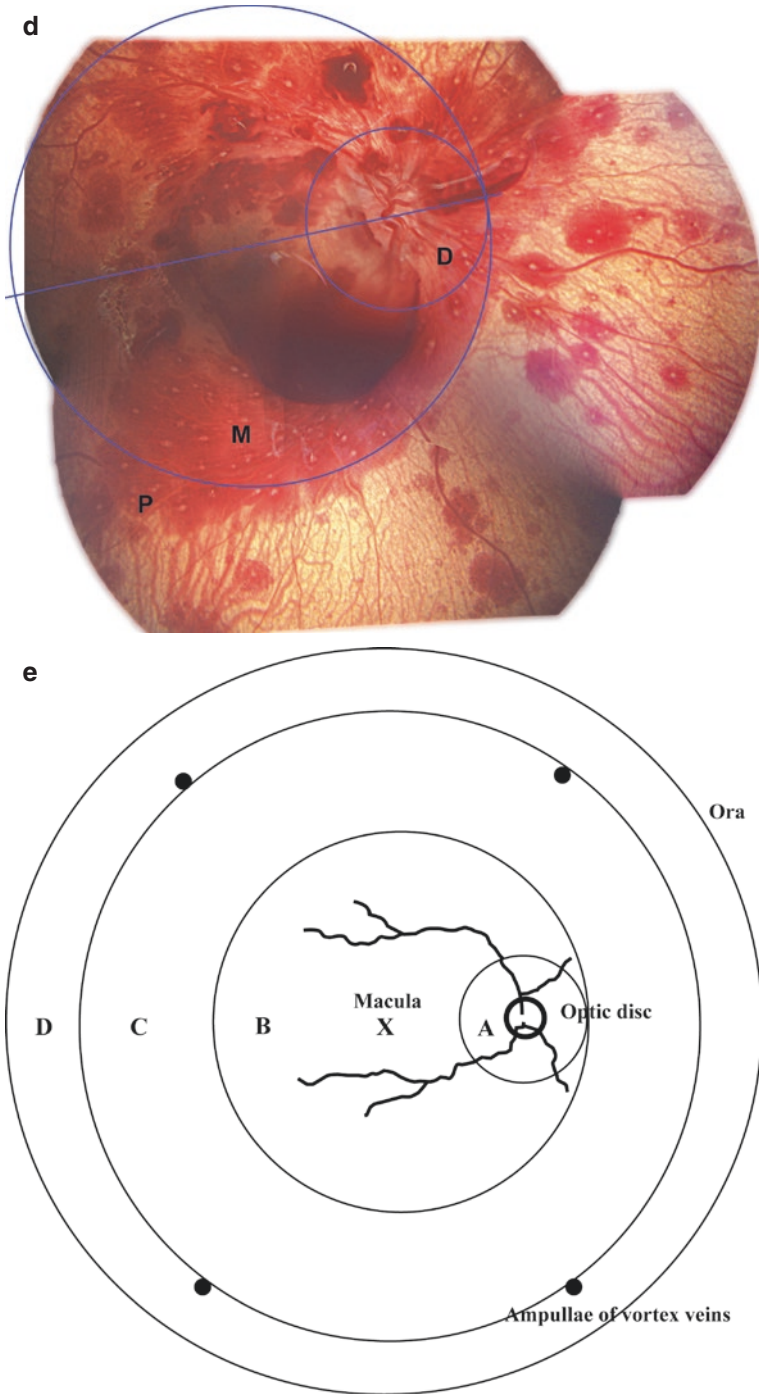


Fig. 9.9 (continued)

These abnormalities are located mainly in areas of strong vitreous attachment (the posterior pole, along the retinal vessels, and in the periphery, at the ora serrata) [3].

2. Some authors also argue for *the role of ocular venous hypertension* [2, 23, 24]. This would involve two different mechanisms: The first is an increase in intrathoracic pressure caused by a Valsalva effect from crying or epileptic seizures or the pressure of the perpetrator's fingers as he holds the lower part of the child's chest tightly while shaking him. The second mechanism is an increase in intracranial pressure due to a subdural hematoma (SDH) or cerebral edema [2].
3. *Orbital impact* has been used to explain profuse retinal hemorrhage in some violent accidental injuries (see section 9.4.1). In those cases, there are grossly visible palpebral injuries.
4. The spread of intracranial hemorrhage via the optic nerve sheath—which might explain the presence of blood in the nerve sheath, as well as some juxtapapillary hemorrhages—is inconsistent with histological and clinical studies, since the majority of retinal hemorrhages occur far from the optic disc.

9.3 Retinal Hemorrhage in Shaken Baby Syndrome

Retinal hemorrhage is found in approximately 85% of SBS cases, whether there was direct head impact or not. According to the literature, the reported frequency of RHs has increased since dilated fundoscopy by an ophthalmologist within 48 h of injury became routine. The retinal hemorrhages are typically bilateral, except in 10–17% of SBS cases, where they can be either ipsilateral or contralateral to the subdural hematoma [3, 6, 25–28].

All types of hemorrhages are found in non-accidental injury [3, 16, 18, 29–31]. They are found in the posterior pole in 86% of cases and in the mid- and far periphery in 57% of cases. They have a specificity of 94% in infant traumatic brain injury. It should be emphasized that superficial intraretinal hemorrhages, when accompanied by papilledema—found in approximately 10% of pediatric TBIs—have no diagnostic value but are a sign of increased intracranial pressure [28]. Type 3 hemorrhages are reported to have a sensitivity of 66% and a specificity of 100% in corroborated non-accidental injury [17]. The severity of the retinal involvement (number, size, and extent of RHs) is correlated with the severity of the intracranial injury and the severity of the neurological damage. Vitreous hemorrhage is a poor prognostic factor.

9.4 Differential Diagnosis

9.4.1 Accidental or Non-accidental Injury? [3, 8, 9, 16, 17, 27, 32]

Concerning the circumstances of the injury, with only a few exceptions [17, 25, 30], the studies in the literature suffer from circularity (RHs being part of the definition of SBS) and subjectivity.

Injuries of unclear origin—e.g., domestic accidents with no impartial witnesses—are often considered:

- *Accidental*, or apparently accidental, if the family immediately gives a precise description of the circumstances of the injury that does not change over time and if the mechanism of injury described is consistent with the clinical findings
- *Suspicious*, or apparently inflicted upon the child, if the caretaker's description of the circumstances changes from day to day and over the course of time, if there is no acknowledgment of trauma, or if there are significant inconsistencies between the mechanism of injury described and the injuries observed

In order to determine which features might distinguish fundus abnormalities due to accidental injury from those due to shaking, we can look at studies that compare RHs in proven accidental injuries witnessed by a reliable impartial observer to:

- Those seen in proven or corroborated SBS with or without head impact, where the child's caretaker admits to having shaken the child violently
- Those seen in battered child syndrome, which is diagnosed based on detailed admissions of repeated abuse, or in a child who, in addition to traumatic brain injury, has recent and/or old fractures and/or suspicious skin lesions

Such comparisons have shown that retinal hemorrhages are less common in proven accidental injury than in the other situations, ranging from 0 to 17%, or 8.9% on average, of all of the cases in the literature [16, 17, 25, 33, 34]. Their frequency is probably underestimated, however, either because the fundus exam was not done routinely in children injured in traffic accidents or because it was performed too late. While retinal hemorrhages from accidental injury are usually unilateral, they can be bilateral [34], in which case they are often asymmetrical.

1. In falls witnessed by a neutral, reliable observer, retinal hemorrhages are rare, whatever the height of the fall (from a window, down a staircase, from a changing table, the child's height, etc.). They are usually accompanied by an epidural hematoma, and in rare cases by a subdural hematoma (SDH) [17]. One hypothesis used to explain the rarity of retinal hemorrhage and SDH after falls is based on the line of action of the force. The majority of falls involve linear, rather than rotational, acceleration-deceleration. The retinal hemorrhages found in falls (either proven or highly likely to be accidental) are Types 1 (intraretinal) and 2 (small dome-shaped), except in very rare cases where profuse RHs and retinoschisis were reported. While there is much debate over the accuracy of the fundus description, the circumstances of the fall, and the mechanism responsible for the fundus abnormalities, the violence of the injury is indisputable, since all of the children died within hours or days of the accident [30, 32, 35]. Some authors see these cases as proof that venous hypertension due to significantly increased intracranial pressure or thoracic compression (in cases of crushing) is the primary—if not only—cause of retinal hemorrhage [24, 36]. To others, however, the possibility of some mechanism comparable to SBS—a single, violent, angular accelera-

tion-deceleration movement with impact—cannot be ruled out. Finally, other authors stress the role of orbital impact accompanied by a crushing of the head [21]. Direct ocular contusions are indeed a known cause of retinal hemorrhage.

2. In traffic accidents, retinal hemorrhages are also rare and tend to be Types 1 and 2 (Fig. 9.10a, b). Profuse bleeding, hemorrhagic retinoschisis, and retinal folds are the exception [8, 34, 37]. In the cases reported in the literature, all of the children had a subdural hematoma and died following the accident. A rotational acceleration-deceleration mechanism with impact is often described in such accidents; the child is ejected from his car seat or hit by a vehicle in his stroller.

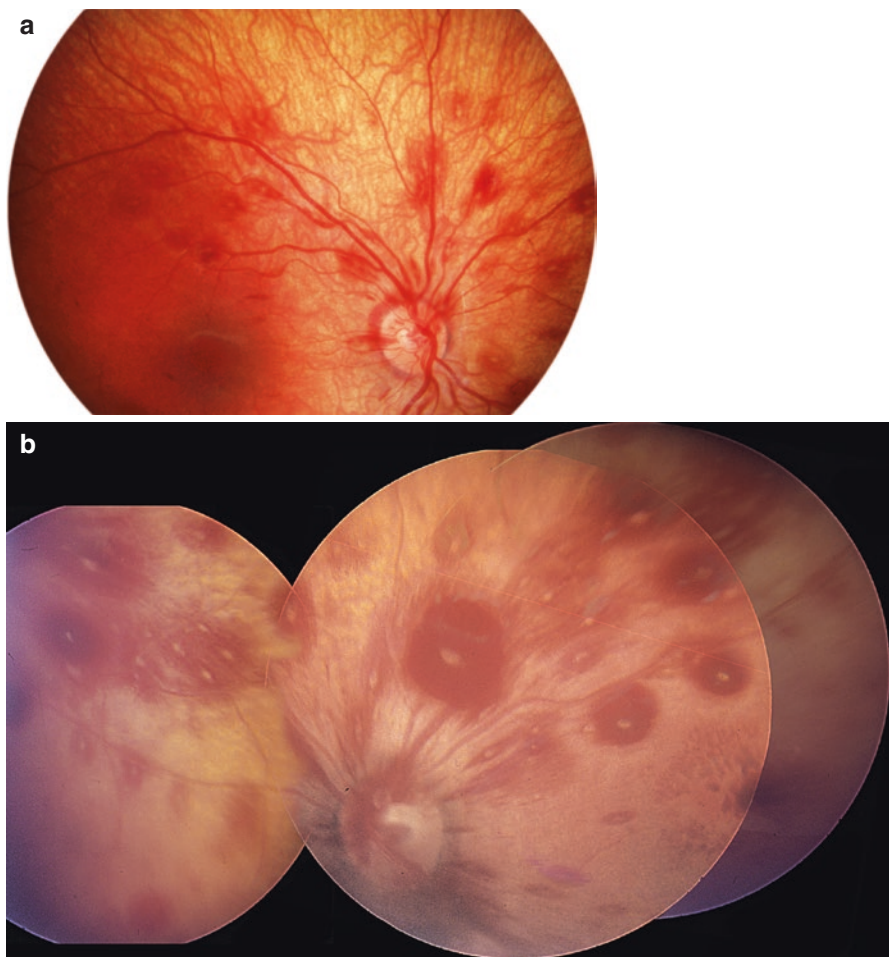


Fig. 9.10 Differential diagnosis. Retinal hemorrhages from accidental injuries. **(a)** Traffic accident. Thirteen-month-old infant with right parietal subdural hematoma. Fundus of the right eye on day 2: bilateral flame-shaped hemorrhages. **(b)** Child ejected from his stroller when hit by a motorcycle. Fundus of the left eye after 36 h: Type 2 retinal hemorrhage, flame-shaped hemorrhage with a white dot in the center and small preretinal hemorrhages (diameter less than or equal to one disc diameter)

We have seen no cases of traumatic brain injury with retinal hemorrhage occurring during everyday play, either in the literature or in our own experience.

9.4.2 Delivery

Approximately one third of full-term newborns have retinal hemorrhages. While RHs can occur with any delivery method, they are more common after forceps delivery and vacuum extraction. They are usually superficial and deep intraretinal hemorrhages, bilateral (88% of cases in Emerson's series) [36], and numerous (more than ten) and extend to the periphery in a third of cases. In 15–20% of cases, they have a white center (Fig. 9.11). They disappear very rapidly, sometimes in less than 3 days. They are very rarely found beyond the age of one month, and never beyond the age of 2 months [38, 39].

9.4.3 Cardiopulmonary Resuscitation (CPR)

In adults and older children, retinal hemorrhage can occur as a result of blunt thoracic trauma, as part of Purtscher retinopathy—a combination of retinal hemorrhages and exudates (cotton-wool spots secondary to capillary occlusion). Based on that, CPR—which can also cause rib fractures—was considered to be a possible cause of retinal hemorrhage in children with traumatic brain injuries. In fact, retinal hemorrhages are rarely found in infants who had even prolonged CPR, unless there was a head injury or bleeding disorder. When retinal hemorrhages do occur, they are Types 1 and 2 (Fig. 9.12) [40, 41]. The same type of RH can be found, though very rarely, in cases of acute hypoxia from drowning, neonatal anoxia, or respiratory distress [36]. It has not been found after strenuous vomiting efforts [42].

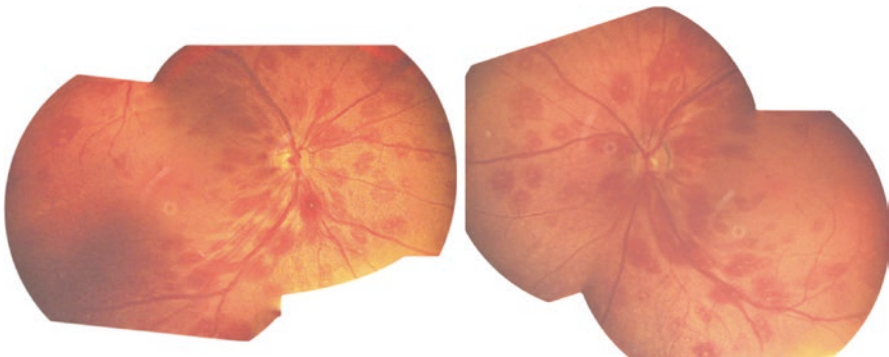


Fig. 9.11 Differential diagnosis. Postpartum retinal hemorrhages. Intraretinal hemorrhages, some with a white center, in a 1-day-old child

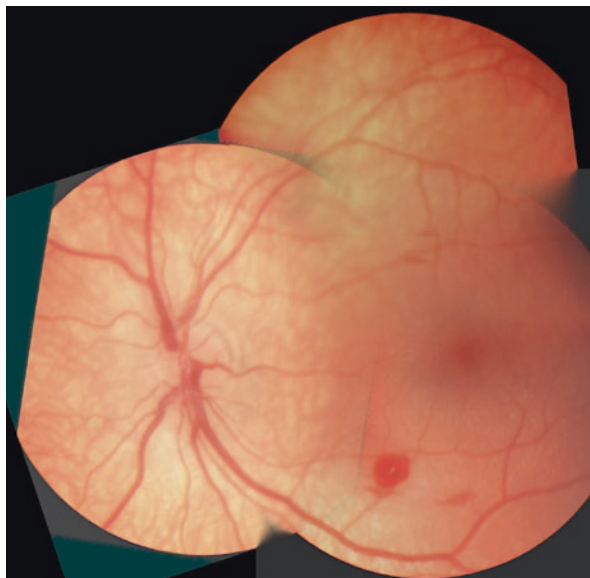


Fig. 9.12 Differential diagnosis. Retinal hemorrhage after CPR chest compressions. Fundus of the left eye: intraretinal flame-shaped and blot hemorrhages

9.4.4 Systemic Illnesses (Table 9.1)

Many systemic illnesses can cause retinal hemorrhage [10, 32], either spontaneously or after minor injuries. These should always be ruled out before suggesting a diagnosis of SBS—though they may coexist with abuse (cf. Table 9.1). The retinal hemorrhages in these illnesses tend to be few in number and confined to the posterior pole.

9.4.5 Seizures

Seizures—even prolonged ones—do not cause retinal hemorrhage unless accompanied by a head injury or bleeding disorder. There is only one reported case, involving a peripapillary flame-shaped hemorrhage, in the literature [9, 43].

9.4.6 Specific Case of Terson Syndrome

Terson syndrome—intraocular, retinal, and/or vitreous hemorrhage due to subarachnoid hemorrhage from a ruptured cerebral artery aneurysm—is rare in children under age 2 years but can cause large dome-shaped preretinal hemorrhages (Fig. 9.13). The mechanism of this syndrome is one of the crucial points used to support the critical role of venous hypertension secondary to elevated intracranial pressure in the genesis of preretinal hemorrhages in infants with traumatic brain injuries.

Table 9.1 Systemic illnesses most likely to cause retinal hemorrhage

Blood disorders	Leukemia Disseminated intravascular coagulation (DIC)
Bleeding disorders	Hemophilia Vitamin K deficiency Factor XIII deficiency Hermansky-Pudlak syndrome
Severe anemias	Thrombocythemia Aplastic anemia
Rare conditions	Osteogenesis imperfecta Glutaric acidemia types I and II
Infectious diseases	Bacterial endocarditis (Roth's spots) CMV infection Herpes
Poisoning	Carbon monoxide

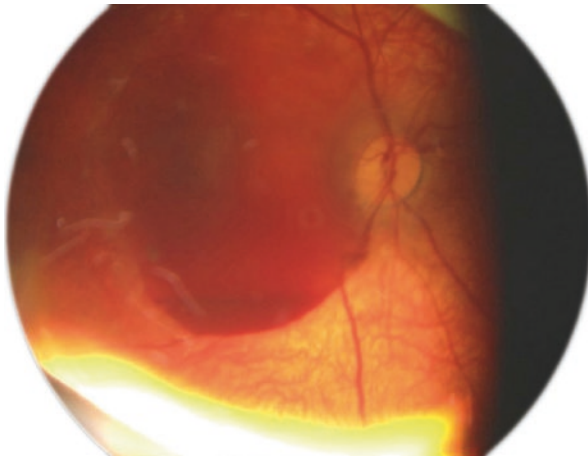


Fig. 9.13 Terson syndrome. Child with a middle cerebral artery aneurysm rupture: enormous preretinal hemorrhage obscuring the posterior pole. As fundus exam was not ordered until day 16, there may also have been other types of retinal hemorrhages that had regressed

9.5 Dating

The ability to date hemorrhages in the fundus would be of great diagnostic value. The coexistence of old and recent retinal hemorrhages would indicate that injuries occurred repeatedly, at intervals, over time, and were thus suggestive of habitual abuse. Unfortunately, this is not currently feasible by fundus exam alone.

To the best of our knowledge, only one study has reported different-age retinal hemorrhages in SBS suspects with subdural hematomas [28]. The author considered retinal hemorrhages to be of different age if both red (“fresh”) and pale or white-centered (“older”) hemorrhages were found on the initial fundus exam. He based this on the hypothesis that white-centered retinal hemorrhages result from

either traumatic capillary rupture with formation of a fibrin-platelet clot or from central clearing of a formerly homogeneous hemorrhage. He used the fact that pale and white-centered RHs disappear first as further evidence that they are older.

The following findings tend to refute those hypotheses:

- White-centered hemorrhages are found in newborns at birth (cf. Fig. 9.11) and in infants who have suffered a proven accidental injury and are examined within 48 h of injury (cf. Fig. 9.10b).
- Small preretinal hemorrhages remain red for several days to several weeks, decreasing in size and thickness and, in some cases, developing a depression in their center, but not a white center. Deep intraretinal hemorrhages often start out red and become paler before disappearing. Both pale and dark red retinal hemorrhages can be found on the initial exam of children who have suffered a single admitted episode of shaking in the previous 24 h.

9.6 Treatment Principles

Retinal hemorrhages regress in less than a month with no sequelae in nearly 90% of cases [35]. Large preretinal hemorrhages, premacular hemorrhagic retinoschisis, and vitreous hemorrhages can take up to 3 months to regress (Fig. 9.14) and cause amblyopia and retinal sequelae.

It is recommended that children with large premacular hemorrhages be placed in a half-seated position while awake to let the blood settle and leave the foveal area clear (Fig. 9.15), thus reducing the risk of deprivation amblyopia.

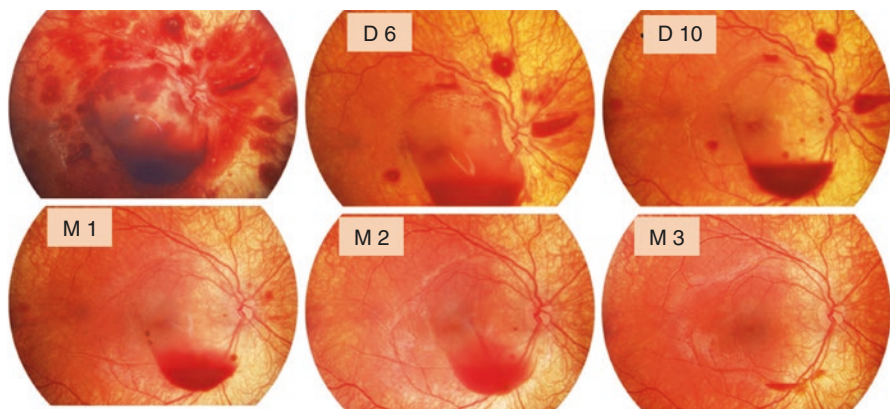


Fig. 9.14 Time course of retinal hemorrhages. Slow regression of profuse retinal hemorrhages (Type 3b)

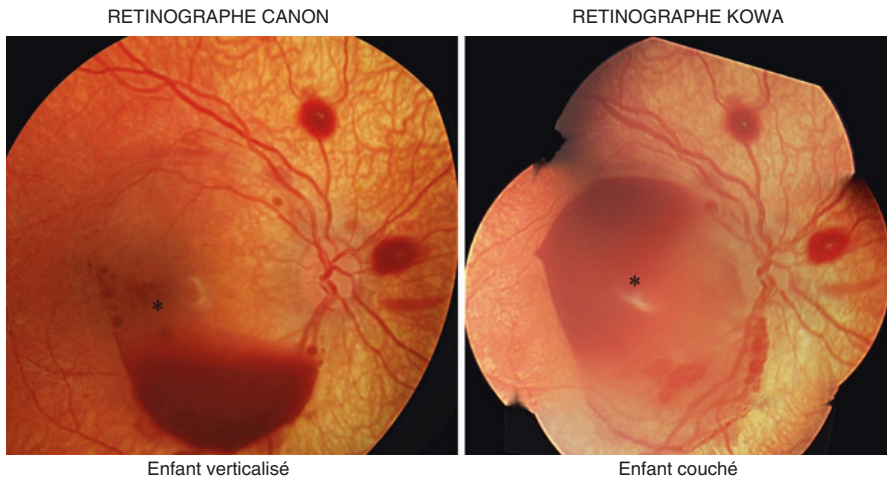


Fig. 9.15 Fundus photos of a child taken 10 min apart. When the child is held upright, the blood settles, leaving the foveal region clear (*asterisk*). Enfant verticalisé = child held upright; Enfant couché = child lying down

Indications for surgery, which are rare, concern the sequelae. Surgery includes:

- Vitrectomy for dense vitreous hemorrhages that do not resorb on their own. The visual prognosis remains poor, however, because vitreous hemorrhage occurs in children with serious brain damage and/or retinal vein occlusion (rare).
- Retinal detachment surgery.
- Epiretinal membrane peeling.

Nd:YAG laser can be used to perforate large premacular subhyaloid hemorrhages, allowing the blood to drain into the vitreous, and can accelerate hemorrhage resorption and reduce the risk of amblyopia. Its benefit has yet to be demonstrated.

9.7 Sequelae

Damage to the visual pathways and cerebral cortex is more likely to result in a poor visual outcome (cortical blindness, blindness due to optic nerve damage, and hemianopsia) than are retinal sequelae. The sequelae from hemorrhage, vitreoretinal traction (primary or secondary), and, more rarely, retinal ischemia include deprivation amblyopia, persistent retinal folds, epiretinal membranes with thickening of the neuroretina, and loss of the foveal pit, macular holes, preretinal fibrosis, retinal detachment, and areas of atrophy or pigmentation at the macula or in the periphery (Fig. 9.16).

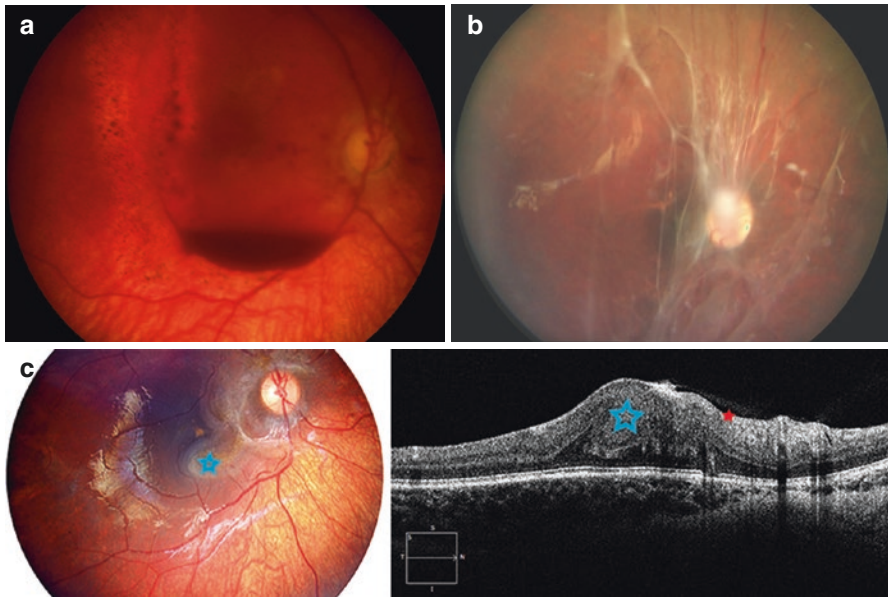


Fig. 9.16 Long-term sequelae of Type 3b hemorrhages. (a) Atrophic, pigmented scar in the macula; the preretinal hemorrhage has not completely disappeared. (b) Total optic atrophy and vitreous bands: blindness due to damage to the optic pathways. (c) Vitreomacular traction syndrome. Epiretinal membrane (*red star*) leading to folding and thickening of the ganglion cell layer (*blue star*) and loss of the foveal pit (cf. normal OCT, Fig. 9.1)

Conclusion

Children who have suffered a traumatic brain injury not witnessed by an impartial observer should have a dilated fundus exam by an ophthalmologist as soon as possible, along with fundus photography of the posterior pole and, if possible, the peripheral retina. The absence of retinal hemorrhage does not rule out the possibility of non-accidental injury. Conversely, the presence of intraretinal (flame-shaped or dot-and-blot) and/or small preretinal hemorrhages in the posterior pole or mid-periphery, even bilaterally, is not conclusive evidence of shaken baby syndrome. However, the combination of any type of hemorrhage (profuse or scattered throughout the retina to the far periphery) with one or more very large dome- or boat-shaped hemorrhages (sometimes resembling hemorrhagic retinoschisis) or with a perimacular retinal fold is quasi-pathognomonic for SBS. That highly suspicious fundus appearance justifies reporting the case to the authorities, once the other (rare) causes have been ruled out. That decision can only be made within a multidisciplinary context.

Key Points

- Children who have suffered a traumatic brain injury should have a dilated fundus exam by an ophthalmologist as soon as possible. Photos taken with a handheld digital fundus camera within 24–48 h are recommended.
- Absent in approximately 20% of cases, retinal hemorrhage is not necessary to the abuse diagnosis.
- Only very violent injury can cause retinal hemorrhage.
- Superficial and deep intraretinal (Type 1) hemorrhages and small preretinal hemorrhages are nonspecific and can be found in all types of injuries. They are common in non-accidental injuries and in newborns after vaginal birth but disappear very quickly. They are possible, but rare, with accidental injury, cardiopulmonary resuscitation, hypoxia, and certain rare illnesses, which need to be ruled out.
- Type 1 peripapillary intraretinal hemorrhages accompanied by papilledema are a sign of increased intracranial pressure.
- Type 3 hemorrhages are primarily and frequently found in non-accidental injuries, of which they, along with hemorrhagic retinoschisis and retinal folds, are the hallmark. They are rare in accidental injuries—even very violent, fatal ones.
- Shaken baby syndrome is the primary diagnostic hypothesis when Type 3 retinal hemorrhages, hemorrhagic retinoschisis, or a retinal fold are accompanied by subdural hematoma, but there is no sign of head impact (and even more so when there are also skin or skeletal injuries).
- There are currently no criteria for dating retinal hemorrhages.

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M.P. Vazquez, D. Haddad, A. Picard, and N. Kadlub

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10.1 Introduction

The head and neck are exposed and vulnerable to physical abuse [1]. This chapter focuses exclusively on injuries to the face, neck, mouth, and scalp; intracranial injuries are discussed in another chapter. The face is the most frequently injured part of the body. Numerous studies have shown that the face or head is injured in 50–75% of cases of inflicted trauma [2–5]. While face and scalp injuries are readily accessible to diagnosis, they can be minor, healing, or, frequently, trivialized by

M.P. Vazquez (✉) • D. Haddad • A. Picard • N. Kadlub
Service de chirurgie maxillo-faciale et chirurgie plastique, Hôpital Necker-Enfants Malades,
149 rue de Sèvres, Paris, France

Faculté de Médecine Paris-Descartes, Université Paris 5, Paris, France
e-mail: marie-paule.vazquez@nck.aphp.fr, marie-paule.vazquez@aphp.fr;
arnaud.picard@aphp.fr; natacha.kadlub@aphp.fr

practitioners. Intraoral and dental trauma often go unrecognized and should always be looked for. The intraoral examination is part of a complete pediatric exam. Anything that seems suspicious—multiple lesions at different stages of healing, lesions in uncommon locations for accidental injury, a failure to seek treatment for (or accord importance to) such lesions, a lack of concordance with the reported history, or the lack of a plausible explanation—should alert the clinician to the possibility of abuse. Basic pediatrics training does not adequately cover facial, oral, and dental pathology, hence the importance of multidisciplinary cooperation between general practitioners, pediatricians, maxillofacial surgeons, plastic surgeons, dentists, and pediatric dentists, depending on the clinical presentation. The practitioners must be alert to these types of injuries, so that he can get the child removed from his home as quickly as possible for the latter's protection. Once that is done, he should endeavor to treat all injuries with the potential for long-term functional, morphological, or cosmetic or psychological impact aside from that due to the abuse itself. Due to their location, facial sequelae and scarring are always visible and can impact a child's inclusion both in society and at school.

10.2 Clinical Signs

Craniofacial injuries in abused children involve the head (33%) and face (61%) [6]. Injuries to the face and scalp can be divided into torn-out hair, contusions, ecchymoses, and hematomas (62%), cuts (26%), burns (3%), fractures (2%), and bites (1%). While intraoral injuries seem to be less common (6%), they are clearly underappreciated. They include injuries to the oral mucosa (contusions, 43%; cuts, 28.5%) and to the teeth (28.5%). A more recent study confirms this distribution but notes a higher percentage of intraoral lesions (12%) [4].

10.2.1 Clinical Examination

In addition to questioning the family, the examiner should interview the child (if possible), keeping in mind that the conversation might cause severe distress. The child can be indirectly questioned using games and miming. The practitioner may discover that certain daily functions or actions are painful reminders of facial abuse, such as feeding, suckling, eating meals, combing hair, or taking medical photos. The other things that should arouse suspicion are those found with any abuse—faltering growth, behavior problems, neglected or delayed care, and inconsistent explanations about the circumstances behind injuries. The physical exam should begin far from the injured areas and end with an examination of the face and the inside of the mouth, as that examination may revive painful memories for the child. The inspection is essential and continues with gradual palpation of all facial structures, beginning with the non-injured areas. The intraoral examination may be difficult. It may be impossible to insert a tongue depressor, dental mirror, or even a very gentle gloved finger into the mouth, which reinforces the suspicion of abuse. Bringing a light close to the child's face may also be difficult. Nevertheless, the inside of the mouth must be examined under good, focused lighting; inspection should include all mucous membranes—on

the inside of the cheeks, the upper and lower vestibules, the intermaxillary commissures, the hard and soft palate, the tongue and the floor of the mouth, the tonsils, and the walls of the pharynx. Should this examination prove difficult or impossible, it should be done later by an experienced pediatric maxillofacial surgeon, assisted by a pediatric dentist to avoid having to repeat the intraoral examination. Examination under general anesthesia may be considered in certain exceptional cases.

10.2.2 Description of the Injuries

While the injuries found are nonspecific, what makes them suspect is their number, associations, uncommon locations, differing ages, and inconsistency with the reported history [2, 3, 7]. Medical photographs are very helpful at all stages for diagnosis and as evidence. In some cases, old or recent family or school photos can also help with retrospective diagnosis.

10.2.2.1 Soft Tissue Injuries

1. *Contusions, ecchymoses, and hematomas* are the most common injuries. Multiple injuries without a plausible explanation by the family suggest abuse. The shape of the bruises is often suggestive, like marks left by fingers pressed against the neck or eyelids and marks from blunt objects on the cheeks or lips or localized areas of hair loss. Hematomas are caused by direct violent blows to the face, ears, and neck or by throwing a child or pushing his face, against a hard surface. These injuries tend to occur in specific locations, depending on the mechanism: the lips and perioral region for force feeding; the orbital/palpebral region (Fig. 10.1), nose, and mastoid for punches; the cheeks and ears for slapping and pushing the child against an object; the neck for strangulation; and the ears for restraining or hard, repeated, continuous rubbing with both hands, which causes



Fig. 10.1 Severe facial trauma with periorbital hematomas. Eight-year-old girl. Zygomatic bone fracture. Investigation required

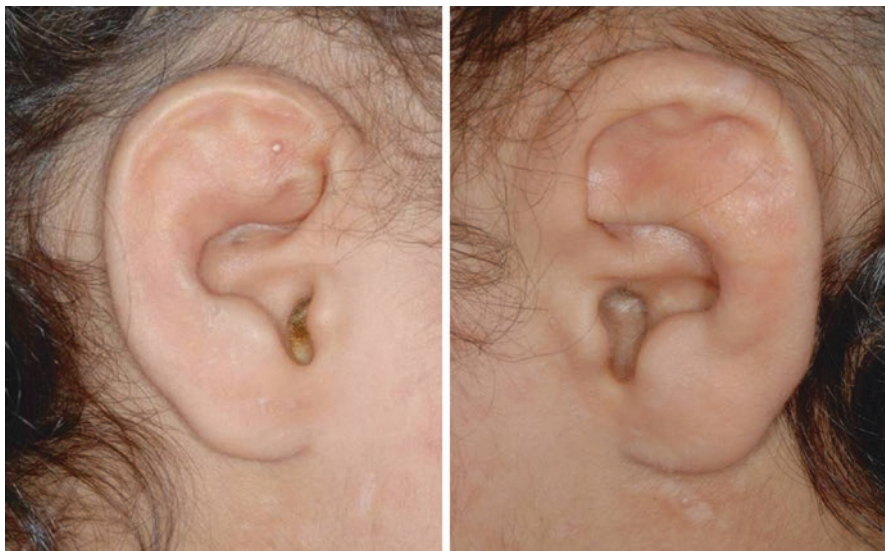


Fig. 10.2 Bilateral post-traumatic cartilage damage due to proven abuse. Right and left ears of a 4-year-old girl. Associated facial scars, one of them visible below the left earlobe

damage to the cartilage known as “cauliflower ear” (Fig. 10.2). These types of injuries usually disappear within a few weeks and can leave pigmented or depigmented marks on the skin.

2. *Excoriations, wounds, and scars* are visible injuries that—while readily accessible to diagnosis—can sometimes be mistaken for the signs of infectious or autoimmune disease. They are suspicious if they are multiple, infected, and/or neglected; have a particular, suspicious shape; or are of different ages. In the medium term, they can leave a variety of unsightly, deforming scars requiring treatment. The clinical appearance can include crusty excoriations, epidermal abrasions, scratches, pinches, bite marks, and punctiform or linear wounds with clean or contused edges. Abrasions are found in cases of crushing-type injuries against a hard surface, such as when a child’s face is pushed against a rough wall or when a child is dragged along the floor on his cheek or face. Wounds will vary in appearance depending on the object used and how long ago they were inflicted, and secondary infection—which is common—is evidence of a lack of treatment. They can resemble impetigo (Fig. 10.3). The added presence of old or still-inflamed scars increases the level of suspicion. One might see:
 - (a) Recent narrow or broad wounds (or scars) due to sharp objects such as scissors, nail files, screwdrivers, or knives, primarily around the mouth, on the nose, and in the forehead/eyelid region (Fig. 10.4).
 - (b) Recent contused wounds (or scars), irregular in shape, rounded or stellate, with thinned or necrosed edges, due to repeated crushing-type injuries with various blunt objects (baby bottles, golf clubs, or umbrellas), primarily around the mouth and nose. There may also be tissue loss (Fig. 10.5).

Fig. 10.3 Labial and nasal lesions with tissue loss. Two-month-old infant brought to the emergency department by his grandmother. Crusty, necrotic, ulcerated, infected lesions initially labeled as impetigo. Correctly diagnosed by the emergency physician. Proven maternal abuse with repeated crushing-type injuries



Fig. 10.4 Multiple cuts and scars. Four-year-old girl. Old scars from multiple clean cuts on the nose and upper lip, accompanied by intraoral and dental injuries and injuries elsewhere on the body, including human bites. Force-feeding with instruments, including spoons and forks

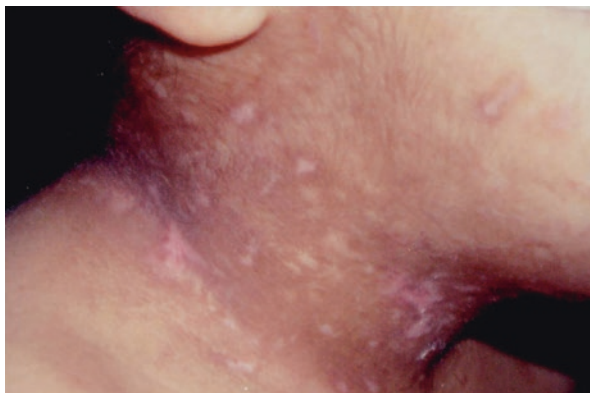


- (c) Recent scratch wounds (or scars) on the neck from attempted strangulation (Fig. 10.6) or on the cheeks, lips, or nose from attempts to suffocate the child and stifle cries.
3. *Bald patches* are caused by violently grabbing handfuls of hair while lifting the child up, or repeated hair pulling. These are areas of scalp that are totally or partially bald, at various stages of healing (Fig. 10.7). Hair begins to grow back as soon as the child is taken out of his usual setting, except, in some cases, in areas that are permanently scarred.
 4. *Burns* are found in 5–20% of physically abused children [8] (also see chapter on burns). They are located on the face in 13% of cases and account for 3–5% of abuse-related facial injuries [6]. They are mainly thermal burns. For a given burn size, the deeper the burn, the more serious its impact on survival, function, and cosmesis. Mechanisms of abuse-related burns to the face and neck include:
 - (a) Scalding: if the child is not held immobile, there should be splash marks peripherally; if the child is held still as he is being scalded, the edges of the burn will be more sharply demarcated.

Fig. 10.5 Tissue loss. Same 2-month-old infant as in Fig. 10.3, after cleansing the crusty wounds. Necrosis due to crushing and repeated, violent, forcible maneuvers. Upper lip defect (middle third of the lip, philtrum, and Cupid's bow). Lower lip defect from the skin of the lip to the labiomental groove. Full-thickness defect of the nasal septum



Fig. 10.6 Scars on the neck and lower face. Two-year-old girl. Multiple bilateral depigmented scars due to strangling maneuvers and neck scratches



- (b) Direct contact: here, the burns replicate the shape and size of the object used, e.g., iron (Fig. 10.8), hot object, or cigarette. Cigarette burns leave round lesions 0.7–0.8 cm in diameter, with areas of necrosis, edema or erythema, or multiple round depigmented scars. In some cases, the thermal agent is an odd one. Ho [9] reported a clinical case in which a mother burned her 4- and 7-year-old children's faces with boiling hot eggs. As with other types of abuse, associated factors may add to the suspicion: parents blaming the burn on siblings, inconsistencies between the account of the supposed accident and the clinical signs, a delay of more than 24 h in seeing a doctor, an account that is inconsistent with the child's age and development, and the presence of other traumatic injuries.

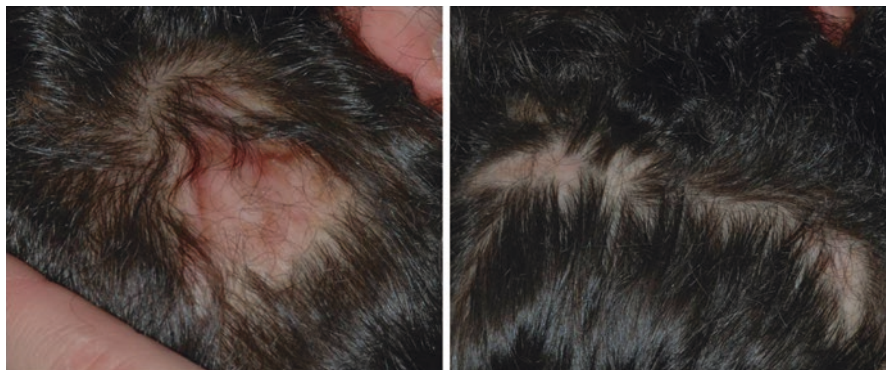


Fig. 10.7 Bald patches at different stages of healing. Four-year-old girl. Hair torn out by one of her parents

Fig. 10.8 Burned cheek. Six-week-old boy. Intentional burn with the print of a hot iron



5. *Human bites*. Forty-three percent of abuse-related bites are on the head or neck [10]. Human bites are more superficial and cause less damage than animal bites. Certain visible characteristics—including the shape, color, and size—of the bite should be accurately documented for the purposes of identifying the perpetrator [11]. Photos should be taken from several angles with a ruler next to the lesion. When the bite mark is well defined, a print should be taken and used to make a cast, which is then superimposed on the photos of the bite (Fig. 10.9). A study of the suspect's dentition makes comparison possible. In France, a bite mark is considered forensic evidence that should be observed and recorded. The print

Fig. 10.9 Human bite.
Two-month-old infant.
Maternal abuse



Fig. 10.10 Open dog bite wound in a 9-year-old girl left alone with the dog. *Left*: the initial jagged-edged appearance of the bite. *Right*: sequelae after surgical repair

includes the upper and lower dental arches with the upper and lower incisors; wider bite marks include the canines and molars. There may be a central hematoma between the marks from the dental two arches, caused by tongue pressure or deliberate sucking during sexual abuse. The print shows both the shape of the teeth and their individual abnormalities, such as malpositions and shape or number abnormalities, and is thus critically important in identifying the culprit. The canines leave the most visible, deepest marks. The adult intercanine distance in adults ranges from 32 to 45 mm. If it is less than 30 mm, the bite is most likely from a child, rather than an adult abuser. Recent human bites should be sampled by swabbing the lesion and storing the swab in the freezer for later DNA identification of the attacker.

Bites can be animal in origin. The animal is usually domestic—the family dog or a friend's pet. Abuse—or, more often, very severe neglect—should be suspected when the family is ambiguous about what happened or greatly minimizes it. The child is often directly blamed for getting bitten and the animal left with the family. Parents do not always appreciate the risk of the child being bitten again (Fig. 10.10). We saw one case where a child was severely bitten on the face on three different

occasions, resulting in tissue loss. Her father was a dog handler who blamed the bites on his daughter each time. We also saw a case of a young child who was bitten by his licensed childminder's dog. The woman invented a story about an accidental injury so she could keep her dog. Dog bites have a very specific appearance, with a combination of narrow lacerations like those made by glass and contused, jagged wounds made by the dog's fangs when it refuses to let go of its prey [12]. No other type of injury can explain that appearance. A dog that has bitten will do it again when it is around the same child; hence, it is essential to keep the dog away from the child.

10.2.2.2 Facial Bone Fractures

Facial fractures require great force and should always raise suspicion, particularly in young children. They account for 2–5% of abuse-related injuries [4, 6]. The younger the child, the more likely it is that the diagnosis will be missed. There are two frequently asymptomatic fractures that can go undetected in young children: mandibular condyle fractures and isolated orbital floor (blowout) fractures. Missing these diagnoses initially can result in significant functional sequelae.

All facial fractures can have functional, morphological, and cosmetic sequelae:

- Nasal fractures, if displaced.
- Mandible fractures, which can involve any part of the mandible, by direct or indirect mechanisms. Condylar fractures are the most common; not clinically obvious, they are caused by direct impact to the chin (Fig. 10.11). There is subtle preauricular pain on palpation, occasional mild edema, pain on palpation of the anterior wall of the external auditory meatus, and mildly restricted mouth opening. In abuse cases (punches, falls caused by being thrown to the ground), such fractures may go undetected and so should always be looked for. One major concern is the potential for temporomandibular joint ankylosis (Fig. 10.12), which reduces or eliminates the child's ability to open his mouth, and serious hemifacial growth problems. Other fractures of the ramus or body of the mandible require even more forceful impact. These are much more obvious clinically, with localized pain at the fracture site, hematoma, trismus (with ramus fractures), and bone misalignment and malocclusion if the fracture is displaced.
- Orbital floor ("blowout") fractures, which are caused by a direct blow (like a punch) to the eye, are found primarily in young children. A blowout fracture should be suspected if a child presents with conjunctival hemorrhage, a history of epistaxis (ask about this), and vertical diplopia in an older child (Fig. 10.13). Such fractures may go undetected, resulting in permanent diplopia and enophthalmus. They may be accompanied by ocular injuries and require an emergency ophthalmological exam.
- Zygomatic bone (formerly called the "malar bone") fractures are caused by an extremely violent blow to the cheekbone from being punched or thrown against a hard surface. The clinical signs include cheekbone swelling and hematoma, pain on palpation, and restricted mouth opening. Zygomatic fractures may be accompanied by an orbital floor fracture. They can have morphological and ophthalmic sequelae.

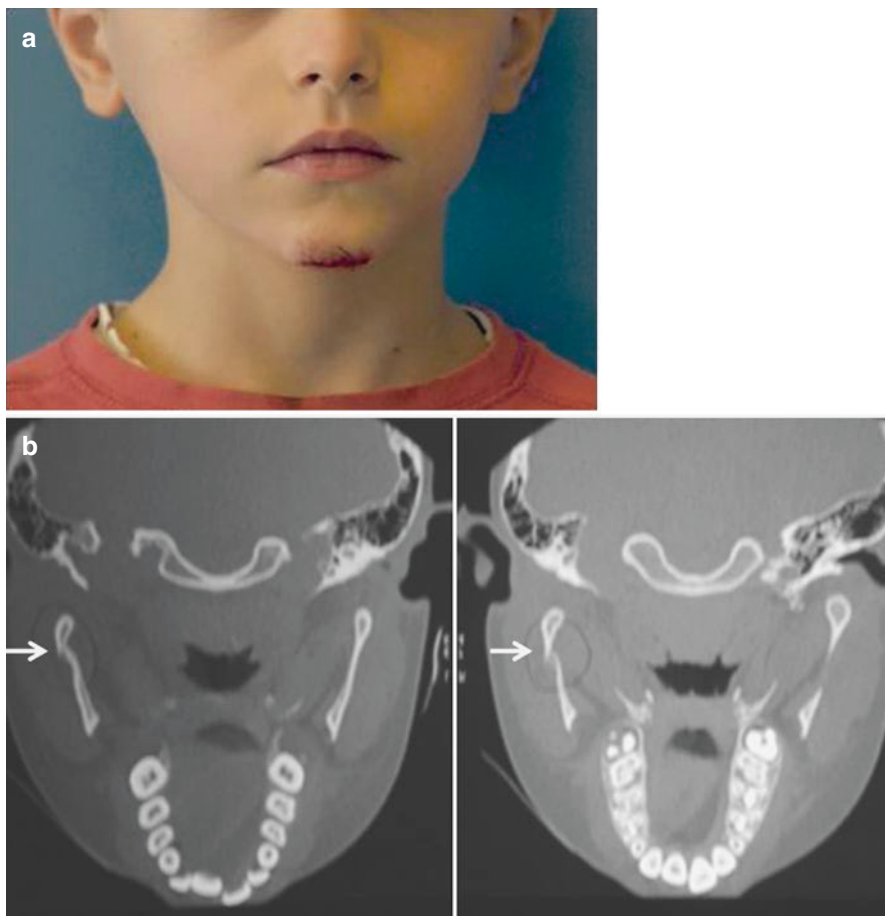


Fig. 10.11 Mandible fracture. (a) Chin wound in a 7-year-old boy due to a direct punch during parental abuse. Moderate pain on mouth opening. (b) CT scan, coronal sections through the mandible. Subcondylar fracture of the right ramus (*arrows*)

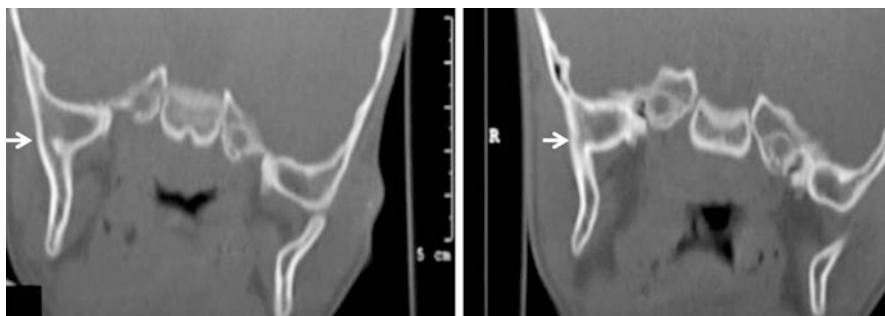


Fig. 10.12 Temporomandibular joint ankylosis secondary to an untreated condylar fracture. Eight-and-a-half-year-old boy with restricted mouth opening. CT scan, coronal sections through the mandible. Complete absence of the joint space on the *right* (*arrows*) and asymmetric bone growth

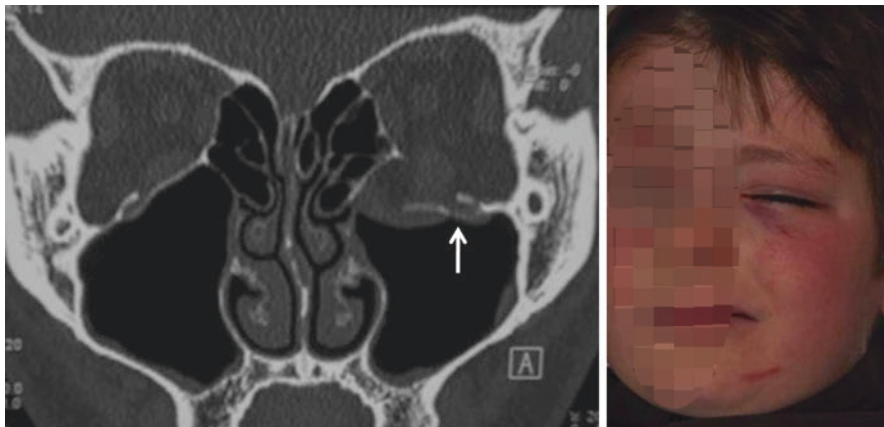


Fig. 10.13 Orbital floor (blowout) fracture. Eight-year-old boy. *Left:* coronal section, CT scan. Left orbital floor (blowout) fracture with inferior rectus muscle entrapment. Direct blow to the child's eye by an adult. *Right:* external appearance. Clinically, the child presented with epistaxis and an inability to elevate the eye

10.2.2.3 Intraoral and Dental Injuries

The oral cavity can suffer a number of abuse-related injuries, thanks to its symbolism in verbal communication, its importance to eating, and its highly sexual connotation. Injuries can involve the mucosa, the mucosa and underlying muscle, and the teeth [1, 2, 5, 7, 13].

Mucosal Injuries

Mucosal injuries are most often caused by forcibly inserting an object into a child's mouth (in order to force him to eat or stop him from screaming or crying) or by fellatio (in the context of sexual abuse). The most common lesions are hematomas, wounds, lacerations, burns, and scarring. The appearance and location of such lesions vary widely, depending on the type of instrument used [7]. There can be more serious injuries involving necrosis or tissue loss; these are generally discovered later, in the form of retractile scars, adhesions, or deformities (Fig. 10.14). Such injuries are often neglected and can lead to inflammatory, ulcerated, necrotic, and infected lesions or scarring, suggesting an infectious or autoimmune condition. Lesions can be found in any part of the intraoral anatomy and are usually accompanied by perioral injuries.

The Labial Frenula

The frenulum of the upper lip is at particularly high risk of injury in children who are learning to walk. A frenulum injury is considered highly suspicious in children younger than 8 months or older than 2–3 years—that is, outside the age where children learn to walk. Two different mechanisms can cause this type of injury. The first is forcibly inserting a blunt object into the mouth—usually a spoon being pushed roughly into the mouth of a child who refuses to eat or is crying. Clenching his jaws, the child prevents entry of the spoon, which slides along the gum and severs the frenulum of the upper lip at its base. The second mechanism involves stretching the frenulum of the upper lip, either by pulling very forcefully on the lip or by hitting

Fig. 10.14 Sequelae of intraoral mucosal and dental injuries. Injuries to the hard palate, intermaxillary commissures, and soft palate caused by violent force-feeding of a 2-year-and-a-half child



Fig. 10.15 Traumatic soft palate injury. Two-and-a-half-year-old girl. Large soft palate defect with retractile scarring due to proven abuse. Velar shortening and a cleft-like appearance in the posterior third of the soft palate, resulting in velopharyngeal insufficiency (food reflux through the nose and hypernasal speech)



the child directly on the mouth, which displaces the lip beyond the frenulum's limits, causing a partial- or full-thickness tear. This injury is often accompanied by other injuries to the lips, buccal or gingival mucosa, or teeth.

Other Traumatic Oral Injuries

While lesions such as wounds, hematomas, and scars on the inside of the cheeks, the intermaxillary commissures, the hard and soft palate, and the tonsillar pillars are highly suspicious for abuse, any anatomical area can be injured in abuse situations. These situations include:

- The forcible insertion of spoons and forks between the dental arches, resulting in dilacerations and grinding injuries to the lips, vestibules, inside of the cheeks, and tongue. These are accompanied by dental injuries such as angular or arch-shaped partial crown fractures or abnormally missing teeth.
- The forcible insertion of spoons or forks deeper into the oral cavity, injuring the hard palate, soft palate, intermaxillary commissures, and even the tonsillar pillars (Fig. 10.14). Any breach in the soft palate can lead to velopharyngeal insufficiency with food reflux through the nose and hypernasal speech, which are highly suspicious for abuse (Fig. 10.15).

- Intentional burning of the buccal, lingual, and hard palate mucosa with hot liquids or objects.
- The mucosal structures can also be injured by other objects during attempts to silence a child (pen, toothbrush, or spoon handle) or acts of sadism (screwdriver, nail file, or skewer); this can result in dilaceration, perforation, and necrosis with tissue loss. Such injuries are often accompanied by dental (see below) and perioral injuries.

Nontraumatic Mucosal Lesions

In cases of sexual abuse, clinicians may also see sexually transmitted intraoral lesions such as:

- **Chancres:** A manifestation of primary syphilis, they are found on the tip of the tongue, tonsils, soft palate, lips, or gums. A chancre is a painless, superficial ulceration with a regular, pinkish base. Untreated, the patient will develop secondary syphilis, which manifests as round, flat, bright red papules. Tertiary syphilis can also cause oral lesions, the best known being palatal perforation.
- **Herpetic lesions:** Herpes simplex virus infection of the oral mucosa can cause gingivostomatitis. This type of lesion generally occurs in children between the ages of 2 and 4 years and is due to HSV-1. When oral lesions are caused by HSV-2—the type normally responsible for genital lesions—the possibility of sexual abuse must be considered.
- **Condylomata acuminata:** These are papillomatous excrescences. This is a potentially venereal disease caused by types 6 and 11 papillomaviruses. Intraoral lesions are most commonly found on the upper lip, the lingual frenulum, the back of the tongue, and the lower lip [14, 15].
- **Oral lesions due to HIV-related disease:** These include candidiasis, acute necrotizing ulcerative gingivitis, destructive periodontal disease, and viral infections such as herpes, oral hairy leukoplakia, and Kaposi sarcoma. These lesions are not pathognomonic for abuse due to the possibility of mother-to-fetus transmission. They should, however, alert practitioners to possible abuse.

Dental Injuries

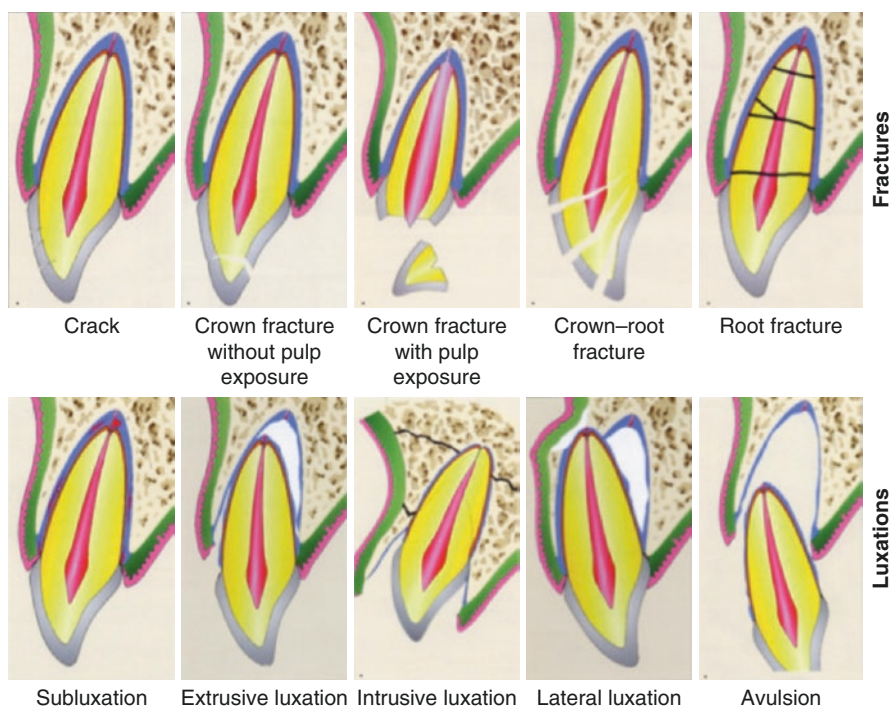
Because traumatic dental injuries are common in children from falling or rough play, they may be trivialized and therefore risk being misdiagnosed in physical abuse [1, 7, 13]. They can involve the primary, mixed, or permanent dentition. The practitioner should be familiar with the timetable and eruption dates for the teeth (Table 10.1). The front teeth are at greatest risk of being injured by direct violent trauma. The following should alert the practitioner to possible abuse:

- Missing teeth in unexpected places, given the child's age and other teeth, leaving a scarred gum in their place
- Gray or black necrotic front teeth
- Fractured teeth, for which the explanation is inconsistent

Table 10.1 Date of eruption, primary and permanent teeth

Primary (milk) teeth		
Age of child	Teeth that erupt	Total number of teeth
6–12 months	8 incisors	8 teeth
12–18 months	4 first molars	12 teeth
18 months to 2 years	4 canines	16 teeth
2–2½ years	4 second molars	20 teeth

Permanent teeth		
Age of child	Teeth that erupt	Total number of teeth
6 years	4 first molars (<i>6-year molars</i>)	24 teeth
6–8 years	8 incisors	24 teeth
8–9 years	4 first premolars	24 teeth
9–13 years	4 canines and then 4 second premolars	24 teeth
12 years	4 second molars (<i>12-year molars</i>)	28 teeth
18–25 years	4 third molars (<i>18-year molars</i>) (or wisdom teeth)	32 teeth

**Fig. 10.16** Types of dental injuries

Possible injuries include (Fig. 10.16):

- Tooth contusion: this is caused by the tooth moving in the socket from a direct blow. There is sometimes a crack in the enamel. A small hemorrhage can often be seen at the cervical margin of the tooth. There is a risk of gradual tooth devitalization and loss.
- Tooth fractures: these can involve the crown, the root, or both and, like contusions, are caused by a direct blow. The front teeth—most exposed to blows—are most often affected. In some cases the pulp is exposed, making the tooth very painful.
- Dentoalveolar fractures: these involve a segment of the alveolar bone that is mobile and has several teeth still in place—usually incisors or possibly a canine.
- Luxation: luxation can be complete (avulsion), with the tooth completely displaced from the socket (Fig. 10.17). The ideal in such cases is to be able to recover the tooth for authentication and detection of past injury and for possible reimplantation if the tooth is a permanent one. Luxation can also be partial, in



Fig. 10.17 Avulsed primary canine tooth. Two-year-old boy. Tooth found by a family member, healthy. Root is not resorbed, suggesting an extremely violent impact to the canine region that knocked out the tooth without fracturing it

Fig. 10.18 Anomalous missing teeth. Two-and-a-half-year-old girl missing primary maxillary incisors 51, 61, and 62, mandibular incisor 72, and primary mandibular canine 73. The parents had no plausible explanation. Accompanied by facial (Fig. 10.4) and intraoral (Fig. 10.15) injuries



which case the tooth, though mobile and displaced from its normal position, has not come out of its socket. Partial luxation can occur in any direction: vestibular luxation (tooth tilted toward the upper or lower lip), lingual or palatine luxation, extrusive luxation (tooth partially displaced out of the socket), or intrusive luxation or impaction (tooth driven deeper into the alveolar bone). The gums are hemorrhagic, edematous, and painful.

Multiple injuries, different-age injuries, inconsistencies in the parents' account, failure to seek care, the force needed to cause such injuries, and missing teeth that should normally be present given the child's age and dentition (Fig. 10.18) all point to the possibility of abuse.

10.3 Imaging

Radiographic examination is essential and should be guided by the clinical exam in order to limit X-ray exposure to the absolute minimum required [1, 7]:

- The digital orthopantomogram, or panoramic dental X-ray, is a simple exam that can be done on children aged 4 years and up; it shows all of the teeth in both dental arches, the tooth germs within the bone, and the temporomandibular joints. Technically, the exam requires the child to hold a mouthpiece for 15 s, which may not be possible in an abuse context (Fig. 10.19).
- Facial CT is a rapid exam that can be done at any age, though sedation is sometimes required in very young children; it shows all of the facial bones, the temporomandibular joints, and the dental and alveolar structures.
- Cone beam computed tomography (CBCT) is an imaging technique that uses less ionizing radiation than CT and is intended for more specific evaluation of dental and alveolar bone structures.
- Targeted periapical and bitewing X-rays offer tooth-by-tooth views and are taken by a pediatric dentist.

Fig. 10.19 Panoramic dental X-ray showing mixed dentition. Eight-year-old boy



10.4 Dating

The presence of both recent and old injuries is usually needed to conclude that cervical, facial, oral, or scalp injury in a child was intentional. Such dating is used as evidence that the child has suffered repeated abuse. In the typical course, there is a contrast between the child's improvement while in the hospital and his relapse upon returning home.

- Wounds, excoriations, and epidermal abrasions: These start out hemorrhagic, becoming crusty on day 2; they may become infected in 4–10 days and be sometimes mistaken for impetigo (Fig. 10.3). They heal fairly quickly, with or without scarring. If there is tissue loss or necrosis, healing will be slower, by second intention, with adhesions, retractions, and secondary deformities.
- Bites: Bite marks change over time. The size and shape can be used for about 48 h.
- Burns: Superficial (first- and superficial second-degree) burns heal in 4–10 days, developing dry crusts, and then disappear, leaving no sequelae or perhaps depigmented or hyperpigmented areas. Deeper (intermediate or deep second-degree) burns become crusty, oozing, and painful and infected in 5–10 days. They do little or no healing on their own and are often discovered at the infected, neglected stage.
- Facial fractures: These often go unrecognized in abused children, especially in the very young ones, and are discovered at the sequela stage when another clinical situation arises. Although they are hard to date in such cases, the degree of associated growth problems, if any, can be an indirect guide in diagnosing and dating the injury.
- Dental injuries: These are crucial for dating. Dating is easier if there are dental exams and/or photographs from different stages of the child's development, as normal variations do exist. Clinical examination by a pediatric dentist provides a very accurate time line of normal tooth loss and eruption, and inconsistencies may be found in some situations (Fig. 10.18). In addition to the clinical exam,

X-rays and photographs should be taken. The analysis is both spatial, tooth by tooth, in the dental arches, and temporal, through reconstruction of the child's dental history. Normally, each tooth goes through an immature phase, which starts at eruption and lasts about 18 months for primary (milk) teeth and 3 years for permanent teeth. Physiological root resorption is characteristic of primary teeth; it continues until the primary tooth falls out and is replaced by the permanent tooth (Fig. 10.20). Root resorption begins approximately 3 years before the primary tooth naturally falls out, as the tooth germ of the underlying permanent tooth advances. The teeth are numbered, and given the functional and cosmetic repercussions, it is essential to specify its number and name on the initial certificate when describing the injuries to each tooth (Fig. 10.21). Every person has two arches in their mouth: a lower dental arch in the mandible and an upper dental arch in the maxilla. Each dental arch has two quadrants or hemi-arches—right and left. For the permanent teeth, the upper right quadrant is numbered 1, the upper left quadrant 2, the lower left quadrant 3, and the lower right quadrant 4. The numbering is continued for the primary teeth. The upper right quadrant is

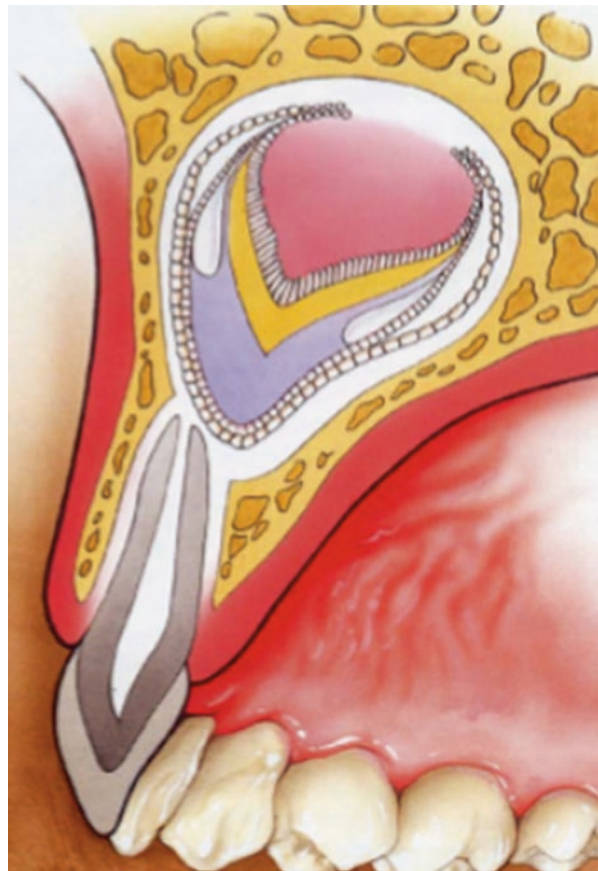


Fig. 10.20 Normal resorption of the primary tooth root upon contact with the permanent tooth germ

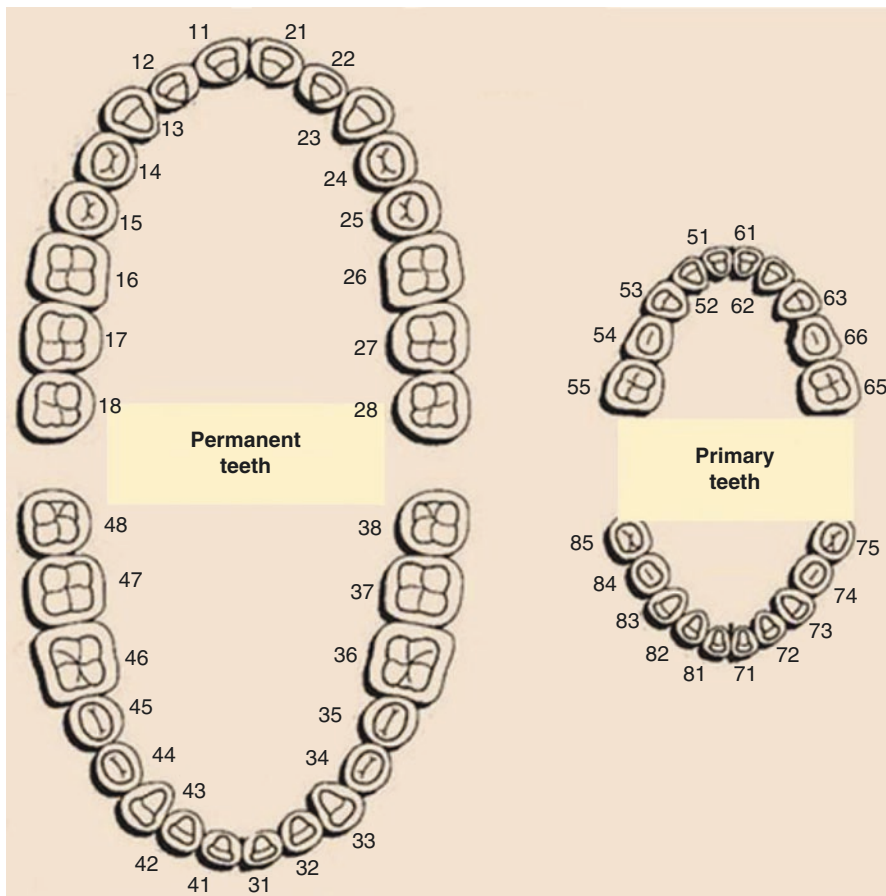


Fig. 10.21 Tooth numbering

numbered 5, the upper left quadrant 6, the lower left quadrant 7, and the lower right quadrant 8. The teeth themselves are numbered as follows: 1 = central incisor, 2 = lateral incisor, 3 = canine, 4 = primary first molar or permanent first premolar, 5 = primary second molar or permanent second premolar, 6 = permanent first molar (6-year molar), 7 = permanent second molar (12-year molar), and 8 = permanent third molar (18-year molar or wisdom tooth). The numbering system for teeth inside the mouth combines the two preceding numbering systems: first the quadrant number and then the tooth number. For example, tooth #16 is the upper right (1) permanent first molar (6); tooth #71 is the lower left (7) primary central incisor (1).

The timetable for the appearance of the primary and then permanent teeth is well established (Table 10.1). Though the dates can vary, the order of appearance is consistent and the averages are known.

10.5 Differential Diagnosis

10.5.1 Accidental Injuries

Many neck and face injuries occur in areas that can be injured accidentally in childhood, but in those cases the findings are fully consistent with the reported history, which is precise and detailed. A large number of injuries, different-age injuries, and neglect of the injuries are all highly suspicious. Hospitalization is necessary for both diagnostic testing and the child's protection. Intraoral accidental injuries are much less common. There are only two classic accidental injuries that may be mistaken for intentional injuries:

- Midline ulcers or hypertrophic scars on the middle or posterior third of the hard palate, due to the infant's overzealous sucking on the nipple of his bottle (Fig. 10.22). These injuries occur on the midline of the hard palate.
- Lateral soft palate wounds, which can occur when a child falls with a pencil or another long, narrow object in his mouth. The object slides along the rigid surface of the hard palate and pierces the soft palate. These injuries are usually lateral.

Dental injuries should be analyzed by a pediatric dentist to determine whether they are consistent with the reported history. For example, avulsion of a perfectly

Fig. 10.22 Differential diagnosis. Hypertrophic cicatricial lesion of the hard palate. Three-year-old boy. Lesion was secondary to an ulcer caused by the nipple of his bottle (intense sucking on the nipple), discovered at the age of 6 months in an infant boy. Lesion strictly isolated and stable



healthy primary canine tooth in a 2-year-old is impossible without very violent direct impact to the canine region (Fig. 10.17).

All other traumatic intraoral injuries are highly suspicious.

10.5.2 Nontraumatic Conditions

There are a number of nontraumatic conditions whose signs can resemble those of abuse. Those conditions must be distinguished correctly from an abuse situation.

- Bald patches caused by hair pulling by another person must be distinguished from alopecia due to a nutritional deficiency. In the latter, the hair stops growing and thins out, and the diameter of individual hair strands decreases. Dermatitis related to systemic lupus erythematosus, scleroderma, or aplasia cutis congenita must be ruled out. The alopecia in those cases is permanent. Another condition that must be ruled out is trichotillomania, in which a child self-mutilates in a context of emotional deprivation (indirect abuse) or a behavior problem of psychiatric origin. In trichotillomania, hair loss is limited to the temporal and parietal regions, often on the right side for right-handed children, and the scalp is intact.
- Hematomas and ecchymoses can occur as a result of some congenital and acquired clotting factor and vessel wall disorders such as hemophilia, von Willebrand disease, thrombocytopenic purpura, and Ehlers-Danlos syndrome. These can be ruled out based on clinical examination, blood tests, and interviews with the parents (also see the chapter on skin lesions).
- Abuse-related burns must be distinguished from infectious or allergic vesiculobullous lesions, such as those caused by herpes, impetigo, photodermatoses, and epidermolysis bullosa (also see the chapter on burns).
- Bites must be distinguished from certain skin conditions such as pityriasis rosea, eczema, and tinea corporis. The history of the illness quickly corrects the diagnosis.
- A number of conditions can arouse suspicion of abuse, such as congenital insensitivity to pain or, rarely, some congenital and acquired bone disorders that primarily involve the face, like cherubism and infantile cortical hyperostosis (Caffey disease) [16, 17]. Other congenital and metabolic bone diseases are not, for the most part, specific to the face and are treated in Chap. 6. In those situations, the history, complete clinical examination, a high-quality skeletal survey, and lab testing help rule out abuse.

10.6 Treatment Principles

In the acute phase, referring pediatricians may need to call upon maxillofacial surgeons, plastic surgeons, and dental surgeons skilled in working with children. The expected course of the injuries and the child's growth—which will alleviate certain sequelae but exacerbate others—must be considered. The treatment should be

appropriate to the situation and should not cause pain; this may mean treating under nitrous oxide, using topical treatments that do not require direct contact (sprays and showers), and in some cases treating under general anesthesia. Pain therapy should be started and evaluated on a continuing basis. Each injury gets its own treatment—dental care, local care, or surgery—preferably in a hospital setting. When there are injuries around and inside the mouth, the feeding method should be decided as a team with the nurses. Scar massage is very rarely indicated and should be avoided. In the secondary phase, each injury should have its own treatment schedule: plastic surgery for the face, soft palate repair, intermediate dental rehabilitation, and orthodontia. All of these treatments should be reevaluated and adapted as the child grows.

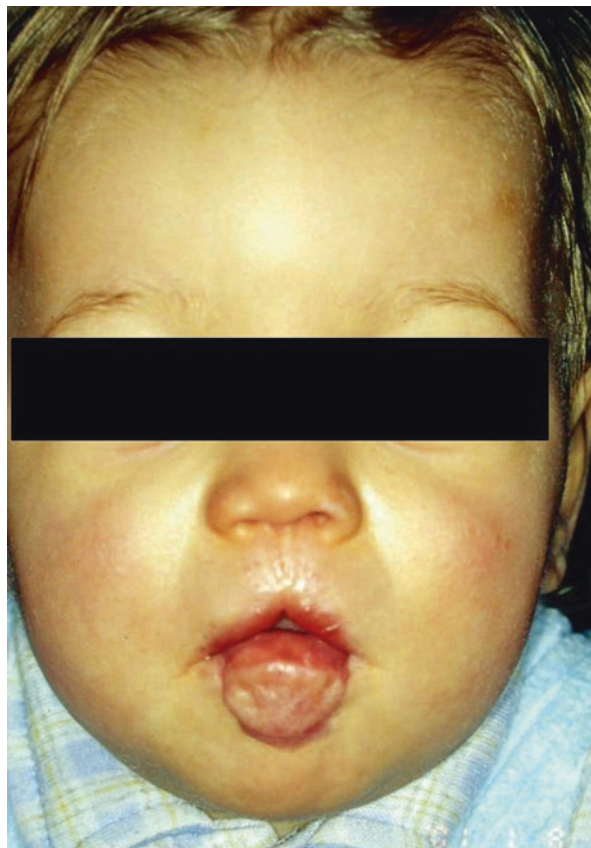
An avulsed permanent tooth can be reimplanted by a family member or emergency physician if the local condition allows it. After rinsing it in clean water and without rubbing the root, the tooth should be reinserted into its socket while holding it by the crown. This procedure is fairly painless and helps save the tooth while waiting for a specialist's opinion and splinting. If an alveolar bone fracture, dilacerated gum, or foreign body in the socket makes reimplantation impossible, the tooth should be kept in a moist environment (saline solution, milk, or the patient's saliva) at room temperature while awaiting a dental specialist's advice; it should never be placed in ice. The other possible dental injuries are summarized in Fig. 10.16.

10.7 Sequelae

Many abused children suffer permanent facial or oral sequelae. Often, facial injuries are not seen until there is already scarring or morphological sequelae and/or until there are bone or tooth growth problems. The prognosis will depend on the child's age, on the stage, or stages at which the sequelae are discovered and the treatment started. Sequelae may be functional, morphological, cosmetic, or psychological. Very often plainly visible, they can impact social and educational integration. They weigh heavily on the child's psychological future and add to the psychological damage of the abuse itself. The most obvious sequelae are those involving the lips, nose, eyelids, and skin. There are two types of nasal sequelae: saddle nose deformity and destruction of the columella and the septum. Saddle nose is caused by a direct blow to the nasal dorsum (bridge)—by a punch, for example. The nose has a shortened, widened dorsum and resembles a boxer's nose. The mechanism by which the columella is destroyed is repeated direct trauma, such as punching or inserting objects into an infant's mouth while crushing the nose. This can destroy the skin of the columella and the cartilage of the septum. In some children there is communication between the two nasal cavities.

Labial sequelae are difficult to evaluate in infants due to the small size of each anatomical unit. They include scarring, gap in the mucocutaneous junction, and partial- and full-thickness defects in anatomical units such as the philtrum, Cupid's

Fig. 10.23 Labial sequelae. Progress of the child shown in Fig. 10.3. Sequelae of upper lip (philtrum and Cupid's bow) and lower lip (temporary skin graft) defects



bow, and intermaxillary commissures (Fig. 10.23). Such sequelae worsen as the child grows, becoming increasingly visible. Labial sequelae after tissue loss or burns can cause an adhesion effect that interferes with maxillary bone growth and tooth orientation, requiring multidisciplinary treatment by a plastic surgeon, maxillofacial surgeon, and orthodontist. Large amounts of cutaneous scarring are treated with laser and surgery, but the treatment should consider what the child has been through, his wishes, and therapeutic advances. Morphological sequelae may require multiple surgeries over time. Surgery itself can be traumatizing, and the treatment schedule should be planned as a team, with the help of a pediatric psychiatrist.

Key Points

- The face is the most frequently affected part of the body in cases of inflicted injury.
- The key diagnostic features are multiple, different-age injuries, located in areas at little risk of accidental injury, a lack of medical care, and the lack of a plausible explanation.

- Face and scalp injuries (torn-out hair, contusions, ecchymoses and hematomas, wounds, burns, fractures, and bites) have to be recognized, because they can be minor, partially healed, or considered trivial.
- Too often, intraoral and dental injuries (due to forcible insertion of an object, violent pulling on the lip, burns, etc.) are underappreciated.
- Bites should be described in detail and photographed (it is sometimes possible to make a cast) in order to identify the perpetrator by comparison with his dentition.
- Always look for mandibular condyle and orbital floor fractures, as these can have significant functional sequelae if left untreated.
- The presence of both recent and old injuries allows confirmation of repeated violence. Dental injuries are decisive for dating, because the teeth appear according to a very accurately established timetable.
- With accidental injuries, the findings are fully consistent with the account of the accident and the child's age. Clinicians should be aware of two specific accidental injuries: midline ulcers of the posterior hard palate due to an infant's overzealous sucking on the nipple of his baby bottle and lateral soft palate wounds due to an older child falling with a pencil or another long, narrow object in his mouth.
- All possible congenital and acquired etiologies (infectious, hematological, autoimmune, etc.) must be ruled out and nutritional deficiencies and/or emotional deprivation (hair loss) recognized.
- Facial sequelae and scarring, which are always visible thanks to their location, can have a serious impact on social and educational integration.

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C. Rey-Salmon (✉)

Unité Médico Judiciaire—Hôtel Dieu, 1 place du Parvis Notre Dame, Paris, France

e-mail: caroline.rey@aphp.fr

C. Jung • M. Bellaïche

Service de Gastro entérologie—Hôpital Robert Debré, 48 Boulevard Serurier, Paris, France

e-mail: marc.bellaïche@aphp.fr

11.1 Definitions

As we begin this chapter on sexual abuse, we run immediately into the problem of definition. There are a number of expressions currently in use. “Sexual abuse” is the term most commonly used in the literature. “Sexual exploitation” refers to the use of human beings for profit—i.e., pornography and prostitution. “Sexual violence” emphasizes the violent or sadistic aspects of certain acts, and “incest” refers to intrafamilial abuse.

In a 1977 lecture to the American Academy of Pediatrics, Henry Kempe [1] defined sexual abuse as the “involvement of dependent, developmentally immature children and adolescents in sexual activities that they do not fully comprehend, to which they are unable to give informed consent, or that violate the social taboos.”

The National Center for Child Abuse and Neglect focuses on the position occupied by the abuser and defines sexual abuse as any contact or interaction between an adult and a child in which the child is used for sexual stimulation—whether that of the adult or some third party [2].

Krugman and Jones [3] discuss the criminological means and define sexual abuse as the participation of a child or adolescent minor in sexual activities that he is unable to understand, are inappropriate to his psychosexual development, are coerced through violence or seduction, or violate social taboos.

Making reference to age and developmental stage, the World Health Organization (WHO) defines sexual abuse as acts performed on a child by an adult or significantly older person for the purposes of sexual pleasure [4].

While there are several proposed definitions, each highlighting particular aspects, all of them frame sexual abuse as child abuse.

Sexual abuse includes direct physical contact (fondling or penetration) and acts that occur via visual, verbal, or psychological interaction (indecent exposure, the production of pornographic images of children, obscene telephone messages, masturbation requests, etc.).

It is important to distinguish sexual abuse from sexual play, which is common and concerns young children at the same developmental stage exploring their genitalia through mutual interest, with no coercion or sexual penetration [5].

11.2 Epidemiology

Sexual violence is endemic. According to a 2011 meta-analysis on prevalence, 12.5% of minors—or one in every eight children—are victims of sexual abuse, which reportedly affects 18% of girls and 7.6% of boys. Girls are two to three times more likely to be victims than are boys in Asia, Australia, Europe, North America, and a number of African countries [6]. Prevalence is lower in China, particularly among girls, and several protective factors have been proposed, including Confucian family values and how masculinity is defined [7].

Although sexual abuse occurs in all sociocultural contexts, it remains little-discussed by professionals due to difficulty in imagining such situations—especially in high-income settings.

Incest is characterized by repetition and progression from fondling to penetration.

Nearly all perpetrators are male and are known to the child in more than two thirds of cases.

Perpetrators may have been victims themselves, and the connection between abuse committed and abuse suffered should always be considered, particularly in adolescence.

11.3 Risk Factors

11.3.1 Risk Factors for Sexually Abusing a Child or Adolescent

The risk factors for sexually abusing a child are better known for men than for women.

On the individual level, sexual abusers are a heterogeneous group in terms of both criminology and psychopathology. Studies have, however, found some common characteristics:

- Poor emotional skills
- Identity construction based on an overvaluation of sexual performance
- Erroneous beliefs or cognitive distortions regarding child sexual abuse
- A history of physical, sexual, and/or psychological abuse [8]

On the relational and familial level, there are also some risk factors more specific to perpetrators of child sexual abuse:

- Difficulty with intimate relationships
- Social isolation
- Association with sexually delinquent peers
- A patriarchal family environment

Lastly, there are *community and societal risk factors*. These include:

- Social norms that support male superiority and the sexual rights of men over women
- Opinion makers who do not do enough to fight gender inequality
- A social construction of masculinity based on violence and sexual domination [9]

11.3.2 Risk Factors for Being Sexually Abused as a Child or Adolescent (0–18 Years)

On the individual level, anyone can be sexually abused at some time in life. For children and adolescents, however, there are certain characteristics that are found more often. Individual risk factors include:

- Being female
- Being between 6 and 11 years of age, but only for intrafamilial sexual abuse
- Being between 12 and 17 years of age, but only for extrafamilial sexual abuse
- Having previously suffered physical or sexual violence
- Having an intellectual impairment, a disability, a chronic illness, or a mental health problem [10]

On the relational and familial level, certain factors are associated with a higher risk of being sexually abused; the most frequently reported are as follows:

- Lack of parental supervision
- Parental alcohol or drug use
- Parents with mental health problems
- The presence of a stepfather in the household [11]

On the institutional level, sexual violence is more likely to develop in a rigid hierarchical system, a culture of silence that protects the reputation of the institution, whether educational or religious, and a lack of regulatory mechanisms—a lack of organizational policy and employee screening, nonavailability of a best practice standards, and a lack of reporting procedures.

At the societal level, risk factors include:

- The hypersexualization of youth
- Traditional norms regarding gender roles
- An ideology in which men have sexual rights over women
- A lack of consequences for committing child sexual abuse [12]

11.4 Clinical Presentation

11.4.1 Circumstances of Discovery

There are a variety of circumstances in which a doctor might encounter a child or adolescent sexual abuse victim. There are two possible basic scenarios.

In the first scenario, there is a clear request for help, and the doctor will have no major difficulties getting the history and managing the case. The child or adolescent reports, unsolicited, the sexual abuse she just experienced—usually in an extrafamilial context—or consults for something that happened in the past, an assault or incest situation from several months, or even years, earlier, that she just revealed to a loved one, who accompanies her. False allegations are extremely rare with such unsolicited disclosures, and what the child says should be listened to closely.

In the second scenario, the sexual abuse is not verbalized directly, and the doctor may have problems. The child expresses what happened to her via the somatic complaints or behavior problems that prompted the visit and need to be decoded. Running away and attempting suicide are two common ways in which adolescents reveal sexual abuse.

Table 11.1 Symptoms of sexual abuse in children and adolescents

Psychosomatic disorders
– Abdominal or pelvic pain
– Secondary encopresis/enuresis
– Genital pruritus
– Anorexia or bulimia
– Obesity
General behavior disorders
– Running away/suicide attempt
– Sleep disorders (hypersomnia, insomnia, and nightmares)
– Isolation or withdrawal
– Aggressivity and hyperactivity
– Seduction behavior
– Refusal to wash or undress
– Fear of physical contact
– Substance abuse
School problems
– Disinvestment or hyperinvestment
– Concentration problems
– Recent change in grades
Sexual problems
– Compulsive masturbation
– Unexplained fear of pregnancy
– Age-inappropriate sexual speech or play
– Excessive inhibition or modesty
– Sexual aggression against other children

Numerous suggestive signs and symptoms have been reported in the literature. One cannot assert that a child has been sexually abused once or more based on a single symptom; what sets off alarm bells is a combination of multiple factors (Table 11.1).

However, *inappropriate sexualized behaviors* are a good indicator of sexual abuse in young children.

To give a few examples, touching one's own genitals and masturbation, attempting to see an adult or another child naked, and showing one's genitals to another child are all considered normal in children between the ages of 2 and 5 years.

In that same age group, however, mimicking sexual movements, trying to put one's tongue in someone's mouth when kissing, or inserting objects into the genitals warrants an assessment [13].

11.4.2 Sexually Transmitted Infections

The discovery of a sexually transmitted infection (STI) can lead to a diagnosis of sexual abuse.

An STI in a prepubescent child should raise suspicion of sexual abuse and prompt testing for other STIs. After age 1, the likelihood that an STI was caused by sexual abuse is:

- Very high for *Neisseria gonorrhoeae* and *Treponema pallidum* infections. In these cases, sexual abuse is almost certain.
- High for *Chlamydia trachomatis*, *Trichomonas vaginalis*, and HSV2.
- Moderately high for HSV1 and *Papillomavirus*.
- Low for *Candida albicans* and nonspecific vulvovaginitis infections.

In practice, *Neisseria gonorrhoeae*, *Chlamydia trachomatis*, and *Treponema pallidum* are the leading cause of sexually transmitted infections in children. While *Neisseria gonorrhoeae* and *Treponema pallidum* infections—aside from the neonatal period and (the very rare) nonsexual vertical transmission—indicate sexual abuse, *Chlamydia trachomatis* is far less specific; because the pathogen can persist for 2–3 years, young children can develop the infection from mother-to-fetus transmission [14].

These infections—particularly those due to *Chlamydia trachomatis*—are often asymptomatic. Otherwise, they present as vulvovaginitis (not cervicitis, like in adults) and urethritis. Rectal or pharyngeal involvement is rare (*Neisseria gonorrhoeae* and *Chlamydia trachomatis*). The risk of developing an upper infection from a lower one has not been determined, but appears to be high for *Neisseria gonorrhoeae* and for *Chlamydia trachomatis*. Syphilis has the same presentation as in adults. The most common cause of leukorrhea is nonspecific bacterial vaginitis (due to *Mycoplasma hominis*, *Gardnerella vaginalis*, *Ureaplasma urealyticum*, *Bacteroides* spp., etc.). Some microorganisms, such as *Mycoplasma hominis* and *Ureaplasma urealyticum*, can be found in the normal vaginal flora at any age, and their presence does not in itself prove sexual transmission [15].

Sexually transmitted viral infections include papillomavirus, HIV, hepatitis B, and herpes virus (mainly HSV2). Papillomavirus infections are discussed in Sect. 11.6 below.

11.4.3 The Clinical Examination

11.4.3.1 Urgency of and Practical Conditions for the Examination

Sexual abuse requires a highly specialized clinical examination. If the doctor seeing the child is unaccustomed to performing such exams, it is better not to do so and to send the young victim to a specialist team quickly.

If it has been less than 3 days since the sexual assault, it is considered a medico-legal emergency. At that point it is still possible to find recent, unhealed lesions and collect samples for evidentiary purposes (to look for semen and touch DNA and take toxicology samples). If the abuse is less recent, it is up to the doctor to decide on the urgency of the clinical examination based on the context and his or her experience. It is always preferable to perform an in-depth clinical exam, however—not just to look for suspicious semi-recent or healing lesions, but also to reassure the child and her family.

To avoid further trauma, the examination should be done in a calm setting, taking as much time as necessary. A properly conducted examination is reassuring, provided the doctor gains the patient's trust, explains the examination process, and pays careful attention to her psychological state. It is also important to pay attention to the family, whose emotional reactions can in large part determine the child's.

11.4.3.2 The Interview

The first phase of the clinical examination is the interview with the child. If possible, the child should be seen without the parents. Having a neutral, reassuring third person (nurse, social worker, etc.) present can be extremely helpful. The interview is done in successive stages, in order to be as non-leading as possible. After being introduced to the child, the doctor explains his or her mission. The goal of the first part of the interview is to gain the child's trust. This is facilitated by talking to the child about her life in general (family composition, rank among siblings, home environment, etc.) and her activities (school, nonschool activities, social life and relationships, etc.). During this step, the doctor assesses the child's psychological state and developmental level. She also determines the child's orientation in time and space.

The second part of the interview deals with the sexual assault itself, allowing the child to describe it in her own words, completely freely, even if she contradicts herself or hesitates. At most, the doctor can repeat her last words back to her to try to get things going again if the child stops talking. It is not until the next part that the doctor asks specific, open questions aimed at clarifying certain points while continuing to use the child's vocabulary.

By the end of the interview, the following should have been ascertained:

- The date, time, location, and circumstances of the assault
- Whether it was a one-time or repeated assault
- The nature of the assault (fondling, penetration, ejaculation, condom use)
- Whether there were any threats or violence
- The relationship between the victim and perpetrator—emotional ties or authority relationship

11.4.3.3 The General Physical Examination

The general physical examination looks for signs of violence (ecchymoses, hematomas, bite marks, etc.), which are described in detail (size, color, and location) and drawn on a diagram or photographed. Ecchymosis on the inner thighs is highly suggestive of sexual abuse (Fig. 11.1). Describing the functional impact of the lesions is helpful in determining total work disability.

If there are blood or semen spots on the child's clothing, the latter must be stored in a paper (not plastic) bag for possible analysis later by a crime laboratory.

11.4.3.4 The Gynecological Examination

The entire vulva should be examined: the labia majora and minora, the posterior labial commissure, the clitoris, the urinary meatus, and the hymen. Colposcopy photos preserve the findings and reduce the number of repeat exams.

The "frog-leg" position (patient on her back, knees bent, and soles of the feet together) should be used for young girls. Under good lighting, the hymen is exposed by simply separating the labia majora (labial traction). Adolescent girls should be examined in lithotomy position; good visualization of the hymen often requires the use of a cuffed tube or Foley catheter (Fig. 11.2). The configuration of the hymen (Figs. 11.3, 11.4, and 11.5), the appearance of its free edge, and its compliance

Fig. 11.1 Ecchymoses on the inner thighs. Postpubescent adolescent girl in lithotomy position. Allegations of penile vaginal penetration the previous day. Two bluish ecchymoses on the upper third on the right inner thigh, suggesting that she was gripped by a hand

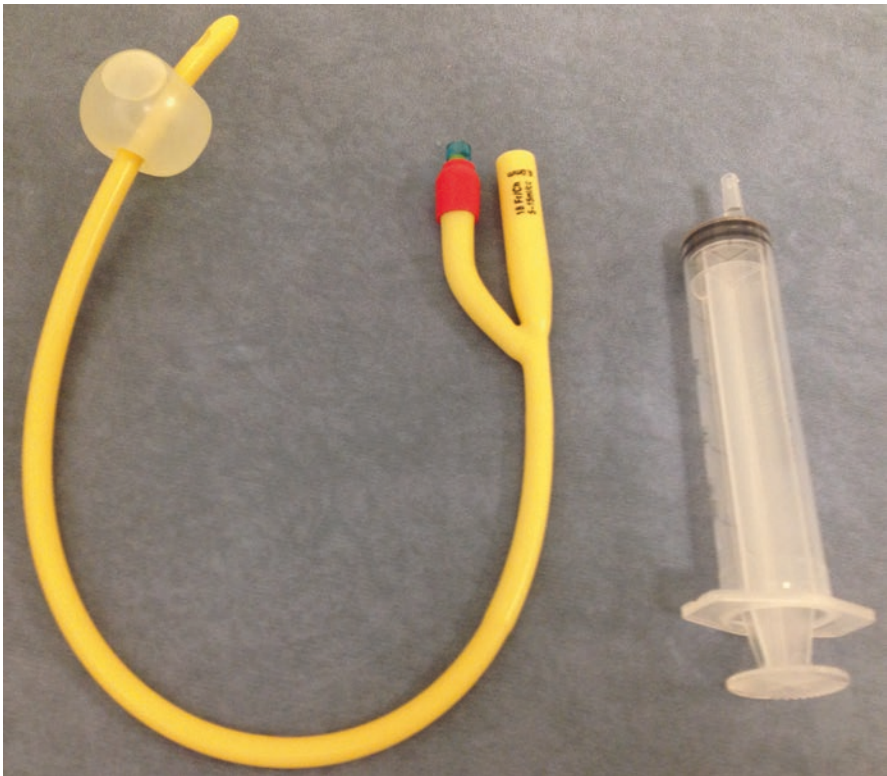


Fig. 11.2 Foley catheter allowing more sensitive analysis of the hymen

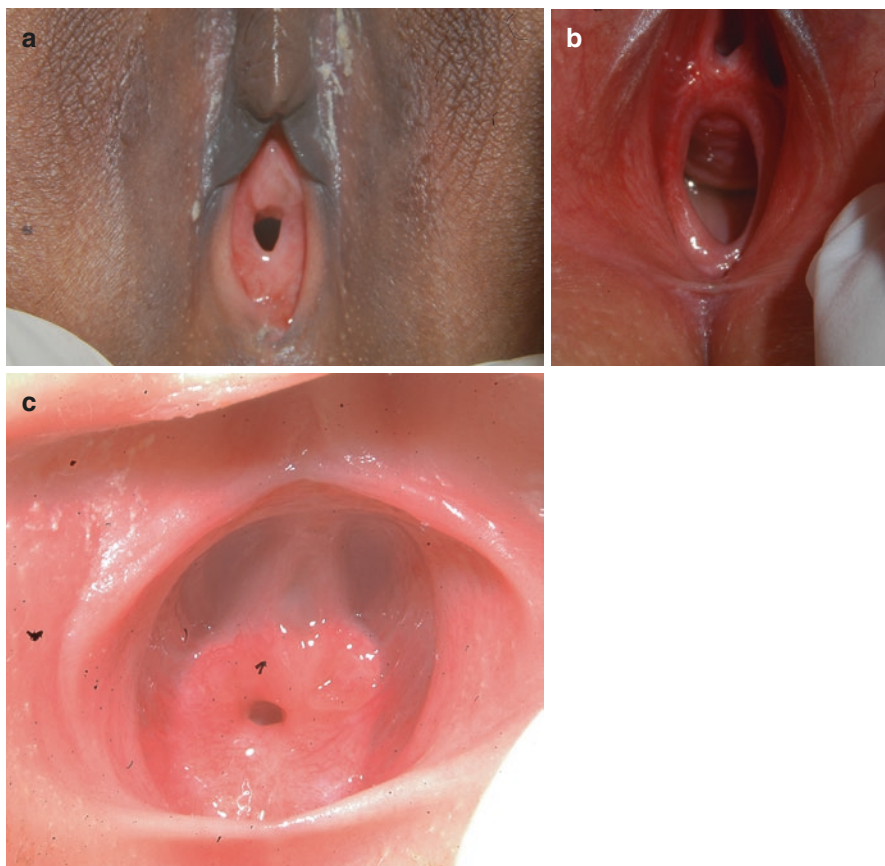


Fig. 11.3 Normal annular hymens with different-size openings. Examination done in frog-leg position. The free edge of the hymen is regular, and there are no injuries meeting the medicolegal definition of defloration. (a) Four-year-old girl. (b) Nine-year-old girl, wide vaginal opening. (c) Five-year-old girl, very narrow punctiform opening

should be described (Figs. 11.6, 11.7, and 11.8). The hymen is sometimes imperforate (Fig. 11.9). For medicolegal purposes, defloration is defined as a complete break in the hymenal tissue up to the vaginal wall (Fig. 11.10). Ecchymosis can sometimes be seen (Fig. 11.11). For most adolescent girls, the hymen is flexible and elastic enough to allow full sexual intercourse without injury, making it impossible for the examiner to either confirm or rule out previous complete penile penetration. In prepubescent girls, however, vaginal penetration always causes a traumatic tear of the hymen, accompanied in some cases by injuries to the vaginal wall.

11.4.3.5 The Anal Examination

In children, the proctological examination is also done in the “frog-leg” position; in adolescents, it is done in supine position with the knees bent. The knee-chest position allows a good view of the anus. The skin, external genitals, and anus are inspected; digital rectal examination is not recommended. The doctor inspects the skin for irritation, wounds, abrasions, and/or hematomas and the anus for fissures,

Fig. 11.4 Normal semilunar (or crescentic) hymen. Two-year-old girl examined in frog-leg position. No allegation of sexual abuse. Examination motivated by recent change in behavior. Semilunar hymen with a highly regular free edge

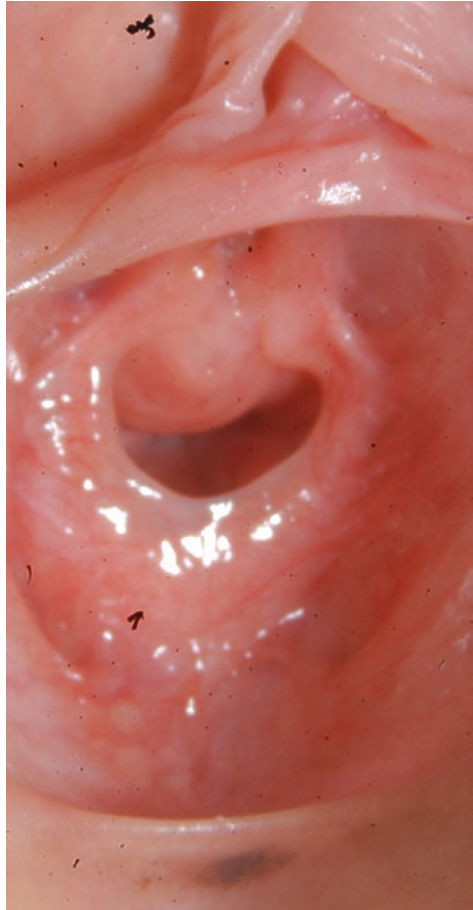


Fig. 11.5 Normal semilunar (or crescentic) hymen. Eleven-year-old girl examined in lithotomy position. Allegations of sexual fondling. Semilunar hymen with a highly regular free edge



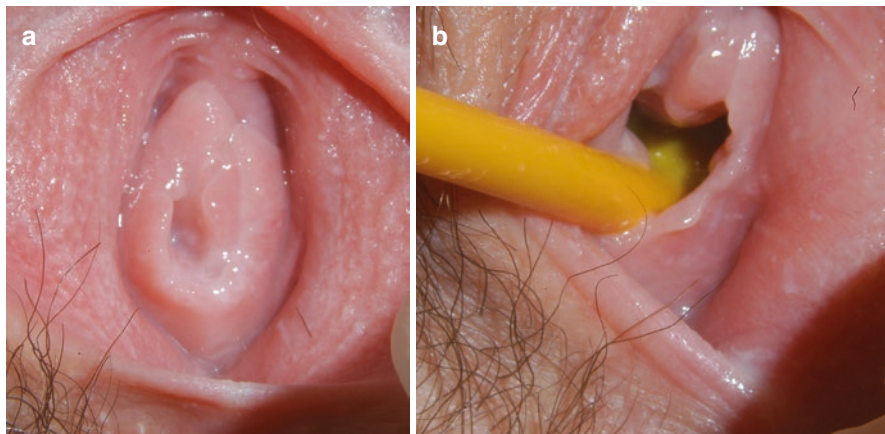


Fig. 11.6 Advantages of using a Foley catheter for examining the hymen. Fifteen-year-old girl in lithotomy position. Allegations of digital vaginal penetration 2 weeks prior to examination. **(a)** Without the catheter, the hymen cannot be explored using labial traction. **(b)** With the catheter, a normal semilunar hymen can be seen. The left edge of the hymen is readily visible. There is no injury meeting the medicolegal definition of defloration



Fig. 11.7 Normal denticulate or fringed hymen. Twelve-year-old girl in lithotomy position. Allegations of digital vaginal penetration 3 days prior to the examination. Denticulate hymen whose right edge is fully displayed against the catheter balloon. There is no injury meeting the medicolegal definition of defloration

Fig. 11.8 Normal septate hymen. Fifteen-year-old girl in lithotomy position. Allegations of sexual fondling without penetration. Septate hymen with a band extending from the 12 o'clock to 6 o'clock position. There is no injury meeting the medicolegal definition of defloration

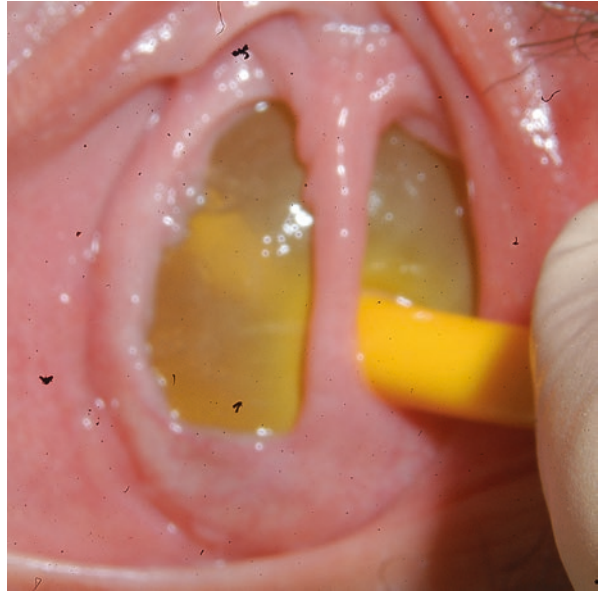


Fig. 11.9 Imperforate hymen. Five-year-old girl in frog-leg position. No allegation of sexual abuse. Examination motivated by the child's sexualized talk



Fig. 11.10 Medicolegal defloration. Sixteen-year-old girl in lithotomy position. Allegations of vaginal penetration less than 24 h earlier. Medicolegal defloration with torn hymen (*arrow*)



Fig. 11.11 Hymenal ecchymosis. Fourteen-year-old girl in lithotomy position. Allegations of vaginal penetration 24–36 h earlier. Hymenal ecchymosis (*arrows*)

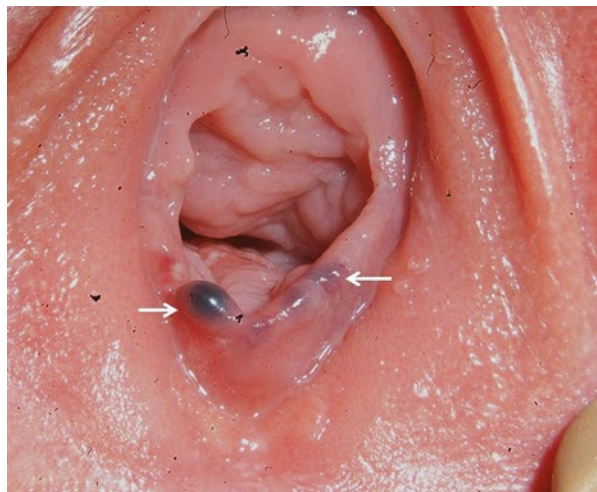


Fig. 11.12 Anal fissures. Sixteen-year-old boy in knee-chest position, allegations of anal penetration less than 24 h earlier, bouquet of superficial anal fissures between the 4 o'clock and 8 o'clock positions



Fig. 11.13 Anal wound. Fifteen-year-old boy in knee-chest position; allegations of anal penetration less than 24 h earlier. Anal wound at the 12 o'clock position



ulceration, skin tags, and/or flattening of the skinfolds radiating from the anal orifice (Figs. 11.12 and 11.13). Perineal anatomy is a bit different in children than in adults, and it is not uncommon to observe “physiological” anal gaping if there is stool in the rectal ampulla or the examination position favors it (Fig. 11.14).

11.4.3.6 Limitations of the Examination

Over the past 20 years, the recommendations on medical examination of children suspected of being sexually abused have changed substantially. In the 1980s and

Fig. 11.14 Anal gaping in a 5-year-old child.

Allegations of anal gaping and suspected incest by the mother, in the midst of a divorce. Imputability difficult to determine



1990s, there was a great deal of data published on the genital and anal findings from examinations of children who had not been victims of sexual violence. Performed systematically on thousands of children, those examinations yielded a better understanding of normal variations [16, 17]. The data has been updated numerous times, most recently in 2011 [18].

Though the examination is normal in the majority of cases, that does not rule out the possibility of sexual abuse [19–23]. Indeed, discovery often comes long after the events, and most young victims are examined several days, if not months, after the assault, when any traumatic injuries have already disappeared. Moreover, some sexual assaults leave no visible marks on the child's body—for example, fondling without penetration or penetration in an already sexually active adolescent girl. Hence, listening to the child is of the utmost importance.

Some injuries are nonspecific and can be difficult to interpret. A large prospective study from the United States, published in 2002, analyzed a sample of 2384 children referred for sexual abuse; it found that the clinical features were nonspecific in more than 96% of cases [21].

Rarely, the findings suggest sexual abuse or sexual contact in an adolescent girl [24]. The prevalence of traumatic injuries in girls who were penetrated vaginally is on the order of 4–6%, depending on the study [25].

Gynecologically, however, we have to distinguish between prepubescent children and adolescents. Penile vaginal penetration invariably causes hymenal injury in prepubescent girls, most often inferiorly. Vaginal bleeding will be immediate.

Regarding the anal region, the injuries that do occur disappear quickly and often completely. Anal injuries are even less common than injuries to the vulva and hymen [26, 27]. This highlights the importance of routine sample collection to look for semen after sexual abuse with penetration, even when the examination appears absolutely normal.

In some cases, examination long after the alleged events reveals lesions suggestive of sexual abuse. Bruni [28] reviewed the clinical examinations of 50 children in whom the perpetrator admitted anal penetration and found that anal scars and skin tags (either single or multiple) were very common (84% and 32% of cases, respectively).

Some perineal injuries are caused not by sexual abuse, but by intentional or unintentional ill-treatment (e.g., penile hair tourniquet and poultices, respectively). The circumstances behind these injuries must be elucidated via careful, in-depth investigation.

Lastly, it is important to be alert to situations in which there is more than one form of abuse. At one British center, the percentage of battered children that were also sexually abused ranged from 7 to 24% [29].

The French National Authority for Health recently proposed a system for classifying medicolegal findings according to whether they are definitely or not definitely related to sexual abuse [30]. There are more detailed classification schemes available indicating normal variations examiners are likely to encounter [31].

Findings Suggestive of Sexual Abuse

- Lacerations of the labia, posterior labial commissure, penis, scrotum, perineal tissues, or perineum (may also be caused by accidental injury)
- Partial or complete tear of the hymen, hymenal ecchymosis, and vaginal laceration
- Deep perianal laceration involving the external anal sphincter
- A break in the hymenal ring with no visible tissue to the base, in the posterior (inferior) half of the hymen, confirmed in knee-chest position
- *Neisseria gonorrhoeae*-positive genital, anal, or pharyngeal culture outside the neonatal period
- Confirmed syphilis, aside from perinatal transmission
- Pregnancy
- Semen inside or on the child's body

Because child victims have no sexual experience, they often lack even the words to describe what happened to them. They might honestly mistake vestibular penetration—that is, between the rolls formed by the labia majora but not past the hymen—for hymenal penetration. In that case, a report of sexual penetration is not deceitful, but due simply to the child's lack of experience. This is why it is useful to try to reconstruct with the child what the abuser did, on the exam table, and note her feelings, to get the best possible idea of what happened.

11.5 Additional Tests

The examiner decides which additional tests should be done based on the child's account. The decision should consider the child's age, the type of assault, how long it has been since the last assault, any signs and symptoms suggesting a possible STI, the perpetrator's serological status (if known), the prevalence of STIs in the child's community, and the fears expressed by the child and her family. Adolescent girls are recommended to have a complete workup for pregnancy and sexually transmitted infections (see below).

The victim and her parents should be given the results at a follow-up visit.

11.5.1 Testing for Sperm

The only absolute proof of recent sexual contact is the presence of spermatozoa. It is essential to look for sperm if the latest assault was recent and included sexual penetration. Samples are taken, based on the history, at every site that might contain semen, even if there is no traumatic injury [32]. Cytological testing for sperm involves swabbing and smearing on a slide, with no cover slip or fixative. The recommendations are to do four swabs and three slides per site and store the swabs in the freezer. The first swab is left intact (not smeared), so that it can be used for later testing should the slides be negative.

Spermatozoa can be found up to 48 h after the assault in the vagina and up to 5 days at the cervix. The time interval is shorter in prepubescent girls due to the lack of cervical mucus. Sperm can be detected for 24 h in the rectum if the victim has not defecated and for 6 h in the mouth if she has not eaten or brushed her teeth [33].

11.5.2 Forensic Samples

In cases of recent sexual assault with sexual penetration, samples are collected for possible genetic identification of the perpetrator; the swabs used for cytological testing and the control swab for the victim should be frozen immediately at -20°C and kept available to the legal authorities.

It is now possible to identify an assailant using what is called "touch DNA," where the assailant's cells are recovered from the child's body—in particular, skin cells, from the areas where she was held, or cells from his saliva, from areas where she was licked or sucked. This is done by soaking a cotton swab in sterile water or normal saline and pressing it against the skin surface to take the sample. That swab, placed back in its sleeve, should also be frozen immediately.

The person collecting the samples must follow strict rules that to avoid contaminating the samples with his own DNA; these include wearing a gown, cap, shoe covers, and a mask and using new gloves for each sample site.

11.5.3 Bacteriology and Virology Samples

A local sample should be collected to look for gonococci if the child exhibits local signs of infection or if the examination is done long after the assault, given that the incubation period is about 1 week.

Serological testing should include TPHA-VDRL, HIV serology, hepatitis B serology (if the child was not vaccinated previously), and hepatitis C serology. These indicate the victim's serological status at the time of the assault and should be repeated at 1 month and at 3 months (or 4 months, if antiretroviral therapy is prescribed).

Chlamydia trachomatis testing requires a urine sample for PCR (polymerase chain reaction)-based identification.

11.5.4 Pregnancy Testing

A beta hCG (β -hCG) pregnancy test should be administered to all adolescent girls past puberty who suffered vaginal penetration. If the initial result is negative but the victim's menstrual period is late, a second test should be offered. If the initial result is positive, the hCG level can be used to date the pregnancy and determine whether it is linked to the assault.

11.5.5 Other Samples

If there is suspicion of drug-facilitated sexual assault—that is, administration of psychoactive substances without the victim's knowledge—blood and urine samples should be collected. The reader is invited to consult the chapter devoted specifically to this topic.

The clothes worn by the child at the time of the assault may contain traces of the assailant and should be stored in paper (not plastic) bags to avoid altering potential DNA until the legal authorities take them.

11.6 Differential Diagnosis

11.6.1 False Allegations of Sexual Assault

All professionals dread false allegations of child sexual abuse. That should not, however, blind us to the fact that the majority of children and adolescents who claim, unsolicited, that they were sexually abused are sincere. They may nevertheless try to conceal the actual perpetrator's identity when they are caught in a "loyalty conflict," that is, faced with the dilemma of having to accuse someone they love or respect—especially a parent.

Most false allegations come from very young children (ages 2–6 years), unconsciously influenced or manipulated by a parent during an acrimonious divorce or

separation. In that context, the signs of distress exhibited by the child are misinterpreted as symptoms of abuse. From there it is only a short step to where a complaint or report sets the legal machinery in motion. The child then has to deal with questioning, medical examinations, and expert evaluations that may ultimately create doubt in her mind about whether the abuse really happened. Hence false allegations have consequences that are comparable to those of a real assault, in the sense that both require a specialized approach [34].

In addition, some adolescent girls use false allegations as a way to explain a pregnancy or as an excuse for being away from the family home. These situations, which are not uncommon, primarily involve girls who are caught in the act, and in addition to giving a vague account of the assault, they often claim “amnesia.”

11.6.2 Accidents

Because an accident is often the initial excuse used to explain a pelvic injury in a young child, accidental mechanisms are especially important to look at.

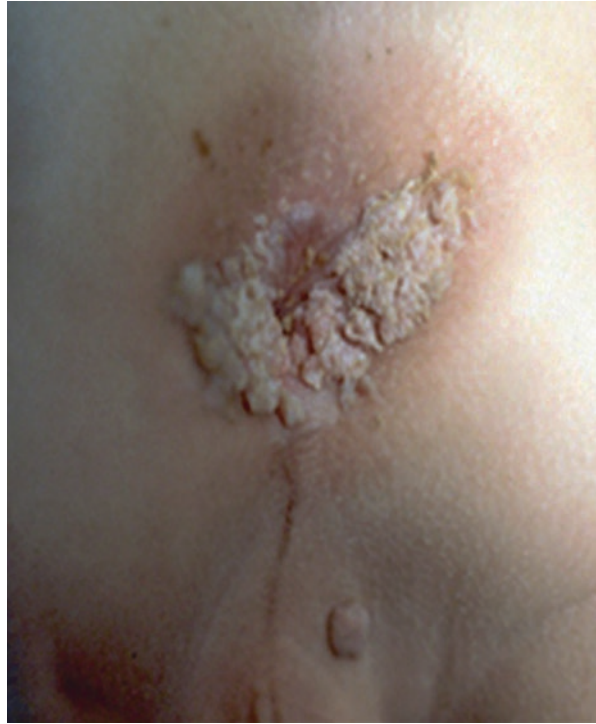
In straddle injuries, which are usually caused by a child falling onto the crossbar of a bicycle, the soft tissues are compressed against the pelvic bones. The injuries in boys—lacerations and/or ecchymosis—are to the scrotum and/or penis. The injuries in girls—lacerations or abrasions—are to the labia minora or majora, but not the hymen. Vaginal and hymenal lesions can only be caused by a straddle injury involving a penetrating object or by sexual assault.

11.6.3 Condylomata Acuminata (Anogenital Warts)

The viruses most often responsible for sexually transmitted infections are the human papillomaviruses (HPVs) [35]. The infection may be entirely latent or manifest clinically as vulvar, perianal, periurethral, perineal, or cervical condylomata acuminata—or even as cervical dysplasia. Condylomata acuminata present as raised, verrucous lesions less than 5 mm in diameter that grow in larger clusters (Fig. 11.15). The warts are usually painless and uncomplicated, but occasionally bleed or become painful or itchy, especially when they are scrubbed during bathing. Because transmission in adults is primarily sexual, anal warts in children and adolescents often raise suspicion of sexual abuse. There are, however, non-venereal modes of transmission. Auto- and heteroinoculation from verrucae vulgaris (common warts) is also possible. That transmission mode was deduced from the fact that a given individual can have identical HPV 2 and 4 subtypes in both common and anogenital warts. Nonsexual transmission via fomites has also been described [36–39]. As HPV has been reported in the amniotic fluid of over 60% of asymptomatic HPV-infected pregnant women, vertical transmission should be the first thing investigated when a child under 2 years of age shows clinical signs of papillomavirus infection [40].

Children with anal or genital warts should have a thorough skin examination to look for common warts, and close family members should be checked to see if they

Fig. 11.15 Papillomavirus condylomata of the anus. Ten-year-old child. Sexual abuse possible but not certain, because mucosal HPV types can be found with this type of lesion



are carriers. The estimated frequency of HPV transmission in sexual abuse situations has declined from 30% in the 2000s to less than 10% today [41–43]. Those data are especially important to keep in mind, given that HPV transmission may have occurred months, or even years, before the warts became clinically apparent.

11.6.4 Other Skin Conditions

There are many skin conditions that can be mistaken for sexual assault-related injuries:

- Hyperpigmentation of the anal margin due to hyperkeratinization.
- Scratches due to nocturnal itching; look for pinworm infection.
- Langerhans cell histiocytosis, in which perianal lesions are sometimes seen. The primary lesion is an infiltrated, occasionally crusted, papule. The lesions have a predilection for the body folds, scalp, and the area behind the ears, in particular. Biopsy confirms the diagnosis.
- Perineal blisters from congenital epidermolysis bullosa and bullous pemphigoid, in particular. Biopsy confirms the diagnosis.
- Behçet's disease, which typically has two foci: oral and genital ulcers.

- Lichen sclerosus, which is more common in females and can cause vulvar bleeding. Examination reveals pinkish papules that grow together in a figure-of-eight pattern around the anogenital region. Here again, biopsy confirms the diagnosis [44].
- Incontinentia pigmenti, an X-linked disorder. A mother with cicatricial alopecia and dental abnormalities (conoid incisors) helps confirm the diagnosis.
- Psoriasis.
- Dermatitis on an infant's bottom, including diaper (napkin) rash, caused by maceration in a child who is not changed often enough.
- Seborrheic dermatitis, which appears between the first and third month of life. It has two foci: on the scalp and around the mouth and in the perianal region, where it tends to form large patches.
- Contact dermatitis, caused by exposure to allergens and irritants like bathing products such as foam or bubble baths, soaps, etc.

11.6.5 Infectious Diseases

- Streptococcal anitis, with its classic perianal erythema (the throat culture is positive in more than half of cases); perianal staphylococcus causes much more desquamation and tends to recur.
- Ecthyma gangrenosum [45].
- Lower urinary tract infections, whose symptoms (burning on urination and polakiuria) may be misinterpreted as the result of sexual abuse, especially in little girls.
- Perianal candidiasis.
- Varicella and herpes.

11.6.6 Inflammatory Diseases

Crohn's disease: Consider this disease if there are anal fistulas, deep anal fissures, and skin tags, particularly when there is also delayed growth, diarrhea, or abdominal pain. Crohn's disease lesions can sometimes be misleading, for example, a deep fistula opening mimicking a deep wound in an adolescent (Fig. 11.16) or a gaping, ulcerated anus in an adolescent (Fig. 11.17). Vulvar sites are also possible.

11.6.7 Urethral Conditions

Urethral polyps and prolapse can cause genital bleeding, thus highlighting how important it is to consider these whenever genital bleeding is found in little girls of African or West Indian origin.

Fig. 11.16 Differential diagnosis: Crohn's disease. Deep fistula opening mimicking a deep wound in a 16-year-old boy



11.6.8 Congenital Abnormalities

Congenital malformations and abnormalities are sometimes discovered late in infants and young children; these include epispadias, hemangiomas of the hymen and vagina, perianal lymphangiomas, and perianal pyramidal protrusion (Fig. 11.18).

11.7 Dating (of Injuries)

If dating injuries is imprecise, dating events is even more so. Acute superficial injuries usually heal quickly—within 48–72 h—and so an examination done some time after the event may be completely normal, showing no sequelae [46]. Deeper lesions may leave scars that can be seen and photographed long after the assault. In medicolegal defloration that causes bleeding, the lesions tend to be located in the inferior (posterior) half of the hymen, and a scar may persist. If there has been recent anal penetration, a bleeding fissure, blood coming out of the anus, or painful anal spasms may be seen. Residual anal gaping is more suggestive of past anal penetration.

Fig. 11.17 Differential diagnosis: Crohn's disease. Gaping anus, ulcerated with a deep rhagade in a 17-year-old boy. A biopsy of the lesion showed a granuloma, confirming the diagnosis

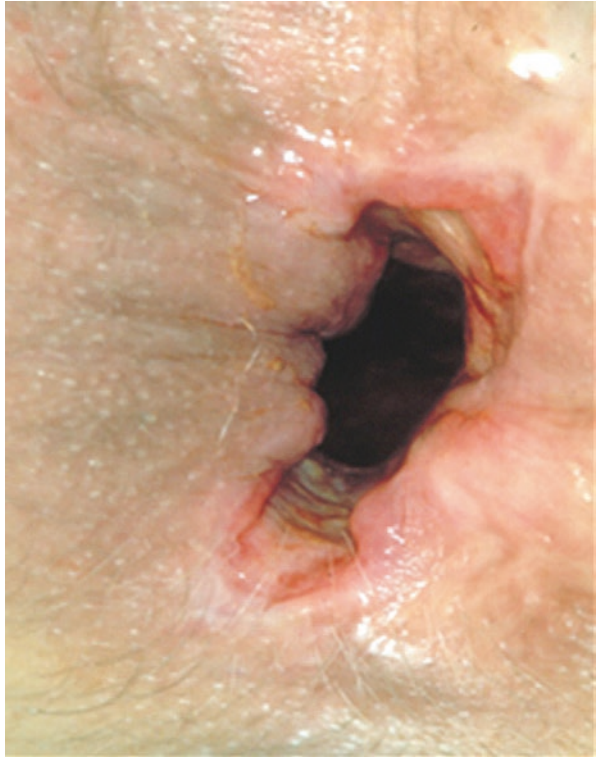


Fig. 11.18 Differential diagnosis: perianal pyramidal protrusion. Benign lesion in a young girl, age 12 years here, which resolved on its own in a few months



11.8 Treatment Principles

Genital wounds: After collecting local samples (semen testing, forensic samples, and gonorrhea testing), wounds should be disinfected with soapy water and then with an antiseptic.

Preventing pregnancy: If an adolescent girl is examined within 72 h of sexual abuse with vaginal penetration, she should be offered a contraceptive drug or the so-called “morning-after” pill. Side effects can include nausea and vomiting, asthenia, abdominal pain, and menorrhagia.

Preventing bacterial infections: Given the low prevalence of sexually transmitted infections in children and the lack of a single antibiotic effective against all offending bacteria, antibiotics are not recommended.

Preventing HIV infection: The aim in instituting antiretroviral therapy after sexual exposure is to reduce the risk of seroconversion. Its indications are well-codified [47]. Accurate risk assessment involves analyzing several factors: the assailant’s HIV status (often unknown, in practice), the time elapsed since the abuse, the type of abuse, whether the victim had an infection or lesions with breaks in the genital or oral mucosa, whether there was bleeding during intercourse, etc.

If it is determined that there is indeed a risk of infection, prophylactic therapy should be started as soon as possible. In practice, a combination of two nucleoside reverse-transcriptase inhibitors (NRTIs) and one protease inhibitor (PI) are administered as soon as possible, and no later than 48 h after the assault. The treatment, taken twice daily, should continue for 4 weeks if the assailant’s HIV status turns out to be positive or remains unknown. Clinical and laboratory monitoring is recommended.

Side effects are common and varied, including nausea, vomiting, asthenia, abdominal pain, diarrhea, and muscle aches. They should be made explicit to patients and treated, so that patients do not stop taking their medications.

Should the presumed assailant be brought in for questioning, the investigators are encouraged to demand an evaluation of his serological status in terms of sexually transmitted infections—HIV, in particular—as soon as possible.

Postexposure prophylaxis for hepatitis B: May be administered within 48 h of the assault if the victim is not already vaccinated and the presumed perpetrator’s serological status is not yet known. It consists of serovaccination, which involves injecting hepatitis B immune globulin in one arm and a dose of vaccine in the other.

Hospitalization: The need for hospitalization should be evaluated on a case-by-case basis. It may be essential in cases where the abuser and the victim live under the same roof and no measures have yet been taken to protect the child or adolescent. The offer of hospitalization may also address other needs, in particular when the emotional reactions of the victim or her family make an immediate return home impossible. It may also be medically warranted in certain circumstances—for example, when the victim needs surgery, turns out to be pregnant, or shows signs of infection.

Follow-Up—Management: If the child is not hospitalized at the end of the medical examination, it is important to clearly explain the aims of outpatient follow-up

and be sufficiently convincing as to its necessity. Beyond the strictly medical aspects, there should always be follow-up to evaluate how the child is handling the aftermath of the assault and its disclosure. There is no one-size-fits-all emotional reaction after a sexual assault. Referral to a psychotherapist will depend on the individual situation, but is required if there are signs of psychological distress. The medical team should reassess the victim's psychological state at each new contact, and in particular when they evaluate her treatment tolerance and recheck her serological status.

Sequelae: The sequelae of sexual abuse have been well-documented in adults. Their likelihood increases when child or adolescent sexual abuse goes untreated. There is a significant association between childhood sexual abuse and anxiety, depression, eating disorders like bulimia and anorexia/bulimia, a variety of psychosocial problems, addiction, high-risk behaviors—sexual, in particular—and post-traumatic stress disorder [48–52].

Psychosomatic disorders like fibromyalgia, chronic pain, functional gastrointestinal disorders, and chronic fatigue are classic [53–55]. A study of encopresis in children ages 4–12 years followed for sexual abuse or psychiatric problems, compared to a control group, showed the same rate of encopresis was as common in the children who had been sexually abused as in those with psychiatric disorders and much more common than in the control group, highlighting the fact that encopresis appears to be more a reflection of psychological distress than an indicator of sexual abuse [56].

Key Points

- There are many ways to sexually abuse a child or adolescent, and most leave no visible trace.
- No single sign or symptom, on its own, can be used to affirm that a child has been sexually abused; the suspicion is based on a combination of factors.
- After age 1, discovery of a *Neisseria gonorrhoeae* or *Treponema pallidum* infection in a prepubescent child is almost certainly an indication of sexual abuse.
- Clinical examination is usually normal; that does not rule out sexual abuse.
- Testing for sperm is imperative if the last assault was recent and involved penile penetration, even when there are no visible lesions.
- Hymenal injuries are highly suggestive of sexual penetration at any age.
- Anogenital warts can be spread in a variety of ways, in addition to sexual transmission.
- Dating based on clinical examination data is highly imprecise.

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12.1 Definition—Epidemiology

The World Health Organization (WHO) defines female genital mutilation (FGM) as “*all procedures that involve partial or total removal of the female external genitalia and/or injury to the female genital organs for cultural or any other non-therapeutic reasons*” [1].

More than 125 million women and girls currently living in 29 African and Middle Eastern countries have undergone genital mutilation. Thirty million girls are at risk

C. Rey-Salmon
Unité Médico Judiciaire—Hôtel Dieu, Paris, France
e-mail: caroline.rey@aphp.fr

of mutilation in the next decade. While these practices also exist in other parts of the world, quantitative data are not currently available.

The most severe mutilation occurs in the Horn of Africa—primarily Somalia and Sudan. Most of the female genital mutilation occurs in certain ethnic groups, ignoring national borders. We are currently seeing a decline in such practices among some ethnic groups and a change in the way the procedure is performed (with a trend toward less extensive removal of tissue) [2].

Sometimes, these practices are imported; in France, for example, more than 50,000 women and 7000 girls have undergone some form of FGM, which means that pediatricians who work with migrant populations are likely to encounter young victims.

The age at which FGM is performed ranges from birth to the premarriage period. It is most commonly done between the ages of 4 and 10 years.

A number of reasons are given to justify the practice. Religious justification appears baseless, insofar as FGM came into being well before the monotheistic religions, none of which prescribe it. In some cases, women ask for excision in the belief that they will be less fertile without it. But the biggest factor seems to be cultural conditioning [3]. Some ethnic groups consider non-excised women to be marginal, hypersexual, dirty, and dangerous.

12.2 Clinical Examination

Like other children, children from populations at risk for mutilation have regular visits to the pediatrician, where screening is usually done.

Routine visits should include a comprehensive general clinical exam, with enough inspection of the vulva to diagnose female genital mutilation.

An examination of the genitalia is also recommended at adolescence. At this exam, most young women can be reassured about their sexual development, which is a typical source of anxiety. It also offers an opportunity to screen for several conditions in both sexes, but female genital mutilation, in particular.

There are several proposed classification schemes for FGM. According to Shandall's scheme, there are three types of genital mutilation [4].

In Type I, or *Sunna*, the clitoral hood is removed; some people also call this "female circumcision." When only the hood is removed, mutilation can be subtle and hard to prove [5]. Type II corresponds to what we call excision, that is, removal of the clitoris and part or all of the labia minora, changing the appearance of the vulva completely (Fig. 12.1). Type III is known as infibulation or pharaonic circumcision. This is the most anatomically mutilating form; the clitoris and labia minora are removed, and the vulva is sealed off by stitching the labia majora together, leaving only a small opening posteriorly for the passage of urine and menstrual blood (Fig. 12.2). Introcision, a consequence of infibulation, refers to enlargement of the residual orifice using the fingers or an object.

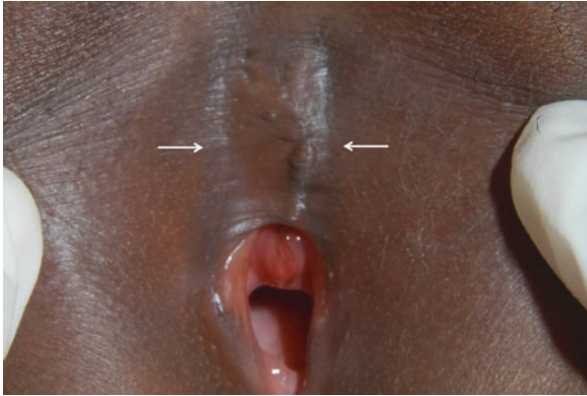


Fig. 12.1 Clitoridectomy. Four-year-old girl; loss of clitoral contours



Fig. 12.2 Infibulation. Five-year-old girl; the labia majora are joined, leaving a small opening posteriorly

12.3 Differential Diagnosis

Differential diagnosis may be required in a limited number of cases and only in young girls from the ethnic groups concerned.

1. There are some normal variants that can be mistaken for genital mutilation
 - Labial adhesions (agglutination) can partially close the vaginal orifice. The remaining orifice is anterior. With these adhesions, which are usually superficial, the clitoris and its hood are still visible.

- The clitoris and its hood may not be readily apparent, as if buried, suggesting the possibility of clitoridectomy. The body of the clitoris can still be palpated, however.
 - The absence of labia minora in the posterior part of the vulva is normal in young girls, as they do not meet posteriorly until puberty.
 - Thin labia minora may suggest excision, but the labial edges are regular and the clitoris is present.
2. In a sexual development condition known as “ambiguous genitalia,” the labia majora are fused either posteriorly or completely, and testes can sometimes be palpated. The clitoris appears enlarged.

12.4 Complications and Sequelae

Infibulation causes the most serious complications.

12.4.1 Immediate Complications

Initially, complications are due to the procedure itself. The psychosexual consequences of pain, fear, humiliation, and the sense of betrayal can be extremely severe [6]. In the short term, bleeding can result in acute anemia, and arterial damage can cause catastrophic hemorrhage leading to hypovolemic shock and death. The use of non-sterile technique and traditional herb- or excrement-based wound dressings can cause life-threatening systemic infections, resulting in septicemia, tetanus, and gangrene. Localized infections in the form of cellulitis or abscess are common.

The procedure can also damage nearby structures such as the urinary tract, vagina, anus, and/or rectum.

12.4.2 Long-Term Complications

Psychological problems may result from post-traumatic stress. How severe they are will depend on each woman’s personal history and the quality of her social support. Organic complications of genital mutilation can also amplify its impact on the person’s psychological equilibrium.

Genital mutilation can affect sexual health, causing libido problems, frigidity, and dyspareunia (pain during sexual intercourse) [7].

There are many gynecological complications, including vulvar deformity and unsightly or problematic scarring, keloid, Bartholin’s cysts, and epidermal inclusion cysts. Chronic pelvic pain is common, in some cases due to a neuroma of the dorsal nerve of the clitoris, which causes shooting pains on urination or contact. Menstrual problems include dysmenorrhea (painful menstruation) and hematocolpos (an accumulation of menstrual blood in the vagina behind the infibulation). Lower genital

tract infections like vulvovaginitis or cervicitis and upper genital tract infections like salpingitis increase the risk of sterility. Chronic urinary tract infections can lead to episodes of urine retention or pyelonephritis with renal abscess and chronic renal failure. Hepatitis B virus and HIV transmission are possible [8].

Obstetric complications are related to the shortening of the birth canal. Cicatricial lesions can interfere with the progress of labor. Excised women are more likely to suffer perineal tears and postpartum hemorrhage.

12.5 Treatment

12.5.1 Curative Treatment

The idea of performing female genital mutilation under surgical conditions to reduce the number and severity of the complications described above has been discussed in Western countries. That solution, rejected by most countries, would likely prolong such practices and allow mutilation for non-therapeutic purposes, something that is strictly prohibited by the penal and public health codes.

Partial repair surgery can, however, be offered; this includes disinfibulation and reconstructive surgery. These do not always yield good functional results. Depending on the specific type, complications are treated medically and/or surgically [9].

12.5.2 Preventive Treatment

Combating female genital mutilation involves informing and educating populations already made vulnerable by their condition as migrants. It requires training medical and social workers specially trained in taking care of women—in particular, in ob-gyn departments, family planning centers, and outpatient peri- and post-natal consultations [10]. Given the patriarchal structure of some of the ethnic groups in question, encouraging male participation in this undertaking seems important.

12.6 Measures to Take

12.6.1 Measures to Take When Faced with a Child or Adolescent Victim of Genital Mutilation

In France, as in several other countries, the doctor who discovers that a young or adolescent girl has suffered genital mutilation is required to report it to the legal authorities. Acts committed in a foreign country against a child who usually resides in France are considered criminal, even if the child is not a French national. In France, the statute of limitations is 20 years after the victim reaches majority; in other words, a woman has until age 38 to file a complaint for acts she suffered as a minor.

The doctor also has a duty to try to prevent such acts from being perpetrated against the girl's siblings. The absolute necessity of reporting, and its consequences, should be clearly explained to the family.

It is also essential that doctors making this diagnosis are able to refer patients for possible surgical repair before they have their first sexual relationship or deliver their first child [11]. Girls who have been cut deserve medical support, social and psychological assistance, and the best information possible.

12.6.2 Measures to Take When There Is a Threat of Female Genital Mutilation

When there is a threat of genital mutilation, particularly when a young girl from an ethnic group that practices FGM will be traveling to the family's country of origin, her vulva should be examined before she leaves.

It is helpful to inform the parents of the need to respect their child's physical integrity and give them a medical certificate indicating the absence of genital mutilation on the day of the examination. Simply producing the medical certificate may be enough to dissuade those family members in favor of FGM. The discussion should be respectful of the family's beliefs, in order to help the parents reflect on the foundations underlying this practice. Information based only on the risk of future gynecological or obstetrical complications is highly likely to fail. In France, we recommend issuing a medical certificate that clearly indicates that the examination of the external genitalia shows no lesions of the clitoris, urinary meatus, labia minora, labia majora, or hymen.

12.6.3 If an Adolescent Girl Refuses to Be Examined

Some adolescent girls who have suffered genital mutilation or sexual assault refuse to have their genitalia examined. Once the purpose and methods of the examination have been clearly and honestly explained, refusal should be considered a very strong indicator that violence has taken place, until proven otherwise. In that case, a one-on-one conversation to discuss possible past or current violence is needed. Adolescent girls will generally agree to such questions if they are asked tactfully and respectfully. An indirect formulation such as "*I have met girls your age who were concerned about...*" can facilitate disclosure.

Key Points

- Any pediatrician who works with migrant populations from Africa is likely to encounter girls who have suffered genital mutilation.
- For at-risk children, the vulva should be checked at all routine medical visits.
- Mutilation consists of removal of the clitoral hood (female circumcision) or of the clitoris and all or part of the labia minora (excision) and may also include closure of the labia majora (infibulation).

- The differential diagnosis mainly involves anatomical variants: agglutination of the labia minora, hidden clitoris, physiological absence of the posterior labia minora, and thin labia minora.
- The main immediate complications are bleeding and infection. In the long term, the psychological, sexual, gynecological, and obstetric complications are often very disabling.
- If there is a threat of genital mutilation during a return to the country of origin, it is essential to inform the parents of the need to respect their child's physical integrity and to give them, as a deterrent, a medical certificate indicating the absence of any genital mutilation on the date of the examination.
- Female genital mutilation is subject to mandatory reporting requirements in some countries.

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13.1 Introduction—Definitions

Chemical submission refers to administration with criminal intent (rape, pedophilia) or wrongful intent (voluntary violence, theft) of one or several psychoactive substances without the victim's consent or under threat [1].

These practices have developed in recent years and primarily impact adults and teenagers, but children can also be victims [2].

Clinical practitioners, and especially pediatricians, remain insufficiently informed about chemical submission. And yet, the more quickly this diagnosis is raised, the earlier it can be treated, and the more effective tests can be to provide key evidence.

I. Sec

Medicolegal Department, Hôtel-Dieu, Paris, France

e-mail: isabelle.sec@aphp.fr

Chemical vulnerability is defined as the voluntary consumption of psychoactive substances, be they medication or not (alcohol, cannabis, etc.), making the subject more fragile and thus more vulnerable to an aggression [3].

13.2 Epidemiology

In 2003, the French Agency for the Safety of Health Products (AFSSAPS) set up an annual prospective study to have exhaustive data regarding chemical submission in France. In this context, the agency sent physicians information regarding the criminal use of psychoactive substances and established a national survey protocol [3].

The survey aimed to identify the substances used, to assess their effects, and to define the contexts in which aggressions occur, as well as the *modus operandi*. The results were designed to enable adapted and updated prevention communication for healthcare professionals and for the general public. They could also lead to changes in the composition of certain medications in order to reduce criminal use.

Cases of chemical submission are to be declared to the Center for the Assessment and Information of Drug Dependence and Addiction (CEIP-A) in the region where the incident occurs. The Paris office centralizes the information and assesses the data, which has been collected since 2003.

13.2.1 The Most Frequently Used Substances

Many psychoactive substances are used, especially those with sedative, disinhibiting, or amnesiac properties. Benzodiazepines and related drugs are the substances of choice. Next in line are H1 antihistamines, neuroleptics, opiates, anesthesia, and antidepressants [4]. Non-pharmaceutical substances involuntarily consumed were also identified: cannabis and cocaine. Amphetamines (MDMA) are also used for the behavioral changes they cause.

The substances are most often incorporated into beverages, and more rarely into food.

13.2.2 National Chemical Submission Survey Results [3]

In 2012, 497 observations had been collected. Among the 497 notifications, 284 (57%) were cases of suspected chemical submission, 128 (26%) were cases of chemical vulnerability, and 48 (10%) were excluded from the study as they were not documented enough or had no connection to chemical submission or vulnerability [3].

Nine cases of chemical submission involved children under the age of 15: six girls and three boys between the ages of 6 months to 14 years, with an average age of 5 years. Abuse was sexual (four cases in children between 5 and 14 years

of age), sedation or maltreatment (four cases, including the homicide of a 2-year-old girl), and one attempted chemical submission (one case). In the majority of cases, the perpetrators were trusted people close to the child. Sixteen cases had been notified the previous year, with victims being nine girls and seven boys, aged 1–14 years old, with an average age of 8.6 years. Abuse was sexual (six cases in children aged 9–12), an attempt at chemical submission (five cases), sedation or maltreatment (three cases), and one kidnapping involving two sisters.

13.3 Legal Framework

From a legal perspective, chemical submission is a misdemeanor related to the administration of a harmful substance [5]. It can be an aggravating circumstance to a misdemeanor (theft or sexual aggression) or to a crime (rape).

13.4 Clinical Signs

The diagnosis of chemical submission should be considered systematically when faced with anterograde amnesia, behavioral issues, confusion, somnolence, or loss of consciousness without apparent reason, following the ingestion of a drink or food. The duration of the amnesia depends on the half-life of the psychoactive molecule that was used. The victim could have no memories of the perpetrator or of the nature of the aggression.

When these issues arise without any apparent reason, clinicians should suspect that there is some toxic origin. If considering chemical submission, clinicians should question the end goal of the submission. Was it to put the child to sleep, or to put the child to sleep and then abuse the child sexually? In such cases, one should always choose to apply the precautionary principle and not wait before undertaking clinical investigations to uncover any clinical or biological signs of sexual abuse.

13.5 Practical Guidelines

13.5.1 Orienting the Victim

As soon as possible, the potential victim should be sent to emergency care or to an abuse consultation unit for examination and swabbing.

13.5.2 Questioning

From the start, it is important to get the victim's medical history from the victim and the parents, as well as information about administration of punctual or regular

treatment, particularly if a psychotropic medication is involved. Taking medication after onset of the symptoms should also be specified.

One should estimate the time that has lapsed between the alleged incident and the medical examination. One should specify the symptoms and their evolution: amnesia (specify the time of the last memory), behavioral issues, falling asleep (specify time and place the victim woke up), attention deficit, or any other neurological anomaly.

13.5.3 Clinical Examination

One should do a full clinical examination, including looking for lesions from physical and/or sexual trauma, as well as signs of toxic impregnation [6].

13.5.4 Tests

1. Testing for foreign DNA: There should be systematic swabbing of all sites that could contain sperm, along with contact zones.
2. Testing for sexually transmitted diseases: blood and urine tests along with local swabbing (see chapter on sexual aggression).
3. Testing for pregnancy in teenagers.
4. Toxicology screening.

- **Time frame for testing**

The shorter the time between the alleged incident and the tests, the more informative the results of the complementary toxicology screening.

Although it is traditionally admitted that one can find certain molecules in the blood up to 5 days after and in the urine up to 10 days, some substances degrade quickly. For some substances like GHB, the time frame is 10 or so hours [7].

Collecting samples. Blood samples are collected with two EDTA tubes and with one sodium fluoride tube, two urine samples with no additive tubes. The whole collection is frozen while waiting to be sealed as evidence that will serve the police inquiry.

- **Methods of analysis**

Chromatographic analytical techniques are the gold standard for supporting a diagnosis of chemical submission [8, 9]. They can identify the molecule or its metabolites. They are more sensitive and specific. The analyses should be carried out by toxicology laboratories listed by the legal authorities.

- **Role of hair**

While a urine test can identify recent exposure—from a few hours to a few days—testing hair collected a month after the alleged date of an incident has shown to be effective in the diagnosis of cases of abuse or maltreatment [10] and has a window of detection of several months. It is possible to distinguish one-time exposure and repeated or chronic exposure. Hair grows an average of 1 cm per month, which allows one to date the intake of the incriminating sub-

stance, by segmenting the capillary stem starting at the root. One can also specify if the psychoactive molecule was absorbed solely at the time of the event or before and/or after [11]. Hair analysis is very useful when the time frame for blood and urine testing has expired or when there is a suspicion of substances with short elimination half-lives, such as GHB [12].

13.5.5 Clinical Example

We will illustrate the clinical signs and diagnostic strategy for chemical submission in children with the following example [2]. An 8-year-old girl spent the weekend with a classmate and reported that one night the classmate's mother's boyfriend had "kissed her on her girl parts with his tongue." The next day, the child had trouble getting up and difficulty talking. Five days later, an examination at the medicolegal unit showed no trauma and notably no hymen deflowering. The child said the perpetrator had her drink "a glass of water" right before bed. Due to the time that had passed since the presumed administration of a psychoactive substance, a blood test was not done as it would not have provided any useful information. In this case, it was preferable to take a hair sample 1 month after the reported events. In effect, the capillary analysis showed the presence of bromazepam only on the segment that corresponded to the event. This evidence was used to accuse the perpetrator.

In conclusion, there is still little and underestimated diagnosis of chemical submission. All clinicians, and especially pediatricians, must be better informed about this phenomenon. It is necessary to get patients to emergency services or forensic units quickly. The victims should be questioned and have a detailed clinical examination in addition to a toxicological screen of the blood and urine as quickly as possible after ingestion of the substance.

Key Points

- Chemical submission can involve young children, but few pediatricians are aware of the phenomenon.
- One should consider chemical submission when faced with the recent, sudden appearance of neuropsychiatric disorders in children.
- One should systematically look for sexual abuse in the presence of chemical submission.
- It is essential to get biological samples quickly, but it is rarely too late for testing.
- It is possible to test blood up to 5 days after the incident and urine up to 10 days after.
- Hair analysis is recommended when it is too late for blood or urine identification.
- A dialogue between the clinician and the biologist can improve the results of the tests.
- Chromatographic toxicology analysis techniques should be done in listed laboratories and in a legally defined framework.
- The most frequently used substances are medications (benzodiazepines and related drugs, H1 antihistamines, opiates) and narcotics.

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14.1 Introduction: Definitions

Defining neglect is difficult, because it does not presuppose any positive action. There are no clear boundaries, and misdiagnosis is a risk in poverty situations. While “acts of omission” are more likely to be alleged in socially disadvantaged

M. Balençon (✉)

Cellule d'Accueil Spécialisé Pour l'Enfance en Danger-CHU Rennes Hôpital Sud,
16 boulevard de Bulgarie, 35203 Rennes Cedex, France

UMJ mineurs Hôtel Dieu-APHP, 1 place Parvis Notre Dame, 75181 Cedex 04 Paris, France
e-mail: martine.balencon@chu-rennes.fr

M. Pierre • M. Roussey

Cellule d'Accueil Spécialisé Pour l'Enfance en Danger-CHU Rennes Hôpital Sud,
16 boulevard de Bulgarie, 35203 Rennes Cedex, France
e-mail: michel.roussey@chu-rennes.fr

families, severe neglect can occur in any setting—including the most affluent, where it can masquerade as respectability, making it harder to identify [1, 2].

According to the WHO, neglect “refers to the failure of a parent to provide for the development of the child—where the parent is in a position to do so—in one or more of the following areas: health, education, emotional development, nutrition, shelter and safe living conditions.” The authors of the *World Report on Violence and Health* (2002) [3] call the reader’s attention to this point and to the cultural differences that make using a different assessment in each part of the world essential.

As with other types of abuse, the exact incidence is hard to know. In their 2009 literature review, Gilbert et al. reported an annual incidence of physical or psychological neglect ranging from 1.4% to 14.5% and a prevalence among children ranging from 6% to 11.8% [4]. Data from the *European Report on Preventing Child Maltreatment* show a 16.3% prevalence of physical neglect and an 18.4% prevalence of psychological neglect [5].

The telltale signs of deprivation-related pathology can take several forms, usually in combination: delayed growth due to nutrient deficiencies and the specific clinical entity of psychosocial short stature, medical neglect, delayed psychomotor development, and behavioral problems.

More recently, links have been found between childhood obesity and neglect. The mirror image of faltering growth and growth problems, according to Harper [6], in such situations, calls for the same multidisciplinary approach and vigilance regarding the association between signs that appear to be medical and a genuine neglect situation.

Whatever the clinical presentation, when there are multiple signs, a medical diagnosis of deprivation or neglect suggests abuse. As with other forms of maltreatment, no one sign is specific on its own. The role of psychological impact should be considered during each evaluation.

14.2 Faltering Growth

14.2.1 Due to Nutrient Deficiencies

This refers to delayed growth that has no underlying organic cause. Severe forms of undernutrition are characterized by the loss of subcutaneous fat and can be life-threatening. In some cases undernutrition is the only finding, making diagnosis difficult. The main diagnostic indicators are a negative etiologic workup and rapid weight gain in the hospital setting.

14.2.1.1 Clinical Vignettes

The clinical picture can be one of trueXE protein-energy malnutrition or protein-deficiency kwashiorkor. The accounts below illustrate the symptomatology.

S. was an 18-month-old girl admitted to the ICU for malaise, hypotonia, and impaired consciousness; she was in extremely poor condition and had numerous facial ecchymoses. She was severely undernourished, weighing just



Fig. 14.1 Severe undernutrition in an 18-month-old girl (clinical vignette 1). (a) Loss of gluteal muscles. (b) Lower extremity edema. (c) Facial ecchymoses and sparse, fine hair

6980 g (-3 standard deviations (SDs)) and had lost 900 g since her last known weighing at age 6.5 months. Clinical examination revealed a distended nondepressible abdomen, a complete loss of gluteal muscles (Fig. 14.1), lower extremity edema (Fig. 14.2), a mid-arm/head circumference ratio of 22.8% ($>30\%$ is considered normal), thin skin with a number of facial ecchymoses, and sparse, brittle hair (Fig. 14.1). Her body temperature was very low ($30.7\text{ }^{\circ}\text{C}/87.3\text{ }^{\circ}\text{F}$), as was her heart rate (56 bpm), but her blood pressure was normal. The little girl was passive, rarely moved on her own, and showed little

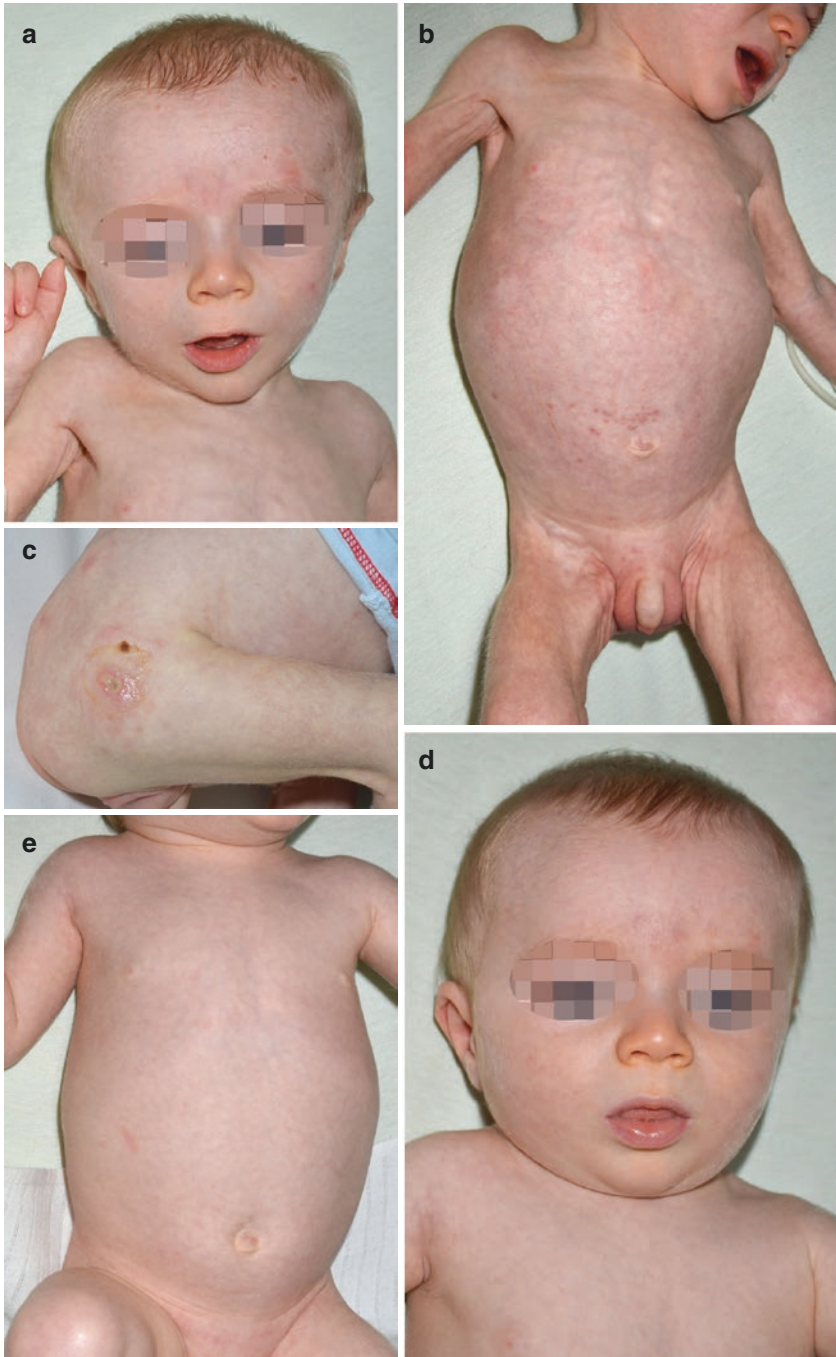


Fig. 14.2 (a–e) Severe undernutrition in an 8-month-old infant (clinical vignette 2) (a–c) Appearance at the start of hospital stay: sad face (a); Major weight faltering and muscle loss (b); Pressure ulcer on the side of the right hip (c), (d, e): Dramatic improvement after 3.5 weeks in the hospital Thanks to Drs. N. Vabres and G. Picherot, CHU de Nantes

reaction to pain. Her lab results showed significant hypoproteinemia (48 g/L), anemia (RBCs: 3×10^6 , hemoglobin: 9.2 g/dL), hypocalcemia, hepatic cytolysis, and low coagulation factor levels. The head CT was suggestive for cortical atrophy. The skeletal survey showed old fractures in both arms and one femur.

This child's life was saved by gradual renutrition. There was no need to look for an underlying organic cause, given the family situation, the progressive clinical improvement, and the fact that the lab results returned to normal during her hospital stay. Her mother's new boyfriend had alerted the SAMU, who went to the child's home. Her mother and father were 18 and 19, respectively, when she was born. The little girl—whose length, weight, and head circumference were normal at birth—was followed regularly by a doctor and a pediatric nurse for the first few months of life, during which time her growth was good, her psychomotor development was normal, and her immunizations were kept up to date. When she was 6.5 months old, her parents separated; after that, she was not seen again until her admission.

Such extreme examples of nutrient deprivation are fortunately relatively rare, and the growth faltering that pediatricians see in practice is generally less severe. This clinical vignette highlights the need for a high index of suspicion whenever an infant stops getting medical follow-up and is no longer monitored by home visit services.

S. was seen back on a regular basis for a series of medical evaluations. She now lives with her father in her paternal grandmother's house. Her clinical exam eventually returned to normal, and she is currently, at age 7 years, attending a regular school and has no learning problems. A follow-up brain scan was considered unnecessary.

G. was an 8-month-old boy admitted for faltering weight (Fig. 14.2). He weighed 4610 g and was 63 cm long, giving him a very low 70% weight-to-length ratio (>90% is considered normal), though his birth weight had been normal (3480 g). An examination of his skin revealed pressure ulcers, one of them on his hip (Fig. 14.2). He was unable to hold his head up, was sad, whined, and seemed famished. He could not seem to get enough to eat. His mother, who was separated from his father, did not report any symptoms and claimed to be unaware of the child's nutritional state. Here again, his medical care had stopped after age 1 month, and it was only at a friend's insistence that his mother took him to the doctor. Further testing was scaled back due to how quickly the little boy gained weight and resumed normal motor development (Fig. 14.2).

14.2.1.2 Mechanisms

Nutrient deficiency is primarily a problem in children under 3 years. The growth abnormality is primarily weight related. Most of these children become mildly to moderately undernourished [7, 8]. In severe forms, intercurrent infections are common, and there may also be gastrointestinal problems such as vomiting, diarrhea, and abdominal distention. Rumination disorder and anorexia have also been reported.

14.2.1.3 Etiology

In severe forms, the child is actually rejected. Not all of the mothers are rejecting, however. Nutrient restriction can be due to ignorance of the infant's nutritional needs or a deliberate attempt to prevent excess weight or the harmful effects of some foods. In all of these cases, the growth delay is due purely to a nutritional deficiency and not to a hormone abnormality. Accompanying emotional deprivation should always be considered and appropriately treated, however.

14.2.1.4 Differential Diagnosis

The diagnostic process consists of confirming that the malnutrition is caused by inadequate intake, which means ruling out an organic cause—particularly when weight faltering does not quickly reverse itself with a normal diet during the hospital stay [9]. In 2013, the American Society for Parenteral and Enteral Nutrition recommended that illness-related growth faltering be distinguished from other clinical situations; because there is a mixed etiology in some situations, it endorses a multidisciplinary approach.

In the conditions below, associated clinical signs can often be used to guide further testing [9]:

- Gastrointestinal causes: chronic GI conditions causing malabsorption, celiac disease, and intestinal parasites causing malabsorption, in particular
- Hepatic causes: hepatic glycogen storage diseases, hereditary fructose intolerance, cirrhosis, and cholestasis-related disorders (Alagille syndrome and biliary atresia)
- Renal causes: chronic renal failure and tubulopathies
- Congenital heart disease
- Pulmonary causes: severe asthma, cystic fibrosis, and chronic respiratory failure (due to a congenital abnormality, bronchopulmonary dysplasia, or neuromuscular abnormalities)
- Metabolic causes: rickets; pseudohypoparathyroidism; Williams syndrome, which combines hypercalcemia and hypercalciuria; and lysosomal storage diseases
- Inflammatory, infectious, hematologic, and neoplastic causes: juvenile rheumatoid arthritis, acquired immune deficiency, cancer, etc.

The fact that inadequate intake may be accompanied by an eating disorder such as *merycism* (rumination syndrome) or infantile anorexia can make diagnosis more difficult.

Both diagnostically and therapeutically, current recommendations call for a multidisciplinary medical/psychosocial team for assessment and long-term management. The prognosis will depend on the timeliness and quality of that multidisciplinary approach [6].

14.2.1.5 Treatment Principles

Hospitalization is needed in order to observe the child's eating behavior and the mother-child bond, evaluate nutritional intake with a dietary assessment, and

perform additional testing, if necessary. Preserved appetite and very rapid weight gain are seen once the child is removed from the family environment.

A medical/psychosocial approach is called for whenever this diagnosis is suspected [6, 9].

14.2.1.6 Sequelae

Without early treatment, children can suffer both physical—an inability to catch up growth-wise—and psychological sequelae. There are also potential repercussions in adulthood, now widely reported after “adverse childhood experience” situations, including anxiety, depression, high-risk behaviors, metabolic disorders, and addictions [5].

14.2.2 Psychosocial Short Stature

14.2.2.1 Clinical Vignette

S. was 14 years old when she was seen by us at a judge’s request. The social work team and hospital pediatrician had reported to the authorities that they strongly suspected psychosocial short stature (PSS). Her weight was $-2SD$, her height was $-4SD$, and she showed no signs of puberty, though they could find no organic cause aside from low growth hormone (GH) secretion. She said that at home her parents made her eat by herself at about 6 p.m. and go to bed by about 6:30 p.m., before her father got home from work—even in recent years, when she was a teenager. Her younger sister, who was six, ate with her parents. Only on Sundays was S. allowed to eat with her parents and her sister. She ate the same dish every day, noon, and night, for years: a slice of turkey and some spinach. She would look on, envious, as the rest of the family ate other things. Putting her in the hospital, away from her family, helped confirm the diagnosis of PSS; her growth hormone level returned to normal, and after being the same height from age 12 to 14, she grew two centimeters in a single month. After being discharged from the hospital, she was placed in a foster home. She was seen again 2 years later; she had gone entered puberty the year before and caught up in height to $-2SD$, like her parents.

14.2.2.2 Mechanisms

The environment’s role in the growth of a healthy child was first studied by Talbot in 1947 [10]. Severe developmental disorders were observed during the postwar period, when many infants were institutionalized. The disorders were blamed on the breaking of emotional bonds with the mother. It was therefore suggested that a severe, prolonged disruption in the child’s emotional relationship with his environment could be harmful to his growth [10]. That idea was later extended by the observation that this type of growth delay could occur in a family where the mother was present. Many studies began describing this problem in the 1960s and 1970s. They described the clinical signs and symptoms and the socioeconomic, intellectual, cultural, and psychological profile of the families. They often found a family history of parental separation and a difficult social context. There was, in addition,

physical or sexual abuse in slightly more than a third of cases [11]. Psychosocial short stature goes by several names: “deprivation dwarfism” [8], “abuse dwarfism” [12], and “maternal deprivation syndrome” [13]. Whatever they call it, all of the authors note the temporary and reversible nature of the growth deficit, which begins to reverse itself within weeks after separating the child from the psychological stressors. This is fundamental to diagnosis and treatment. Hence, PSS can be defined as a linear growth delay in children unexplained by organic disease. What makes diagnosis so difficult is that although there is a growth hormone deficiency, it alone cannot explain the disorder. The failure of growth hormone therapy to bring about acceptable catch-up growth is another clue to the diagnosis.

Psychosocial short stature primarily affects prepubescent children, often the oldest or second oldest child in a family with three or more children. Typically only one child—the target child—is affected [14]. The stunting can be dramatic—often more than three standard deviations. This collapse in growth velocity is associated with delayed bone maturation. Disorders of psychological and emotional development and behavior disorders suggest a problem with the mother-child bond, but are not found in every case [11, 12, 14]. They include:

- Delayed acquisition of neuromotor, intellectual, and language skills.
- Emotional isolation: child refuses to make eye contact, lacks facial expression, does not play, etc.
- Eating disorders: child refuses to eat but is constantly looking for food, and primary polydipsia.
- Sleep disorders.
- Sphincter control problems: enuresis and encopresis.

The clinical exam and lab results show a partial or complete growth hormone deficiency. Hormone levels show abnormal basal GH levels and pulsatility [15]. A lab workup (prealbumin, vitamin levels, CBC, iron tests, BUN, serum protein, phosphorus and calcium tests, coagulation factors, and IGF-1) is needed to look for signs of malnutrition, though these are not always present [16–18]. Malnutrition severity can be assessed by laboratory testing. IGF-1 is usually low, due to both GH deficiency and hypoproteinemia.

14.2.2.3 Differential Diagnosis

PSS is rarely diagnosed at the child’s first visit, because all other potential organic causes—thyroid related, gastrointestinal, and autoimmune—must be ruled out first. The hormone abnormalities make the diagnosis difficult. Hospitalization—often necessary for a comprehensive workup—is crucial for observing the mother-child relationship and for analyzing the child’s behavior outside the family environment. A radical change in behavior is frequently seen.

14.2.2.4 Etiology

This syndrome is caused by a severe, early problem in the mother-child bond. It can begin in the first few months of life or even prenatally. The pathogenic

psychological environment varies. There are several different profiles. The family may be disorganized and socioeconomically or culturally marginalized. Parental separation or conflict is common. There may have been a sudden rupture in family ties, with a breakup in the family unit for a variety of reasons—accidental, child removal, etc. But PSS can also occur in families that do not appear to have any problems, at least outwardly, as in our clinical vignette or in another case we personally observed, in which the parents were teachers. In such cases the diagnosis is even more difficult and can only be confirmed by taking the child out of the family environment. What is common to all, however, is the profile of a rejecting mother, unable to establish physical and emotional contact. There is a chronic lack of interaction with the child. At the heart of this very severe relational problem between mother and child is an unusually violent psychological aggressivity that is difficult to express verbally [10].

Several physiological changes take place when children are placed in a different environment. In some cases they start eating again, their fat distribution changes, and their GH level returns to normal [15]. Those changes result in a sometimes dramatic resumption of growth. The prognosis for final height is good, close to the target parental height, provided the child receives early, intensive care.

14.2.2.5 Treatment Principles

The key to treatment—which helps confirm the diagnosis, as indicated above—is taking the child out of his environment. A prolonged stay in a medical setting is necessary in the beginning, because it allows observation of the child's behavior and an evaluation of whether it is possible to work with the family on a multidisciplinary treatment plan. Nutritional, medical, and psychological care is essential. The child must be able to continue appropriate schooling [19]. The child is almost always removed from his home environment by child protective services, which is often the necessary response in such situations. Vigilance is required, however, because these children continue to be vulnerable and require long-term support. Rebuilding family ties can be difficult.

Early diagnosis and care is critical, because the ability to catch up growth-wise diminishes over time. The psychological sequelae are often permanent.

14.2.3 Mixed Mechanisms of Faltering Growth

The currently accepted opinion is that in neglect situations, faltering growth is not due to nutrient deficiencies alone. Studies have shown that the more prolonged and severe the deprivation, the greater the impact on physical development and higher brain functions [20]. Despite appropriate—though perhaps delayed—care, brain function abnormalities persisted in older children. Objectively, head circumference and mean intellectual quotient (IQ) were significantly lower than in the reference population [21]. That finding led to studies on the origin of such lesions in the absence of nutrient deficiencies.

Biologically, early deprivation affects several systems [22]:

- There is greater catecholamine turnover in the central nervous system. Urinary catecholamine secretion is higher than in the general population.
- There is elevated serotonin turnover and lower levels of circulating serotonin in the areas of the brain that control the emotions (the limbic system, prefrontal cortex, etc.) and behavior.
- Two mechanisms affect the hypothalamic-pituitary-adrenal axis: abnormal activation due to excessive secretion of CRH (corticotropin-releasing hormone) and inhibition of negative feedback due to saturation of the cortisol receptors. The consequences of these disturbances affect not only the subject's behavior and higher functions but his immune system as well. Appropriate mothering is thought to increase the number of cortisol receptors and thus help compensate for the increase in circulating glucocorticoids.
- Similarly, early exposure to neglect can influence the size and structure of the hippocampus. The greater the exposure to stress, the smaller the hippocampus will be [22].
- Lastly, growth hormone secretion is reduced in deprivation situations. There are also fewer slow-wave sleep phases and less REM sleep time.

In the most severe cases, these biological abnormalities can be seen on imaging studies. In a population of adopted Romanian children, average age 9 years, Chugani et al. [21] demonstrated lasting changes in glucose metabolism evaluated by positron emission tomography (PET using 2-deoxy-2-fluoro-D-glucose) in brain areas particularly involved in the management of emotions. Those abnormalities were thought to result from early stress and were associated with problems in behavior, attention, and higher brain function.

The recent contribution of epigenetics adds new insight into these situations of severe, prolonged neglect, their clinical manifestations, and their transmission.

14.2.4 Dating

Faltering growth is the objective clinical marker of deprivation. When it becomes obvious, an interruption in weight gain can be used to date when the symptoms started. The degree to which the deficiency manifests itself clinically depends on the duration of exposure and the severity of the deprivation. Weight is the first anthropometric marker affected by deprivation-related illness. It is also the first to return to normal when the child is treated and removed from the deprivation setting. Resumed growth and, a fortiori, a return to the normal range on the weight-for-age growth chart indicate clinical cure. In contrast, however, improvement in or resolution of the physical symptoms does not necessarily portend recovery from psychological damage. An assessment by a pediatric psychiatrist is needed to best evaluate the situation. Particularly in severe situations, complete recovery cannot reasonably be confirmed until adulthood.

14.3 Medical Neglect

Medical neglect is another form of child abuse, where the child pays the price for his parents' (often religious) convictions; this clearly constitutes an infringement of the child's right to health.¹ It is important to distinguish between:

- Refusal of treatment for an often serious symptomatic illness that the parents deny, resorting to alternative medicine when a treatment could cure or improve the child's condition. This also applies to cases where neonatal screening shows that a newborn has an illness that without a special diet (e.g., phenylketonuria) or replacement therapy (e.g., congenital hypothyroidism) will result in intellectual impairment, but the parents fail to adhere to that treatment. The only possible solution is for child protective services to intervene to ensure that the child receives appropriate care and protection.
- Children whose parents refuse all immunizations, including those that are mandatory—in particular, for access to kindergarten, school, etc. Criminal or administrative sanctions are rare. Children's medical records sometimes contain falsified vaccination certificates, so doctors have to be extremely cautious. Parents may continue to refuse despite conversations and explanations; since the practitioner cannot go against their wishes unless the act is mandatory, the child is clearly out of luck.
- Religious training that promotes an inappropriate diet leading to serious deficiencies is another potential threat to a child's physical health. That was the case for two brothers, ages 15 and 10, raised in a religious community and fed a strictly vegan diet. Both boys had severe deficiency-related rickets with severe hypocalcemia and osteoporosis and permanent orthopedic sequelae. The eldest also had severe deficiency-related aregenerative anemia with a hemoglobin level of 2.4 g/dL. Treatment was difficult, especially on the psychological level, since the children “only wanted to talk to God, with no intermediary” [23].

14.4 Delayed Psychomotor Development and Behavioral Problems

This refers to infants who show delayed psychomotor development in all areas and thus may be mislabeled, prematurely, as having encephalopathy. Psychomotor delay often accompanies growth delay. Here again, it may be necessary to hospitalize the child to study his behavior away from the parental home. If the family context is worrisome from the start, further testing—often expensive and useless—is pointless, especially if the child makes dramatic strides in catching up; the earlier the treatment, the better.

¹Declaration of the Rights of the Child (1959) and Convention on the Rights of the Child (1989).

14.4.1 Clinical Vignettes

- J.** was examined when she was 15 months old. She was her parents' first child. A child protection measure was put in place at birth due to her father's history of alcohol abuse and violence and her mother's lack of financial resources and competence. Nothing that might explain her faltering growth was reported; her weight and height were normal at birth, $-1SD$ at 11 months and $-2SD$ at 15 months. Her motor development was also delayed; she was unable to sit unsupported until 12 months or stand until 15 months. She did not talk; she was apathetic and showed no particular reaction to being examined. During her 2-week hospital stay, she began growing again, her psychomotor development recovered almost completely, and she became playful. There was no need for further testing.
- M.** was the youngest of three siblings. She was born at full term after a normal pregnancy; her length, weight, and head circumference were normal at birth. She was seen by the mother and child protective service teams who visited the home for the first 2 months, but after that, follow-up languished. She was admitted at 8.5 months at the request of those services, because she weighed only 4400 g and her head circumference and length were $-3SD$. She showed a severe psychomotor delay; she could only hold up her head, and could only grab hold of objects by raking. She was sad and apathetic. Aside from the severe cachexia, there was nothing to suggest inflicted injury or a specific organic illness. Though she was initially fearful in the unit and barely responded to her family's coaxing, she gained weight beyond that expected for her age and seemed eager to eat. She was discharged and placed full time in a child welfare center for continued care. Thanks to good support, she became physically healthy again and caught up to normal weight, height, and then head circumference. Her psychomotor development was dramatic.

Her sister **I.** was admitted 24 h after **M.** She was 2 years old and also in a very worrisome condition. Child protective services had been unable to access this little girl during their assignment, on the grounds that she was sleeping or not at home at the time of their visits; the parents claimed she was receiving medical care from their primary care physician. When she was 2 years old, the educators found **I.** at home, eating her own feces. She had not learned to walk, rocked when she was awake, and mumbled syllables to self-soothe. Her growth had been average to age 6 months and then declined to $-1.5SD$. The clinical exam found no lesions suggesting past or recent inflicted injury. She did, however, exhibit alopecia on her temples. Aside from low-serum vitamin D, no organic pathology was found. She had trouble making contact with the caregivers and went through a long phase where she would vomit during periods of almost bulimia-like eating. She was treated in a center before quickly being placed in a foster family.

14.4.1.1 Clinical Signs and Symptoms

Deprived children often look sad; an occipital bald patch is evidence that they are constantly confined to bed. There are usually behavioral problems as well; these can be in the forefront or isolated, unaccompanied by developmental delays. These problems can be subtle or even misleading, like for example [14, 19]:

- *Avoidance behavior*: some infants turn away from their mother’s face but can readily make eye contact with a stranger. This unsatisfying, even aggressive, behavior makes it even harder for the mother to develop a relationship with her child.
- *Frozen watchfulness*: this behavior indicates abnormally early emotional self-control. In particular, these infants can stop themselves from laughing or crying, interrupt what they are doing, and remain motionless for long periods, usually after being scolded by their mother. Children exhibiting avoidance behavior and frozen watchfulness are likely to end up apathetic, inhibited, and withdrawn by the second or third year of life. They tend to exhibit the same type of behavior in a group and are incapable of establishing trusting relationships with either the children in their group or adults.
- *Indiscriminate attachment*: this behavior can be very misleading. These are children between ages 1 and 2 years who, instead of crying and running away when they see a stranger’s face, throw themselves into the arms of whoever happens to be there. While such children are easy, affectionate, and gratifying for caregivers, they are actually incapable of establishing ongoing relationships and can go from one person’s arms to another’s, indiscriminately.
- *Instability, excessive agitation, or even aggressivity*: these symptoms can be another sign of psychological and physical abuse, and the whole can lead to actual psychomotor regression.

14.4.2 Mechanisms

When very young, neglected children alternate between periods of withdrawal—with autoerotic behaviors such as ceaseless rocking or repetitive gestures—and appeal, where crying, attempting to merge, and then gaze avoidance reveal a child with serious problems interacting with those around him [14]. This tableau can in some cases resemble autism. Food whims, sleep problems, and other somatic manifestations like abdominal pain, encopresis, and restlessness disrupt a family setting already ill-suited to support child development. A delay in language and play activities, together with mood swings, reflects a general state of suffering that, if not identified and modified, herald future deprivation-related problems [14].

The picture becomes clearer when the child starts school—i.e., when the child’s socialization skills begin to come into play. At that point, one sees a child

in a perpetual quest for emotional contact, clinging to adults indiscriminately. Paradoxically, affectionate gestures, though yearned for, are poorly received—as if the narcissistically wounded child is incapable of “processing” signs of love and respect. He wants everything, but cannot hold onto anything—either people or objects [14].

14.5 The Impact of Abandonment and Deprivation on Psychosocial Development

John Bowlby’s attachment theory [3, 25] has profoundly changed how we view a young child’s development and the trajectory of his life. It not only helps clarify normal developmental processes—it gives us a better understanding of certain manifestations in the realm of behavior disorders. Lastly, it offers a richer approach to early childhood prevention practices [14, 24].

Abandonment—whether in a family or institutional setting—causes serious attachment disorders that worsen over time. It is often compounded by past severe psychological abuse, which is discussed in its own chapter.

Such abandonment situations have serious, long-lasting, and delayed impacts on these children [25].

In the juvenile psychiatric population, one finds disturbed children who have experienced apparently different situations whose impact was, nevertheless, fairly similar [14, 19]. Those situations fall into several basic categories:

- In a single-parent family, most often a mother, usually alone, raises one or more children under difficult emotional and socioeconomic circumstances. Sometimes she merges with one child or seems to use him as a reparative object for her own distress; sometimes she loses interest in and neglects him, both emotionally and in terms of his physiological needs. Then she smothers him for a few hours or days with shows of love. The child quickly responds with deviant behaviors that make demands on a mother already ill-equipped to provide continuous care [26].
- This sort of emotional inconstancy also exists in well-to-do families but in a different way. The deprivation is hidden; the child goes from one parent figure to the other, with varying degrees of investment. This creates an emotional void that is difficult to bring out. Such children usually give the impression of being spoiled and angry.
- Such emotional back-and-forth can also exist between the child’s family and the extrafamilial care home(s) imposed on the parents due to parental problems or suspected or obvious early childhood abuse. The child becomes increasingly unapproachable due to repeated placements interspersed with returns to the original facility, each time raising the child’s hope of a permanent home. Hopefully, now that we know the devastating impact of poorly organized institutional placements, these situations will become less common [14].

Such situations always take a complex course. As adults, these children will have trouble relating to others and to the world—particularly in their emotional lives. It will be difficult for them to have a stable emotional life and to invest in a love relationship, since they are always seeking some unattainable ideal.

Often, they perpetually seek happiness by creating a magic universe. In children, this takes the form of an unquenchable need for sensory input, which makes them vulnerable. Adolescents and adults who were neglected as children are more likely to suffer from addiction of all kinds, depression, anxiety, and isolation than the general population [2, 5, 26].

Children identified as having disorganized, disoriented attachment are at risk for disturbed behavior and significant developmental delays [5, 26]. They are often oppositional and angry, thus recreating the disturbed, violent atmosphere in which they grew up.

They may also have poor parenting skills when they themselves have children, thus confirming the idea that attachment styles are transmitted from one generation to the next. As adults, they are often grappling with personal and social problems and in some cases even exhibit antisocial or sociopathic behavior.

This description shows how potentially serious the sequelae can be for neglected or severely deprived children who do not get appropriate, timely care.

Conclusion

No single clinical symptom, on its own, is specific to deprivation and neglect. However, some appearances and combinations of symptoms should alert the clinician, especially if a child blossoms after being taken out of his usual environment. Connecting symptoms to mistreatment is especially difficult if parents appear to be caring toward their child or are from a socioeconomic class that professionals consider reassuring. However, children who are victims of abuse by omission are in danger, at risk of permanent damage to their ability to flourish psychologically and emotionally. The problem is how best to assess the danger, which in each case requires a multidisciplinary team of physicians, social workers, psychologists, and pediatric psychiatrists.

Key Points

- Deprivation-related pathology can take the form of faltering growth, medical neglect, psychomotor delay, and/or behavioral problems, in various combinations.
- Severe neglect can occur in any family setting.
- Nutrient deficiency is primarily a problem in infants under age 3 years, and growth faltering is the objective clinical marker. The point at which a child begins to deviate from the weight-for-age curve can be used to date the start of symptoms.
- Psychosocial short stature (deprivation dwarfism) is a specific type of faltering growth involving a reversible growth hormone deficiency; it primarily affects prepubescent children.
- Severe undernutrition can be life-threatening.

- A key diagnostic indicator of nutritional and/or emotional deprivation is rapid and dramatic improvement in symptoms during hospitalization.
- Medical neglect is a form of abuse that violates the child's right to health.
- The initial treatment of deprivation and neglect generally requires a prolonged stay in a medical setting with multidisciplinary intervention.
- While early multidisciplinary care improves the prognosis, the sequelae—psychological, in particular—are often permanent.

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15.1 What Is Psychological Maltreatment?

Many of a child's fundamental needs have a psychological or emotional dimension, including the need for affection, stability, empathy from family, authority, encouragement, and praise.

Yet, healthcare professionals have often not given sufficient consideration to psychological maltreatment or emotional abuse and neglect, and its consequences have

M. Leray • G. Vila (✉)

Psychopathologie de l'enfant et de l'adolescent—Hôpital Trousseau,
26 avenue du Dr Arnold-Netter, Paris, France
e-mail: marie.leray@aphp.fr; gilbert.vila@aphp.fr

not always been correctly assessed. However, it is now fully recognized as a form of abuse, in its own right, along with physical and sexual abuse [1].

Studies carried out since the middle of the 1980s in English-speaking countries have enabled a better definition of psychological maltreatment and emotional abuse, with specification of assessment criteria and the measurement of long-term consequences on emotional and behavioral development and on the mental and physical health of children who were victims of it. Comparing the main propositions made by clinicians and researchers [1, 2], we can offer an operational definition: psychological maltreatment of a child stems from an attitude (words and actions) that is intentionally and/or lastingly hostile or rejecting. It can take the form of abuse and of neglect. It is committed either individually or in groups, by people who exploit the victim child's vulnerability from the position of superiority or power. It can occur inside or outside the family. Most often, the perpetrator is a parent, but it can also be a caregiver—nanny, teacher, relative—or a school peer (bullying). Sometimes it is indirect, such as in situations of serious conflict within the parental couple when the child is drawn into conflicting loyalties toward the parents (cf. Sect. 15.2.7). Acts of psychological maltreatment do not correspond to short crisis periods in a child's life, but have long-lasting harmful effects on the child's behavioral, cognitive, and emotional development and even on his or her physical health.

Psychological maltreatment is often related to other kinds of abuse. It is key in terms of long-term impact.

The majority of children subject to sexual abuse are not seriously injured physically, but their emotional wounds have lasting effects. The severity of the abuse is also related to how the child experiences betrayal of the trust he or she had in adults and to the seriousness of the threats the abuser used to obtain submission. What is most important is not the physical injury, but the message it conveys, its underlying meaning. Physical abuse has harmful psychological effects that last long after the body has healed, with the exception of cases in which severe physical abuse leads to serious neurological damage, for example.

The harmful effects of maltreatment, and the psychological damage caused by it, are not always immediately visible. They appear as the child develops and sometimes last for a number of years following the actual acts of abuse and maltreatment.

This raises a central question: how can maltreatment be diagnosed and how can the seriousness of psychological violence be assessed, as it is an important indicator for the prognosis of long-term effects?

In the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (DSM IV), there are no diagnostic elements regarding the emotional components of abuse [3].

Psychological maltreatment can result from sadism or an "abuser's" mental cruelty; it can also result from parents' failure or inability to respond to the child's basic emotional needs and to assume the role of a benevolent and protective parent. The treatment of these is different.

Care for the victims should, wherever possible, be accompanied by work with the perpetrator.

15.2 Maltreatment by Parental Figures

15.2.1 Maltreatment Attitudes and Behaviors

Six forms of psychological maltreatment fitting into a repeated pattern of extreme incidents can be distinguished [4]:

Spurning	<p>This category includes behaviors that aim to criticize, belittle, or degrade the child or not recognizing any legitimacy:</p> <ul style="list-style-type: none"> • Spurning the child, refusing to give the child any importance, value, or attention • Belittling, scorning, or humiliating the child in public • Constantly criticizing the child, punishing him, and showing very little recognition • Shaming or ridiculing the child whenever he or she expresses affection or sadness
Terrorizing	<p>This form includes behaviors that aim to threaten the child (abandonment, injury, or killing) and lead to a climate of terror (fear of imminent danger to oneself or a loved one):</p> <ul style="list-style-type: none"> • Placing the child in situations that are visibly dangerous or chaotic, where he/she must face unforeseeable events • Setting unrealistic and rigid objectives, accompanied by threat of loss, danger, or physical injury if they are not met • Threatening or inflicting violence on the child • Threatening or inflicting violence on people or objects the child is attached to • Exploiting the child's fears and anxieties accompanied by threats of rejection
Isolating	<p>This category includes behavior that aims to deny the child opportunities to meet needs for interacting/communicating with peers or adults inside or outside the home:</p> <ul style="list-style-type: none"> • Confining the child or placing unreasonable limitations on the child's freedom of movement within his/her environment • Placing unreasonable limitations on the child's freedom to interact at home • Cutting the child off from the outside world or placing unreasonable limitations on his/her social contact (with peers or other adults)
Exploiting/ corrupting	<p>This category includes behaviors that encourage the child to develop inappropriate behaviors (self-destructive, antisocial, criminal, deviant or other maladaptive behaviors):</p> <ul style="list-style-type: none"> • Modeling, permitting, or encouraging antisocial behavior (e.g., prostitution, performance in pornographic media, initiation of criminal activities, substance abuse, violence to or corruption of others) • Obliging the child to play a parental role, infantilizing the child, or expecting the child to live out a parent's unfulfilled dreams • Encouraging or coercing abandonment of developmentally appropriate autonomy through extreme over-involvement, intrusiveness, and/or dominance (e.g., allowing little or no opportunity or support for the child's views, feelings, and wishes, micromanaging child's life)

Ignoring	<p>This form includes behaviors characterized by indifference and lack of reaction to the child's emotional needs and demands or showing no emotion in interactions with the child:</p> <ul style="list-style-type: none"> • Demonstrating complete lack of emotional responsiveness and a total lack of involvement, either by incapacity or lack of motivation • Limiting interactions to absolute necessity • Failing to express affection, care, or love for the child
Neglecting	<p>This category includes all behavior demonstrating adult neglect of a child's needs or problems related to emotional well-being, physical health, medical care, or education:</p> <ul style="list-style-type: none"> • Ignoring the need for failing or refusing to allow or provide treatment for serious emotional/behavioral problems or needs of the child • Not seeking medical assistance when the child's health is threatened • Ignoring the need for failing or refusing to allow or provide treatment for services for serious educational problems or needs of the child

As varied as they are, these forms of maltreatment all have a common point: they all directly oppose fulfilling the child's basic needs. Terrorizing the child puts him in danger and counters his need for physical safety. Rejecting a child or ignoring his or her emotional needs counters the child's need for love and recognition and exacerbates the child's fear of being left alone to face danger.

When psychological maltreatment is not linked to physical or sexual abuse, it is difficult to identify. Some forms of emotional abuse can appear obvious. Others are hard to pinpoint when there are no physical marks left behind or when the victim is not aware of the abusive nature of the parental interactions. For that matter, the child often feels partially responsible or guilty.

Identification of maltreatment cannot be established based on an adult's violent psychological reaction, which could be occasional or linked to an isolated incident. It must stem from observing a pattern of recurring relations between the perpetrator and the child, in which the dynamics of an abusive and alienating system are clearly visible. Forms of psychological violence can be direct or indirect (when a child witnesses family violence), verbal or nonverbal.

The most frequent interactions found in maltreatment are the following:

- Unrealistic or outrageous expectations regarding the child's behavior (in school, sports, culture, intellect, science, art, etc.)
- Erroneous or displaced qualifications (stupid, ugly, crazy, dumb, etc.)
- Repetitive humiliation in the presence of others (teachers, peers, friends, neighbors, relatives, etc.)
- Deformed or delirious perceptions (inverting roles, perverted interactions, persecution, mistrust, suspicion, etc.)

15.2.2 Links to Aggressiveness, Mental Cruelty, Sadism, and Control

In a number of cases, maltreatment is not intentional and can be treated with information and prevention. For example, some "tough" approaches to education are too rigid and punitive, but they are more dictated by preconceptions about how children

should be brought up than by any real intention to do harm. Children in these cases can feel frustrated and bullied by the educational model, but they are not destroyed emotionally.

In more severe forms, the adult clearly intends to attack, cause suffering, or dominate the child. The adult feels unconscious satisfaction and even pleasure. The abusive and alienating interactions should be understood in connection to the mechanisms that govern aggressiveness, mental cruelty, sadism, and controlling relationships.

15.2.2.1 Mental Cruelty

Some parents presenting with serious personality disorders are cruel and profoundly destructive. Their meanness seems to be intentional, and they give the impression of wanting to harm the child, without any clear reasons why. Their cruelty is repetitive and nothing seems to change their attitude. Tenderness is completely absent from their relationship with the child.

Mental cruelty traumatizes the child and impacts his or her mental state. Mental cruelty goes far beyond hurt pride, because it attacks the victim's very humanity. It breaks and pulverizes the child's mind, attacking the links between mental functions, breaking the "self" into pieces that are no longer connected, impeding the various aspects of the mind from integrating and working together. The child feels broken, fragmented, and depressed.

Mental cruelty is based on various patterns of psychological manipulation:

- Double messages, fragmented communication, and unforeseeability in the relationship
- Denials that do not consist of contesting or refusing what characterizes the other person, but rather of acting as if the other person did not exist
- Desubjectification of the victim, who is reified
- Exclusion, which dehumanizes the other by forbidding contact and interactions
- Organized separation between the intellect (overvaluing reason and intellectualization) and feeling (devaluing affection and destabilizing the victim's emotional life)
- Blocking the victims' capacity for personality integration, in terms of cognition, emotions, and drives
- Encouraging future destructive forces (failure, suicide)

The most spectacular aspect of the perpetrators' relationship with the victim children is their merciless and absolute coldness. "Here, insensitivity to what the attacked object feels takes center stage, more than pleasure. The disinvestment results in the other no longer being perceived as a fellow person, which means he can be considered with indifference and can easily become the object of any kind of destruction, partial or total, without guilt and without pleasure" [5]. A maltreating adult's emotional indifference can be understood in reference to the "cruel infant" as described by D. Winnicott [6], because mental cruelty stems from primitive mechanisms in the adult related to the infant's original destructiveness. According to Cupa, "the drive to cruelty belongs to original destructiveness, it is pre-object. It is related to a primitive dynamic without love or hate; rather it is hostile and demonstrates no pity. The drive for cruelty does not have a sadistic goal; it is an attack, breaking into the first maternal content and container for self-preservation" [7].

15.2.2.2 Aggressiveness and Sadism

Aggressive tendencies lead to a large portion of abusive behaviors that aim, on a real or imaginary level, to do harm to the child, to destroy him, to constrain him, to humiliate him, etc. They are linked to the individual's drives and to their entanglement (drive for self-preservation, drive for destruction, drive for death, etc.).

Parental aggressiveness becomes sadism when the parent experiences perverse satisfaction linked to the suffering and humiliation inflicted on the child. Sadism is associated with the aggressive component of libidinal drives in which love transforms into hate. It is fed by the pleasure experienced in dominating and humiliating the child, on one hand, and of seeing him feel pain on the other. That is why sadism is often associated with sexual abuse.

15.2.2.3 Relationship of Control and Dominance

Domination and control are important aspects in child maltreatment and are found in behaviors aiming to exploit, pervert, or isolate the child.

Control is a dispossession and an appropriation of the other. It is domination that leaves one's mark on the other: "in a controlling dominant relationship, there is always and very effectively harm done to the other as a desiring subject who, as such, is characterized by his singularity and his own specificity. Thus, the target is always the other's desire, in that he is profoundly foreign, escaping all possible grasp by his very nature. Control translates a very fundamental tendency to neutralize the other's desire, to reduce all otherness, all difference, to abolish all specificity: the goal is to bring the other to the function and status of an object that can be entirely assimilated" [8].

Control can become obsessional in terms of power and duty. The parent in these cases uses force to constrain the child, who has no possibility for escape. Control is totalitarian and englobes the child's entire personality; the child must act as the adult expects and must think in line with the standards imposed upon him. The child's desire must conform to a pattern that is predefined by the adult, and the child must adopt the same world view; what is good and bad for the child are also imposed on the child without him having any say in the matter or being able to doubt it. The adult's need for power makes him or her a tyrannical parent, whose power is all the more effective because it is imposed by constant monitoring the child and by invading the child's personal space. The parent demonstrates attitudes of active opposition or passive resistance to the child's plans. The parent is constantly arguing and discouraging all initiatives that are not his or her own. Family life is perfectly static; everything that is alive is frozen, petrified, and inert. There is not more space for freedom.

Control can also include a perverse or destructive dimension, which when played as seduction aims to deny the other the difference that contributes to his status as a desiring, autonomous subject. The pervert is thus looking to capture the child in his own desire and to definitively leave his mark. He is looking to submit and subject his victim to the demands of his own desires, to create a dependence and to dispossess the other of his own emotional liberty.

15.2.3 Psychopathological Consequences

Research and clinical studies carried out over the last 30 years have unanimously shown that the consequences of psychological maltreatment are serious. Various factors impact the form and seriousness of the repercussions: the child's age, the length of the maltreatment, its repetition, the degree of proximity (both physical and emotional) to the child, and the child's vulnerability and capacity for resilience. This can be seen in the range of resulting psychopathological, cognitive, relational, social, and somatic disorders [9].

Psychological maltreatment has a long-term impact on the person's mental state in a more marked fashion than other forms of abuse, due to the particularly high frequency of disorders and their chronic nature. When child psychological maltreatment is accompanied by physical or sexual abuse, the risk of aftereffects in the adult increases considerably.

In the six categories of psychological maltreatment, two have particularly harmful consequences: rejecting and terrorizing the child. Terrorizing the child with incessant criticism, threats, and demeaning and pushing the child away are particularly harmful.

The child's disorders do not always stand out and can have the same features as other psychopathological disorders linked to the same age. Furthermore, despite the serious emotional stress the child feels, he or she will attempt to hide the reality of his/her experience because he/she is afraid of the aggressor, and the child often adopts attitudes of submission and fleeing when the situation is revealed.

15.2.3.1 Post-traumatic Stress Disorder (PTSD)

Post-traumatic stress disorder can arise after the child is exposed to a potentially traumatic event during which the child had an immediate reaction of distress. This has been observed in particular when psychological maltreatment is accompanied by physical or sexual abuse and after a particularly violent scene of terror.

During the event, the child generally reacts with intense fear, a feeling of powerlessness or horror, and agitated or disorganized behavior. Repetition compulsion is the most marked effect. The child becomes stuck in repetitive games in which aspects of the traumatic event replay, without the child being aware of it. Pleasure is absent from the games. The child's sleep is often disturbed [10].

Syndromes include retrieval or renewal syndrome, phobia, dulling of overall reactions, and a state of alertness with neurovegetative hyperactivity that persists more than a month after the event [11].

Post-traumatic stress disorder can develop over several years and can greatly complicate and disrupt the child's development. Overall, girls present more severe and persistent PTSD than boys.

15.2.3.2 Disruptions in Self-Image and Vision of the World

Psychologically abused children seem to internalize the critical voice of the maltreating person, which forms the basis of low self-esteem and mood disorders at adulthood. The child has the impression that he is worthless, that he is not loved by

others, that he only has faults, or that his life only has meaning if he responds to the needs of others [12]. He feels like he is not adapted and maintains a feeling of inferiority.

Rejecting and degrading comments and attitudes lower the future adult's perception of himself, of others, of relationships, and of the world in general. They will have an impact on how that future adult manages emotions, on her self-control, on interpersonal relationships, on learning, on work, and on the person's health. The victim runs the risk of having a negative, anxiety-filled vision of life and the world.

15.2.3.3 Disruption in Emotional Life and Personality Disorders

Some children who are victims of psychological maltreatment experience serious psychological distress tainted with anxiety and irritability, which often takes the form of fears, nightmares, or anxiety attacks. They can be sad and depressed, and when they reach adolescence, they run more risks of attempting suicide.

Emotional instability is frequent: these children can be very impulsive and have trouble managing their emotions. When they reach school age, these victims feel anger and they can develop aggressive behavior.

Depression and bipolar disorders can arise in adults who were subjected to criticism, rejection, humiliation, or degrading behavior. They feel shame and recurring fear of being criticized or rejected. They have trouble managing the emotions they judge to be socially unacceptable.

One of the major consequences of parental psychological maltreatment is the development of *attachment disorders* [13, 14]. Children who have been abused in this way present with dependence or with emotional inhibition. They are unable to build sufficiently safe relationships of attachment, because their experience of disorganized relationships leads to avoidance behaviors. Their representations of human relationships are skewed. Repeated experiences of criticism, rejection, and condemnation strengthen these negative patterns and increase any tendency toward anxiety or avoidance.

These attachment disorders can be found in adults who were victims of psychological maltreatment in their childhood. They experience relationship troubles and stormy love relationships because they have a very disturbed understanding of other people and skewed awareness of what feelings they show.

As teenagers and adults, they could experience *sexual disorders, alcoholism, or drug addiction*.

Psychological maltreatment increases the risk, once a teenager, of *perpetrating or being a victim of sexual aggression*, for both boys and girls [15]. Resulting from the abuse they experienced, when faced with a threat of falling apart, victims of repeated psychological violence often experience disassociation phenomenon, which are demonstrations of their distress. This type of disorder impedes their capacity to detect dangerous situations, to correctly assess risks, and to defend themselves.

Lack of empathy along with trouble managing frustration or moderating anger is also a risk factor that can predispose these individuals to violence.

Finally, the most serious effects of child psychological maltreatment are the development of *personality disorders* such as borderline or complex personalities.

15.2.3.4 Disruption in Social Life and Relationships

As maltreatment impacts their image of themselves and their self-esteem, some children prefer to internalize symptoms (especially girls). They turn in on themselves or remain in a strong dependent relationship with the other, which complicates their interpersonal relationships. They are not at ease in social situations. Other children will externalize symptoms (especially boys). Hyperactivity is sometimes observed in these cases, which could result from the failure of the mental counter-stimulant functions when the child faces assault from abusive parents.

Some victims go through a full range of deviant behaviors, from simple disobedience to criminal activity. Problems of aggressiveness (hetero- or auto-aggressiveness) and violence arise frequently, sometimes with delinquent behavior observed at adolescence. The level of aggressiveness and violence is closely linked to the level of exposure to negative interactions (criticism, lack of valuing the child's accomplishments, frustrations, demonstrations of discontent and irritability). The more the parents are verbally aggressive, the more the child runs the risk of becoming physically aggressive. It would even appear that verbal aggression is more closely correlated to the various forms of later juvenile delinquency than parental physical aggression [9].

Numerous studies have demonstrated a clearly established link between juvenile delinquency and parental rejection, absence of parental involvement in the relationship with their child, and a lack of parental supervision. One finds among the predispositions for criminal attitudes, both the imposition of random, punitive, and unfair justice and laxity, combined with parental attitudes of rejection, neglect, and cruelty.

15.2.3.5 Cognitive Disorders and Learning Difficulties

Emotional disturbances and behavioral disorders make it harder to concentrate, leading to learning difficulties. The appearance of cognitive disorders impedes the child's development. These various elements often translate into low grades and failure in school.

When cognitive disorders are linked to difficult relationships and lack of self-esteem, they can tarnish the future adult's career and success.

15.2.3.6 Somatic Disorders

Some children and teenagers who are victims of psychological maltreatment complain of insomnia, headaches, abdominal pain, and nausea. Once adult, they develop psychosexual disorders that impact their relationships when they have been victims of both psychological maltreatment and sexual/physical abuse.

Some children develop food-related disorders (most often bulimia) at adolescence or when they reach adulthood; these disorders can result either from alexithymia or arise in relation to depression [16].

As with physical maltreatment, psychological maltreatment can lead to failure to thrive.

15.2.3.7 Clinical Presentations of Serious Emotional Deficiencies

Behavior aimed at ignoring the emotional needs of young children tends to cause many delays in physical and mental development, notably in the context of institutionalization.

The consequences of parental negligence are particularly detrimental. Emotional indifference, the lack of reaction to interactions with the child, causes anxious attachment, major dependency issues, disobedience, impulsiveness, limited learning capabilities, low self-esteem, negative feelings, a lack of enthusiasm, self-punishing behaviors, and serious psychopathologies.

15.2.4 Risk Factors

Research has not been able to identify family types or victim types. It has, however, shed light on risk factors that, when combined, clearly increase the risk of the development of an alienating system of psychological child maltreatment [17]. These risk factors are linked to the child victim, to the perpetrator of the psychological violence, and to the environment.

15.2.4.1 Risk Factors in the Child Victim

Several factors predispose a child to psychological maltreatment, including being older than age 6 and being perceived by those around him/her as being “different.” Behavioral disorders or the presence of physical or mental particularities (disabilities, specific developmental disorders, premature children, etc.) can make parenting more difficult and increase the risks.

Furthermore, children who are victims of violence in his/her family will run more risk of being victims of peer violence.

15.2.4.2 Risk Factors Among Perpetrators of Psychological Maltreatment

The main risk factors impacting adults are linked to:

- *Personality traits*: emotional disorders, aggressiveness and hostility, low self-esteem
- *Poor social relations*: low levels of involvement in social activities or social anxiety
- *Cognitive and emotional disorders*: dysthymic symptoms, learning disorders, low levels of verbal reasoning, and mental illness
- *Health problems*: illness, disability, alcoholism, or drug dependency
- *Troubles linked to their parenthood*: major parental preoccupations, the fact of being a young parent

The risk increases also when the adults themselves have a history of maltreatment. For example, adults who themselves had poor relationships with their parents are more inclined to “scream at” their own children, due to the fact that their capacity to face and manage stressful family situations has been affected.

15.2.4.3 Environmental Risk Factors

Child psychological maltreatment in a family is also linked to factors related to social and economic environment, such as low income, social exclusion, or isolation in a rural zone. Some family configurations run more risks, including single-parent

families, families with many children, and those in which intra-family or conjugal violence impacts the child by putting the child's objects of attachment in danger.

15.2.5 Assessment

15.2.5.1 Assessment Goals

The goal of assessment is to evaluate and qualify the kind of maltreatment in place and to clarify the situation in order to choose how to intervene. The assessment should be quantitative and descriptive.

15.2.5.2 When to Assess

Considering the lack of specific observable symptoms in cases of "pure" psychological maltreatment, it is necessary, in cases of doubt, to compare various observations of parent-child interactions with the child's symptoms and with the environmental risk factors.

In cases of sexual abuse, physical violence, or negligence, caregivers should systematically question the possible existence of psychological maltreatment, in order not to forget to treat the emotional element of the maltreatment.

15.2.5.3 What to Assess

The assessment of suspected psychological violence can cover several factors [18]:

- The form(s) of psychological maltreatment
- When it appeared and how long it has lasted
- The intensity
- The frequency
- Whether it is intentional or not
- How harmful it is (to what extent these violent attitudes infiltrate the family relations or the relations between the child and his/her peers)
- Risk factors
- Symptoms observed in the child victim
- Presence of people in the child's environment who play the role of protector

One should note the child's developmental stage at the time the psychological violence began and the period in which the first symptoms appeared.

The frequency and duration are key factors to take into consideration: identifying proven psychological maltreatment stems from the observation of a recurring pattern of harmful relationships between the perpetrator and the child that extend over a sufficiently long period of time. It is not occasional or punctual. One should only consider psychological maltreatment if the observed or reported violence is repeated and has been occurring for some time. It is important to assess the quality of the parent-child relationship and to explore the representations conveyed by the family history in terms of the genesis of these bonds, the emergence of conflicts, and the way they are played out.

The seriousness depends primarily on the scaled combination of intention and harmfulness of the abusive or coercive attitudes.

For example, mild family maltreatment is more a problem related to parenthood than attitudes that are voluntarily psychologically violent. The parents need help in the sometimes difficult exercise of parenthood. One example is the situation in which parents put too much pressure on their child to do well in school. Even if they have no intention to harm their child, their excessive expectations, when they are daily and the source of repeated criticism, end up becoming emotionally violent for the child. If intra-family communication is disturbed, a few sessions of family therapy or parental guidance can unblock the situation. This type of problem is sometimes observed when the child has a specific disorder (such as dyspraxia) that has not been diagnosed or when the parents have not understood the full implications.

In situations of moderately severe maltreatment, the perpetrator intends to harm a third party. He or she unknowingly harms the child emotionally. The clearly harmful attitudes require educational guidance and sometimes psychotherapy for the child. Some professionals consider that these situations of moderate maltreatment should be the object of preventive legal reporting [1]. We believe, however, that it is important to take the time to assess the abusive person's capacity for change, once that person has been informed about the consequences his/her attitude has on the child. In high-impact situations when the parents do not seem to be able to change their behavior, reporting to the authorities could support educational guidance and therapy. A frequent example of this type of psychological maltreatment is found in families in which the parents separate and one parent systematically denigrates the other in front of the child or tries to isolate the child as much as possible from the other parent. Little by little, the child develops difficult relationships with certain adults, who can go as far as suspecting that the child is the object of sexual abuse by the other parent.

Severe psychological violence is characterized by an intention to harm the child emotionally, which progressively engenders mental distress in the child. Most often, this occurs with parents who have psychiatric pathologies or a family history of maltreatment and emotional void. It can also be linked to the child's background or to a disability. These parents have trouble putting a stop to their psychologically violent attitudes, particularly as soon as the situation becomes stressful, whether the stress is related to the child or not. Even when informed of the seriousness of his behavior, the adult continues to mistreat the child. It is recommended that the authorities be informed in addition to therapy. If the situation does not change despite the proposed support, distancing the child from the family situation should be considered.

15.2.5.4 How to Assess

The assessment of suspected or proven maltreatment is never easy: one needs to discern it with the most objective criteria possible, without introducing too much subjectivity in the evaluation of its seriousness. It is therefore important to use a methodology that is as explicit as possible. The observers must beware of intuitive judgements, false evidence, and biased interpretations.

Assessment requires a multidisciplinary approach in which each profession uses its analytical framework. The team must then compare and put the various points of view into perspective. The assessment is based on a collection of direct observations led by various professionals using several sources (interviews, reports about the situation). It must be all the more rigorous in cases in which psychological maltreatment is not accompanied by physical or sexual abuse, due to the lack of explicit physical evidence.

The assessment requires a comparison of information taken from the maltreating parent, the child victim, and the non-maltreating parent, depending on the case.

Observing the parents' reaction to their child's experience and listening to them about what they have or have not set up to protect their child gives precise information regarding their capacity to take their child's needs into account and to support them [19]. Some exploratory questions can help understand the parents' attitude:

- How do they describe daily family life and intra-family relations?
- How do they explain their child's problems?
- What have they tried to change in the situation?
- Have they sought outside help? What type?

Regarding the child victim, the questions asked should not take the form of an interrogation: it is often difficult for the child to recognize that there is maltreatment. On the other hand, one can encourage the child to:

- Describe incidents (e.g., was he/she yelled at).
- Describe situations in which he/she was treated in a way he/she didn't like.
- Imagine changes that he/she would like to see in his/her life.

A step-by-step approach is needed to *assess the seriousness of the psychological damage*, noted in these interviews, observations, and reports from other professionals. Here, we propose the basis of a methodology:

1. Identify and list violent or potentially violent behavior in the parent, distinguishing reported behavior from directly observed behavior.
2. Class the behavior in the six above-described categories.
3. For each behavior, indicate when it appeared, how long it lasted, and the frequency.
4. Consider the presence or absence of parental intention to do harm with harsh words or violent/potentially violent attitudes or behaviors.
5. Note the mechanisms and modes of protection that the child and those around him have set up.
6. List the child's symptoms and their seriousness.
7. Assess the potential consequences of the psychological maltreatment on the child's development based on the period of time the acts began and the maltreatment behaviors.
8. Bring to light risk factors in the family environment or in family background.
9. Identify potential people who could provide the child with support.

Collecting this data enables one to assess the seriousness of the psychological maltreatment (mild, moderate, severe), to determine the most appropriate responses (therapeutic, social, educational, and/or legal), and to reflect on how best to implement those responses.

In situations in which one parent is perpetrating the psychological maltreatment, we recommend an observation period after awareness-raising with the parents, in order to assess their ability to react, cooperate, and change.

15.2.6 Intervention and Therapy

The goal of intervention is to put an end to, shorten, or reduce the psychological violence experienced by the child. It will attempt to prevent recurrence. Finally, it will seek to reduce the harmful effects of the psychological maltreatment the child has already experienced. Generally speaking, there is benefit in envisioning the intervention as part of a systemic approach that includes the child victim, the family, and the perpetrator of the maltreatment.

15.2.6.1 Protecting the Child

Involvement of professionals in a situation of child maltreatment consists first of all of protecting the child. This protection is necessary, but not enough: it is indispensable to provide treatment for the child.

Approaches to intervention and their timing should be adapted to each situation and to the local possibilities, depending on the country. They will differ based on the severity of the maltreatment, where it is anchored, and whether the violence occurs at school or in the family. They must also take into consideration the child's capacity to recount the story. In cases of psychological violence in school, quick protective intervention is possible to shelter the child, by changing schools, for example. In situations of psychological maltreatment within the family, the initial intervention must be approached from the perspective of providing the most efficient long-term protection for the child. Although separation can provide immediate protection, it also has iatrogenic effects and should be accompanied with counseling both for the child and his/her family. The professionals should not stop at immediate emergency separation.

Interventions should be carefully planned after detailed observation of the child and his/her environment and a precise assessment of the situation.

When there is refusal or failure to work with the child or when there is severe psychological maltreatment, intervention by social workers and legal authorities is required. In cases linked to sexual abuse, emergency intervention is necessary.

Choices of interventions in the case of intra-family maltreatment:

Many parents who psychologically maltreat their children do not intend to harm them. It is generally appropriate to have a psychotherapeutic intervention covering the parent-child relationship, even when the social and legal authorities are involved. Different interventions could be proposed and chosen based on the types of pathogenic parent-child interactions.

In cases in which the parents are not able to adequately provide for the emotional needs of their child, the parents are often overwhelmed by their own troubles: parents who had been victims of conjugal violence, drug-addicted parents, alcoholic parents, or parents with mental illness. The intervention in these cases places a priority on treating the parents with protective measures for the child when necessary. It is important to note that, sometimes, the other parent is capable of responding to the child's emotional needs.

When the parent projects negative attributions onto the child, the hostility is based on negative fantasies and beliefs about the child, his personality or his temperament. This is often difficult to change, and parental guidance is rarely accepted or effective. These cases require psychotherapy for the parents, which nevertheless could fail due to a lack of perception of its necessity. It could be judicial to privilege intensive educational support that could lead to psychotherapy at a later time.

Certain parents have inappropriate expectations of a child considering the child's developmental age. They expect the child to participate in tasks or be involved in problems that are the responsibility of the adults. They could, for example, flood the child with their own emotional or social problems. Some parents do so in an inconsistent or excessively harsh manner. These parents are often not aware that, in order to grow, the child needs to have a framework with clear limits that are not only related to punishment. They punish their child if he/she cannot do things that do not correspond to the child's developmental age or capacities. This is sometimes observed with children who have motor disabilities, and their parents denigrate them because they cannot walk. In these situations, education with counseling regarding parenthood seems to be the most appropriate approach.

Other parents use the children to respond to their own needs. These are often parents who cannot seem to fully perceive the psychological limits between their child and themselves. This can be observed in some cases of non-resolved conjugal conflicts in which the child is pulled into a process of denigrating one parent to meet the other parent's need for revenge. Munchausen syndrome by proxy is the most serious form of this type of interaction and requires that the authorities be notified. Therapeutic intervention will aim to find the factors that maintain the child in the role of satisfying the parent's needs. One should attempt to help the parent understand the benefits of a change in behavior. One could help him/her explore the child's perceptions of these interactions, for example, the feeling the child has for the other parent.

Cases in which the child's socialization is impeded often correspond to parents who have not considered the effects of this mode of interaction on the child's own interactions with other children in an educational or school context. Parents who limit their child's social contacts excessively are not aware of the child's developmental need to participate freely in social activities and to explore the world. A combination of intervention with adult-care services (for parental guidance) and educational and social services for the children is required. In situations in which the child is actively corrupted and involved in criminal behaviors, legal intervention is also required.

15.2.6.2 Educational Intervention

Educational intervention could take various forms depending on the country and adapted to each situation. A specialized educator can provide parents with a basic understanding of their child's education, schooling, and leisure activities. Such an educator can do educational work with the child if the latter has asocial behavior or is having trouble in school.

It is sometimes useful to accompany the families in their daily life in order to enable the child to experience positive relations with adults and to give rise to new capacities. Sometimes, "educational" intervention can progressively lead to a therapeutic intervention that would have been refused or impossible to start with.

15.2.6.3 Social Services Intervention (*Country Dependent*)

Depending on the country, the social services can participate in assessing the situation and can help to act on the social and environmental factors that increase the risk of violent behavior. For example, a social worker could help parents with a search to find adequate housing, in the day-to-day management of their budget, and in other interventions such as accompanying the family in the healthcare establishments.

15.2.6.4 Child Therapy Intervention

If the child is particularly vulnerable due to immaturity, he or she is also in a phase of development that opens a potential to evolve, which supports the idea of providing counseling as early as possible.

To support a child who is the victim of psychological maltreatment in the family, Danya Glaser proposes a few interesting approaches [17]. First of all, it is essential to recognize explicitly, with the child, the reality of the experience he/she is having while not denigrating the parents. One can explain to the child the parents' difficulties, work with the child on his/her feelings of guilt and low self-esteem, offer the child a possibility of maintaining or building a lasting respectful relationship with adults, and ensure that the child is able to develop his full education potential, which will promote a reconstruction of his/her self-esteem. This work offers the child a needed space for reflection in order to develop and individuate.

Family therapies and the systemic approach in particular can be very effective in some configurations of maltreatment in family interactions, but various therapeutic approaches with the child him/herself can also be used.

Cognitive therapy techniques, sometimes used for the treatment of physical and sexual abuse, seem to also apply in situations of psychological maltreatment [20]. Their goal is to establish new cognitive patterns and mechanisms in connection of human relations. In particular, these include identification techniques, emotional management techniques, stress and anger management, problem recognition and resolution, and cognitive restructuring techniques.

Ericksonian hypnosis is an effective method to treat manifestations of anxiety and generally for emotional trauma.

Relaxation is also helpful, in particular for teenagers suffering from sleep disorders and anxiety attacks.

Psychodynamic psychotherapies offer a holistic approach to the person. Setting up a psychoanalytic therapeutic framework enables the development of transfer in which the child can replay, from an active position, positive and pathological interactions with his/her parents. Little by little, with the help of interpretations and a safe transfer setup, the connecting process starts working again, thus decreasing separation and disassociation symptoms. The child puts himself back in his own story and opens the way for smooth mental development.

Whatever technique is used, psychotherapies should provide the child with an opportunity to experience a feeling of safety while feeling emotions. Increasing the level of attachment safety in a context of relations of trust with the therapist and with other members, in the case of group therapy, is a key component in the healing process.

Use of psychotropic medication is for the most severe symptoms and depressive states. It can be useful for particularly debilitating periods in social interactions and learning, in particular when there are invasive anxiety attacks.

15.2.7 Specific Cases: Loyalty Conflicts in Conflicted Divorces and Separations

Often, conflicted divorces lead to psychological maltreatment of the child, who witnesses the parental conflict or is called upon to take sides. Whether or not there had been conjugal violence, one parent's systematic attack and denigration of the other (or both parents reciprocating their attacks) result in true psychological maltreatment in children. The constant stress the children experience when the two parents are present at the same time impedes their tranquility and keeps them from developing freely.

Sometimes, psychological violence between parents lasts well after they separate. The struggle to be the child's favorite parent has an underlying goal of vengeance against the ex-spouse. The child is prey to emotional blackmail from one or both parents. Sometimes this occurs out in the open or violently and is recognized by those close to the family; other times it occurs in a more insidious manner. Inevitably, the child feels anxiety and guilt when he/she reacts in favor of one or the other parent. When these situations are repeated over long periods of time, there are long-term detrimental consequences on the child's development and his/her relationships with others. Even if the parents do not intentionally want to harm their child, this is not enough to avoid trauma.

Loyalty conflict in a child stems from the filial bond, as the child automatically feels an ethical duty of loyalty toward his/her parents. Loyalty conflicts are inherent in everybody's life, resulting from inherited family expectations, which are different and sometimes contradictory [21]. But loyalty becomes divided when a child is forced to be loyal to one parent over the other. The child gets stuck in a paralyzing internal conflict resulting from an impossible choice between two solutions that engage his feelings and attachment to each of his parents. Inevitably, he feels as

though he is betraying one or the other parent at any given moment. The situation causes despair that quickly becomes unbearable. The external parental conflict is mirrored in the child by an internal loyalty conflict.

A child who tries to remain neutral, showing no preference to one or the other parent, quickly finds himself in a game of trying to hide as much information as possible to each parent to avoid hearing disobliging comments about a parent or to keep from hurting a parent. When the child's words are used by the parents, the child quickly learns to be quiet. His life becomes divided into two parts he cannot reconcile, and spontaneity becomes dangerous. There is a risk the child loses his identity.

Another way for the child to attempt to remain loyal toward both parents is to tell each parent what he/she believes they each want to hear. In consultation, one often sees children whom the parents describe as hiding things or lying. The child could even accentuate the other parent's negative traits, or invent them. Sometimes, the child perceives the influence of his/her words and could have the impression of controlling the situation, with the anxiety of being all powerful.

Many children opt to defend one of the parents, with more or less aggressiveness toward the other. One of the parents may have manipulated or skillfully suggested to the child to do so, or the child has entered into a mechanism of parentification in which she protects the parent she believes is the most vulnerable. Little by little, a binary reflex takes hold, in which loving one parent excludes loving the other. In these cases, the child uses defense mechanisms such as denial and cleavage. This position allows for a certain mental economy and appears more comfortable, but it has serious long-term consequences. The child develops based on a split, Manichean perception of representations and parental references, which keeps the child from developing interpersonal relationships based on complementarity and reciprocity. The child's future conjugal relations could be endangered.

From a systemic point of view, siblings can react differently. Some will adopt a single, often unilateral, position, in which all the children seem to be thinking the same thing and develop a faux self in which ambivalence is not allowed. In these cases, it is important to see the brothers and sisters separately so that each one can dare to express his or her own point of view and feel ambivalence. Other siblings chose to remain neutral will decide how they split up between the two parents, notably in their choice of where to live. Some of the siblings will choose to live with the mother, and others will choose to live with the father.

Some children will identify with the more aggressive parent because they need to identify with someone to grow, and they have not yet built the necessary reference points to tell the difference between acceptable and pathological behaviors. This can be observed, particularly, in little boys who have witnessed their father abuse their mother, physically or verbally, on a daily basis. They mimic the father's attitudes to "test" them inside the family or at school while experiencing serious anxiety as they do so. The process of identification that is necessary for the child's psychological development takes the form of identification with the aggressor. These children could adopt pathological behavior fed by aggressiveness and may be unable to develop enough empathy.

Children can also identify with the more vulnerable parent. In these cases, they tend toward depression and turn in on themselves. Sometimes they become incapable of defending themselves from outside abuse and could become scapegoats in school or introverts.

Split loyalties disturb the child's psychological and emotional state. The guilt the child feels translates into a propensity for self-denigration. The child feels nearly constant anxiety. He or she is in a state of internal insecurity that keeps him/her from exploring the world and creating new bonds.

Some children seem to adjust to the situation and do not appear worried in their everyday life. For a long time, these children will show no worrying symptoms, and when one sees them in consultation, they seem to be operational, suppressing their emotions with the risk of developing a faux self.

In cases in which parental conflicts maintain an atmosphere of psychological violence, it is important to remain neutral. The mechanisms of cleavage that are often in place in the children cause despair. We are often led to doubt in the child's words. It is up to psychotherapists to work with the child's contradictions to help him to progressively access the ambivalence and the complexity of the emotions in play. The therapist could "invite the child to say what he thinks more precisely, to place himself in the context of his relationships, and to bring together trustworthiness and authenticity in his words" [21].

One should be attentive not to give the child too much responsibility regarding his/her choices. Too much responsibility inevitably leads to anxiety and guilt [22]. In addition, the child could contradict himself depending on what he thinks you expect of him.

Support for the parent could help them to better manage their emotions, anxiety, anger and, most of all, their deception. This is what they need to do in order to respect and recognize the child's right to exist as a human being. Once empathy is again possible, they could accept the balance of loyalty inherent in all filial bonds [21].

15.3 Psychological Maltreatment at School: School Bullying

15.3.1 Definitions

Some children suffer from psychological maltreatment perpetrated by other children at school or in their everyday environment. The term "school bullying" is generally applied to all behaviors in which a child experiencing anger releases it in the form of aggressive behavior toward a peer chosen for his/her vulnerability. The angry child used tactics of constant criticism for futile motives, intimidation, harassment, exclusion racketeering, isolation, teasing, etc.—often along with physical violence.

In school settings, four types of behavior have a direct psychologically violent impact: insulting a person, giving a mean nickname, isolating, and teasing about good behavior in class. These behaviors, sometimes called "micro-violence" can,

when repeated on a daily basis, have serious consequences on the physical and mental health of the child victim. They generally focus on a small number of pupils. When the violence becomes collective, the victim becomes a scapegoat. This kind of psychological violence can be accompanied by physical and sexual abuse.

This kind of behavior can occur at any moment, in school, near school, on the bus, etc. More subtle forms often take place when the children are under adult supervision, either in class or during extracurricular activities. These are insidious and hard to identify.

Psychological maltreatment at school can also stem from teachers. This presents clinical characteristics and psychopathological consequences similar to parental maltreatment and to situations of peer school bullying. We will not develop it further here.

Modern technology (Internet, portable devices) is often used as a vector to increase the pressure and torment inflicted on the victim. Telephones are used to send insulting, mean, and threatening messages. The Internet enables very quick and wide dissemination of defamatory rumors, criticism, teasing, or scenes of humiliation, which then spread quickly throughout the school or beyond. This is called “cyberbullying.”

15.3.2 School Bullying Behaviors

15.3.2.1 Intimidation

Intimidation consists of sparking fear in a person in order to dominate him/her. In school, children who intimidate verbally threaten another child or his/her possessions, they push another child to do something dangerous or illegal, and they demand money or other things in exchange for the child’s safety. Intimidation also takes the form of encouraging hate toward the victim or by transferring responsibility for wrongdoing onto the victim. Intimidation is committed by girls and boys in nearly equal proportions [23].

15.3.2.2 Harassment

Harassment is defined as any inopportune or undesirable act committed toward another person or any hurtful, degrading, humiliating or shocking comment directed toward that person. This can consist of badmouthing a person or embarrassing him/her in public, teasing a person about some aspect of their being (appearance, disability, background, religion, etc.), constantly reiterating inopportune comments, bothering someone, insulting them, or making offensive comments.

Sometimes, harassment takes more insidious forms, such as being condescending and constantly lowering a person’s self-esteem. Harassment can also take the form of systematic exclusion from a group of peers, which can lead to the victim being isolated. It can also have a sexual dimension to it, through inappropriate, unwanted, and unsolicited sexual gestures or remarks. The child victim experiences these acts as intimidating, offensive, and even shocking. They group together a large range of verbal behaviors (insults, gossip, threats, etc.) and nonverbal behavior

(isolation, touching, spitting on, fighting, pushing, etc.). Three aspects differentiate harassment from senseless acts of violence and from violent conflict resolution: premeditation to increase effectiveness, prior assessment of power relationship which increases the victim's difficulty to defend himself, and repetition, which results in deep wounds. Harassment can be physical (carried out or threatened), verbal (teasing, embarrassing, diminishing in public or private), and it is sometimes indirect, such as exclusion from a social group in a concerted manner.

15.3.2.3 Racketeering

Racketeering is extortion and punishable by law in some countries. It differs from theft in that the victim hands over the object or acceptance against his own will in exchange for something. The extortionist generally uses some form of blackmail or threat of reprisal on a victim weaker than himself.

Parents will often uncover racketeering when objects or money disappear, and they observe a change of attitude in their child, who becomes more taciturn, irritable, or who turns in on himself. He/she has trouble sleeping and eats less, and his/her grades fall.

15.3.3 Actors and Spectators

15.3.3.1 Child Perpetrator and Child Target of School Bullying

There is no specific profile of a scapegoat or bullied child. School bullying is about relationships of power. All one can do is pinpoint risk factors linked to a person or a context, notably some particularity that makes the child stand out from the others. The harasser perceives the target child as different, due to something physical, having a shy personality, some special center of interest, etc. Targeted children are not systematically vulnerable but are frequently more sensitive, nervous, or reserved. Fear takes over in confrontations or when the victims experience conflict with other children. They are chosen because they can be easily isolated. They are often children with strong moral integrity, who easily forgive and who have good relationships with adults, but who are not well integrated in a group of friends. Their social isolation makes them vulnerable, and that is the most harmful consequence of intimidation: this isolation deprives the victim of opportunities develop and practice healthy social skills.

However, there are also bullied children who have trouble in school, whom Olweus [24] describes as provoking victims: they are often turbulent and they get angry easily. They are irritating and jeer at others, who then could respond.

Although any child could become an aggressor in certain contexts, bullying children are often aggressive, physically stronger, and easily inclined to be violent. Their social and communication skills are limited. Their family life could be disrupted. They have that much more trouble managing interpersonal conflicts because their relations are built on an insecure base and low self-esteem. They believe that aggressiveness is the best way to resolve conflicts. They look to attract the attention of peers and need respect, but confuse respect with fear. They want to make an

impression, but do not respect others; they lack empathy and have trouble understanding the way other people feel. They are often the children with the lowest grades, who lie frequently and refuse to take responsibility. They often believe that the child victim caused the problem because the victim annoyed them. They perceive hostility where there is none.

The mechanisms at play with individuals and groups are defense mechanisms: self-hatred is projected onto the other in order to avoid thinking about one's own discomfort. The victim, despite himself, serves as a rampart against mental collapse. The bullying child or group is not feeling empathy, for lack of having identified what hurts inside. A very evident transformation in one person (greasy hair, acne, strong or weak intellectual capacities, etc.) can mirror problems other teenagers are not taking responsibility for and can thus attract their antipathy. Changes in the body, emotions, and intellect that occur during adolescence stand out all the more in teenagers who are also experiencing them. The implicit rule among teenagers is to be like others if they want to have their place, because everything that reminds them of difference causes fear. That is why the bullied student often finds himself reduced to that particularity that caused the rejection.

It is important to identify the reasons for which a child bullies another child [25]. It can stem from frustration: a child fails at something and feels frustrated. If the source of his difficulty has not been identified (e.g., deafness, dyslexia, etc.), vengeful anger could arise. At first, this violence is not directed toward another person, but the child could direct it toward a scapegoat. The bullying child could also be an abused child who is starting to be aggressive because it is the only means he has to survive in a climate of violence and to express his anger. Bullies can also be children who have no quality role models and whose parents have poorly adapted or neglectful behavior or children with the beginnings of behavioral or personality disorders.

Bullying behavior is not predetermined. It is adopted in situations where social skills are not working. As a result, anyone could become an aggressor if that person's specific trigger is present: a feeling of frustration, a mistaken perception, peer pressure, power over someone, or an opportunity to regain power considered lost [26]. The bullied child can become the bully and vice versa.

It seems that girls and boys are bullied and bullies equally, if one considers all the types of peer maltreatment. Boys tend to use physical forms of aggression more, and girls practice acts of social alienation such as spreading rumors, refusing friendship, or ignoring someone.

15.3.3.2 What About the Witnesses?

Witnesses of harassment within a group play an essential role. Young or adult, we are more inclined to be aggressive when we witness acts of aggression committed by someone we think is more powerful than we are [27].

This reaction is exacerbated when the aggressor's behavior seems to give one attention or prestige. As soon as one has the impression that the victim sought or deserved what happened to him, one will feel better toward the aggressor. Witnesses participate in school bullying as soon as they encourage or provoke the aggressor

(e.g., by laughing or calling out to him when watching the scene, by refusing to help the victim, or neglecting to report the event). It is all the more important to highlight that when witnesses do intervene, it is generally effective, particularly when those witnesses have an enviable social position.

15.3.4 Psychopathological Consequences

It is estimated that about 10% of students, aggressors and victims, run the risk of long-term effects from school bullying [28].

A *bullied student* will often exhibit signs after a period of time, and these should be a warning: stomach ache, repeated headaches, trouble sleeping, turning inward, aggressiveness toward friends and family, anger, feeling sick on the way to school, refusing to go to school, being absent a lot, strategies to be alone or to avoid things, mutism, drop in grades (or the contrary, with excellent grades from escaping into books), damaged clothing, deteriorated or lost possessions, etc. The most frequent disorders include school phobias, depression, food disorders, scarification, behavior disorders, and enactment. These are all signs of the violent psychological impact of school bullying. It is indispensable to listen to these young people when they manage to talk about it and not to minimize their experiences. Due to a feeling of insecurity, they often express their emotions in tears, complaints, or avoidance.

The suffering victims endure and impede the development of their identity. The young people feel diminished and shameful. They lose self-confidence and find themselves in a state of great vulnerability. They can adopt passive, submissive, or fleeing behavior. A vicious circle can settle in: the more the victims close up in their own powerlessness, the less they can defend themselves and the more the aggressor's potential control increases. A feeling of shame accentuates the difficulty of confiding in adults. Victims feel they will never resolve the issue alone. Fear of reprisals from the bullies and fear about what peers think ("they'll think I'm a rat") make it all the more difficult to talk to adults. It is estimated that more than a third of children who are bullied at school do not report it to adults, either out of fear of not being taken seriously, or out of fear of being blamed for the incident. They also fear that the adults will be powerless to protect them or indifferent to their suffering. In these cases, the victims close up even more and think they deserve the bullying and feel a lot of guilt.

The repercussions of school bullying depend on frequency, duration, the scope, and the seriousness of the acts. The victim's personal background, psychological state, and the circumstances are also variables. In any case, the event never leaves a victim indifferent, and the harmful effects, be they mild or serious, can last a long time. Victims are often rejected by former friends and struggle to make new ones. The consequences can be dramatic: targeted young people could end up socially isolated, develop chronic depression, and even attempt suicide. In the long term, victims have trouble approaching others, and their social integration is impacted. Some, through the long-term development of post-traumatic stress disorder, suffer personality changes with behaviors linked to avoidance and fear.

The bully is also a child who needs help, all the more so because many bullies have been victims themselves, and their behavior is often a reaction of self-defense. Punishing intimidating behavior without taking into considerations the victims' experiences increases frustration and the development of aggressive behavior [29]. Several studies demonstrate a significant correlation between intimidating behavior or harassment at school and violent criminal behavior in adults.

Committing harassment or intimidation can lead to the development of a false self-image and a way of seeing the world in which aggression is considered a means to exercise power. Bullies run the risk of progressively losing their friends and affection from those near them. Physical wounds are frequent. Their mental health is affected. The number of suicides is even higher among bullies than among victims [30]. Quitting school and unemployment are more frequent among bullies than in the general population.

15.3.5 Principles for Intervening in Cases of School Bullying

Prevention is still the best possible form of intervention in schools in order to avoid the emergence of bullying or to reduce prevalence, even more so because children are not inclined to discuss bullying with adults. Schools can significantly reduce harassment and intimidation by helping students develop social skills, including stress, anger and conflict management, responsible decision making, and effective communication skills. It has been demonstrated that there is a link between the atmosphere in the school and the violence committed. Prejudice and discrimination can lead to any difference standing out. In addition, the behavior adopted by children is either in accordance with or in reaction to the hierarchy in their school. Thus, it is important to work on the atmosphere in school and on the idea of living together. A prevention or intervention program must be designed as part of a systemic vision. It should promote communication and facilitate the development of a culture in which everyone makes a positive contribution. It includes establishing a method for conflict resolution that focuses less on punishment or the actual bullying and more on reestablishing relations, of repairing wrongs, and of building a shared feeling of belonging in the school.

Disrespect for individual differences opens the door for intimidating and harassing behaviors. Intervention should englobe the entire school. Its goal should be to promote communication, to increase empathy, and to encourage responsibility. It is necessary to break the silence, to make reporting safe, and to enable all involved parties to communicate among themselves to resolve the situation and to promote language that contributes to conflict resolution rather than an aggravation of the situation. To encourage empathy, one should help the perpetrators understand the consequences of their behavior for the victim and for other people in the school setting. One should take into consideration how hard this work is for the perpetrators, who themselves have been victims of harassment. One should also take into account their tendency to avoid all responsibility and blame others.

The school should therefore choose an approach to resolving the situation that enables the parties involved to reestablish a relationship, which gives them the opportunity to acquire social and personal organization skills. It is essential to create a follow-up plan in order to ensure that the behavior or conflict has truly stopped and to respond in a satisfactory manner to the needs of the victims, the perpetrators, and the direct and indirect witnesses. Resolving school bullying involves networking with the children, the school, and the families.

It is also necessary to spot the harassment as early as possible in order to limit it in time, which implies that professionals and parents listen to the child in order to help, tactfully, to break the silence. Recognizing the violence the victim experiences participates in restoring self-esteem and in reducing feelings of guilt. Caretaking professionals should listen to children, clarify the mechanism of what happened, and help the children develop their own self-defense mechanisms and then pinpoint who can help him (teacher, nurse, monitors, psychologists, doctors). After having evaluated the psychological scope of the events, and if the victim's state requires it, one should propose a specific follow-up (victim support, medical care, child psychiatry). One needs to make sure the child knows he/she should report any other incident of the kind.

At the same time, providing information and practical advice and guidance to parents is useful. In the case of psychological maltreatment by other children, it is not the healthcare professional's role to intervene with the perpetrators of the violence, but the healthcare professional can encourage the parents to approach the school. This is all the more important, as having the trust of their child, parents often hesitate to make a report because of fears the child has expressed regarding the bullying at school. If the situation continues, it is recommended that parents inform the principal or the school counselor. If they get no response, the parents should inform the school board or the authority responsible for the establishment. Parents can also contact parent-teacher organizations. If the situation has gone on for a long time and the child already shows serious symptoms, the priority is to protect the child by changing schools.

Parents can also file a police complaint, which is at least symbolically recognition of the fault. It is recommended that victims and their parents who file a complaint use the terms psychological violence, verbal violence, physical violence, hazing, and threats, and they give as many details as possible regarding the situations the child experienced (words used by the perpetrators, the facts, the day, the time, etc., like a log).

Educational or legal intervention has a twofold goal: protecting the already bullied child and the other potential victims and establishing the law, at least symbolically, against bullying, which is important for both the perpetrators and the victims. The young perpetrators should be punished for their acts, or else the victim could presume that he/she is the cause of the psychological violence. Such a situation would strengthen an erroneous conviction that the victim nearly always has, which is that it was his fault. It is all the more important to intervene, because if there is no serious reaction to such unacceptable behavior, then all those involved will conclude that such behavior is acceptable.

The bully is also in danger: he/she could be forced to act, could be trying to attract attention to his own discomfort, or could himself be persecuted. All intervention systems working with perpetrators must take into account that these behaviors vary, ranging from an isolated or accidental incident to a chronic model of interaction with others. It is useful to provide the perpetrator with an opportunity to reflect on inadequate behavior that he be helped to find more socially acceptable behavior. If he is a frequent bully, it is probable that he has problems in other aspects of his life. If the school has not consulted the parents, or the parents didn't cooperate, the authorities could intervene as a way of attracting the attention of professionals who could help this young person.

In many cases of school bullying, a reminder of the rules is not enough, if not accompanied by counseling for the perpetrator, alongside that of the victims. An approach to maltreatment should encompass victims and perpetrators in order to put an end to a chain of repetitions and traumas engendered by psychological violence.

Key Points

- Psychological maltreatment can occur inside and outside of the family.
- There are six categories of repetitive maltreatment behaviors: rejecting and terrorizing, which are the most harmful, isolating, exploiting/perverting, ignoring, and neglecting. In the more severe forms, the perpetrator has the intention of attacking, causing suffering, and dominating the child, and he/she derives satisfaction or pleasure from it.
- A controlling relationship is a form of maltreatment found in acts aiming to exploit, pervert, or isolate the child.
- Psychological maltreatment results most often from sadism, mental cruelty, or a parent's incapacity to respond to the child's emotional needs. Sadism, a perverse satisfaction linked to inflicting suffering and humiliation on a child, is often related to sexual abuse. However, in a large number of cases, intra-family maltreatment is not intentional, and it can be treated with information, prevention, and counseling.
- School bullying includes a range of aggressive behaviors from one or several children toward a child victim chosen for his/her vulnerability.
- The harmful effects of psychological maltreatment are not always immediately visible. They appear as the child develops and could spread out over several years after the acts.
- The intervention of professionals in the face of a situation of child maltreatment benefits from encompassing a global vision of the victim child, his/her family, and the perpetrator. It consists of, above all, protecting the child victim. This protection aims to shorten or diminish the psychological violence and prevent recurrence. It is necessary but not sufficient in and of itself: counseling is indispensable.

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It is an old maxim of mine that when you have excluded the impossible, whatever remains, however improbable, must be the truth.

—Arthur Conan Doyle [1]

16.1 History of a Name

Baron Hieronymus Karl Friedrich von Münchhausen (1720–1797) fought in the army of the Prince of Brunswick against the Turks. Later he retired to his castle, where he entertained guests, recounting incredible tales about his adventures in

M. Nathanson, MD
61 rue Manin, 75019 Paris, France
e-mail: mireille.nathanson@wanadoo.fr

battle. Some of these stories were published by Rudolf Erich Raspe in 1785 in a book entitled *Baron Munchausen's Narrative of his Marvelous Travels and Campaigns in Russia*. Gottfried August Bürger translated the book into German and Théophile Gautier into French [2].

In 1951, Asher [3] used the name Munchausen syndrome to describe patients—generally men—that went from one hospital to the next complaining of factitious somatic disorders that could lead to unnecessary and costly medical and surgical procedures had the patients not been found out or had they not spontaneously avoided treatment.

In 1977, the pediatrician Roy Meadow [4] finally gave the name Munchausen syndrome by proxy (MSbP) to situations in which a parent, generally the mother, invents fictitious symptoms in a child: “Here are described parents who, by falsification, caused their children innumerable harmful hospital procedures—a sort of Munchausen syndrome by proxy.”

Munchausen syndrome by proxy (MSbP) is a severe form of abuse.

16.2 Definitions and Diagnostic Criteria

The term “parent” is generally used, but in fact designates any adult having parental responsibilities.

The name MSbP is under discussion, because there is the risk that it involves a psychiatric diagnosis and that the focus is not be placed on the child. Who has Munchausen syndrome by proxy? The child or the parent? Many authors now use the term fabricated or induced illness by carers (FIIC).

Three mechanisms leading to MSbP have been described and can coexist:

- Fabricated signs and symptoms, which can include invention of a medical history.
- Fabricated signs and symptoms with falsification of clinical or biological data.
- Inducing illness by various means.

Faced with the wide variety of clinical presentations, it is necessary to define criteria to affirm or eliminate a diagnosis.

In 1987, Rosenberg provided four diagnostic criteria [5], all of which must be present:

- The illness is fabricated or induced by a parent.
- There are repeated requests for medical care for the child, leading to numerous medical procedures.
- The parents deny knowing the causes of the symptoms.
- The symptoms regress when the child is separated from the person responsible for the syndrome.

Rosenberg took another look at these criteria in 2003 [6] and highlighted the difficulties of diagnosing MSbP, leading to inconclusive determinations, wrongful exclusion of MSbP, or, on the contrary, wrongful diagnosis of MSbP when there is some other real pathology. She insisted that MSbP is a pediatric diagnosis, not a psychiatric one, as there is no univocal psychopathological agreement among authors.

She distinguished between:

- Criteria allowing a positive diagnosis, by inclusion or exclusion.
- Criteria for possible diagnosis.
- Inconclusive criteria.
- Criteria allowing exclusion of the diagnosis.

16.3 Epidemiology

The incidence and prevalence of MSbP are difficult to specify, as the diagnosis is often not made and the number of cases found in the various epidemiological studies depends on the defined criteria. The risk is that only the most serious or obvious cases will be included, which could lead to underestimating the incidence of the syndrome.

One can nevertheless suppose that it is not a rare syndrome. Among siblings of certain MSbP victims, one often finds a complex medical history that could result from a factitious disease, including situations of abusive treatment or negligence, or deaths from unknown causes from birth to the age of 18 months.

A review of the literature published in 2003 by Sheridan [7] analyzed 451 cases of MSbP published in the United States and Europe, in 154 medical or psychosocial journal articles. The syndrome was found in victims between the ages of a few weeks to adulthood. Nearly a third of the cases were diagnosed before the age of one and 51.7% before the end of a child's second year. The average time frame between onset of the symptoms and the diagnosis was a little less than 2 years (21.8 months), with an average age at diagnosis of 4 years.

Mortality is 6%, and 7.3% of the surviving children had permanent or prolonged damage. Among siblings, 25% of known children were deceased, and 61.3% had a pathology comparable to the indexed case or leading to suspected MSbP.

In 1996 [8], McClure published an epidemiological study covering cases found in Great Britain between 1992 and 1994. Upon the basis of 128 cases, he estimated that the annual incidence is at least 0.5/100,000 in children under the age of 16 and at least 2.8/100,000 in children less than 1 year old. Using larger inclusion criteria, Watson [9] estimated that over a period of 2 years, the prevalence was 89/100,000.

All the available data found in the literature confirms that the syndrome is more frequent among young children and that the sex ratio is 1/1.

16.4 Clinical Signs

Symptoms are fabricated by parents in 25% of cases, including repeated declarations of inexistent symptoms, such as bleeding manifestations [10], addition of maternal blood (from menstruation or self-inflicted injury) to urine, stools or the child's diaper, convulsions, fainting, apnea, vomiting, etc.

In 50% of cases, symptoms are induced, e.g., with the administration of toxic substances or medication such as laxatives leading to chronic diarrhea, emetics, antidepressants, anxiolytics or neuroleptics, hypoglycemic medication [11], theophylline, etc.

Signs can take the form of prolonged fever subsequent to septicemia from septic manipulation of a central catheter, rashes from the application of various colorants and caustics, and bullous lesions from friction.

In 25% of cases, the symptoms are both fabricated and induced.

In a 2000 study that examined 120 cases [12], the initial presentation took the form of convulsions in 24 cases, life-threatening events in 22 cases, lethargy or coma in 13 cases, and hematemesis or rectal hemorrhage in 13 cases.

A recent review of the medical literature describes fabricated or induced neurological manifestations [13].

Other cases have been published more recently, including one in which lethargy and tachycardia led to the discovery of hypoglycemia in an 8-week-old infant [14] and another one of intoxication with salt in an 8-week-old newborn, a situation first published by Meadow [7, 8].

The syndrome has entered fiction as well: Thierry Jonquet, a French writer of excellent crime novels, some of which have been translated into English, described a case of recurrent hypoglycemia by insulin injections that were the object of an investigation in his book *Moloch* [15].

The majority of MSbP cases are encountered in hospital. Emergency-room doctors, gastroenterologists, and pediatric neurologists are the specialists most often confronted with this kind of abuse.

Generally speaking, discrepancy between the fabricated clinical history and lab tests should raise alarm and suggest this diagnosis [16].

It is important to note that symptoms are often induced in the hospital setting [17], which means the dangers persist in the hospital if the perpetrator of the abuse has access to the child.

Doctors find it all the more difficult to suggest a MSbP diagnosis since in 75% of cases, short-term morbidity is caused both by the medical team (which prescribes additional invasive tests and useless and dangerous therapeutic interventions) and by the parents and in 25% of cases by the medical team alone, particularly when the perpetrator of the abuse invents the symptoms without causing them himself (Table 16.1).

False allegations of sexual abuse within a MSbP can occur, often in the context of parental separation [18]. These false allegations are often associated with some induced organic symptoms, notably gynecological in nature, such as perineal irritation.

Table 16.1 MSbP symptoms, induction methods, and diagnostic strategies [5]

Symptoms and incidence	Methods for simulating or inducing	Detection method
Bleeding 44%	Intoxication with anticoagulants Intoxication with phenolphthalein Exogenous blood Bleeding caused by mother	Toxicology screen Stool or diaper testing Blood type testing Observation of mother
Convulsions 42%	Fabrication Intoxication (theophylline, insulin, psychotropic drugs)	Context; interviews with other members of the family Toxicology screening
CNS depression 19%	Intoxication (barbiturate, benzodiazepines)	Toxicology screening (blood, urine)
Apnea 15%	Strangulation or deliberate smothering	Usually no visual signs
Diarrhea 11%	Intoxication with laxatives Intoxication with salt	Blood in stools Testing Na in urine and stools
Vomiting 10%	Fabrication Intoxication with ipecacuanha	Context Toxicology screening
Fever 10%	Fabrication Bacterial contamination of IV perfusion	Checking temperature Unusual bacteria in culture
Rash 9%	Intoxication Scratching wounds	Toxicology screening Topography the child could not reach

16.5 Perpetrators of the Abuse

Among the 117 cases compiled by Rosenberg in 1987 [5], 97 perpetrators were identified: in 98% of cases, it was the biological mother and in 2% the adoptive mother. The mother—a nurse, social worker, and wife of a doctor—generally had good knowledge of medical topics. Typically, the mother responsible for MSbP appeared to be very cooperative and seemed to want to help the doctors to understand the child’s medical problems. She was constantly present at the hospital with her child and blossomed in an environment that others found depressing. Caregivers often found her “admirable.”

These mothers were not considered sick on a psychiatric level, but frequently they had had a difficult childhood, and many of them said they had undiagnosed diseases, history of depression, suicide attempts, and personality disorders. It appears that these mothers are trying to take the center stage and use their child to attract attention to themselves. Some MSbP mothers recently published blogs [19] in which they deformed the information given by the caregivers, with occasional requests for financial assistance to meet the child’s needs.

In MSbP involving several siblings successively, the maternal psychopathology is more serious.

The father is often in the background and can be considered a passive accomplice [20].

Sheridan [7] found considerably different results concerning the perpetrators of MSbP: the mother was responsible in 76.5% of cases, the father in 30.6%. In her review of the literature, she found 22.8% of the perpetrators had a psychiatric diagnosis, the most frequent being depression but sometimes various personality disorders: 21.7% had, or said they had, a history of abuse in childhood or by their partner.

16.6 Differential Diagnosis

It is as important not to miss a diagnosis of MSbP as it is not to overdiagnose it. At the two ends of the spectrum of clinical signs that can suggest MSbP, the diagnosis can be wrong, either by a lack of understanding of another pathology that could explain the signs or in the face of excessive maternal concern, in which a mother multiplies doctor visits, sincerely believing that there is some pathology [21]. It is often possible to reassure the mother, but the situation could repeat itself. It can then be necessary to suggest psychotherapy.

16.7 Short- and Long-Term Impact

The children who are victims can be subjected to numerous unpleasant or dangerous interventions (surgery), spend more or less long periods in the hospital, or undergo useless treatments. Their daily life could be considerably impacted through missing school, a limitation of their activities, and the use of a wheelchair to get around. The latter can be requested by parents looking for secondary benefits, such as financial aid for handicapped children. A study by Bools [22] covering 54 children showed that 30 young victims, whose cases had not appeared to be very serious, still lived with their mother; in this group, Munchausen syndrome had continued in ten of them, and eight had major disorders (somatic symptoms, difficulties of concentration, etc.). The 24 other children lived with other family members or in a foster home.

Around half of the children, living with or without their mother, had a range of troubles including conduct and emotional disorders and problems related to school, including difficulties in attention and concentration and nonattendance. In total, 20 children, or half of those that could be followed, had outcomes considered unacceptable. This study demonstrates that separation from the perpetrator of the abuse is not enough to resolve the issues for the children, although the children separated from their mother were doing better than the others.

Another study of 13 children [23] showed that 10 children who were assessed and then returned to their family with therapy had a good evaluation 17 months later. The authors of the study highlighted that it is necessary to provide long-term follow-up to ensure that the children are not subjected to psychological abuse; the parents' mental health must be monitored.

Another study by Bools [24] focused on comorbidity associated with MSbP. The study examined 56 children victims of MSbP and 82 of their 103 brothers or sisters. Sixty-four percent of the index cases had had other MSbP manifestations in the past, and 29% of them showed failure to thrive and 29% a history of non-accidental injury, inappropriate medication, or neglect. A total of 73% of the index cases had suffered at least one of these additional problems. Among siblings, 11% died in early childhood from an unexplained death, 39% were victims of MSbP from their mother, and 17% had a history of non-accidental injury, inappropriate medication, or neglect.

A remarkable document [25] published by the government of the United Kingdom in 2008 (revisited in 2012) for professionals noted that according to international research, mortality in children who are victims of MSbP is around 10%, and around 50% have a long-term morbidity. The consequences can be physical but also psychological and emotional.

Some children, in particular the older ones, collude with the perpetrators in fabricating and inducing pathologies before they eventually become active in fabricating or inducing their own illnesses or in developing a somatization [20]. We can cite the case of a 16-year-old girl [26] with multiple sites of mucous or visceral bleeding that only the mother witnessed; the mother and daughter were obviously colluding in this simulation.

Children who are victims of MSbP can also become abusive when they become parents and can even reproduce MSbP with their own children.

16.8 Management

Initial management should occur as early as possible, which highlights the necessity of bringing up the possibility of MSbP broadly, in order to reduce the diagnostic delays reported in the literature (Table 16.2). Let us recall here that the diagnosis of MSbP is clinical, and it is indispensable to reconstitute the entire past and present medical history of the child and his or her family. The diagnosis is not, in general, made with a single event, but with a series of events over a period of time that is

Table 16.2 Guidelines for early MSbP recognition

-
- Suggest MSbP if the clinical and biological signs do not correspond to any medical reasoning
 - Consider scheduled hospitalization to help establish the diagnosis
 - In a hospital context, expect some team members to formally reject the diagnosis, due to the mother's "exemplary" behavior
 - Right from the start, consider tests that can confirm MSbP or the use of a differential diagnosis: MSbP cannot be diagnosed by elimination, and investigating less likely hypotheses could have useless iatrogenic effects
 - Take into consideration other hypotheses that could explain the clinical signs: Anxiety or a parent's lack of knowledge, a parent's psychiatric condition that could lead her to think that the child is sick, or an organic illness in the child
-

more or less long, and treatment could have occurred beforehand in different places. It is highly recommended, when there is suspicion of MSbP, that a referring pediatrician be named to coordinate the investigations and to lead the majority of interviews with the parents.

One question should be raised immediately: is the child in danger? It could be necessary to hospitalize the child urgently and, if the parents do not agree, to request a temporary foster placement via legal channels.

Clinical strategies and those designed to protect the child must be shared among the various teams taking care of the child.

Other diagnostic tools discussed in English-language papers [21] include video monitoring, which cannot be used legally in France.

What should one say to parents when there is suspicion of MSbP? Mentioning it too early, when it is just a suspicion, could push the parents to break from the team in charge and take the child elsewhere. At this stage, it is possible to explain to the parents that the medical team does not understand what is happening very well and that they need to place the child under observation to complete the examination.

Only when a decision to report the case has been made in a multidisciplinary meeting with caregivers who know the child (doctors, nurses, social worker, psychologist, and child psychiatrists), and only then, should the parents be informed and get an explanation for the report being made.

It is recommended that this announcement be made to the parents with tact, in a place that offers intimacy and confidentiality, never in the presence of the child, and by at least two people such as the referring pediatrician and the social worker.

The situation of danger to the child must be clearly enounced to the responsible parent. This often leads the parent to reaffirm any denial of the etiology of the disorders and could lead to “seeking a second opinion” and the medical team no longer seeing the child, unless the authorities have been notified.

A detailed report of the meeting must figure in the child’s medical file.

The perpetrating parent could attempt suicide after such a meeting.

It is hard to provide proof of MSbP and it is not exclusively the role of the caregivers. As in other situations of abuse, they are not required to have proof of abuse or know with certainty who committed the abuse in order to alert the authorities.

In practice, reporting to the authorities is indispensable in the majority of cases and most of the time, protecting the child requires separation from the responsible parent. Keeping the child at home depends for the most part on the manner in which the responsible parent recognizes the facts and accepts the proposal of psychotherapy. In the case of separation, it is rare that the child ultimately returns to that parent’s care [27].

The diagnosis of MSbP, which often meets with initial skepticism among doctors when it is mentioned, risks causing even more skepticism among magistrates. It is therefore necessary to evaluate the situations with extreme care, to provide all the necessary arguments, and to insist on the danger to the child if the abuse continues.

Key Points

- Munchausen syndrome by proxy (MSbP) is a “fabricated or induced illness” that is a severe form of child abuse.
- MSbP is more frequent in young children, with no predominance in one sex or the other.
- Three mechanisms can combine: fabricated symptoms, falsification of clinical or biological data, and/or inducing an illness using various means.
- MSbP is a difficult clinical diagnosis to make, relying on a series of events that have occurred over what is often a long period of time.
- The symptoms regress when the child is separated from the perpetrator.
- The danger persists even in the hospital if the perpetrator has access to the child.
- MSbP has high long-term morbidity.
- Notifying the authorities and separating the child from the perpetrating parent are required in most cases to protect the child.

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Elise Thellier, Claire Colmant, and Marie-Victoire Sénat

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The concept of fetal abuse arose approximately 20 years ago, and the definition proposed by Diquelou [1] seems appropriate: “Outside the legal possibilities for terminating a pregnancy, a fetus that is abused or at risk of abuse is one that is the victim of physical or chemical trauma or serious negligence leading to an alteration in his or her development or the absence of parental interest or involvement, compromising the emotional environment at the time of birth.”

E. Thellier • C. Colmant (✉)
 Gynecology and Obstetrics, Kremlin Bicêtre Hospital,
 78 rue du Général Leclerc, 94275 Le Kremlin Bicetre Cedex, France
 e-mail: elise.thellier@aphp.fr; claire.colmant@aphp.fr

M.-V. Sénat
 Gynecology and Obstetrics, Kremlin Bicêtre Hospital,
 78 rue du Général Leclerc, 94275 Le Kremlin Bicetre Cedex, France
 Paris Sud University, Le Kremlin Bicetre Cedex, France
 e-mail: marie-victoire.senat@aphp.fr

Several kinds of maternal or parental behavior can result in fetal abuse, and they are often difficult to objectify. In this chapter, we will detail the various forms of fetal abuse:

- Toxin intake: alcohol, smoking, illicit drugs
- Physical violence and negligence: abuse, injury, pregnancy denial

In this chapter, we will not address the concept of fetal pain, as this is a very recent notion that remains little explored. However, it is very probable that a component of pain does exist in the fetus, as it can be demonstrated by the presence of heart rate anomalies in certain malformations such as gastroschisis. However, for the time being, no pain relief treatment is used in utero.

17.1 Psychoactive Substance Use During Pregnancy

It is relatively difficult to obtain epidemiological data regarding psychoactive substance use in pregnant women [2]. A 2013 American Academy of Pediatrics report indicated that pregnant women consume significantly less alcohol, tobacco, and illicit drugs than nonpregnant women. However, consumption among 15–17-year-olds, whether they are pregnant or not, seems to be particularly high compared with adult women [2]. Screening during obstetric appointments is key in order to provide early and adapted care for these women.

17.1.1 Smoking

17.1.1.1 Tobacco Toxicity in Women During Child-Bearing Years and in Pregnant Women

It is recognized that tobacco use decreases female and male fertility. It alters the fallopian tubes and increases the risk of extrauterine pregnancies, compared with non-smokers. Tobacco smoke contains many toxic substances, including carbon monoxide (CO), which crosses the placental blood barrier. This is the most harmful substance for the fetus, because its affinity for hemoglobin is 250 times that of its affinity for oxygen. CO has an even greater affinity for fetal hemoglobin than for adult hemoglobin. The fetus is in hypoxia with every cigarette smoked. The degree of tobacco intoxication can be evaluated by the number of cigarettes smoked in a day and by the measurement of CO that is breathed out: a rate of CO less than 5 ppm (parts per million) reflects an absence of tobacco consumption, a CO rate of 6–10 ppm reflects passive smoking, and a rate of CO that is higher than 11 ppm reflects active tobacco use.

Several studies [3–5] have shown that smoking doubles the risk of premature birth, of premature membrane rupture, of intrauterine growth retardation linked to chronic hypoxia, of in utero fetal death, and of diminished average birth rate. Smoking also appears to be a risk factor for placenta previa [5]. Furthermore, it increases the risk of retroplacental hematoma, resulting in premature birth or in utero death. However,

smoking is not responsible for fetal malformations, although the prevalence of cleft lip and cranioostenosis seems slightly higher than in the general population.

17.1.1.2 Neonatal Effects

Maternal smoking seems to increase the risk of cerebral palsy, behavioral disorders, and sudden infant death. However, there is little data available on the topic, because it is difficult to differentiate in utero exposure to tobacco from passive smoking, to which the child could have been exposed after birth.

17.1.1.3 Care

The best prevention consists of primary prevention via anti-smoking campaigns. When a woman smoker wants to become pregnant, she should be strongly encouraged to stop smoking, without causing her to feel guilty. The Fagerstrom test can be used for nicotine dependence, and breath CO tests can measure nicotine addiction, with a 10 ppm threshold indicating active smoking. Treatment should be both psychological and include the use of nicotine substitutes that do not provide CO, the component that is the most toxic to the fetus. Patch dosage should be adjusted to the patient's level of dependence and to the exhaled breath CO measurement. Smoking cessation medications, such as Bupropion[®], which is an antidepressant, are not recommended during pregnancy [6].

Smoking cessation is beneficial at all stages of pregnancy. It is important to inform patients about the risks linked to tobacco use and what aids are available to stop usage. Consultation with a tobacco addiction specialist is essential to provide optimal care for these patients.

17.1.2 Alcoholism

Alcohol consumption can be quantified in unit of alcohol: 1 unit of alcohol = 10 g of alcohol. The World Health Organization has defined excessive alcohol consumption in women who are not pregnant as being higher than 14 units of alcohol per week. To date, there are no data on the prevalence of alcoholism in pregnant women, but as alcohol is a teratogenic agent, even very low daily consumption, or episodic drunkenness during pregnancy, could lead to serious fetal complications. The seriousness of the damage done to the fetus is correlated to the length and intensity of alcohol consumption during pregnancy but remains hard to foresee prior to birth due to great individual variation in sensitivity. It does, however, seem that there is no minimal threshold under which there is no risk of harm to the fetus. As the consequences of light to moderate drinking are not foreseeable, pregnant women should abstain entirely from alcohol consumption [7].

17.1.2.1 Effects on Pregnancy and the Fetus

The effects of prenatal exposure to alcohol vary from death to neonatal withdrawal syndrome in healthy newborns, and the range includes the full spectrum of more and less severe symptoms related to fetal alcohol syndrome (FAS).

Early miscarriages could be more frequent in women who consume alcohol in excess, without the possibility of determining any real threshold, but there are a number of confounding variables that make it impossible to come to a clear conclusion.

In 80% of cases, there is balanced intrauterine growth restriction, predominantly affecting the long bones and developing during the second half of the pregnancy. Among growth anomalies, FAS can be diagnosed based on the presence of at least two of the following signs: pre- or postnatal growth deficiency, anomalies in the cephalic extremity, and central nervous system dysfunction. FAS is the most serious consequence of prenatal alcohol exposure. Often underdiagnosed, it is one of the major causes of mental deficiency in the world.

Children with FAS have characteristic facial features including short palpebral fissures, a marked nasal bridge, a convex philtrum, a thin upper lip, a domed forehead, micrognathia, and microcephaly (Fig. 17.1). Some of these signs can be objectified with prenatal fetal ultrasound and suggest FAS (Figs. 17.1 and 17.2). The presence of stippled epiphyses should also lead to a suspicion of FAS diagnosis.



Fig. 17.1 (a–c) Fetal alcohol syndrome (FAS). Characteristic prenatal and postnatal dysmorphism. Fetal ultrasound at a gestational age of 25 weeks: strict profile obtained using multiplanar images (a) and rendered in “surface” mode (b) At birth (c): marked nasal bridge, convex philtrum, thin lip, domed forehead, and microretrognathia (courtesy of Dr. Jean Philippe Bault, Bicêtre and Poissy Saint Germain, France)

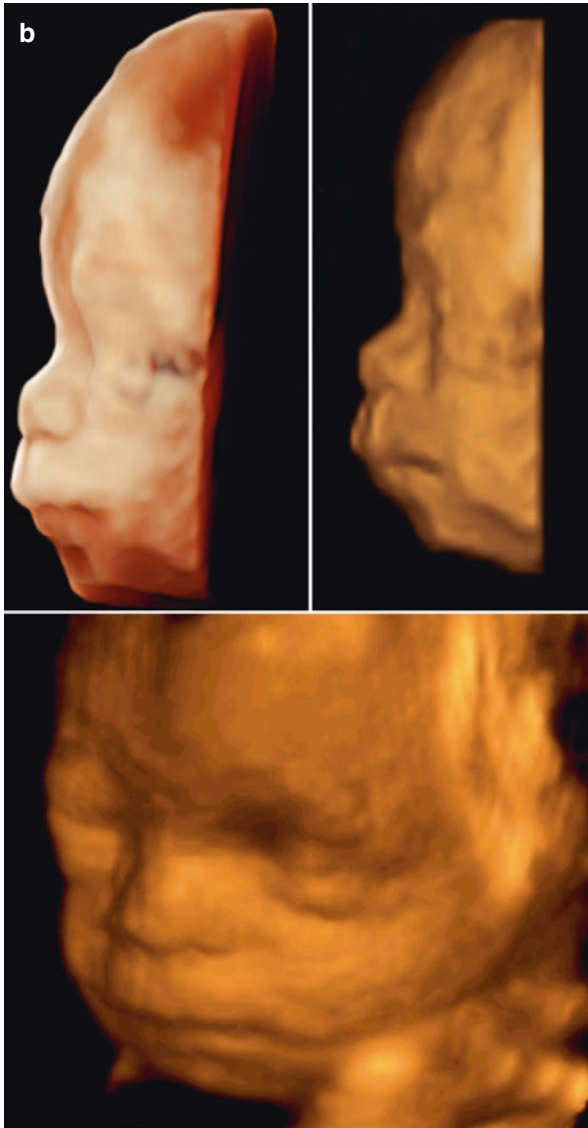


Fig. 17.1 (continued)



Fig. 17.1 (continued)

In 10–30% of cases, alcohol consumption during pregnancy can lead to other malformations, such as cardiovascular defects (interventricular and interauricular communications, tetralogy of Fallot) and cerebral malformations (neural tube defects, agenesis or hypoplasia of the corpus callosum, microcephaly). There can be defects affecting the extremities, including phalange defects, polydactyly, radioulnar synostosis, clubfoot, or clubhands. Some urogenital malformations could also be related to excessive alcohol consumption during pregnancy: ectopias, renal hypoplasia or aplasia, hydronephrosis, urethra duplication, cliteromegaly, hypoplasia of the labia majora, hypospadias, and cryptorchidism [8].

The most severe effects of fetal exposure to alcohol are neurodevelopmental and directly linked to the effect of alcohol on the central nervous system [9]. Microcephaly is not constant, but it is characteristic. Autopsy and magnetic resonance imagery (MRI) find microcephaly associated with structural anomalies of the brain such as, in particular, glial and neuronal migration anomalies. In the long term, these children develop behavioral disorders, hyperactivity, and learning difficulties, with memory and attention disorders. Everything in between is possible, and neurological, behavioral, and cognitive disorders with psychomotor development deficiencies and language acquisition troubles can be observed in children of alcoholic mothers without actual FAS. The child's intellectual quotient could be lower [8].

17.1.2.2 Care

Maternal alcoholism can be suspected when faced with signs of fetal alcohol exposure. It can be confirmed in a one-on-one appointment, with a questionnaire or by testing the mother's blood alcohol level. Treatment is pluridisciplinary, involving the obstetrician, a psychiatrist, and an addiction specialist [10]. Withdrawal could be attempted during pregnancy under medical supervision, with vitamin

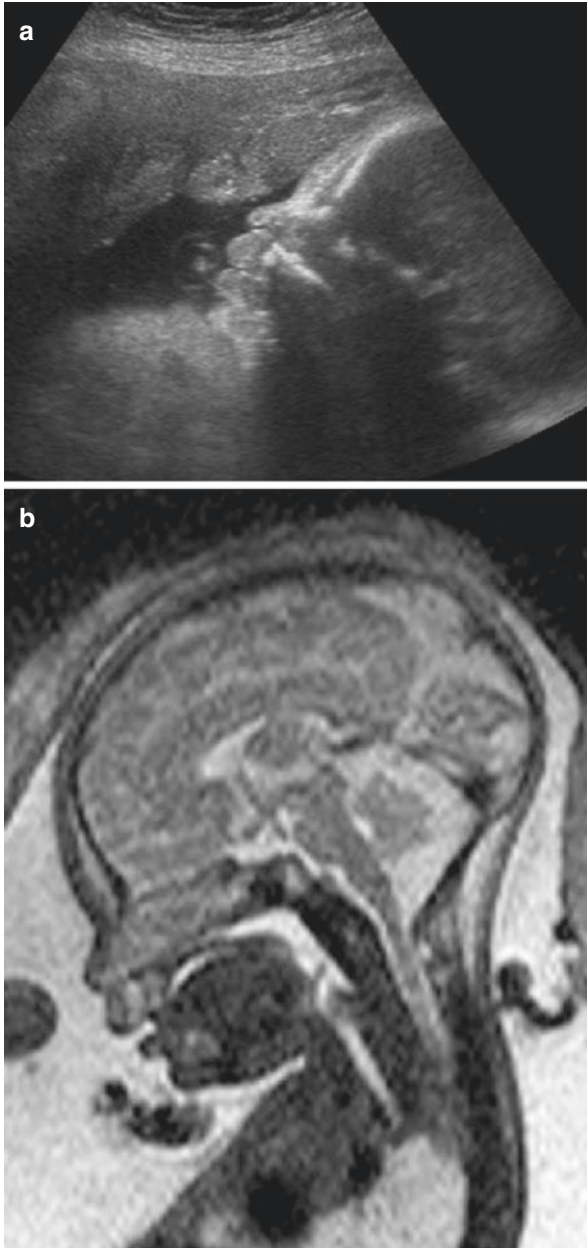


Fig. 17.2 Fetal alcohol syndrome (FAS). Fetal ultrasound (a) and MRI (b) at gestation age of 32 weeks and 5 days. Characteristic profile and microcephaly (courtesy of Dr. Catherine Garel, Paris, France)

supplementation. If withdrawal is impossible, monitoring of both fetus and mother should be increased, notably with regular ultrasound examinations looking for intra-uterine growth deficiency and/or malformations.

17.1.3 Cannabis

According to the World Health Organization, 13.1 million people are dependent on cannabis worldwide. It is the most consumed illicit substance [13]. Most frequently, cannabis is administered via inhaled smoke, and the psychoactive substance is tetrahydrocannabinol (THC), which passes the placental barrier. The sought-after effects are a feeling of well-being, relaxation, and sometimes euphoria. Cannabis also causes disinhibition. Furthermore, it can lead to a lower level of attentiveness and concentration, somnolence, and psychiatric disorders, along with, on the cardiovascular level, an increase in heart rate and blood pressure [11].

Currently, there is little data regarding the effects of cannabis on pregnancy due to the fact that it is difficult to assess cannabis consumption among pregnant women, on one hand, and due to the large number of confounding variables that are difficult to control, such as tobacco use. Risks of defects have not been associated with cannabis use, but there could be a prenatal withdrawal syndrome, and in the long term, it appears that children exposed to cannabis in utero could have an increased risk of behavioral disorders compared with the general population [12].

17.1.4 Cocaine and Crack

Cocaine comes in the form of a fine, inodorous white powder that can be pure or, more often, cut with various substances including sugar and sodium bicarbonate (and sometimes ammonia). Although it is possible to administer cocaine in many ways, the most frequent is via sniffing, but it can also be injected intravenously or smoked.

Cocaine's mechanisms of action are complex. Impact on the central nervous system includes increasing dopamine action on the limbic system. It causes euphoria, a feeling of being all powerful either intellectually or physically, indifference to pain or fatigue, with agitation and hallucinations. It also lowers the threshold of epileptogenicity and can cause seizures and psychiatric disorders. Cocaine also acts on the cardiovascular system, causing excessive stimulation of alpha and beta adrenoceptors leading to increased heartbeat, hypertensive flare-ups, myocardial infarction, aortic dissection, and heartbeat and conduction disorders. Cocaine can also be responsible for hyperthermia, pneumomediastinum, and rhabdomyolysis.

17.1.4.1 Effects on Pregnancy and the Fetus

The cardiovascular and neurological effects of cocaine use are exacerbated in pregnant women as a result of the hemodynamic changes that occur during pregnancy. As cocaine passes through the placental blood barrier, it can lead to complications

in the fetus. Cocaine use leads to intrauterine growth deficiency in 25–48% of cases, premature births in 17–29% of cases, retroplacental hematomas from hypertension in 2–15% of cases, as well as spontaneous miscarriages in 38% of cases [13]. The occurrence and seriousness of complications depend on the quantity, frequency, and intensity of consumption. Cocaine could probably cause congenital defects via ischemic lesions, but currently there are no published data that enable a precise determination of these risks.

17.1.4.2 Postnatal Effects

Children born to cocaine-using mothers could have an Apgar score that is lower at birth than other children. Furthermore, more than a third of these children present with withdrawal syndrome. In the long term, they could demonstrate moderate behavioral and learning disorders [13].

17.1.4.3 Screening and Care

Screening occurs during obstetric appointments, based on the mother's behavior and any physical signs of intoxication. As with other narcotic substances, evidence of cocaine use can be found in urine, blood, and hair tests. Meconium testing is used in fetuses. Treatment requires a multidisciplinary approach, but there is no substitution treatment for cocaine, and withdrawal can prove difficult due to strong psychological dependency.

17.1.5 Heroin

Heroin is an opioid drug that is synthesized from morphine extracted from the poppy plant. It comes in the form of a fine white or brown powder and most often is consumed by intravenous injection, but it can also be inhaled. The sought-after effect is a feeling of well-being and calm. Heroin is a powerful painkiller and anxiolytic that acts on both a psychological and a physical level. Like all drugs, it leads to a strong dependence and increasing tolerance with a need to have higher doses in order to feel the same effects. Overdoses occur when the body's tolerance threshold is crossed, and this threshold varies greatly from one person to another.

17.1.5.1 Effects on Pregnant Women

Heroin crosses the blood-brain and the placental blood barriers. It increases the risk of premature birth and intrauterine growth restriction. It can lead to fetal malformations such as heart defects, spina bifida, and wall closure defects such as gastroschisis, but their frequency is hard to evaluate. There is also a risk of maternal infections transmissible to the fetus, due to the use of intravenous injections.

17.1.5.2 Postnatal Effects

Children born to heroin-using mothers present with withdrawal syndrome at birth and afterwards develop behavioral disorders and learning difficulties. Furthermore,

due to the drug addiction, the mother-child bond is hard to create, which often leads to social problems and can result in the child being placed in foster care.

17.1.5.3 Care

Treatment requires a multidisciplinary approach. Wherever possible, a substitution treatment with methadone or buprenorphine should be used. Studies do not show one being better than the other but clearly demonstrate that substitution treatment reduces neonatal complications compared with continued heroin use.

17.2 Physical Violence and Negligence

17.2.1 Maternal Trauma

Physical trauma experienced by a pregnant woman can have serious consequences on the fetus, particularly in the cause of abdominal or serious multiple injuries. Abdominal injuries touch 6% of pregnant women [14, 15]. These injuries are related, in decreasing order of incidence, to traffic accidents, falls, and physical violence against the mother. The mechanisms of the injury, the pregnancy term, and the mother's state assessed using the injury severity score all have an impact on the occurrence of complications in the fetus.

17.2.1.1 Effects on Pregnancy and the Fetus

Abdominal injuries in pregnant women can have purely mechanical effects, such as the premature rupture of the membranes and the threat of premature birth [7, 16]. Retroplacental hematoma, a direct result of the abdominal shock, can lead to a partial or complete ablatio placentae, leading quickly to an interruption in maternal-fetal vascularization and in utero death. A retroplacental hematoma could occur 3–4 days following the injury. It most often translates into sudden abdominal pain that persists, abnormal fetal heartbeat, and more or less abundant metrorrhagia. More rarely, very violent abdominal trauma can lead to uterine rupture and direct fetal injury. In utero fetal death essentially occurs in cases of maternal hemorrhage, major abdominal trauma, and mother's death [17]. One more insidious effect can be fetomaternal hemorrhage. If minor, it could initially go unnoticed and lead to fetal death within 24–48 h of the abdominal injury. Fetomaternal hemorrhage can also lead to fetal alloimmunization, which can have serious consequences on later pregnancies.

Recommendations for fetal monitoring following abdominal injuries in pregnant women are clearly defined in France. The fetal heart rate is measured the day of the injury and 24 and 48 h afterwards, and a fetal ultrasound is done to assess fetal well-being using the Manning score. Measuring the systolic peak of the middle cerebral artery is a very good marker of fetal anemia. It should be associated with the Kleihauer test to analyze the passage of fetal red blood corpuscles into the mother's bloodstream. In cases of severe abdominal injury, hospitalization is recommended for 48 h for traffic accidents, with intensive care sometimes being required, and fetal extraction could prove necessary to allow for proper resuscitation of the mother.

17.2.1.2 Care

The incidence of violence done to pregnant women is estimated at 3–11% depending on the country. Pregnancy is recognized as a period in a woman's life that is particularly conducive to the emergence of conjugal violence. Such violence can lead to the mother's death.

Situations of violence within a couple should be identified and their seriousness assessed. The woman can receive medical, social, and legal help. In some countries, such as France, abuse is recognized by the law as a misdemeanor or a crime depending on the seriousness of the inflicted violence. The sentence is aggravated when inflicted on a minor under the age of 15 or on a pregnant woman. In all cases, close follow-up with the patient is required to avoid repetition of the violence or a more dramatic outcome.

17.2.2 Negligence and Denial of Pregnancy

In this section, we are looking into a pregnancy denial as a cause of psychological abuse of the fetus and child to be born, but we will not attempt to explain the processes that lead to such denial.

The discovery of a denied pregnancy is always surprising for those close to the patient and for the medical staff: how can one imagine an adult woman in full possession of her physical and mental capacities to act as if the reality of her state of pregnancy did not exist? This kind of case is not one of dissimulation but a defense mechanism against a situation that is experienced as being psychologically intolerable. Denial of pregnancy is not reserved for any specific profile of a woman and can touch woman in all age categories and all social backgrounds and living in a variety of conjugal situations.

As far as obstetrics is concerned, the denial of pregnancy does not theoretically carry any specific risks. However, these women are not having their pregnancy monitored and can interpret some alarm signals in the wrong way, such as when their waters break [18]. Some studies show a greater risk of low birth weight and premature births [19].

One prospective study, called the Prague cohort, followed children born in a pregnancy denial context for many years [6]. The control group was made up of children born into a desired pregnancy, with matching of confounding variables. Monitoring was done at 9 years, 14–16 years, 21–23 years, 26–28 years, 28–31 years, and 32–35 years. This study demonstrated that children born in a context of denial of pregnancy had more trouble adapting socially and in school and did fewer secondary studies. As adults, these children were more often single or divorced and developed more psychiatric disorders than the control group [20].

Denial of pregnancy therefore does not have obstetric effects but seems to influence the social future of these children, with a greater risk of developing psychological and psychiatric disorders.

In conclusion, the concept of fetal abuse is a complex and recent one which includes the use of toxic substances, physical trauma, and maternal negligence. The issues of the status of the fetus and fetal pain have not yet been resolved, and research prospects are open for future generations. Currently, the consequences of fetal abuse can be serious for both the mother and the fetus, but they remain difficult to evaluate.

Key Points

- It is essential to screen pregnant women for risks of fetal abuse in order to quickly adopt an adapted approach to care.
- Fetal abuse includes intake of toxic substances (alcohol, tobacco, drugs), physical violence, and negligence (abuse, denial of pregnancy).
- Cessation of smoking is beneficial whatever the stage of pregnancy.
- Fetal alcohol syndrome is a frequent cause of mental retardation, associated with characteristic facial dysmorphism and peripheral skeleton bone defects.
- Cocaine and heroin pass through the placental blood barrier and can lead to intra-uterine growth restriction, premature births, and spontaneous miscarriages.
- Abdominal trauma and serious multiple injuries can result in retroplacental hematoma, uterine rupture, and direct fetal injury. They require strict monitoring of fetal heart rate and ultrasound.
- Pregnancy denial can occur in women of all ages and from all social background and has an impact on the fetus due to a lack of or insufficient monitoring of the pregnancy.

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Initially, studies of maltreatment focused primarily on infants and young children. Little by little, professionals realized that teenagers were far from being safe from this kind of violence. All forms of abuse are observed: physical, sexual, psychological, and neglect. We will discuss their peculiarities at this age without repeating the detailed descriptions found in the other chapters. The reader will find some topics more specific to adolescence, such as maltreatment and ICT (information and communication technology) as well as so-called indirect warning signs.

G. Picherot (✉) • N. Vabres

Child Abuse and Neglect Unit, Pediatrics Department, HME-CHU, 44093 Nantes, France
e-mail: picherotgeorges@orange.fr; nathalie.vabres@chu-nantes.fr

18.1 Epidemiology

The epidemiology of maltreatment in adolescence is poorly understood. Fifteen percent of French teenagers aged 11–19 report physical violence and 3.8 percent report sexual violence [1]. In the under-15 population in Canada, the 12–15 age group represents 22% of physical violence, 7% of sexual violence, 12% of neglect, and 9% of psychological violence [2]. In the second “National Survey of Children’s Exposure to Violence” (NatSCEV II), the age group 14–17 years was the subject of a specific investigation. In the year prior to the study, 19.4% of American adolescents had experienced psychological violence, 5.5% physical violence, 16% sexual assault, and 13.9% aggression by Internet or telephone. There is no difference between boys and girls, except that physical violence is more frequent among boys and sexual violence more frequent among girls [3].

18.2 Specificities of Maltreatment During Adolescence

18.2.1 Revelation

Expression seems easier, revealing facts that occurred in adolescence or during childhood.

This should be weighed by frequent retractions, especially in situations of sexual assault, whether by family or not. Pressure from the family, fear of the consequences, and ambivalence regarding the perpetrator explain these retractions [4].

Revelation can occur through the direct consequences of ill-treatment (pregnancy, psychological distress, sexually transmitted diseases) or indirect signs: suicide attempts, running away, malaise, fuzzy symptoms, eating disorders, agitated violence, etc. (cf. *infra*).

Revelation is sometimes associated with a request for emergency shelter, in situations of violence that has become unbearable.

Revelation is not always addressed to the usual authorities or institutions. Many teenagers speak to their peers or to their teachers. They also use public services or volunteer telephone helplines, blogs, or social networks.

Finally, revelation of abuse can undermine the rules of confidentiality affirmed in many teen caregiving relationships (e.g., teen homes), and a report may be required in certain cases.

18.2.2 Specificities Based on Types of Abuse

Under the pressure of the transformations occurring during puberty, maltreatment becomes sex dependent. For example, boys are more vulnerable to physical violence, while girls are more likely to be sexually abused.

18.2.2.1 Physical Abuse

Physical maltreatment in adolescence is more difficult to establish than in young children. Trauma, when present, is generally less severe, and teens can often avoid seeing caregivers. Revelation occurs through behavioral disorders and behavior that blur the reading that the doctor can have. It is ultimately very difficult for the professional to perceive the adolescent as a truly “innocent” victim in situations of intra-family violence. Indeed, because the adolescent is considered to be less vulnerable because of his or her physical abilities and has possibilities for external recourse, it is often expected that the teen respond to or at least evade abuse. Even when maltreatment is proven, the adolescent’s role in inducing it is still suspected. The stereotype of the difficult teenager, given to deviant behavior, an image conveyed by the media, influences this representation.

Physical violence is often associated with gestures of humiliation: flogging, burning, and corporal punishment.

As in other situations of maltreatment, the explanations given may not correspond to the observed situation or not be plausible: falling down the stairs, blunders, sports trauma, self-aggression, and sensitive skin. The teen sometimes accuses himself of provoking the aggressiveness of others.

Traces on the body are invisible, accessible only upon systematic examination or visible “by chance.” This information should invite professionals to undertake a fairly broad somatic examination.

18.2.2.2 Sexual Abuse

Sexual maltreatment is frequent and frequently revealed at adolescence. The clinical description and management were discussed in a previous chapter.

Here, we will cover three aspects: the circumstances of the abuse, the notion of secrecy, and the difficulties and conditions of the physical examination.

The circumstances of the abuse can be intra- or extrafamilial.

Incest situations often start before puberty. The age of adolescence accompanies the awareness of the abnormal character of this relationship. Revelation is frequent through the consequences, especially suicide or attempted suicide and also early pregnancy (see below).

Protective attitudes by the family are rare in these situations. Reactions are negative and incredulous, seeking to turn the accusation into a destructive lie for the family. Protection by hospitalization is required at the time of disclosure in the majority of cases.

Extrafamilial sexual assaults are sometimes perpetrated by authors unknown to the adolescent. The immediate consequences can be major: death by associated violence or sexually transmitted infection. The authors can be known: adults in the school, education, or friend environment.

Perpetrators can also be other teenagers, sometimes in the context of harassment. In all cases, revelation is associated with a phase of doubt regarding the teenager’s story, based on the insinuation of a possible consent.

Secrecy often surrounds sexual abuse in adolescence. Silence is linked to “guilt and shame.” The power relationship prevents speech. This is referred to as the “incestuous pact.” The adolescent sacrifices himself to preserve his family and can give false leads, directing suspicions toward unknown persons [4, 5].

Care, intake, and examination must be age appropriate. The consultation should be done following the rules used when consulting adolescents. In the suspicions of sexual aggression, the adolescent is seen alone but always by two caregivers in our service. The physical examination is done carefully and immediately performed by a competent examiner in the field of teen gynecology and proctology. In no case should legal pressure impede the caregivers from taking an appropriate and ethical approach. Explanations are given both of the clinical examination and of the samples. Preventive measures for pregnancy (emergency contraception) and infections are prescribed and compliance ensured. Hospitalization is systematically discussed in situations of recent violence or intrafamilial abuse. It also ensures the relay of care, in particular in terms of protection and psychological support.

Situations of maltreatment are sometimes linked to self-mutilation. Thus, scarifications and self-inflicted burns are often related to sexual violence [6].

18.2.2.3 Psychological Maltreatment

To complement the chapter on “psychological maltreatment,” we will show some specific aspects related to age.

Teenagers are often targets for isolated psychological maltreatment, more often than at other ages.

The context may be the family, school, or institution.

- In a family context, child-abusive family systems are based on maladaptive relational patterns, including unrealistic or disproportionate expectations in all areas of the young person’s life (studies, sport, etc.); insults or repeated use of humiliating or demeaning words, including sexually degrading, sexist, and homophobic comments; humiliation in front of others; systematic disqualification, persecution, threats, discipline and inadequate punishment; and neglecting medical treatment [7, 8].

The association with conjugal violence is little known and yet frequent upon closer examination. Teenagers are never mere spectators. Spousal violence is associated with increased frequency of behavioral disorders in adolescents. Girls are more likely than boys to have internalized troubles. Spousal abuse not only has a negative effect on the young person’s behavior; it also has a destructive impact on the relations that the young person has with his or her parents. In teenagers, this is described as the “disruption of parenting hypothesis,” the loss of all parental models [9–11].

- In school, harassment could affect more than 10% of adolescents. It combines invective and verbal violence, exclusion by rumor, and physical brutality. With repetition, the teenager becomes a punching ball in a dominator-dominated relationship. Vexations focus on weight (50%), height (15%), look, family name,

skin color, and ethnic origin. Recognition is difficult because direct complaints are rare. Indirect signs are frequent (see below), in particular those related to the school: school failure, dropping out, and isolation [12].

- Adolescents may be subjected to institutional maltreatment. Prevention is key. Identification can be difficult in closed institution. The diagnosis of psychological abuse in teenagers poses a real challenge to pediatric practitioners [8]. The risks are comparable to other types of abuse, with probably more psychiatric disorders. In 2012, the American Academy of Pediatrics issued a warning about the consequences of not understanding this type of abuse [8].

18.3 Information and Communication Technologies (ICT), Social Networks, and Maltreatment

The development of information and communication technologies has brought new forms of abuse. Twenty percent of adolescents could be victims of cyber violence (they are also sometimes the perpetrators).

Some situations have been identified:

- *Cyber bullying* is media harassment via humiliating messages, degrading photos, or online racketeering.
- *Happy slapping* consists of filming pornographic or degrading images of a teenager and the teen's knowledge or consent disseminating them without via SMS, social networks, chat, etc. [13].
- *Sexting* is sexual harassment on the Internet.
- *Grooming* is a technique used by attackers on the Internet via social networks to prepare the youth for sex. The adult identifies the teenager on a chat site or social network. The aggressor builds trust with the adolescent using an increasingly personalized dialogue. A real encounter is proposed and results in sexual assault. The teenage victim believes in the honesty of the aggressor's feelings and only belatedly reveals this dangerous relationship to his entourage. The consequences of this virtual violence are comparable to real violence with the same indirect signs [14].

18.4 Indirect Signs of Abuse or When to Discuss Abuse with a Teenager

Speaking is deemed to be easier for teenagers, and yet much of physical, sexual, or psychological abuse is never revealed.

Indirect signs are the consequences of abuse. They are often non-specific. Their identification makes it possible to open a dialogue with the adolescent. Many are real coded languages inviting the search for a history of trauma.

18.4.1 The Main Signs in Adolescents

They can be classified into somatic and gynecological manifestations, behavioral disorders and enactment, psychological disorders, and school-related warning signs. They are summarized in Table 18.1.

None has a specific value. Their presence in an adolescent should lead to a discussion about possible abuse [5, 15].

18.4.2 Six More Specific Cases

18.4.2.1 Post-Traumatic Stress Syndromes

Clinical vignette: Adeline, who is 15 years old, is seen in consultation for sleep disorders and for leaving school. A year earlier, she revealed she was the victim of a sexual assault by a group of three teenagers. A complaint was filed. Unprepared confrontation with her attackers was followed by major psychological distress and regular threats from the perpetrators' families. Legal action is ongoing. Adeline has severe sleep disorders. Her nights are occupied by nightmares featuring her

Table 18.1 Warning signs of abuse in teenagers

Somatic signs	Abdominal pain Asthenia Chronic pain Recent obesity Enuresis, encopresis
Gynecological signs	Pregnancy Sexually transmitted infections Pelvic pain Repeated vulvovaginitis Inappropriate sexual behavior
Behavioral manifestations	Suicides and attempted suicide Running away Taking toxic substances Self-abuse: scarification alone or with self-afflicted burns Inflicted violence Eating disorders
Psychological disorders	Post-traumatic stress disorder Sleep disorders Isolation Depression Withdrawal Anxiety and dissociative disorders
School-related warning signs	Absenteeism School phobia Disinvestment Isolation Refusal to participate in activities showing the body (sports) or school trips

aggressors. She has not gone to school for a year. She refused to return to the school she initially attended for fear of reprisals and of meeting the perpetrators or their friends. Boarding school or home schooling was not possible. In addition to the insomnia, Adeline presents repeated fainting spells identified as vasovagal syncope.

Abuse is the most common cause of post-traumatic stress disorder (PTSD) in adolescents [16], taking into account all forms of abuse including those associated with ICT [17]. This syndrome combines intrusion symptoms related to traumatic memory (frightening dreams), avoidance symptoms leading to isolation (refusal to go to school), and so-called hyperactivity disorders: insomnia, outbursts, and tantrums. This syndrome affects girls more than boys. The association with acting out (suicide, attempted suicide) and with the consumption of toxic substances is frequent.

18.4.2.2 Suicide Attempts and Suicides

Clinical vignette: Mélanie, 13 years old, is hospitalized for a suicide attempt by phlebotomy. She reveals that she was the victim of a sexual assault by a friend of her father-in-law a few weeks before at a family event where there was alcohol consumption. She has a heavy background story. In early childhood, there was already a report related to physical abuse by her father. An educational measure had been put in place, and her father was no longer allowed contact with her. Mélanie's clinical examination shows numerous scars on the wrists and the abdomen.

A history of sexual abuse is four times more frequent among teens who commit or attempt suicide than in routine consultations. Similarly, they are twice as likely to be cases of physical abuse [15]. Suicide and attempted suicide are well signs of trauma during adolescence. They can also reveal past childhood trauma. The age of the suicides is earlier [18].

18.4.2.3 Teen Pregnancy

Clinical vignette: Vanessa, 14, is brought by her mother and stepfather to the planning center for an abortion. Her pregnancy was diagnosed recently. The mother says she thought of it quickly in view of Vanessa's abdominal pain. The family agree to request the abortion. The alleged father is a 16-year-old friend of Vanessa's, according to the mother and father-in-law. Vanessa confirms this information at first and asserts her consent to sexual intercourse. Vanessa's apparent lack of emotion, and few words overall, leads the hospital team to request pediatric hospitalization for medicopsychological evaluation. During hospitalization, Vanessa collapses and accuses her stepfather of raping her after several years of sexual abuse. An investigation and genetic samples confirm Vanessa's revelation.

Sexual abuse in adolescence is a significant risk factor for early "unwanted" pregnancy. This obvious notion is yet forgotten by many publications. Two types of sexual assault are frequently involved: incest and rape during parties under the influence of alcohol or other toxic substances. It is difficult for the teenager to reveal these two types of situations. They involve known aggressors (family or "friends"). The leads given by the teenager are often wrong. Evoking the possibility of rape must be systematic when faced with any teen pregnancy [19, 20].

18.4.2.4 Obesity

Clinical vignette: Jessica, 13 years old, is seen in consultation for significant obesity. Her body mass index is 37 kg/m². Overweight since childhood, her obesity has skyrocketed after the age of 10. Hospitalization for a few days is requested. She demonstrates bulimic behavior, which decreased quickly during hospitalization. Jessica reveals that she suffered from several years of repeated sexual assaults by a mentally handicapped uncle who often stayed in her parents' home.

There is a proven link between the trauma of abuse and certain cases of obesity triggered during adolescence [21]. Exposure to this event could be the triggering factor of obesity with manifestations of binge eating disorder.

The co-occurrence of sexual and physical abuse increases this risk [22].

Similarly, there is a strong correlation between adult obesity and sexual abuse in adolescence (and childhood) [23].

In very severe obesity (BMI around 50 kg/m²), Zeller found an increase in prior psychological and sexual violence but also a very frequent association with serious psychosocial problems if there is history of abuse [24].

18.4.2.5 Anorexia Nervosa

Clinical vignette: Romain, a teenager aged 14, is hospitalized for significant weight loss. His body mass index is 13 kg/m². He lost 10 kg in 2 months. He continues his school and sports activities. He vomits regularly. During the assessment made in hospital, the team observes constant hyperactivity. The mother leaves the conjugal home during Romain's hospitalization, because she reveals that she is a victim of physical and psychological conjugal violence. Romain watched violent scenes and was sometimes beaten. His father humiliated him about his physical appearance and eating behavior. Yet he refuses to follow his mother and be separated from his father.

The detection of traumatic events related to sexual assault in the history of anorexic adolescents is known, but all types of abuse can be encountered. There appears to be a clear overrepresentation of binge-/purge-type anorexia bulimia over restrictive anorexia [25].

18.4.2.6 Violence Committed ... Violence Suffered? The Scars?

Clinical vignette: Anaïs, 14, is sent to the emergency room by the doctor on duty after a home crisis of destructive behavior. She had a serious altercation with her mother. She broke a chair and threw a lot of objects from her room. The distraught mother called the paramedics. The on-call doctor indicated hospitalization. On arrival at the hospital, Anaïs calmed down without treatment. The mother refuses to take her back and comes back the next day asking for her placement in a foster home because "she can't stand being around her." Anaïs lives with her mother and father-in-law, who also have a three-month-old infant. Anaïs's stepfather is violent and has strict educational principles with repeated physical violence against Anaïs and also against her mother. The mother justifies the violence against Anaïs "as necessary in view of her unbearable behavior."

The relationship between violence committed by teenagers and the violence they are subjected to via maltreatment is well established, although many abused

children do not develop this type of behavioral disorder. Protective factors can exist and depend on what the family is capable of [11].

The major forms of violence and associability (teens who don't fit in) appear to be associated with a history of psychological violence in 100% of cases. Teenagers subject of legal measures for delinquency have suffered acts of abuse in childhood in 20% of cases [17, 26].

The repetition of violence in childhood and adolescence is a major risk factor.

Prevention must be taken against the risk of acting out the violence as a teenager and repeating it in adulthood.

Conclusion

Maltreatment has specific characteristics in adolescents, but the basis of the diagnostic approach is the same as in younger children: "open the eyes." Evoking abuse is as difficult as in early childhood. The mask of indirect signs is misleading. The consequences are serious, involving the physical and mental life of the adolescent and the adult he or she will become.

Key Points

- The diagnosis of abuse is as difficult in adolescence as it is in early childhood.
- Abuse in teenagers can be revealed by its direct consequences (pregnancy, psychological distress, sexually transmitted disease) or indirect signs.
- Understanding the indirect signs is fundamental to recognizing abuse in teenagers. These include suicide attempts, running away, malaise, eating disorders, and acts of violence.
- Sexual abuse must systematically be evoked in cases of teenage pregnancy.
- There is very high prevalence of bullying and cyber bullying during adolescence.

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A little boy was on the way to school, accompanied, I do not know precisely, by his grandfather or a family assistant. Crossing the road, he was hit by an automobile and thrown to the ground. The motorist stopped, got out to check the condition of his bumper, and then left again after finding that his car had not suffered any damage. The child's grandfather or the family assistant then turned to the child and said, "Get up, you're going to be late for school!" The child got up with difficulty and resumed the walk, limping. When he arrived at the school, the principal told him to "run to class, you're late" and then his teacher asked him to sit quietly in the back so not to disturb his classmates, who are already at work. For the entire day, the child remained isolated, no adult worrying about his wounds and fractures.

Of course, this child's story is imaginary, and no one would accept that no help or attention be paid to a child who is the victim of a traffic accident. Yet, this is exactly what children who are victims of domestic violence are experiencing: they are subjected to moments of terror and suffer major traumas, and their lives

E. Durand
Bobigny District Court, Bobigny, France
e-mail: edouard.durand@justice.fr

continue without their suffering being identified and considered by professionals and more broadly by the adults who surround them.

This is somewhat excessive because we must recognize that real progress has been made gradually in research, in legislation, and in professional practice. However, as these advances are made, resistance appears more prominently.

The profession of *juge des enfants*—whose competence includes child protection—leads to an awareness both of the frequency of domestic violence, both in child protection and juvenile delinquency contexts, and the limitations that exist to providing a fully protective response adapted to the specific mechanisms of domestic violence.

It is not excessive to think that these limitations, which are sometimes confined to denial and even institutional complicity with the aggressor [1], question our personal and social representations of the family; relations between men, women, and children in the family; as well as manhood.

Thus, domestic violence challenges one of the most powerful paradigms of contemporary family law: co-parenthood. We must agree that it is difficult for us to accept the idea of making an exception to this principle, whereas marital violence is one of the situations in which co-parenthood is not only unsuitable but dangerous.

The seriousness of the trauma inflicted on children in domestic violence must lead us to consider that domestic violence is one of the most serious forms of abuse and that children are not only witnesses but also victims of domestic violence. Designating the child as a victim of domestic violence requires that the child be guaranteed protection.

How can we ensure that the child victim of domestic violence be fully protected?

Physicians, educators, nurses, social workers, police officers, teachers, psychologists, and judges are among the many professionals who encounter children who are victims of domestic violence. All are third parties, temporarily intervening in a family context, without being the aggressor, the victim mother, or the child.

The challenge for these professionals is therefore to adopt, as a third party, a protective posture. However, as we become aware of the seriousness of the impact of domestic violence on the child, the risk is to dissociate the protection due to the mother and the child, both victims of the same situation.

The protection of the child victim therefore implies an understanding of the mechanisms of domestic violence.

19.1 Some Keys for Comprehension

19.1.1 Differentiating Domestic Violence and Marital Conflict

The differentiation between violence and conflict is an essential prerequisite for the identification and understanding of domestic violence. Unfortunately, professionals are too often confused about these situations.

Of course, we are often confronted with conflicting situations, and the conceptual category of the conflict is relevant to provide adapted responses to the dysfunctions identified within the family. Nevertheless, the category of conflict is often used extensively and abusively, leading professionals to implement inappropriate protective measures, especially in the context of parental separations.

19.1.1.1 Four Models of Conjugal Separation

When parents separate or are separated, four broad types of patterns can be modeled: agreement, absence, conflict, and violence.

- *Agreement*: Despite their separation, it is possible that parents reach agreement, be it only for the sake of their child(ren). Their separation is then dealt with in a civil procedure, to which they have consented. The agreement can also be rebuilt gradually over the years following the separation. In both of these cases, the child enjoys peaceful conditions of education, both parents being able to respect the parental function of the other; the child is preserved from any conflict of loyalty, the affection which binds him to his father and mother being accepted by both parents. In this category are also situations in which parents agree to abuse their child(ren). Situations of agreement are those where both parents are protective or, on the contrary, dangerous.
- *Absence*: The child may also be faced with the absence of a parent. The other parent, the mother most often, has to organize the child's life alone and make decisions about the child's education. The absence can take the form of a random presence, without the parent being a reliable "teammate" for the other or a figure who is safe for the child. In situations of absence, the present parent must have the means, both educational and legal, to exercise parental authority alone.
- *Conflict* is a disagreement between two subjects who are in a symmetrical position. As subjects, the two people in conflict can present a different perspective to the other. Everyone recognizes that disagreement is possible, which the other subject has the right to express disagreement. Each can accept to be convinced by the other and neither is afraid of the other.

Conjuality and parenthood are fields of human existence that necessarily confront conflict. To live as a couple, to be a parent, is inevitably the experience of differentiation, be it regarding the humblest events in everyday life or the most serious decisions regarding the family or one of its members.

A conflict is resolved first by language, the persuasion which, as Hannah Arendt recalls, "presupposes equality and operates through a process of argumentation." Both parents, whether separated or not, are able to work together to find the best decision for the child despite their disagreement, whether it is related to an outing with peers or the organization of the child's life after the couple's separation.

It is also possible to resolve a conflict by the provisional intervention of a neutral third party, such as a judge in a divorce proceeding in which both parents disagreed as to the choice of the child psychiatrist for their child, who was severely affected by the separation. The parents agreed to put an end to their life together, agreeing to the residence of their child, agreeing on the necessity of the child benefiting from care, but disagreeing on the choice of the practitioner. The choice of a child psychiatrist is a responsible and serious decision, and parents have the right to disagree and have recourse to a third party to decide.

Finally, it is possible to resolve a conflict by the provisional intervention of another neutral third party who puts the two members of the couple in the presence of each other and helps them to find a solution in accordance with each of their interests and those of their child. This is mediation, which is a useful tool for conflict resolution. But in a family, not everything is conflict.

- *Violence*: One of the key risks faced by victims of domestic violence is that third parties conceal the violence, confusing it with the model of conflict. In child welfare, it is often the case that professionals say that the child who is the victim of domestic violence is the victim of marital or parental conflict. It is therefore essential to measure the specificities of the mechanisms of conjugal violence and to clearly differentiate it from marital conflict.

The first distinction, fundamental but too often forgotten, is that the law prohibits domestic violence while it authorizes conflict. Then, while in a conflict, the two members of the couple, both parents, are in a symmetrical position; domestic violence translates an asymmetrical configuration in which one is a subject who commits the passage(s) to action, while the other is the object of the violence. From this perspective, we must also consider that domestic violence is outside of the conjugal relationship, for there exists no relationship between a subject and an object.

In a context of domestic violence, the aggressor does not tolerate differentiation, and the victim knows that she cannot express a different point of view without incurring the risk of violence. The persuasion of which Hannah Arendt speaks is therefore impossible [2]. Moreover, the motives of the aggressor's actions are only pretexts, the aim being the establishment and perpetuation of asymmetry, that is to say, of power. Children's education is often used as a pretext for violence, and it is known that 75% of the triggers for violence are related to parenting, thus increasing the guilt felt by the mother and the child.

All professionals working with victims of violence can observe that victims experience often, if not always, fear, shame, and guilt. But unlike most victimization experiences, in domestic violence (and other forms of family violence), victims are confronted with the permanence of the aggressor's presence and the repetition of the traumatic event.

Finally, for the protagonists of conjugal conflicts, there is always a representation of separation. Indeed, it is an experience that seems to me to be fairly common, because it is impossible to live as a couple without sometimes being at odds with one's spouse and perhaps experience a severe and prolonged disagreement. In these intimate moments, each represents the conjugal separation and even desires it and perhaps chooses it. However, it seems to me that in conjugal violence, a representation of death overrides the representation of separation. Domestic violence does not enable one to envision the possibility of a separation, but rather the death of the victim. The aggressor says "I'm going to kill you," the victim says "he's going to kill me," and the child says "he's going to kill her." This is undoubtedly one of the reasons why victims of domestic violence sometimes take a long time to leave their aggressors; they know that they are in mortal danger.

19.1.2 The Impact of Domestic Violence on Children

We know today that marital violence has a serious traumatic impact on children and that it generates disorders that deeply and lastingly harm their well-being and development.

Indeed, “regardless of gender, children exposed to spousal violence demonstrate a higher rate of aggression, anger, anxiety and depression than the general population” [3, 4].

Although the impact of spousal abuse on children exists from the time of pregnancy until the child’s potential death, the consequences of domestic violence on children can be grouped into three categories: harm to the child, harm to others, and post-traumatic stress disorder.

In terms of harm to the child, depending on the child’s age, one observes age-related retardation, developmental delay, disturbances in eating and sleep patterns, dependence, anxiety, withdrawal, disinvestment, depression, running away, addictive behavior, suicidal equivalents, and suicidal passages.

In the case of harm to another person, one observes, again depending on the age of the child, brutality toward others, general aggressiveness, cruelty to animals, acts of property destruction, violence against peers, violence against mothers or friends in relationships, and stereotyped beliefs about the role of women and men.

Finally, post-traumatic stress disorder is manifested by symptoms of neurovegetative activation (difficulty concentrating or falling asleep), avoidance symptoms (especially people, places, or objects recalling the violence), and repetition symptoms (nightmares, revivification) [5].

As Dr. Maurice Berger points out, “exposure to scenes of domestic violence has more impact the younger the child because during the preverbal period, that is, when he or she is younger than 2 years old, he does not have the ability to put words on what he feels and the scene is internalized (or engrammed) in the raw state in the form of sounds, cries, looks, etc. These sensations settle in at a cerebral level in the form of traumatic memories that can re-emerge as is in circumstances reminiscent of the past” (interview with the author).

Finally, Professor Miri Keren states that “the most predictive factor of post-traumatic stress disorder in children is not an event directed against their bodies, but the fact of having witnessed a threat to the person who cares for them, and that the most serious trauma is domestic violence because it threatens the physical and emotional integrity of the person responsible for the child, the person who secures the child, who usually reassures him or her, and who is most often the child’s mother. It is now known that infants and young children remember traumatic events, without necessarily being aware of them in the adult sense” [6].

One can thus measure the severity of the impact of domestic violence on children, justifying that children be considered victims of the violence and not only witnesses or exposed to it. However, in (French) criminal law, the child is not a victim of the conjugal violence in the criminal sense. Only her mother is considered to be a victim of violence against her by her spouse. In order to better take into account the impact of domestic violence on children, two legal channels are possible in France: the first would be to take into account the existence of children as an aggravating circumstance of domestic violence, thereby increasing the penalty incurred; the second, in reference to the legal concept of “ideal accumulation of qualifications,” would lead to the view that domestic violence constitutes two distinct and cumulative offenses, one against the mother and the other against the child [7].

19.1.3 Domestic Violence and Parenthood

19.1.3.1 Parenthood of the Mother Victim

Domestic violence has a severe impact on the emotional state of the mother and constitutes a serious attack on the mother-child bond from the moment of pregnancy onward. However, professionals can forget on the one hand that “the woman who is the victim of conjugal violence does not present any particular flaws that may explain her being a victim of conjugal violence: the configuration of the relationship is enough to explain the trap” [8] and on the other hand that “helping the mother by treating her as a woman in danger allows the child to resume normal development,” as Ernestine Ronai recalled in the National Assembly on 12 May 2009 [9].

However, the protection of victims of domestic violence is in practice liable to be defeated by the silos of public services and professionals (criminal system, family services, child protection, or the judiciary, health, and social services) on the one hand and by the reversal of guilt in the field of parenthood to the benefit of the aggressor on the other.

The Three Planets

The protection of victims of domestic violence is primarily undermined by the tendency of professionals to isolate their interventions based on the register of their intervention, mainly the criminal treatment of the offense, the social and civil treatment of marital separation, and the clinical and educational protection of the child. The exchange of information between these three sectors of intervention is limited, and each of these sectors has a different way of taking into account the violence and its traumatic consequences.

The English researchers Lorraine Radford and Marianne Hester, cited by P. Romito, explained this problem by the very illuminating metaphor of three planets [10, 11]:

“On planet A, domestic violence is considered a gendered crime of men over women and the police and the court may intervene to protect the latter (arresting the man or issuing a protection order). Planet B corresponds to child protection services, whose approach is ‘*gender neutral*.’ On this planet, we talk about abusive families rather than conjugal violence. It is the mother’s responsibility to protect children from the violent man: if she does not, she fails in her duty to protect and could lose custody of the children. But if she separates from the man, she ends up in the orbit of planet C, namely the services responsible for contact between the father and his children after separation, which are motivated by the principle of ‘parental responsibility’ and a concern to not deprive fathers of their rights. On this planet, the woman may be compelled to consent to visits between the children and this same violent father, under pain of being punished by a loss of custody of the children. On the planet C, the man’s violence is ignored as much as possible, thanks to a discourse according to which there is no contradiction between being a violent ex-partner and a good father, or at least a ‘good enough’ father.”

The Inversion of Guilt

As the metaphor of the three planets suggests, as soon as professionals focus their attention on protecting the children or on the organization of their lives after

parental separation, less or no consideration at all is given to the aggressor's violence and the dangerousness. Between the time the victim of domestic violence enters the court, the hospital, or the social center and the moment she arrives in the office of the juvenile judge, psychologist, or educator, she ceases to be looked upon as a woman in danger and is regarded only as an irresponsible or manipulative mother.

The concept of "parental alienation" or "parental alienation syndrome" must be mentioned here in so far as it conceals the seriousness of the suffering incurred by victims of domestic violence and reverses guilt in favor of the aggressor. While marital violence is a serious attack of the mother-child bond and a manipulation of the child against the mother (that can even lead to the child reproducing the violence against the mother), "parental alienation" is used to disqualify the mother in her legitimate attempts to protect the child and makes her suspected of wanting to break the father-child ties.

This dangerous and controversial concept guarantees the denial of domestic violence and its related child abuse [12, 13]. It is also possible to observe the increasingly frequent and probably excessive use of Münchhausen syndrome by proxy so as not to question the child's refusal to visit his father, especially in situations of domestic violence.

19.1.3.2 The Aggressor's Parenthood

Just as violence disappears in the eyes of professionals under the mask of conflict, on often hears that "a violent husband does not make a necessarily bad father." This formula reflects what Karen Sadlier calls the premature separation of the conjugal and the parental, which is also a manifestation of denial and leads to minimization of the aggressor's dangerousness and to the child's safety not being taken into account.

Yet, the personality traits found in violent marriages must lead professionals to assume that they are dangerous fathers.

First, it is essential to bear in mind that domestic violence is a criminal offense only because it results from a choice made by the perpetrator. The latter has the opportunity to act differently but chooses violence in order to gain and maintain control over the mother and child. This choice is one of transgressing the law, and as the psychologist Linda Tromeleue reminds us, professionals must be careful not to "let their thoughts be infiltrated by those of the perpetrator because it is a matter of serious criminality" (interview with the author).

Secondly, one must think of the aggressor's parenthood from what is revealed by his violence in conjugality and the personality traits identified; this is the legal mechanism of presumption [14]. These personality traits run from intolerance to frustration. Is it possible to be a parent to a child, regardless of age, without having to face frustrations, whether it is the infant's screams or a teenager's transgressions? Aggressors also demonstrate immaturity. Does not educating a child require maturity? Karen Sadlier also recalls that those perpetrating violent marital relationships are often lacking in empathy [5]. Doesn't protecting a child require that the child's needs are not only distinct from one's own but also a priority? She also specifies that violent spouses have specific difficulties enduring seeing others become autonomous. Is educating a child anything other than gradually teaching him to become autonomous?

This reasoning must be conducted with all the components of the personality identified in the violent spouse: annihilation anxiety, perverse tones, and tendency to trivialize the seriousness of the violence and to position oneself as a victim.

However, this information is insufficient to take into account the dangerousness of the perpetrator in parenthood, that is, in the relationship with the mother and the child.

And yet, we also know that 40% of children who are victims of domestic violence are directly victimized by physical violence against them by the father, and daughters of violent spouses who are 6.5 times more likely to be victims of sexual abuse perpetrated by their father [15].

The protection of the child victim of domestic violence is therefore imperative and cannot be fully achieved without the protection of the victim parent and the taking into account of what is revealed by the marital violence.

19.2 Means for Protection

The protection of children who are victims of domestic violence requires, first of all, identification of the violence and having it be taken into account in professional practices by informing the law, insofar as it is essentially a transgression. This is the prerequisite for the implementation of appropriate modalities for exercising parental authority. Finally, the possibility a child protection intervention will be examined.

19.2.1 The Necessity of Referring to the Violence

As we have seen above, the protection of children who are victims of domestic violence is only possible if all professionals refer to the specific model of domestic violence. In addition to the distinction between conflict and violence, professionals need to understand the aggressor's strategy in order to develop an effective protection strategy.

19.2.1.1 The Perpetrator's Strategy

The aggressor's strategy was modeled by the Feminist Collective Against Rape for the Protection of Victims of Sexual Violence and by Ernestine Ronai for the Protection of Women Victims of Domestic Violence [16]. The narrative of multiple victims gradually made it possible to identify a repeated mode of operation used by perpetrators; understanding it makes it possible to thwart this strategy by opposing protective attitudes.

The first stage of the aggressor's strategy is the isolation of the victim and the child by gradually breaking ties with the family, the network of friends, preventing her from working or leaving no space for freedom outside working hours. Isolation hinders speech and thought and allows the victim to be controlled. Faced with the isolation strategy, professionals should open the victim's and children's relational space, help the victim to recreate a support network, and be one of the safe links.

Then the aggressor uses devaluation and humiliation. As we have seen, the reasons for the act are only pretexts. Devaluation weakens the victim, instills self-doubt, and is even more cruel when it focusses on parenting. Faced with the strategy of devaluation, professionals should help the victim to regain confidence in herself and her abilities, especially her parental abilities.

The reversal of guilt corresponds to the personality traits we have seen above. The aggressor does not accept responsibility for his violence and justifies it by making the victim or the children responsible. This inversion of guilt disturbs children and can infiltrate into their thinking. I recall a child who said to his mother “every time he was forgiving you.” Faced with the reversal of guilt, professionals must restore the law, which is why the distinction between conflict and violence is so fundamental.

The perpetrator creates a climate of fear and insecurity. Insecurity results, in particular, from unpredictable behavior, even if the victim and the children know that no attitude will satisfy the aggressor. Professionals must provide safe answers.

The aggressor ensures his impunity and seeks allies. Professionals should be vigilant not to be used as allies. Finally, he imposes secrecy; as stressed by psychologist Linda Tromeleue at a conference at the National Magistrates School, marital violence replaces prohibition of violence by prohibition of speech.

19.2.1.2 Systematic Identification

Once again, stemming from the expertise of the Feminist Collective Against Rape and the work of Ernestine Ronai, the systematic identification of domestic violence is an important step in protecting victims.

It is up to professionals to question whether there is domestic violence. In our various functions, we show no hesitation to ask many very intrusive questions to both adults and children, but we are more reserved when it comes to pinpointing domestic violence.

In any case, the disorders manifested by children must lead professionals who work with children to question the possibility of the domestic violence and to check this hypothesis [17].

19.2.1.3 Law Over Treatment

Insofar as domestic violence is an offense, a breach of criminal law, a reminder of the law is essential, and all third parties, professional or not, but even more so if they meet the family in a professional context, must be the guarantor of the law. Yet, marital violence is probably one of the only offenses where professionals dispense with this essential dimension of their function, because of the confusion between violence and conflict or under the pretext of apprehending marital violence as a “pathology of the bond” of which the two members of the couple would be co-responsible equally.

Recalling the law serves to thwart the perpetrator’s strategy of reversing guilt and to help the victim become aware that she is experiencing violence. Victims of domestic violence frequently meet with professionals who tell them to take specific decisions, in particular to ensure protection of the child, but do not mentioning or informing the law.

The recall of the law must also lead to adjusting professional practices to the model of violence, in the organization of space during family appointments, and by rejecting any benevolent neutrality.

The spaces where families are seen must be adapted in cases of domestic violence, to protect the victim and allow her to speak freely. Similarly, benevolent neutrality would bolster the aggressor's strategy at a hearing, and the child thinks "if the judge did not tell my father that he has no right to be violent with my mother is that it has the right."

19.2.1.4 Parental Authority: Protecting the Mother Protects the Child

At the time of the couple's separation, defining the terms of exercise of parental authority is of course crucial. It is these conditions that allow the child to be protected or not.

But our difficulty conceptualizing exceptions to the principle of co-parenting leads to maintaining custody terms that allows the attacker to keep a grip on the mother and children. Is it too much to say that we are implementing "a patrimonial conception of parental authority"? While parental authority's aim is the interest of the child, that is to say covering basic needs (starting with the need for security) and development, perhaps it is also a legal for recognizing the status of parent.

Moreover, even in child protection institutions, we confuse parentage, parental authority, the relationship, and the encounter. Parentage and parental authority do not necessarily intersect, as the relationship does not always mean the encounter. Of course, in most family situations, even after parental separation, filiation, parental authority, the relationship, and the meeting may coincide, at least in situations of agreement and slight conflict.

But child protection requires separation of these four registers in situations of violence. Sometimes one says "it is his father after all" to impose the child encounters, meaning that parentage encompasses parental authority, the relationship, and encounter. This results in protecting the abuser, not the child or the mother.

Conversely, think parenthood of the aggressor from the perspective of what his conjugal violence reveals leads to parental authority of a more protective nature, by giving the mother the exclusive exercise of authority parental and granting the father of mediated visits.

By giving the victim exclusive exercise of parental authority, one prevents decisions regarding the children's protection and education from becoming an area in which the aggressor perpetuates his hold, even many years after the couple's separation, either by opposing any decision made by the mother (including regarding the child's healthcare) or by imposing, even remotely, a family organization.

Once we take into account the fact that domestic violence is one of the most severe types of abuse inflicted on children, that it is known that 40% of these children are direct victims of violence by the aggressor, and that the daughters of a violent spouse run a risk of being sexually abused that is 6.5 times higher, is it necessary to justify the importance of mediated visits? In truth, these visits are often

ordered by the court in less serious cases. They are needed in domestic violence situations.

19.2.1.5 Intervention of the Child Protection System

The severe traumatic impact of domestic violence on children leads undoubtedly to feel that the child is in danger. However, entering child protection is perhaps not systematic. It should not lead the various professionals in the child protection chain to equate “domestic violence = report = child’s placement.” This equation isolates the mother and children on planet B, so finely analyzed by Radford and Hester [12]. This is the risk faced by victims as domestic violence is understood as a child abuse.

Faced with domestic violence, it is first the application of the criminal law and the organization of procedures for exercising parental authority on the pattern of violence and not on that of conflict that will allow the mother to protect the child. In my opinion, the challenge is to protect the protecting parent. In domestic violence, only one parent is abusive, and only one is protector.

However, how the situation is treated is often determined by the intervention of the professional who first identifies the domestic violence, placing the family on one of the three planets mentioned by Radford and Hester [12]. If it is the police who are called in first, for example, by a complaint from the victim, a criminal approach will be privileged and may lead to separating the perpetrator.

If the first professionals identifying the violence come from the educational and social field (schools, social centers, etc.), it is likely that the situation will enter the child protection circuit. Whatever the decision of stakeholders in child protection, it seems important to preserve some guidelines:

- The mother should be considered as a subject of child protection; in other words, the actions taken by the professionals should not invalidate her for not colluding with the aggressor’s strategy.
- Professionals should know as much as possible about those to whom they transmit information and who will intervene after them. Institutional partnerships take on their full meaning in this context.

Educational Assistance in an Open Environment

It is possible that the educational assistance measures are necessary, sometimes at the request of the mother. Again, the issue is that the measures be implemented based on a model of violence, not of conflict.

As children of the same family are not necessarily in the same situation (confidant of the father or the mother, wrong object), the educational process should ensure to provide an appropriate response to each of them, focusing on activities that allow emotional expression and development. Spurred by Ernestine Ronai and with contributions from Karen Sadlier, the Observatory of Violence Against Women of the French department of Seine-Saint-Denis has developed a guide called “The Right Words” to help professionals work with children who are victims of domestic violence [18].

It is also important to help the mother to restore parental authority that domestic violence may have been denatured. This can be done reassuring the children that everyday educational decisions are legitimate. In sum, educational services should be on the mother's team.

The Placement of Children Victims of Domestic Violence in Foster Care

If the placement of children who are victims of domestic violence is considered or implemented systematically, it is highly likely that soon, no woman or any child victim of domestic violence will take the risk of trusting in others. In the culmination of the abuser's strategy, this professional posture would confine the victims in a trap.

It is possible to order the placement of a child victim of domestic violence in a children's home or with a family assistant. But most often, this decision is necessary when there are related but distinct issues, for example, when the mother suffers a psychiatric disorder.

In addition, issues of mutual protection between the mother and the child must be taken into account, and I have noticed repeatedly when a child is separated from the mother and unable to check whether she is safe, the child is overwhelmed by concern and cannot invest in the placement and could even run away to return to his mother.

However, placement may appear necessary when the child fails to detach from identification with his father or is violent with his mother and does not want to meet her.

But placement is particularly relevant for the protection of very young children when the mother, in the grips of her violent spouse, does not consider separation. In this situation, the mother's protection and child's protection may seem incompatible. But if domestic violence is sufficiently established to warrant the placement of the child, it can also justify criminal proceedings to neutralize the aggressor.

Key Points

- It is essential to differentiate domestic violence and marital conflict to provide an appropriate response to each situation.
- Conflict is a disagreement between two subjects that have a symmetrical position. It is resolvable by language or by the intervention of a neutral third party (judge, mediator).
- Domestic violence reflects an asymmetrical configuration of the two subjects involved with one victim and one perpetrator.
- The impact of domestic violence on children is significant, notably resulting in later aggressive behavior.
- Post-traumatic stress disorder can be caused by exposure to scenes of domestic violence.
- In cases of domestic violence, the first stage of the aggressor's strategy is often to isolate the victim and the child.
- In cases of domestic violence, protecting the mother also protects the child.

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C. Rambaud
Service d'Anatomie Pathologique et de Médecine Légale,
APHP-CHU Raymond Poincaré, 92380 Garches, France
e-mail: caroline.rambaud@aphp.fr

20.1 Neonates

Under French law, until 1994, infanticide was defined as the killing of a newborn less than 3 days old—the deadline for officially registering a child's birth. It was treated differently, with lighter sentences, than other murders and killings. The woman—the primary perpetrator in most cases—was likely to be sentenced to between 10 and 20 years in prison. The revised French penal code eliminated the charge of infanticide, treating all voluntary homicides in Article 221–1: “The willful causing of the death of another person is murder. It is punished with thirty years' criminal imprisonment.” The victim being a minor under 15 years of age is an aggravating circumstance for which the perpetrator faces life in prison.

Most newborn homicides occur within a few hours of birth. Newborn homicide, or neonaticide, assumes that the infant had been alive, i.e., had taken breath after birth. If the infant had never breathed, it was a stillbirth and no crime had been committed.

Autopsy serves a number of purposes when the corpse of a newborn is discovered. It must:

- determine whether the newborn had been viable (evaluation of the gestational age in weeks since the first day of the last menstrual period or weeks LMP)
- evaluate how long the infant was breathing (alive), if live-born
- determine the cause or causes of death
- provide genetic samples for identifying or confirming the filial relationship with a potential mother (by freezing the psoas muscle and a fragment of the chorionic plate with villi and by placing drops of blood on filter paper, which then air-dried and placed in the record along with a lock of hair from the top of the head)

Ideally, the placenta should be examined along with the body (concept of the fetoplacental unit). Generally speaking, natural causes of death can be broken down as follows: a third are fetal in origin (e.g., malformation, infection, infant respiratory distress syndrome, or meconium aspiration), a third are maternal in origin (e.g., eclampsia), and a third are placental in origin (e.g., abruptio placentae or chorioamnionitis).

Newborn homicides are either deaths due to apparent trauma (usually traumatic brain injury) or deaths due to asphyxiation (suffocation, strangulation, or drowning) and/or neglect (hypothermia, dehydration, or hypoglycemia). The latter leave no visible marks on the body and are only be detected histologically after all natural causes of death have been ruled out. The autopsy is also used to compare what the mother (if known) reports with the objective findings from examining the body. We are increasingly hearing about “pregnancy denial,” a rather convenient excuse for killing a child. Such denial situations are, in fact, rare and far from all of them end in neonaticide [1]. Autopsies in all neonaticides must follow a strict protocol.

The autopsy should start with a skeletal survey, preferably using an imaging system (like the Faxitron®) that can accommodate the entire baby. Otherwise, it should

be done in a pediatric radiology room (see Chap. 21). The limbs, hands, and feet should be taped to the plate to keep them fully extended and aligned, with no overlapping. The skeletal survey will show the ossification centers and tooth buds, which help with age assessment, and document any potential fractures. These X-rays also show whether there is air in the lungs, the stomach, or possibly the small intestine. Any newborn that has breathed will have a gastric air pocket due to the crossing of the air and food pathways in the pharynx. The autopsy should include a photograph of the newborn dressed or wrapped in a blanket after being examined and washed; this is for the mother, if known, and/or the father and siblings, who might want a memento of the baby. It should be left in the file and the family (if known) informed of its existence. After that, anatomical photographs of the infant are taken: one of the entire body from the front and the back, one of the face from the front and from each side, and photographs of any abnormalities that are found. Sterile samples are taken from the liver and lung to document any infection; a pathogen in the lung indicates amniotic infection, and a positive liver sample indicates dissemination in the blood. Interpretation is also based on the C-reactive protein (CRP) level. The autopsy looks for any potentially fatal malformations, especially cardiac abnormalities, and samples all of the organs for histological analysis.

20.1.1 Viability

Viability depends on gestational age, calculated in weeks LMP. A newborn is full term between 37 and 42 weeks LMP. A baby is premature when the gestational age is less than or equal to 36 weeks LMP and postmature beyond 42 weeks LMP.

Viability requires being able to breathe unaided. That in turn assumes that the lungs have developed to the alveolar stage, which begins at 32 weeks LMP, and the presence of surfactant, without intrapartum fetal hypoxia or other cause requiring neonatal resuscitation.

The gestational age assessment is based on a number of criteria.

20.1.1.1 Gross Findings

These include the child's measurements and appearance: weight (3–3.5 kg), length (50 cm), head circumference (35 cm) and foot length, appearance of the skin and appendages (nails), nipple size, plantar creases, ear cartilage (Table 20.1), and brain development, which is evaluated based on the appearance of the cerebral gyri.

Table 20.1 Criteria for fetal maturation

	36 weeks LMP	38 weeks LMP	40 weeks LMP
Breast buds	2 mm	4 mm	7 mm
Plantar creases	Anterior 1/3	Anterior 2/3	Entire sole
Ear cartilage	0	+	+

20.1.1.2 Radiological Findings

Gestational age is assessed based on the length of the long bone diaphyses and on the ossification centers, of which the full-term newborn has six: proximal humerus, distal femur (Béclard's center, which appears at 36 weeks LMP), proximal tibia, talus, calcaneus, and cuboid (Fig. 20.1).

20.1.1.3 Histological Findings

There are four stages of lung development: the pseudoglandular phase (from 7 to 15 weeks LMP), the canalicular phase (from 16 to 26 weeks LMP), the saccular phase (from 26 weeks LMP to postnatal), and the alveolar phase, which begins at 32 weeks LMP (and continues to age 7 years). Alveolar growth occurs by adding alveoli, layer by layer, at the end of the respiratory bronchiole, until they reach either the pleura or the nearest interlobular septum. The number of alveolar layers is directly related to age. Growth can therefore be assessed using a radial alveoli count on at least ten microscopic fields; this technique, initially described by Emery and Mithal [2], was later refined by Cooney and Thurlbeck [3], who worked on lungs that were inflated by injecting formalin into the airways. Using kidney maturation to assess gestational age is another well-established technique. Starting from two to three layers of immature glomeruli on the subcapsular surface, glomeruli are added



Fig. 20.1 Radiological ossification centers in a full-term neonate (proximal humerus, distal femur, proximal tibia, talus, calcaneus, and cuboid) and air in the lungs, stomach, and small intestine

layer by layer until 36 weeks LMP (seven or eight layers of mature glomeruli). By 36 weeks LMP, the layers of immature glomeruli have disappeared, and growth continues until birth (at full term) by the addition of one or two layers of tubules between the last layer of glomeruli and the capsule. Lastly, gestational age is also assessed based on the histology of the placenta, according to the appearance of the villi.

20.1.1.4 Putting the Findings Together

All of these findings are used to produce the final, precise assessment of gestational age. This is particularly important in cases of intrauterine growth retardation, where the radiological and (especially) histological findings help correct for anatomical measurements that, taken by themselves, would underestimate the gestational age. In cases where the body has begun to decompose, the histological findings are less reliable. While the glomerular layers of the kidneys can still generally be counted, using the lungs—where bubbles from putrefaction destroy the alveolar architecture—is more difficult.

20.1.2 Live Birth

The autopsy must determine whether the newborn ever breathed. That assessment is based on three criteria:

- *Radiological findings*: Imaging will show the presence of air in the lungs, an air pocket in the stomach, air in the middle ear, and possibly air in the intestines. How long it takes for air to pass the pylorus varies from one child to another, and to the best of our knowledge, no minimum time has been published.
- *Gross findings*: Aerated lungs are pink and expanded, and the lung float test (docimasia) is positive—i.e., the lungs will float in water (Fig. 20.2)—unlike non-aerated lungs, which are wine colored (Fig. 20.3) and sink in water. Though it is done routinely, the lung float test is in no way a gold standard. There are false positives—due to attempted resuscitation or to decomposition, in particular—and false negatives, in cases of hyaline membrane disease or severe pneumopathy. Another gross indicator that the infant had breathed is an air pocket in the stomach or air bubbles within the gastric contents, which confirm the radiological appearance. It is also possible to see whether the small intestines have air in their lumen and how aerated they are.
- *Histological findings*: Respiration results in a smoothing out of the bronchial and bronchiolar lumina and aerated alveoli. In an infant who has never breathed, the bronchiolar lumina will have an “offering bag” appearance, and the alveoli will be closed. A few respiratory movements will result in only partial opening up of the alveoli, and there will be alternating smooth and more fetal-looking areas.

Fig. 20.2 Normal lungs. They are expanded, pale pink, and float well above the surface of the water (positive lung float test)

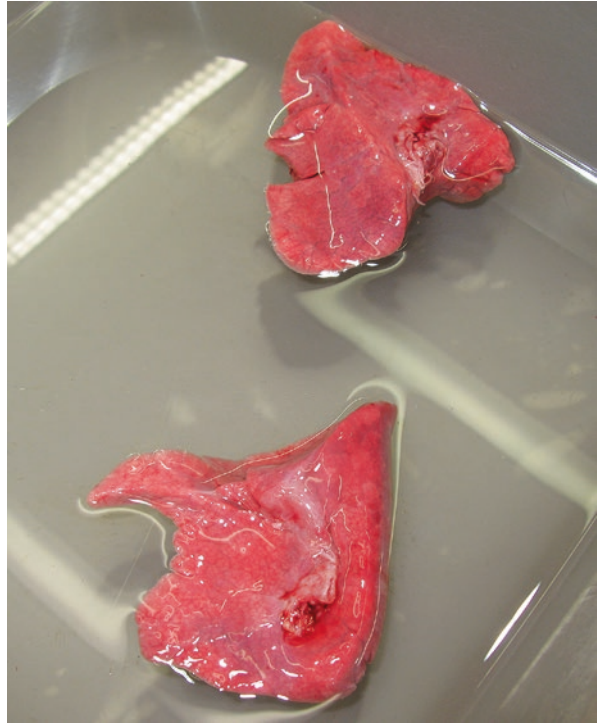


Fig. 20.3 Non-aerated lungs. They are compact and wine colored. They do not float in water (negative lung float test)

20.1.3 Duration of Extrauterine Life

Provided there was no attempt at resuscitation, fully unfolded lungs prove that there was well-established, effective breathing prior to death but cannot be used to determine its duration. The best indicator is the presence of an inflammatory reaction, even just a few cells, at the junction between the umbilical cord and skin of the belly (Figs. 20.4 and 20.5)—hence the need for serial slices. The inflammatory reaction does not appear until 3–4 h after birth, however. If there were traumatic injuries, the

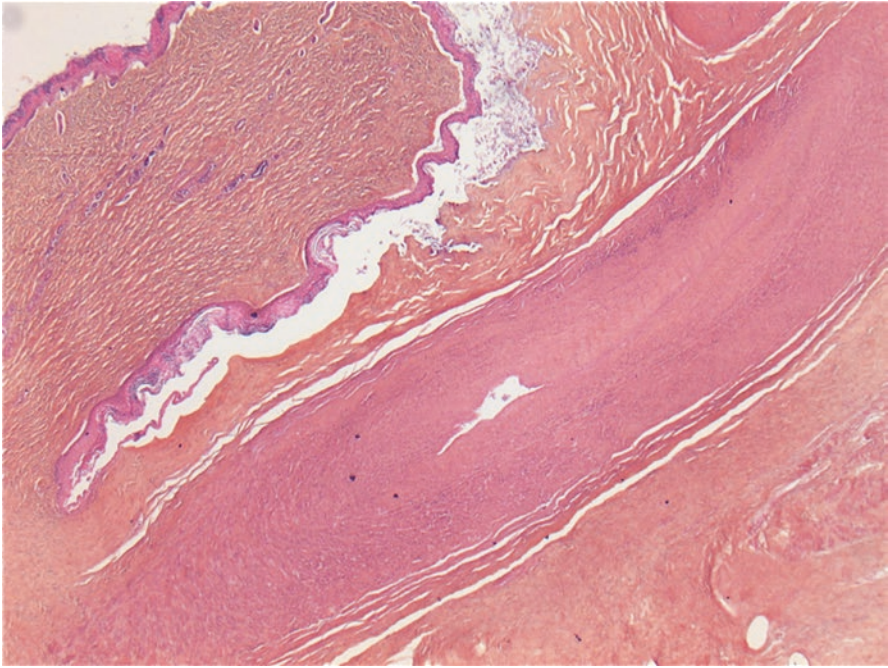


Fig. 20.4 Histology: junction between the umbilical cord (*on the right*) and the skin of the abdomen (*on the left*)

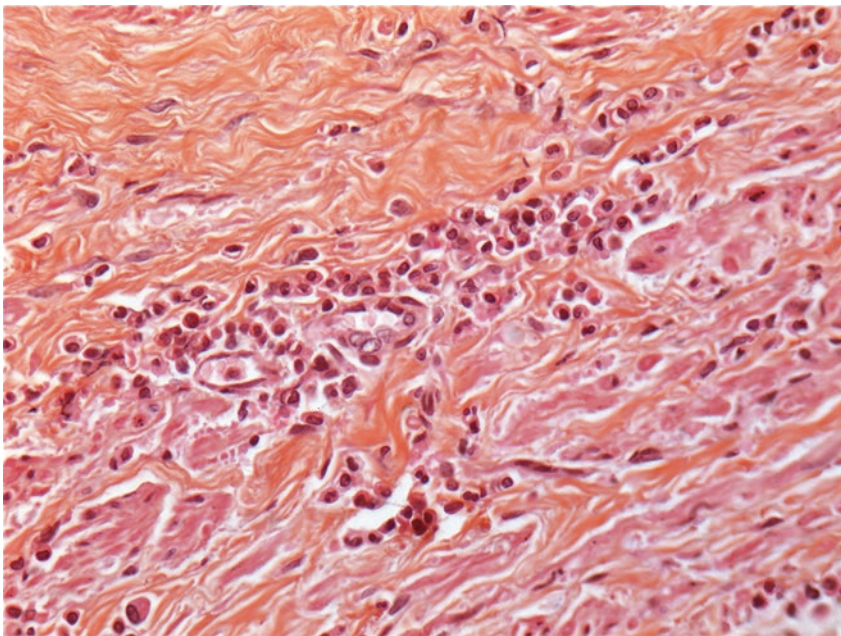


Fig. 20.5 Inflammatory reaction in the connective tissue at the junction between the umbilical cord and the abdomen

presence and character of the associated inflammatory reaction can also be used, but this is another relatively late feature, given that it takes approximately 2 h for the first inflammatory cells to appear after injury [4]. While other criteria can be used to determine how long the infant lived, they do not occur much earlier and show wide temporal variability. For example, umbilical artery occlusion occurs approximately 6 h after birth; it takes a “few hours” (but at least one) for air to appear in the intestines; while the ductus arteriosus ideally closes after a few hours, normal closure can take several days (to 2 weeks); the meconium is typically completely expelled in 2–5 days; the caput succedaneum is resorbed in 3–5 days; and the umbilical cord falls off in 5–10 days. The presence of milk in the stomach indicates that the child has been fed; this is a rare finding. Histologically, the appearance of the hepatocytes (Fig. 20.6) and myocytes can also be helpful; diffuse cytoplasmic clearing suggests “prolonged anoxia,” but the time frame is imprecise [4] and can only be characterized as “long.”

20.1.4 Cause(s) of Death

In the absence of obvious trauma, the autopsy must determine whether death was due natural causes or not.

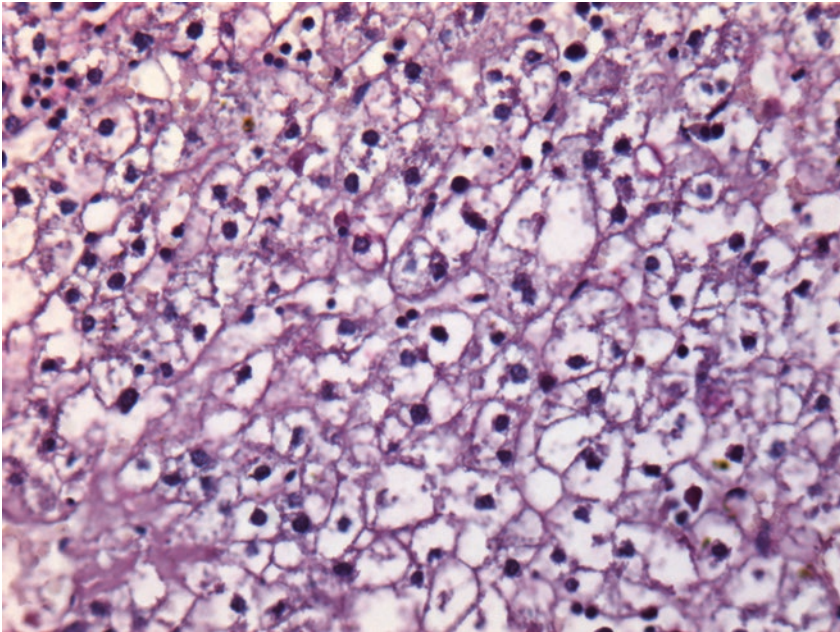


Fig. 20.6 Prolonged anoxia. The histological examination of the liver shows hepatocyte clarification and lysis

Natural causes of death include acute hypoxia (acute fetal distress), maternal to fetal infection (which can kill within the first few minutes or hours of life), meconium aspiration, malformation (heart), or metabolic disease. All of these causes are easy to diagnosis with a complete autopsy that includes bacteriology samples and histologic analysis of all tissues and organs, including the placenta. A rare cause of death is acute anemia due to fetomaternal hemorrhage when the child is placed on the mother's belly before the cord is cut. On the other hand, failing to clamp the cord does not cause significant blood loss.

Death can also be due to a *lack of intensive care*. Here again, the diagnosis is easy—delivery occurs outside a medical facility, where immediate management of neonatal respiratory or cardiac distress would have been possible. In infant respiratory distress syndrome (hyaline membrane disease), which begins a few minutes after birth, a surfactant abnormality causes production of hyaline membranes when air enters the alveolus. Respiratory distress due to meconium aspiration occurs within hours, like in cases of maternal to fetal infection.

Neglect kills via the combined effect of hypothermia, hypoglycemia, and dehydration. It is a slow death; the time it takes can vary. As an example, newborns are sometimes found in trash chutes or in clothing collection bins in the city or left in a field.

Death can also be due to *toxicity* when a mother takes drugs or to neonatal abstinence syndrome.

Death by asphyxiation can be caused by ligature or manual strangulation, suffocation (obstructing the upper airways with a pillow or gag), or confining an infant in a plastic bag (trash or other type of bag). Fatal asphyxia can also be positional, e.g., when a newborn delivered in a restroom is left hanging head down, when a baby is left bent in two, or when a heavy weight is placed on an infant's chest. Lastly, it can be due to drowning, in particular when a baby is delivered in a bathtub or into a toilet bowl, if the head enters the pipe, or the bowl is wide.

Whatever the cause, the signs of asphyxia are intrathoracic petechiae and a characteristic appearance of the lungs, which are overaerated with air-filled pseudocysts (due to rupture of the alveolar septa) and subpleural and interalveolar lymphatics distended by air (Fig. 20.25). These features have no diagnostic value after resuscitation efforts, of course. Umbilical cord strangulation requires that the cord be wound tightly around the neck; in that case, there may be petechiae on the face and neck—which are very congested and cyanotic—along with a circular white mark around the neck from the cord (Fig. 20.7).

With *traumatic deaths*, any scenario is possible. These most commonly involve traumatic brain injury due to a forceful direct blow (e.g., with a bludgeon, rolling pin, or hammer or by slamming the child's head against a wall (Figs. 20.8 and 20.9)) or to defenestration.

There are numerous possible *combined causes*. For example, placing a newborn in a trash bag combines neglect with asphyxiation due to confinement. If their airways are not obstructed by something in the bag or by the wall of the bag itself, such children take several hours to die. Children may also be placed in a freezer alive and die from a combination of hypothermia and asphyxiation.

Fig. 20.7 Asphyxia due to umbilical cord strangulation. Intense cyanosis of the face, multiple skin petechiae, and a wide circumferential *white mark* on the neck

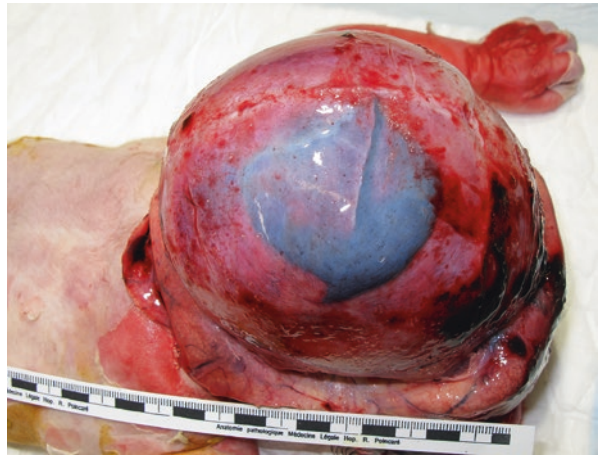
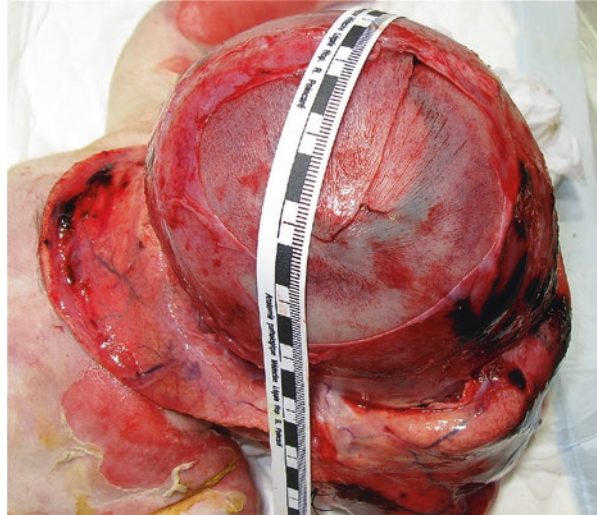


Fig. 20.8 Skull fracture with a subgaleal hematoma

Fig. 20.9 The same case as Fig. 20.8: removing the galea reveals the skull fracture



20.2 Sudden Unexpected Infant Death and Shaking

20.2.1 Protocol for Handling a Sudden Unexpected Infant Death

In the absence of any obvious injury or circumstances suggesting a violent death, the term sudden unexpected infant death (SUID) refers to any death for which determining the cause of death requires a comprehensive multidisciplinary protocol, as recommended by the French National Authority for Health (Haute Autorité de Santé, abbreviated HAS) [5]. That protocol is very similar to the *Standardized Autopsy Protocol* for the “Evaluation of Sudden Unexpected Infant Death” used by medical examiners in California (USA) (see <https://www.cdph.ca.gov/pubsforms/forms/CtrldForms/cdph4437.pdf>). These are postmortem investigations and autopsies, in particular, that will determine whether the death was natural (sudden infant death syndrome or SIDS) or violent (accident or homicide). In France, an infant is defined as a child younger than 24 months of age. These recommendations call for investigating all child deaths and stress the need for collaboration between pediatrics and forensics. There are two phases to postmortem investigations: first, what is done when the child’s body arrives at the hospital, and second, the autopsy. The protocol recommends that when the circumstances are suggestive of SIDS (a child who was doing well or only had apparently banal symptoms like those from a cold or cough, was put to bed, and later found dead), the body should be taken to the nearest pediatric emergency department for application of the SIDS protocol (Appendix). The protocol has a clinical section that reviews all of the findings, including the pregnancy and delivery, the neonatal and postnatal period up to the time of death, and most particularly what occurred over

the previous 48 h, and information about the scene where the infant was found (including, in particular, his sleep position, whether there was any reflux or vomit, any resuscitation attempts made, any resumption of cardiac activity, the core body temperature, and the temperature of the room). This requires obtaining the pre-hospital treatment forms (fire department, ambulance services, etc.), which can provide crucial information. The clinical section also covers the clinical examination of the infant, including height, weight, head circumference, core body temperature, and ocular fundus. Laboratory samples are taken, including blood for a complete blood count, platelets, C-reactive protein, calcium, and serum for plasma acylcarnitine profile analysis; a sample of the vitreous humor is also collected, as are bacteriology and virology samples (two blood cultures done on two different draws, lumbar puncture, urinalysis from a catheterized specimen, samples from the nose, throat and trachea, and a stool sample). Toxicology samples including blood, urine (if any), gastric contents, bile, hair with hair bulbs, and vitreous humor are collected in case they are needed later. AP and lateral X-rays are taken of the entire skeleton, along with a chest X-ray and brain imaging (CT or MRI, depending on the possibilities), and even whole-body CT or MRI. Skeletal X-rays require top quality bone images done limb segment by limb segment, and absolutely must be read by a pediatric radiologist. More detailed information on this topic can be found in the chapter on postmortem imaging. Ideally, imaging should be done prior to autopsy so that any abnormal areas can be sampled for histological dating. The parents are then asked for their permission to do an autopsy; a medical autopsy requires signed consent from both parents. Should the parents refuse, the child may only be interred without an autopsy if the history is absolutely unremarkable and clear, with no contradictions between the different participants, and if the clinical, laboratory, and radiological findings—especially the skeletal X-rays and brain imaging (Fig. 20.10)—are completely normal. If there is certainty regarding a traumatic injury, a report should be drafted immediately and sent to the proper authority. If the findings are questionable, an autopsy is obligatory; parents are told that the abnormalities found require an autopsy and that if they refuse their consent, the case will be reported, resulting in a forensic autopsy. If the parents consent, reporting is only required when abuse is a certainty.

20.2.2 Natural Deaths

Natural deaths have a multifactorial etiology, with a significant infectious component [6]. Sleep position is another essential factor; after the recommendation to lay infants on their backs was adopted in 1994 in France, the death rate from SIDS declined by approximately 80%, to the point that we can now say that putting an infant to sleep on his stomach is tantamount to child endangerment. Information about the scene where the body was discovered is essential to determining the cause of a sudden unexpected infant death. In France, the InVS developed a protocolized data collection form to be completed by the first physician to arrive at the scene (see Appendix).

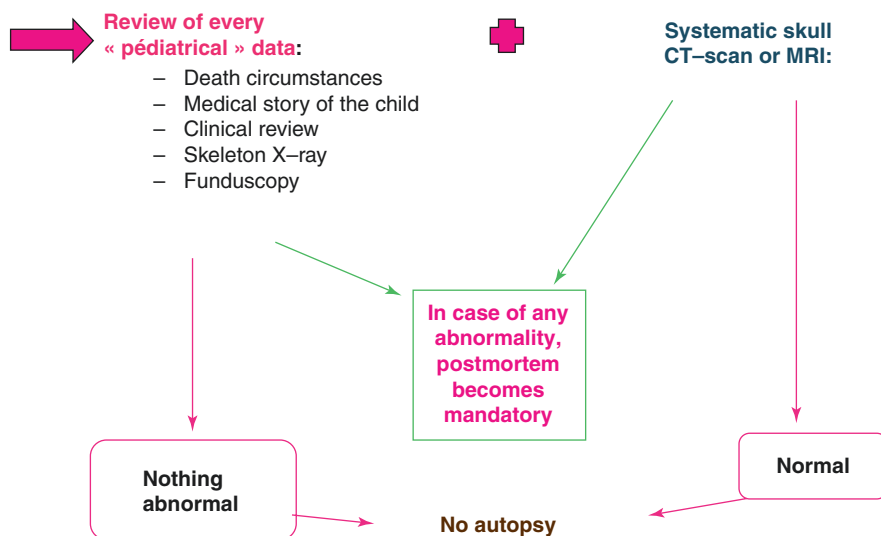


Fig. 20.10 If parents refuse autopsy for SUID



Fig. 20.11 High-arched palate in a child who died suddenly

Facial morphology is another important element in the events leading to the death of an infant with an apparently benign upper respiratory tract infection; a narrow face combined with a small, triangular chin, mandibular retrognathia, and (especially) a high, arched palate (Fig. 20.11) can cause sleep apnea or upper airway resistance syndrome, which are particularly dangerous during deep sleep [7]. In addition, it has been shown that when infants are placed in a prone position with their face in the mattress, the mandible is pushed back, favoring upper airway obstruction by the tongue in the oropharynx. Upper respiratory tract inflammation is associated with swelling, which can cause upper airway

narrowing that, though minor, is enough to change the amount of pressure needed to keep the airway open during inspiration. One millimeter of narrowing reduces the lumen by 75%, which according to Poiseuille's law increases the airway resistance by a factor of sixteen [8]. The conjunction of these three factors—facial morphology, upper respiratory tract infection, and a prone sleep position—is responsible for a large number of deaths.

The other major category of natural death causes is heart disease, like cardiomyopathy—particularly arrhythmogenic right ventricular dysplasia or myocarditis from a viral infection [9].

20.2.3 Accidental Deaths

These are mainly “bedclothes” accidents that could have been avoided had the usual safety advice been followed. Accidental deaths can be due to suffocation, when an infant is placed face down on a soft mattress with a pillow and later found with his face in the pillow; they also include accidents involving a folding travel crib, when the crib's original structure is modified by adding a mattress or extra height with one or more covers. There are the rare crib wedge accidents, in which a baby slides down the (incorrectly attached) wedge and ends up sitting, folded in half, with his head on or between his knees and dies of positional asphyxia. Other possibilities include strangulation caused by a baby slipping his head through the loop holding crib bumpers, sliding into and getting stuck in the space left by a mattress that is the wrong size for the crib, or even getting his head stuck in crib slats that are too far apart.

20.2.4 Shaken Baby Syndrome (SBS)

Infant homicides (violent deaths) are very often due to violent shaking, labeled “shaken baby syndrome” (SBS). SBS is discussed in this section because there may be no externally visible injuries, and it is only discovered by imaging or autopsy. This underlines the importance of using the full SUID protocol and refusing to let a child be buried without making certain that his death was, indeed, SIDS, i.e., without rigorously ruling out the possibility of accidental or violent death. If a medical autopsy discovers an intracranial bleed, that autopsy must be stopped and the case reported immediately to the proper authorities. The prosecutor will decide who will do the (now) forensic autopsy and under what conditions.

In 1993, the American Academy of Pediatrics defined shaking as [10]: “the act of shaking/slamming [...] so violent that competent individuals observing the shaking would recognize it as dangerous.” The brain injuries are similar whether the shaking is accompanied by impact or not; the severity depends on the associated neurological damage [11]. SBS is a particularly severe form of abuse. Mortality is high, ranging from 10 to 30% of cases, depending on the series. There are two ways to die from shaking:

- Direct injury to the brainstem at the craniocervical junction, or “*whiplash syndrome*,” caused by hyperflexion/hyperextension of the head relative to the spine. This can cause an apparent life-threatening event (ALTE) and/or cardiac and respiratory arrest due to direct damage to the cardiovascular and respiratory centers, which are located far posteriorly on the brainstem and hence just below the craniocervical junction.
- Intracranial bleeding and brain lesions. It is the severity of the brain lesions accompanying or secondary to the intracranial hematoma that leads to the child’s death. The bleeding is the telltale sign of the mechanism of injury. Shaking tears the bridging veins, causing a subarachnoid hemorrhage and/or subdural hematoma. Any intracranial bleeding of this kind is shaken baby syndrome until proven otherwise (except when there is an immediately recognizable accidental cause, of course) and requires the “traumatic baby autopsy” protocol.

The bridging veins (Fig. 20.12) arise from the confluence of the brain’s collecting veins, which run beneath the arachnoid and come together at the vertex before reaching the superior sagittal sinus. They travel a short, straight course, with no tortuosity, between the arachnoid and dura mater; they bridge (hence their name) the space between the medial edge of the cerebral hemisphere on each side and the superior sagittal sinus, which runs through the midline portion of the dura mater, above the falx cerebri [12]. That is why bleeding from torn bridging veins occurs mainly at the vertex and in the interhemispheric region. The falx cerebri protects the brain from side-to-side movements but not from fore-and-aft movements, which are

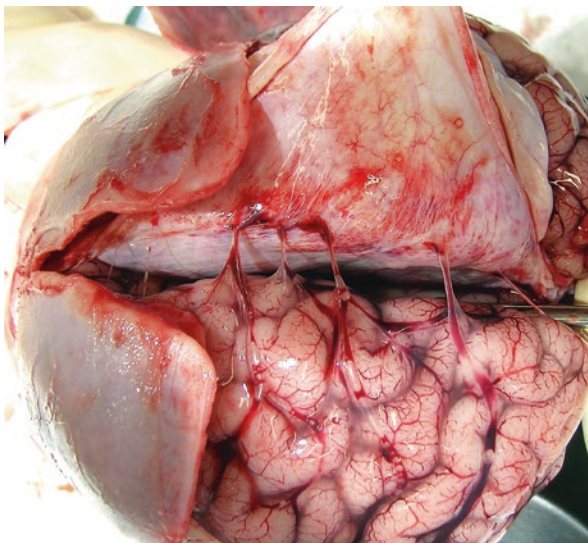


Fig. 20.12 Skull of an infant after parietal bones removed. Reflecting the dura mater upward shows the bridging veins, which travel a short, straight course from the surface of the brain to the superior sagittal sinus in the dura mater. The veins pass over the interhemispheric space

therefore more likely to tear the bridging veins. The anatomy of the bridging veins is such that the subdural portion is more fragile than the subarachnoid portion. In addition, the collagen fibers in their walls are arranged circumferentially, making them more resistant to distension and less resistant to traction. The risk factors for shaking injuries are age dependent and include large head size relative to the rest of the body and weak neck muscles. Head and neck injuries may be accompanied by eye injuries (retinal hemorrhages) and skeletal injuries (fractures) via the same shaking mechanism and by bruising in the places where the child was held and/or scalp bruising or hematoma, if there was head impact. In that latter case, there may also be a skull fracture.

20.2.4.1 “Traumatic Baby Autopsy” Protocol

The “traumatic baby autopsy” protocol basically consists of the SUID protocol plus procedures for documenting all of the injuries—cervical spine and spinal cord injuries, in particular [13]. In shaking deaths, the circumstances tend to involve the discovery of a child with an ALTE, who is revived by cardiopulmonary resuscitation and ends up in the intensive care unit. This immediately suggests a specific scenario, because successful resuscitation is extremely rare (1–2%) in sudden infant death syndrome (natural deaths). It is at that point that a workup is done to determine the cause of the ALTE and/or cardiac arrest; it will show intracranial bleeding—subarachnoid hemorrhage and/or multifocal subdural hematoma—and cerebral edema (already severe, in some cases).

The clinical examination looks for any injuries that the first responders might have missed in this extremely urgent context, even apparently minor injuries that nevertheless point to violence—in particular, a small bruise behind the ear, on the scalp, on the sides of the chest, or in the armpits.

Posterior Cervical Spine and Spinal Cord

The autopsy begins at the back of the body, with an occipital incision from ear to ear and a midline incision that runs from the midpoint of that incision, down the neck and back, to the top of the buttocks. This makes it possible to reflect the cervical, thoracic, and lumbar skin, layer by layer, looking for traumatic injuries. This reflection continues to the sides of the chest, exposing the posterior and lateral portions of the ribs (Fig. 20.13). Special attention is paid to the cervical spine at the craniocervical junction (Fig. 20.14); the muscles are removed, layer by layer, looking for hemorrhagic suffusion, and samples are taken for histological examination, which can reveal hemorrhagic suffusion not visible to the naked eye. Identification of a traumatic injury at the craniocervical junction or on the cervical vertebrae is of paramount importance, as it helps confirm that there was hyperflexion/hyperextension of the head and thus shaking. Starting from posterior incisions, the skin on the extremities is reflected circumferentially for the entire length of the arms and legs. Using this technique, the sutures used to sew the body back together will be posterior; the anterior skin is left intact for presentation to the family. Samples are taken of any traumatic injuries. After that, the posterior vertebral wall is removed using an oscillating saw to cut it away from the pedicles on either side of the spinous processes. That exposes the spinal canal and cord, allowing a view of any epi- and/or subdural hemorrhage around the cord. The distal end is marked with a string after



Fig. 20.13 “Traumatic baby autopsy”: reflecting the skin via a posterior approach



Fig. 20.14 Exposure of the craniocervical junction: area of muscle hemorrhage on the left at the CCJ

the spinal nerves on each side have been sectioned and the entire cord is free. The cord will not be removed until later, however, with the contents of the posterior fossa, in order to keep the brainstem and cervical cord together (Fig. 20.15). The brainstem and cervical cord will be submitted *en bloc* for histological examination; subdural hemorrhage around the cervical cord and/or hemorrhagic suffusion within the cord tissue (Fig. 20.16) is another confirmation of shaking.



Fig. 20.15 Removal of posterior cranial fossa contents (cerebellum and brainstem) still attached to the cervical and thoracic spinal cord

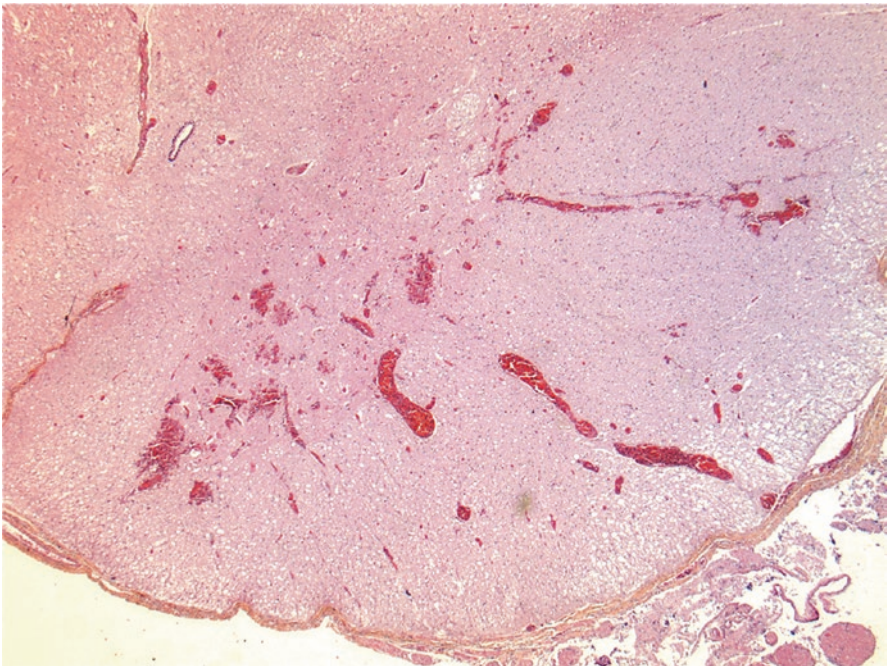


Fig. 20.16 Histology: cross section of the cervical spinal cord containing numerous small foci of intraparenchymal hemorrhage

Brain

The next phase of the autopsy concerns the brain. Starting from the initial occipital incision, the scalp is reflected forward, and any hemorrhagic suffusion (bruising or hematoma) is documented and sampled for histological dating. The sample includes only the dermis, the subcutaneous layer, and the underlying tissues; the epidermis is preserved to make it easier to put the body back together. If the anterior fontanelle is still open (very young infant) or the sutures have separated due to increased intracranial pressure, the bones of the calvarium are removed one by one, leaving the dura mater in place (Fig. 20.17). If the cranial vault is closed, it is opened with the oscillating saw using a single low circumferential cut with a V-shaped notch on each side. Here again, the aim is to remove the calvarium leaving the dura mater in place. Because it is difficult to separate the dura mater from the overlying bone along the sutures, this can be a lengthy process. Then, starting from a horizontal incision at the base of each parietal bone, the dura mater over each hemisphere can be reflected upward toward the superior sagittal sinus [12]. This must be done gently and gradually in order to show the still-intact bridging veins and those that were torn (Fig. 20.18). This technique for exposing the bridging veins on autopsy can be difficult when the subdural hematoma is just beginning to clot. Demonstration of torn bridging veins is important, because it proves that the subarachnoid and/or subdural bleeding was caused by trauma and that shaking was the mechanism. “[...] the presence of several [bridging vein] ruptures combined with [a subdural hemorrhage] of insignificant volume in an infant dead or in a deep coma on clinical presentation is not compatible with the supposition of a minor fall as the cause” [14]. The result of torn vessels is bleeding; a subdural hematoma—or even the thinnest film of subarachnoid hemorrhage—is shaking until proven otherwise. If such is the case, the eyes and cervical cord are removed for analysis. The subarachnoid and subdural

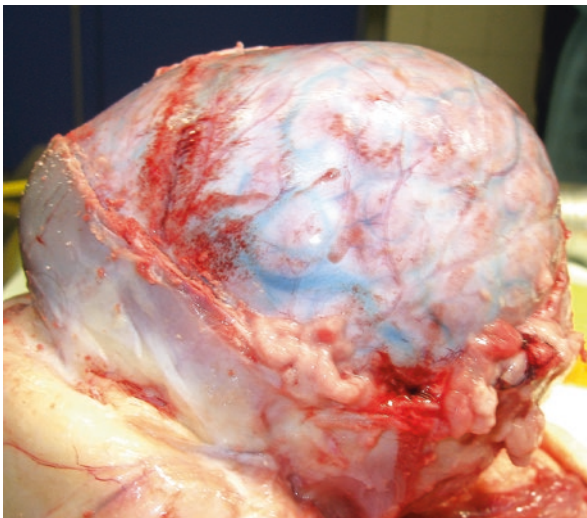
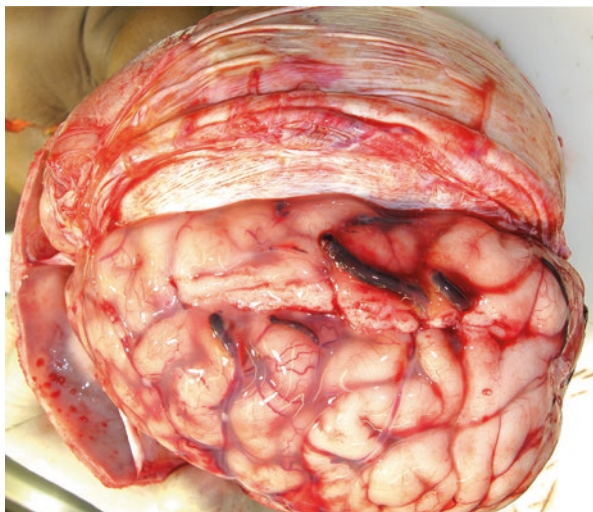


Fig. 20.17 Removal of the calvarium, showing the dura mater covering the brain, which is visible underneath it

Fig. 20.18 Demonstration of torn bridging veins on the surface of the brain after the dura mater is reflected upward



spaces communicate with each other in the first year of life, and blood circulates from one to the other. Bleeding will cause an inflammatory reaction; the cellular components of that reaction change over time and can be used to date the injury. The children tend to fall into one of two categories. Those who are going to die have extremely serious neurological damage, dominated immediately, or almost immediately, by severe cerebral edema. In those cases, the bleeding is light and, because it is only found at the vertex, may be difficult to detect even on CT scan. Being venous, the bleeding is slow, and the extensive cerebral edema will seal off the ends of the ruptured veins by pressing them against the skull. The children who survive probably have less severe edema and thus have time to develop larger subdural hematomas, which are easier to see on imaging.

The brain is removed in two stages: first the hemispheres and then the contents of the posterior fossa, connected to the previously prepared spinal cord. The step of demonstrating the bridging veins in situ is very important, because in some cases the brain is so edematous that it becomes a shapeless pulp when taken out, making later neuropathological analysis unreliable. The neuropathology exam is best done on a brain that has been suspended in a pail of formalin by a length of string threaded through the circle of Willis and hooked to each end of the pail's handle. Histology samples are taken from the areas most likely to be injured in anteroposterior and rotational acceleration events: the frontal, parietal, and occipital areas of the vertex with the ends of the torn bridging veins (for dating bridging vein thrombosis, if any), the central areas, including the corpus callosum, the medial edges of the hemispheres in contact with the falx cerebri, and the thalamus, pons, brain stem, and cerebellum [15]. The histology exam looks for intraparenchymal contusions and/or hemorrhagic venous infarctions that, though they can be subtle, are nevertheless important because their location in the abovementioned areas renders them pathognomonic, as is the presence of axonal retraction balls due to axonal tearing. Though the latter are not specific to shaken baby syndrome (they are also seen in prolonged anoxia, in particular), their location in the central areas makes them specific [16]. The pathologist also looks for areas of necrosis and/or hemorrhage at the gray/white

matter junction; having different densities, the two types of tissue move differently during shaking, causing hemorrhagic lesions at their junction.

The entire parietal dura mater is removed with the superior sagittal sinus and the clot from the subdural hematoma. It is very important to note whether the SDH adheres to the dura mater or not; as adherence occurs on the fourth day post-injury, it serves as a landmark for dating. The entire dura mater is removed after being rolled up and cut into 5-mm cross-sectional slices along its full length (approximately 15 slices). The aim is to identify areas where a neomembrane is beginning to form, as those are the areas that will be used for dating. All of the slides of the dura mater and clot are stained with Perls' Prussian blue to look for hemosiderin. Neomembrane formation is the body's reaction to a foreign element—in this case, the subdural hematoma, which it is attempting to encapsulate with successive layers of fibroblasts.

The pituitary gland—frequently the site of posttraumatic ischemic injury—is also removed for study.

Internal Organs and Anterior Cervical Spine

The autopsy continues on the front of the body by incising the skin from the top of the neck, under the chin, to the pubis. The tissues of the neck are reflected layer by layer, and the rest of the visceral autopsy looks for other violence-related injuries (liver injury, hollow organ rupture, or visceral contusion). The anterior cervical spine is examined just as the posterior cervical spine was examined previously, looking for any traumatic injuries that would confirm shaking. The samples taken for histological analysis are the same as for SUID, and the thymus is a key element for dating. Of greatest interest here are visceral injuries. Because they are rare with accidental injury, visceral injuries are highly suggestive of a “non-accidental mechanism.” There may be one or more contusions or hematomas, perforation of a hollow organ, a ruptured spleen, or a liver wound. Pancreatic contusions and adrenal gland hematomas require an extremely violent blow. It is not uncommon for there to be no visible injury on the skin of the abdomen, even directly over a deep injury. The skin of the stomach is supple and depressible, and the panniculus adiposus is fairly thin. As a result, the kinetic energy is transmitted directly to the viscera below.

Any stress on the body that triggers corticosteroid secretion will lead to acute corticosteroid-mediated involution of the thymus [17]. Acute thymic involution is specific for corticosteroid-mediated stress but not for a particular type of stress. In this particular case, head trauma is a stressor in the same way that a serious bacterial infection or a fracture, for example, is a stressor. Stress-induced thymic involution begins at hour 12 and can be broken down into four stages according to the number of macrophages that have penetrated the cortical layers of the thymus to phagocytize the apoptotic lymphocytes, as follows: grade I = 12–24 h of stress; grade II = 24–48 h of stress. Thinning of the cortex to the point that it cannot be distinguished from the medulla indicates grade III = 48–72 h of stress. Grade IV (more than 3 days) corresponds to total disappearance of the lymphocytes, leaving nothing but the thymic scaffold visible (Fig. 20.19). This classification based on the histological appearance of the thymus is very helpful in early dating.

Toxicology samples (blood, urine, vitreous humor, bile, gastric contents, hair, and tissue samples from the liver, lung, and kidney) are taken routinely.

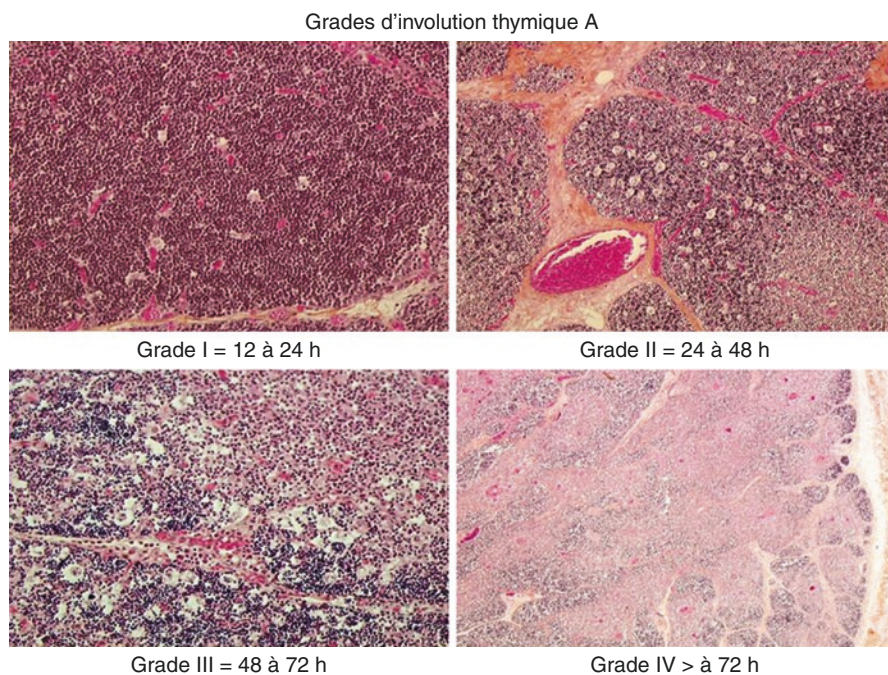


Fig. 20.19 Grading system for acute thymic involution (from ref. [27]).
Histological appearance of the thymus corresponding to each of the four grades

Eyes

Each eyeball is removed with the origin of its optic nerve, approaching either from the front after sectioning the four rectus muscles (medial, lateral, superior, and inferior) and enucleating or through the skull after breaking through the roof of each orbit, at the examiner's discretion. There is often a hemorrhage within each optic nerve's sheath at its origin, immediately confirming ocular involvement. That hemorrhage is the result of traction by the globe on the optic nerve. The eyes are placed in formalin for fixation and then are sampled starting with an initial coronal section to separate the anterior chamber and posterior chambers [18]. Examination and photos of the latter through the vitreous provide the same view of the retina as the ophthalmologist's fundus exam (Fig. 20.20). Samples are then taken in the sagittal plane, the first passing through the optic nerve, and the entire posterior retina is submitted. Retinal hemorrhage is found in 80–90% of cases and is a strong argument in favor of shaking—particularly diffuse, bilateral, and large preretinal hemorrhage. Their absence, however, does not rule out shaking (see Chap. 9). Retinal hemorrhage is caused by the same mechanism as subdural bleeding—i.e., from the eyes being jolted back and forth in the orbits during shaking. The vitreous, which adheres tightly the retina (especially at the macula), exerts strong traction forces on it and can tear the retinal vessels. Retinal detachments can also occur. The histological study looks for hemorrhagic suffusion, which can involve any retinal layer. The location most specific for shaking is the subhyaloid space [19]. In especially violent shaking, the bleeding can extend into the vitreous, its severity proportional to the



Fig. 20.20 Posterior half of the eye after a coronal cut through the globe. Multiple retinal hemorrhages as seen through the vitreous. This section is equivalent to the clinical fundus exam by an ophthalmologist

force of the shaking. Retinal hemorrhages can leave pigmented atrophic scars, and survivors are often left with sequelae. For more detailed information, readers should refer to the chapter on retinal hemorrhages.

As always when there is bleeding, the autopsy attempts to date it with respect to time of death. Histologically, the presence of hemosiderin-laden macrophages (HLMs) is important. It takes HLMs 2–3 days to appear in the retina and 4–5 days to appear in the brain or dura mater, as compared to only 24–48 h in the skin [20].

Bones

The entire skeleton is X-rayed prior to autopsy. Any definite or presumed traumatic injury should be sampled to confirm its existence and then dated. During autopsy, the entire spine and rib cage are examined directly by the eye. Each side of the rib cage should be checked visually and by palpation. Posterior rib fractures indicate lateral compression of the thorax, which occurs when the baby is grasped by the thorax during shaking (Fig. 20.21). Lateral rib fractures are caused by anteroposterior thoracic compression and though they are, a priori, more suggestive of accidental injury, anything is possible—from fractures caused by external cardiac massage to fractures caused by an adult sitting on the child's chest. Because bones are richly vascularized, antemortem fractures will have a hematoma around them, distinguishing them from postmortem fractures, which do not.

Growth charts should always be used to look for faltering growth or deviation from the weight-for-age curve, if these are not noted in the child's medical record. If found, they can be used to place the traumatic brain injury into a broader context of abuse.

Mécanisme des fractures de côte

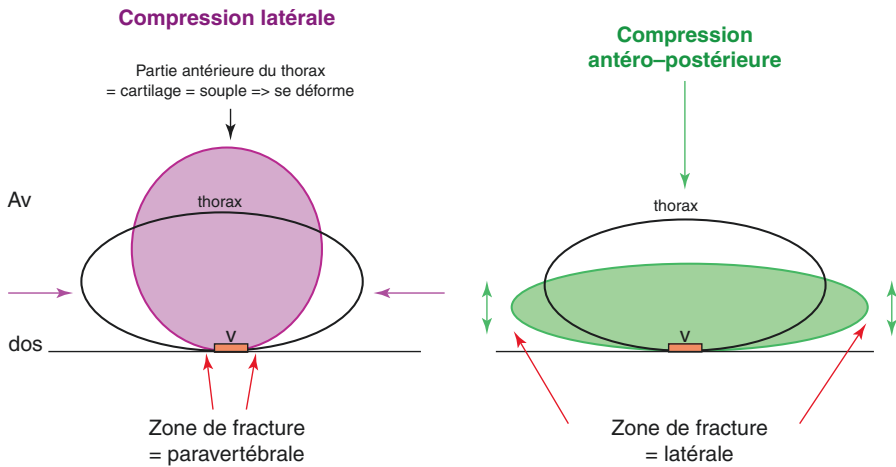


Fig. 20.21 Diagram explaining rib fracture location as a function of the applied forces. Black ellipse = normal shape of the thorax; V = vertebral body; pink and green ellipses = deformation of the thorax after application of lateral and anteroposterior forces, respectively

The initial conclusions should place all of the injuries found into context. The report should be detailed, citing all of the lesions found and the corresponding mechanisms of injury. At every stage of the forensic investigation, it is important to help the investigators compare the accounts of those who had access to the child with the injuries observed, in order to determine whether they are consistent.

20.2.4.2 Differential Diagnosis

The differential diagnosis is essentially that of a child said to have been found with an apparent life-threatening event and shaken in order to revive him. In practice, if there was no resumption of cardiac activity, there will be no antemortem injury; any hemorrhagic intracranial injuries necessarily existed previously. If cardiac activity did resume, the cause of the ALTE must be identified. It is important to point out that the presence of intracranial bleeding explains the child's impaired consciousness—not the reverse. Moreover, Raul et al. [21] showed that shaking done to “revive” an infant is in no way comparable, in terms of amplitude and consequences, to that needed to cause the brain injury and bleeding found in SBS. The main differential diagnoses to consider are as follows:

- *Birth trauma*: typically, the delivery was difficult (breech birth, forceps delivery, or fetal distress); the baby is big (> 3500 g), and—a crucial feature—there are clinical signs from the first days of life. The subdural hematoma tends to be in the posterior half of the brain in contact with the tentorium cerebelli, the ocular fundus is normal, and it is diagnosed early by brain CT or MRI. In contrast, with subdural hematomas caused by shaking, the birth was normal, there were no clinical signs during the first few weeks of life, the subdural hematoma tends to be in the anterior (frontal) half or top of the brain, there may be different-age lesions, and there are often retinal hemorrhages.

- *Accidental fall* (e.g., from a changing table, someone’s arms, or a high chair): the neurological consequences are minor (low kinetic energy fall), skull fracture is rare, and when it does occur, it tends to be a simple parietal fracture less than 3 mm wide, with no associated intracranial injury (no cerebral edema), and the ocular fundus is normal. In contrast, in non-accidental injuries, the skull fracture is complex, star shaped, crosses a suture, occipital, more than 3 mm wide, and accompanied by intracranial injury and retinal hemorrhage.
- *Minor trauma causes minor injuries*: as proven by Chadwick et al. [22], who were specifically attempting “to approximate the incidence of child deaths resulting from short falls in the population of young children.” A short fall was defined as less than 1.5 m in vertical height, at a horizontal speed no higher than what a child could attain by himself; a young child was defined as a child less than 5 years of age. The data reviewed included five book chapters, two reports from learned medical societies, seven major literature reviews, three large public databases on injuries (California EPIC Database, Web-based Injury Statistics Query and Reporting System of the Centers for Disease Control and Prevention, and Consumer Product Safety Commission data), and 177 articles from the medical literature published as late as September 2007 having the keywords “child,” “fall,” and “injury” in any search field. The study showed that the risk of death is less than 0.48 per one million children per year [22]. The severity of traumatic brain injury is indeed related to the mechanism that caused it. A skull fracture is benign and does not predict intracerebral injuries. With shaking, the often serious neurological status is related to the extent of the cerebral lesions caused by the mechanism of injury. It is essential to remember that bleeding is evidence of the mechanism involved—i.e., shaking violent enough to have torn the bridging veins.

20.2.4.3 Dating

Dating is based on both the gross and histological examination. Injuries are dated counting backward from the date and time of the child’s death. For gross examination, day 4 is key—that is the point at which subdural hematomas begin adhering to the dura mater. Before that, the blood is still liquid. After about 10 days, the neomembrane becomes visible on the outer (dural) surface of the hematoma. Histological dating is done by analyzing the appearance of the clot, the dura mater, and the surface of the brain [23, 24]. On day 4 or 5, the red blood cells in the clot begin to lyse (losing their round shape and changing color), and hemosiderin-laden macrophages begin to appear. On day 7 or 8, fibroblasts and capillaries begin to invade the clot. Between days 11 and 14, the clot is broken up by large clumps of fibrin with newly formed capillaries and fibroblasts. After that, vessel development and hemolysis continue. By the end of the first month, the capillaries are huge, explaining why bleeding can recur. After 4 weeks, the clot has liquefied. The dura mater creates a neomembrane by laying down successive layers of fibroblasts, one on top of the other. In the beginning, it forms roughly one fibroblast layer per day; there are two to four layers of fibroblasts by day 4, and three to five layers by day 5 (Fig. 20.22). By day 7 there are 12–14 fibroblast layers. On day 11, the fibroblasts begin migrating around the edges of the clot. By week 2, the neomembrane thickness is a quarter to half that of the dura mater itself; by week 4, it is equal to that of the dura mater. Hemosiderin-laden macrophages appear in

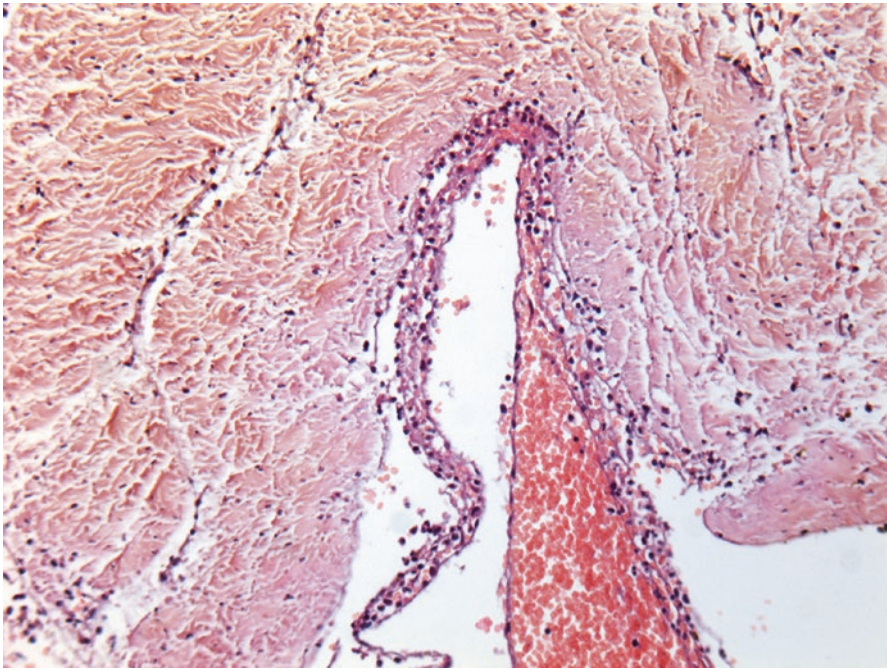


Fig. 20.22 Subdural hematoma. Neomembrane, four to six fibroblast layers thick, at the surface of the dura mater enveloping one end of a subdural hematoma

the neomembrane on about day 5, becoming abundant and distributed throughout it within a month. The surface of the brain will show a thin layer of blood and fibrin for the first 10 days. Hemosiderin-laden macrophages are present on the surface of the brain by about day 11. By day 14–17, the neomembrane may have completely enveloped the clot.

While histological dating is sometimes accurate to within about a day (early stages), it is usually only possible to establish a range of time within which the injury occurred. To be really useful, histological dating should be used in conjunction with the clinical findings and the interview.

20.3 Infant and Small Child Homicide by Means Others than Shaking

Any child death suspected of being a violent death should be explored with the full “traumatic baby protocol” (*see above*), including a complete skeletal survey done prior to autopsy so that any bone lesions suspected or known to be traumatic in origin can be sampled during the autopsy. After the bone is X-rayed *ex situ*, it is fixed in formalin for histological examination. If the anatomical part cannot be X-rayed immediately, however, it can be fixed in formalin first; this will not affect X-ray penetration.

20.3.1 Asphyxia

Asphyxia can be due to strangulation, suffocation, confinement, or drowning. Carbon monoxide poisoning is generally accidental. All of these forms of asphyxia share certain features:

- On gross examination: a combination of intense cyanosis, numerous petechiae (on the face, conjunctivae, inside of the scalp and thoracic organs), and significant cerebral edema. The petechiae are a characteristic sign of respiratory movements against an obstacle; the number of petechiae increases with the number of respiratory movements and the presence of a pre-existing respiratory infection. They begin inside the chest cavity, before appearing on the face (Fig. 20.23). One or more petechiae on the posterior wall of the pharynx are a characteristic but variable sign of an asphyxial mechanism (Fig. 20.24).
- On histological examination (of value only if there was no attempt at resuscitation): a combination of overaerated-looking lungs and air-filled pseudocysts due to rupture of the alveolar septa in the subpleural regions and along the interlobular septa (Fig. 20.25) and hemorrhagic edema in the central parenchymal regions.

Once the asphyxia diagnosis has been established, the cause must be determined.



Fig. 20.23 Suffocation due to a plastic bag over the head. Petechiae on the face and neck and marks where the bag was sealed around the neck

Fig. 20.24 Asphyxia.
Petechiae on the posterior
wall of the pharynx

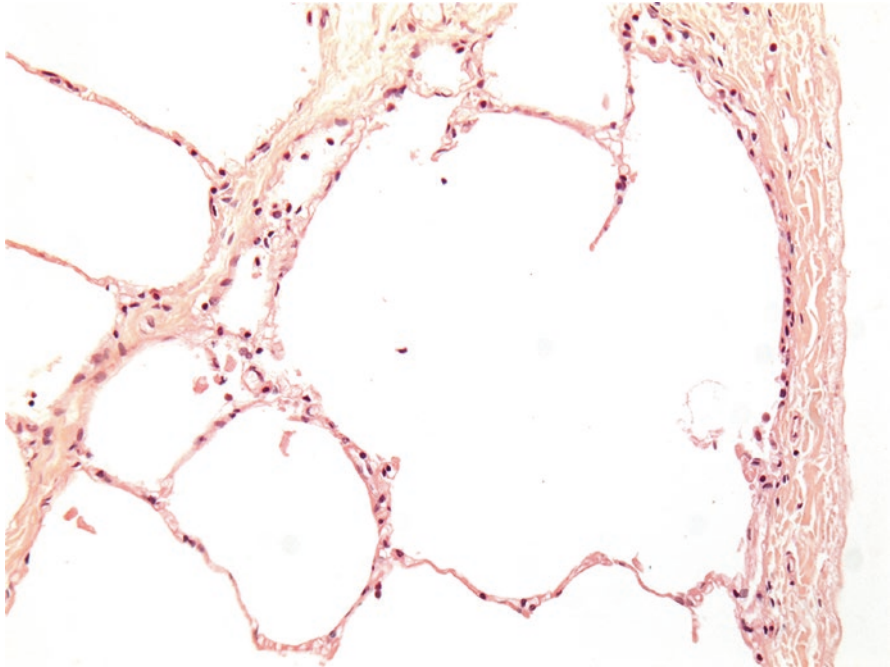
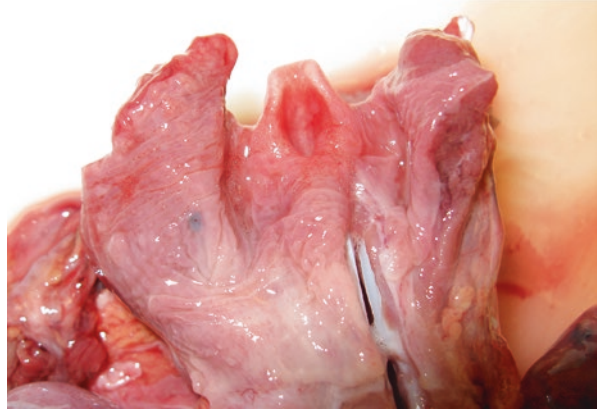


Fig. 20.25 Histologic section of a lung post-asphyxia. Overaerated lung and air-filled pseudocyst due to rupture of the alveolar septa

Strangulation is easy to identify when there are externally visible injuries on the neck, such as a ligature furrow or finger marks on the skin. Inside the neck, there will be hemorrhagic suffusion of the subcutaneous tissue, muscle, and thyroid gland.

Suffocation by a pillow, on the other hand, leaves no trace unless the child has teeth; in that case, there may be erosions or red marks on the inside of the lips and



Fig. 20.26 Suffocation. Two traumatic lip injuries, one on the left half of the upper lip and one on the right half of the lower lip

cheeks. Care should be taken to look for these, as they are evidence of mucous membrane compression between the applied force and the teeth (Fig. 20.26). There may also be bruises around the nostrils and mouth. It is very important, given how subtle these signs can be, not to be misled by claims that the marks were caused by resuscitation efforts, when such efforts were made. If such marks exist, it is vital to contact the doctor who attempted resuscitation to find out exactly what he or she did, and whether the marks were there before resuscitation was attempted. This is essential, because in some cases these are the only signs of imposed external upper airway obstruction. Marks that are actually due to resuscitation efforts tend to be linear or arc-shaped (from fingernails) microabrasions just behind the angle of the lower jaw and/or behind the ear, made when the lower jaw is pulled forward to open the airways or during mask ventilation.

Repeated suffocation to the point of unconsciousness, causing seizures but not cardiopulmonary arrest, falls within the scope of Munchausen syndrome by proxy (see Chap. 16). The clinical signs of such repeated episodes of asphyxia by suffocation [25] are recurrent bouts of cyanosis or pallor, even apnea with oxygen desaturation and a slowed heart rate (bradycardia), which can lead to a seizure. If prolonged, this smothering can be fatal [26]. Death in a Munchausen by proxy context is considered an “accident,” since the aim was not to kill the child but to produce a credible illness from which the perpetrator (often the mother) derives personal narcissistic validation. Histologically, there will be significant hemorrhagic pulmonary edema, together with the signs of asphyxia described above. If there were one or more repeats suffocation attempts prior to the one that ultimately kills the child, the pathology exam will be characteristic, with a marked increase in alveolar macrophages, which Perls’ Prussian blue staining will show to be hemosiderin-laden macrophages (Fig. 20.27). Such staining must be done routinely on all lung slides in all SUID cases. Hemolysis in the alveoli releases red blood cell nuclei, made up in large part of iron; the iron breaks down, producing the hemosiderin demonstrated by Perls’ Prussian blue staining. The pigment is phagocytized by the alveolar macrophages, which are then called hemosiderin-laden macrophages. It takes approximately 3 days for HLMs to appear after an intra-alveolar hemorrhage [20]; they remain for a long time afterward.

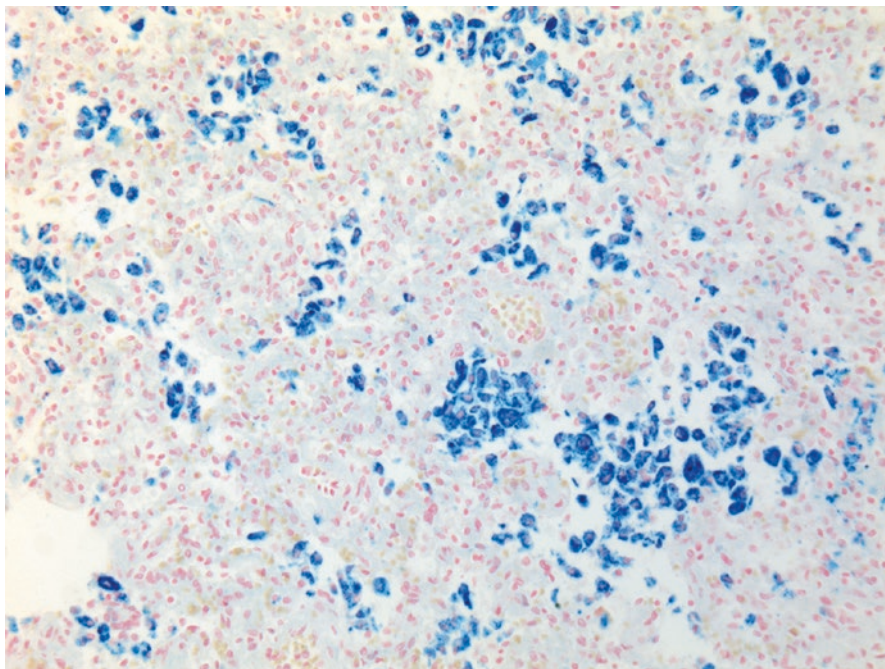


Fig. 20.27 Histologic section of the lung of a child who was suffocated repeatedly. Multiple hemosiderin-laden macrophages (*blue cells*) filling the lung alveoli (Perls' Prussian blue stain)

Death by thoracic compression is possible (a heavy weight pressing down on the thorax, e.g., an adult sitting on an infant's chest) but rare. It can also be caused by equivalent thoracic compression due to bilateral rib fractures (with or without flail chest), preventing breathing.

Death by confinement is a diagnosis of exclusion, based mainly on the circumstances in which the body was discovered, when there is nothing to suggest another mechanism, though suffocation by a soft object like a pillow cannot absolutely be ruled out. Deaths by confinement tend to be accidental, however—a child getting trapped in a container or refrigerator at a dump. For that reason, household appliances must have their doors removed before being left at the dump.

Drowning is the most common cause of death among children ages 2–5 years. It is very difficult to distinguish between accidental drowning, willful or unintentional neglect (child left alone or with his brother or sister in the bathtub), and homicide in infants. Infants are not strong enough to struggle and will die very quickly without making any noise. Older children can struggle and will make more noise while drowning, perhaps even scream. Foam around the nose and mouth (Fig. 20.28) is especially suggestive but more likely to be observed when the body is examined at the scene. The external findings at the autopsy are subtle: bruises or abrasions from holding the child's head under water and/or injuries where the arms were held. Gross examination of the thoracic organs shows overinflated lungs that practically meet at the midline (Fig. 20.29). When there is any suspicion of drowning, blood from the right and left heart should be collected separately for laboratory testing. If



Fig. 20.28 Drowning. Foam around the nose and mouth (severe pulmonary edema)



Fig. 20.29 Gross view of a cervical-thoracic evisceration in a drowning case. *Pink* overinflated lungs that meet at the midline above the heart (anterior mediastinum)

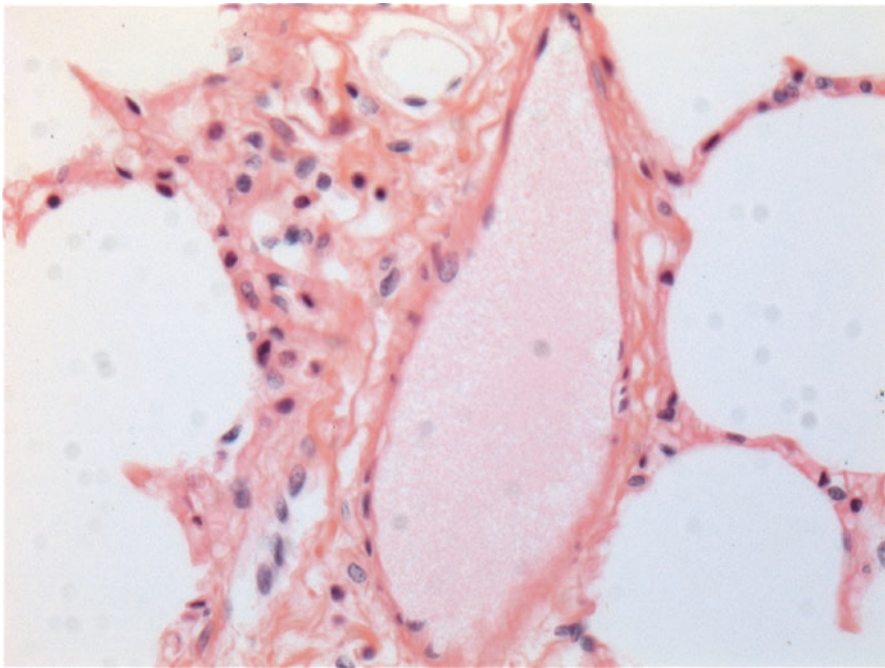


Fig. 20.30 Histologic section of a lung in a drowning case: blood that has undergone hemolysis

there was no attempt at resuscitation, these samples will show different hemoglobin levels due to the hemodilution that occurs in the lungs. Fresh water in the alveoli will move from the less concentrated environment (the alveoli) to the more concentrated environment (the blood), diluting it. Histological evidence of this includes intravascular hemolysis and the characteristic appearance of hemolyzed blood (Fig. 20.30).

20.3.2 Burns

Children have thinner skin than adults. Their skin burns four times faster and more deeply at a given temperature. Homicides due solely to burns are rare. Rather, it is a child's burns or history of being burned that draw attention to the possibility of abuse, and burns found on autopsy that raise the suspicion of violent death. The severity of the burn depends on the temperature of the burning agent and the contact time. It takes a minute to give a child a third-degree burn with 50 °C (122 °F) water but only 3 s with 60 °C (140 °F) water (Fig. 20.31). In France, a decree from November 30, 2005, stipulates that in rooms intended for washing or bathing, hot water temperature at the faucet can be no higher than 50 °C. At autopsy, the goal is to determine whether the burn or burns occurred while the child was alive. Antemortem burns cause significant vascular congestion (Fig. 20.32). Histology samples, like all skin samples, should include both healthy and burned skin. With a third-degree burn, the answer is immediately



Fig. 20.31 Lateral view of the thorax and abdomen of a child with third-degree burns from a viscous scalding agent (like boiling oil) that adhered to the skin

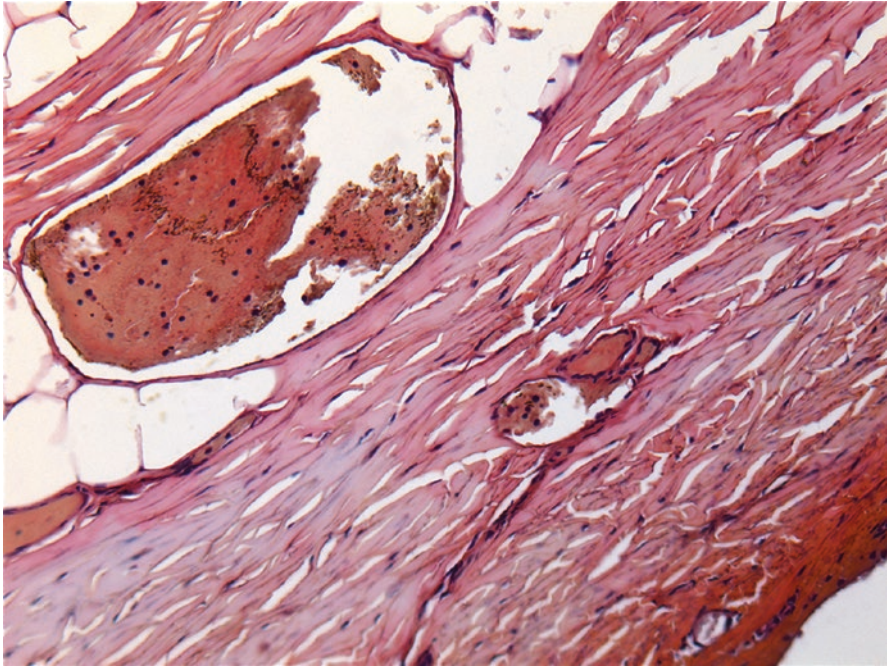


Fig. 20.32 Histologic section of an antemortem third-degree burn. Intense congestion of the vessels of the dermis beneath the epidermal burn

apparent if blood vessels are visible underneath the burned area. Burns affecting even a relatively moderate percentage of the body surface area can be fatal if there is underlying heart disease like cardiomyopathy. Intense pain and stress cause tachycardia that can trigger an arrhythmia in compromised hearts.

20.3.3 Trauma

20.3.3.1 Traumatic Brain Injury

By far the most common way to kill infants is traumatic brain injury, including shaking (*see above*). Whether it is an isolated head injury due to a violent blow with a blunt object or an impact against a hard surface (e.g., holding an infant by the feet and smashing him against a wall), external examination reveals a contusion or contused wound or swelling due to a hematoma and underlying edema. Bleeding from the ear indicates a fracture of the petrous part of the temporal bone. Brain matter can escape through an open wound. The skull X-ray (AP and lateral) shows one or more often wide and complex, star-shaped fracture lines. The autopsy should provide a full, detailed description of the injuries. There may be a mark on the skin from the blunt object; it should be both photographed and traced onto a transparent sheet of plastic. If the brain is fragmented, removal may be difficult. It should be fixed in formalin for later neuropathological examination.

20.3.3.2 Defenestration

The primary aim of the autopsy in defenestration cases is to determine whether the child died as a result of the fall or was already dead before falling. The answer to that question requires knowing whether his injuries occurred while the child was alive (i.e., heart beating); if so, the injuries will be accompanied by hemorrhagic suffusion. The direct cause of death may be the aspiration of regurgitated stomach contents as the child is dying or asphyxia due to hemopneumothorax, either of which would indicate that the child was alive at the time of defenestration.

20.3.3.3 Homicide by Internal Injury

This way of killing is relatively rare. It usually involves punching or kicking very young children in the abdomen. There may be no visible marks on the skin, especially when the skin is pigmented. The internal injuries tend to be more severe because children have very flexible abdominal walls with little muscle tone, and all of the kinetic energy is transmitted directly to the underlying viscera. Death is not instantaneous; it is usually the result of hemorrhagic shock due to a ruptured liver and/or spleen or to damage to a large blood vessel [27]. It can also result from septic shock due to untreated peritonitis after hollow organ rupture. Hypovolemia occurs more rapidly and is more serious in children than in adults. Initially, the blood loss is relatively well compensated by peripheral vasoconstriction, and the blood pressure can be maintained until 25–30% percent of the total blood volume is lost. The total blood volume is age dependent: 90 mL/kg in neonates, 80 mL/kg up to age 1 year, and 70 mL/kg thereafter. Once the compensation threshold has been passed, the blood pressure drops precipitously, leading rapidly to cardiac arrest (a few minutes). Table 20.2 summarizes the clinical signs as a function of blood loss. Knowing these data is important, because they can be used to compare the family's account with the anatomical findings. Due to severe pain, a ruptured liver (Fig. 20.33) is very disabling from the outset. Children show pain differently than adults. The child will be stunned, withdrawn, and bent in two but not crying. At most, he might complain of abdominal pain. The rupture is caused by a sudden increase in abdominal pressure. Less severe liver and spleen injuries may manifest clinically in two separate phases, with initial subcapsular hematoma formation and secondary intraperitoneal

Table 20.2 Clinical signs of hemorrhage as a function of blood loss in children

Clinical signs	Blood loss		
	< 20%	25%	40%
Cardiovascular	Thready pulse Tachycardia	Thready pulse Tachycardia	Hypotension Tachycardia or even bradycardia
Cutaneous	Cold skin	Cold extremities Cyanosis	Pallor Cold skin
Neuropsychological	Irritability Aggressiveness	Confusion Lethargy	Coma

**Fig. 20.33** Gross view: fracture/rupture of the liver, which was cut into two parts, right and left

rupture. Effective external cardiac massage increases the amount of intraperitoneal blood beyond the loss that caused the cardiopulmonary arrest, and blood continues to flow from damaged blood vessels after circulation has stopped. Histology will help more precisely determine how much time elapsed between injury and death based on the associated inflammatory reaction [28]. It can also help distinguish between abdominal visceral injuries alleged to be due to resuscitation efforts—which are very rare [29]—and the traumatic injury causing death.

There may be other internal injuries, depending on the number of blows and their force [27]. In particular, pancreatic injuries are due to the pancreas being crushed against the spinal column behind it and are characteristic of very powerful blunt force trauma, as is a hematoma of the adrenal gland, which lies deep in the retroperitoneum. Such injuries are quasi-pathognomonic for abuse because these organs are very deep, requiring a high level of violence. They are rarely injured in accidents. There can also be kidney injuries, contusions, and even mesentery and bowel tears (see Chap. 8).

20.3.4 Gunshot and Stabbing Death

These types of homicide are very rare in children and will not be discussed in this chapter because no particular characteristics distinguish them from what is seen in adults. Firearms are used mainly in multiple murders where a parent commits



Fig. 20.34 Extreme wasting

suicide after shooting his child or children. Knives are more likely to be used in cases of psychiatric decompensation.

20.3.5 Toxic Substances

Routine toxicology testing is done whatever the type of death; toxic substances are often used in conjunction with another method to reduce the child's resistance and make him easier to kill.

Toxic substances can also cause death directly; in some cases, these deaths are ascribed to SIDS until toxicological evidence proves otherwise.

20.3.6 Food Deprivation

Food deprivation affects the weight curve first and the height (length) curve later. Deaths due to extreme undernutrition are rare, and the diagnosis can be made by looking at the child (Fig. 20.34).

The reader is invited to consult the corresponding chapters in this book.

Key Points

- Killing a child is only considered homicide if the child was live-born and viable.
- A sudden death is, by definition, a natural death.
- Any unexpected death of a child should be investigated to determine whether the death was natural or violent (accident or homicide).
- In child deaths, close collaboration between the medical examiner and the pediatrics side (the pathologist and pediatrician) is very important for the sake of both justice and the child's parents.
- A violent death cannot be ruled out based only on external examination of the body.

- Shaken baby syndrome is a traumatic brain injury caused by extreme violence.
- Minor trauma causes only minor injuries.
- Accidental injuries are rare and generally not very serious.
- Witness accounts should always be compared against both the mechanism responsible for the observed injuries and the child’s psychomotor development and skills.

Appendix: Unexpected Death of A Child Under Age Two Years Intervention Form (Example from France)

UNEXPECTED DEATH OF A CHILD UNDER AGE TWO YEARS INTERVENTION FORM (Example from France)

Name of person completing this form: _____ Date: dd ____ mm ____ yyyy _____
 Position: SMUR physician SDIS physician On-call physician Other physician: _____
 Specify..... Physician's telephone no.: ____ ____ ____ ____

LAST NAME: _____ FIRST NAME: _____ SEX: M F

Date of birth: dd ____ mm ____ yyyy _____
 Parents' telephone no.: ____ ____ ____ ____
 Telephone no. of person who found the child (if different): ____ ____ ____ ____

Age in months (>3 months): ____ or age in days (<3 months) ____
 Month: ____ Time of call: ____ : ____ : ____ Time medical team arrived at the scene ____ : ____ : ____
 Which service did the person who discovered the child call? 15 18 17 other specify.....

EXAMINATION ON ARRIVAL OF EMERGENCY SERVICE			
Description when child discovered: time ____ : ____ : ____		By whom?	
Breathing:	absent <input type="checkbox"/>	gaspings <input type="checkbox"/>	present <input type="checkbox"/>
Heart: arrest	yes <input type="checkbox"/>	no <input type="checkbox"/>	don't know <input type="checkbox"/>
Child's color:	pallor <input type="checkbox"/>	cyanosis <input type="checkbox"/>	grey <input type="checkbox"/>
Resuscitation attempted prior to medical team's arrival:	yes <input type="checkbox"/>	no <input type="checkbox"/>	don't know <input type="checkbox"/>
Which procedures:	mouth-to-mouth <input type="checkbox"/>	ECM <input type="checkbox"/>	shaking <input type="checkbox"/>
Child's response:	awake <input type="checkbox"/>	awake then back to sleep <input type="checkbox"/>	somnolence <input type="checkbox"/>
Vomiting:	yes <input type="checkbox"/>	no <input type="checkbox"/>	
Description on intervention team arrival			
Breathing:	absent <input type="checkbox"/>	gaspings <input type="checkbox"/>	present <input type="checkbox"/>
Heart: arrest	yes <input type="checkbox"/>	no <input type="checkbox"/>	Heart rate: ____ /min
Child's color:	pallor <input type="checkbox"/>	cyanosis <input type="checkbox"/>	grey <input type="checkbox"/>
Rectal temperature:	____ , ____ °C	Time:	____ : ____ : ____
Lividity:	yes <input type="checkbox"/>	no <input type="checkbox"/>	If yes: location:
Rigidity:	yes <input type="checkbox"/>	no <input type="checkbox"/>	If yes: jaw <input type="checkbox"/>
Hypotonia:	yes <input type="checkbox"/>	no <input type="checkbox"/>	extremities <input type="checkbox"/>
Dehydration:	yes <input type="checkbox"/>	no <input type="checkbox"/>	If yes: skin tenting <input type="checkbox"/>
Signs of malnutrition:	abnormally thin <input type="checkbox"/>		sunken eyes <input type="checkbox"/>
Child's hygiene:	normal <input type="checkbox"/>	abnormal <input type="checkbox"/>	specify.....
Rash:	no <input type="checkbox"/>	yes <input type="checkbox"/>	If yes: Purpura <input type="checkbox"/>
Perspiring:	no <input type="checkbox"/>	yes <input type="checkbox"/>	where.....
Reflux:	no <input type="checkbox"/>	yes <input type="checkbox"/>	Erythema <input type="checkbox"/>
Bruising or trauma:	no <input type="checkbox"/>	yes <input type="checkbox"/>	where.....
Scar(s):	no <input type="checkbox"/>	yes <input type="checkbox"/>	location.....
PROCEDURES PERFORMED BY THE MEDICAL TEAM			
Start time	____ : ____ : ____	End time	____ : ____ : ____
External cardiac massage	<input type="checkbox"/>	Mask ventilation	<input type="checkbox"/>
Intubation:	<input type="checkbox"/>		
If intubation: airway status on intubation:	clear: yes <input type="checkbox"/>	no <input type="checkbox"/>	If no: specify.....
Drugs administered:			
		intratracheal <input type="checkbox"/>	IV <input type="checkbox"/>
		intratracheal <input type="checkbox"/>	IV <input type="checkbox"/>
		intratracheal <input type="checkbox"/>	IV <input type="checkbox"/>
		intratracheal <input type="checkbox"/>	IV <input type="checkbox"/>
Heart restarted:	no <input type="checkbox"/>	yes <input type="checkbox"/>	If yes, for how long:
Vomiting:	no <input type="checkbox"/>	yes <input type="checkbox"/>	

CHILD'S ENVIRONMENT PRIOR TO HIS DEATH

Place of death: home group day-care childcare provider outdoors other
(specify):

Was the child sleeping with someone when found? No Yes, in the same room Yes, in the same bed

If yes: with whom?

Sleep position

- in which he was put to bed: on his back on his stomach on his side sitting don't know

- in which he was found: on his back on his stomach on his side sitting don't know

head position: face against the mattress face turned to the side face free

Type of bed where the child was found:

crib folding crib cradle Moses basket car seat rocker

adult bed sofa armchair stroller baby carriage other

Mattress characteristics: firm soft

Objects found in the bed near the child's face, nose, or mouth:

Pillow(s): yes no don't know

Blanket: yes no don't know

Comforter: yes no don't know

Soft toys: yes no don't know

Crib bumpers: yes no don't know

Sleep positioners: yes no don't know

Other: yes no don't know

Head covered by blanket, comforter or other: yes no don't know

Was child stuck? yes no don't know

Diagram:

Ambient temperature: measured in °C (thermometer)

Assessment: hot (>25°C) cold (>15°C) normal

Clothing: describe:

Possibility of poisoning: carbon monoxide smoke medication other

Time of last meal: :

Contents: Amount:

Time put to bed: :

Time of last living contact (seen or heard): :

Did the child have a pacifier when put to bed? yes no don't know

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Alexia Dabadie, Maïa Proisy, Eleonore Blondiaux,
Marie-Dominique Piercecchi-Marti, and Guillaume Gorincour

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A. Dabadie

Service d'Imagerie Pédiatrique et Fœtale, Hôpital de la Timone Enfants,
264 Rue Saint Pierre, 13385 Marseille Cedex-5, France

M. Proisy

Service d'Imagerie Pédiatrique, CHU Rennes, Rennes, France
e-mail: Maia.PROISY@chu-rennes.fr

E. Blondiaux

Service de Radiopédiatrie, CHU Trousseau, Paris, France
e-mail: eleonore.blondiaux@aphp.fr

M.-D. Piercecchi-Marti

Service de Médecine Légale, Hôpital de la Timone, Marseille, France

G. Gorincour (✉)

Service d'Imagerie Pédiatrique et Fœtale, Hôpital de la Timone Enfants,
264 Rue Saint Pierre, 13385 Marseille Cedex-5, France

Groupe de Recherche en Autopsie Virtuelle et Imagerie Thanatologique, Pôle d'Imagerie
Médicale, Marseille, France

e-mail: guillaume.gorincour@ap-hm.fr

© Springer International Publishing AG 2018

C. Rey-Salmon, C. Adamsbaum (eds.), *Child Abuse*,
https://doi.org/10.1007/978-3-319-65882-7_21

21.1 Introduction

Forensic medicine has always used radiographic techniques, and interested readers may also want to consult the “Autopsy and Histological Findings” chapter for more about the post-mortem context. For over a decade now, forensic medicine has been taking advantage of the new cross-sectional imaging modalities (ultrasound and especially CT and MRI), spurred by the work of Michael Thali and his team, who pioneered the era of virtual autopsy or “virtopsy” [1]. In virtual autopsy, one or more of these imaging techniques is performed prior to autopsy to prepare, guide, and facilitate the work of medical examiners in determining the cause of death. Post-mortem imaging is playing an increasingly important role, particularly in the field of suspected or confirmed abuse.

Virtual autopsy is a nondestructive technique for analyzing the entire body. Volumetric reconstruction can be performed after one “pass” with a CT and/or MRI device (Fig. 21.1), allowing:

- Less gory, and often more objective, documentation than standard autopsy photos. This is especially useful for difficult-to-dissect anatomical regions like the facial bones and pelvis.
- Digital data storage, in keeping with the confidentiality requirements for medical imaging departments’ electronic records management systems.

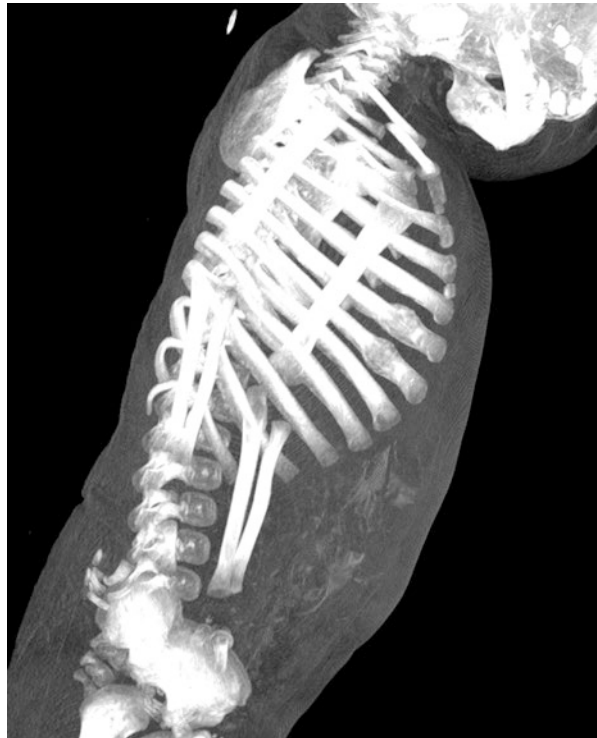


Fig. 21.1 Value of post-mortem volumetric reconstruction. Child who died at age 14 months in a context of probable sudden infant death syndrome. Three-dimensional MIP reconstruction. Identification of rib fractures suggesting abuse, which was later confirmed

- Later reinterpretation, should a case be reopened some time after the initial event.
- Multidisciplinary interpretation of cases around image post-processing consoles and autopsy photos, by providing the reconstructions most appropriate to the situation at the various participants' request. There are currently a broad array of options, including multiplanar reformation (MPR), curvilinear, maximum intensity projection (MIP), and volume rendering (VR) reconstructions for the most informative possible image rendering [2].
- Data “transferability” for obtaining expert opinions in specific areas. This could be a future application for tele-expertise.
- Measurement (with a spatial resolution as high as 0.6 mm for CT) and near-perfect localization of foreign bodies.

Computed tomography offers particular added value in the detection of gas effusion [3] and traumatic bone lesions and in victim identification [4]. It does have its limitations, however. Contrast resolution is limited for soft tissue and fluid effusion, which have similar densities on non-contrast CT. It is difficult to detect small amounts of fluid effusion in some cases—especially when in contact with solid organs.

Where MRI is really an advantage is in the detection of neurological injuries [5] in the brain and spinal cord and cervical injuries in general [6]. Accordingly, MRI's contrast resolution is invaluable in characterizing fluid and blood effusion [7] and solid organ lesions. Its disadvantages include artifacts from metal foreign bodies, the risk of displacing ferromagnetic foreign bodies, difficulty in identifying gas effusion, exam duration, and the fact that there are fewer machines available. In pediatric practice, post-mortem MRI can be used to estimate the volume of the body's organs [8]. Measurements are satisfactory for the large organs (brain, liver, and lungs), though MRI tends to overestimate the actual volume, particularly for organs with a fluid compartment under pressure [8]. It is less accurate for measuring the small organs (spleen and adrenal glands)—especially the paired organs [8]. MRI can also be used to detect changes in the lung parenchyma such as a lack of aeration or alveolar infiltrates and can help the pathologist take targeted samples from abnormal areas, which can then be correlated with the microscopic images.

21.2 Techniques

One problem that all the techniques have in common is moving the body from the forensics department (or referral center for sudden unexpected infant deaths, depending on the country) to the medical imaging department and back again. There should be a step-by-step protocol for each of the procedures involved and for all personnel concerned (stretcher-bearers, nurses, technicians, supervisors, medical examiners, radiologists, etc.) before starting this activity. Imaging should be done as soon as possible. While there is no time limit beyond which it is contraindicated, it is important to record how much time elapsed between death and refrigeration of the body.

21.2.1 Standard Radiographs

The usual practice in fetal pathology is the “babygram”—a single-exposure whole-body AP X-ray. When abuse is suspected, however, a standard radiography protocol at least as extensive as that for live patients is essential. It should include the head, AP and lateral; the entire spine (in segments), AP and lateral; the extremities in their entirety (in segments), AP or lateral; the chest, AP and lateral; and the pelvis, AP. All long-bone images should include the proximal and distal joints. The metaphyses should be fully analyzable, and additional centered images should be obtained if there is any clinical or radiological doubt [9] (also see “Inflicted Skeletal Injuries”).

However, standard radiographs—even targeted ones—are only about half as sensitive as CT [10] in detecting rib fractures (Fig. 21.1). On the other hand, radiography appears to be more sensitive than CT reconstructions in diagnosing extremity fractures (phalangeal fractures, e.g., which are highly specific for abuse). Similarly, classic metaphyseal lesions are better analyzed on radiographs than on CT images.

21.2.2 Computed Tomography (CT)

A single helical sequence is obtained from the top of the skull to the tip of the toes. No contrast agent is used. The acquisition is done in supine position, arms alongside the body, as close as possible to anatomical position. The acquisition parameters vary depending on the size of the body (tube voltage, 80–120 kV; tube current-time product, 60–300 mAs with dose modulation; field of view, 24–400 mm; pitch, 0.4–0.6; collimation, 1 mm; and thickness, 0.6 mm). When post-processing the images, reconstruction is done using different filters to permit successive readings appropriate for analyzing the brain, bones, lungs, and solid organs.

21.2.3 MRI

When MRI is done relative to the time of death is unimportant, provided the body has been stored at +4 °C. To obtain the best quality images, it is important to use a coil sized appropriately for the body. On a 1.5 T clinical MRI device, a “chest” coil is usually adequate. At a minimum, there should be three-plane T2-weighted sequences centered on the head and on the whole body, a sagittal T1-weighted sequence of the head, and a coronal T1-weighted sequence of the whole body. The so-called “balanced steady-state free precession (SSFP) imaging” sequences (abbreviated TrueFISP, FIESTA, or bFFE, depending on the manufacturer) are useful because they are fast and offer a wide field of exploration and mixed-weighting detection. The inherently three-dimensional images are very helpful, and there is no problem with movement artifacts in the post-mortem context. T2-weighted

STIR sequences are useful for bone and soft tissue injuries. Post-mortem MR angiography has been described only in adults. Though T2*-weighted sequences can be done to look for bleeding, there is little in the literature regarding post-mortem changes.

A post-mortem MRI study takes about 45 min, which can be problematic if there is no dedicated machine. The body can be left in its plastic cover, in supine position, in as close to anatomical position as possible, as for CT. Oblique acquisition is often needed, however, to obtain images in the standard anatomic planes.

21.3 Pitfalls

We will limit ourselves here to pitfalls related to the post-mortem nature of the studies; the differential diagnosis of injuries is discussed in the chapter devoted to the organ in question.

21.3.1 Radiographs

Our understanding of “physiological” post-mortem—or taphonomic—changes is constantly improving. We are speaking, in particular, of portal venous gas (presence of gas in the portal vein and its branches) and distension due to gastrointestinal gas. The radiologist must also be able to recognize the changes produced by attempted resuscitation, so that they are not mistakenly assumed to have caused—or even contributed to—the child’s death [11]. This refers mainly to pneumothorax, pleural effusion, and inhaled or ingested dental foreign bodies.

21.3.2 CT

When interpreting an infant’s post-mortem CT scan, thorough familiarity with non-specific post-mortem changes—basically thrombosis and putrefaction [12]—is essential. In particular, cerebral venous thrombosis appears hyperdense on unenhanced CT and should not be confused with interhemispheric (straight or sagittal sinus) or tentorium cerebelli (transverse sinus) subdural hematomas.

“Normal” post-mortem changes include:

- Vascular changes due to sedimentation of the blood: on unenhanced CT, the superior sagittal sinus is approximately 50 HU hyperdense (Fig. 21.2), and there is an approximately 50 HU gravity-dependent hyperdensity within the chambers of the heart (Fig. 21.3).
- Gaseous and vascular changes due to putrefaction gases: gastrointestinal tract distension (Fig. 21.4) and pneumatosis intestinalis and the presence of gas in the brain and/or liver; unless accompanied by air in the heart, the latter is not considered part of the normal post-mortem picture (Figs. 21.5a, b).

Fig. 21.2 Normal post-mortem change #1 on unenhanced CT. Age at death: 8 months. Hyperdense superior sagittal sinus

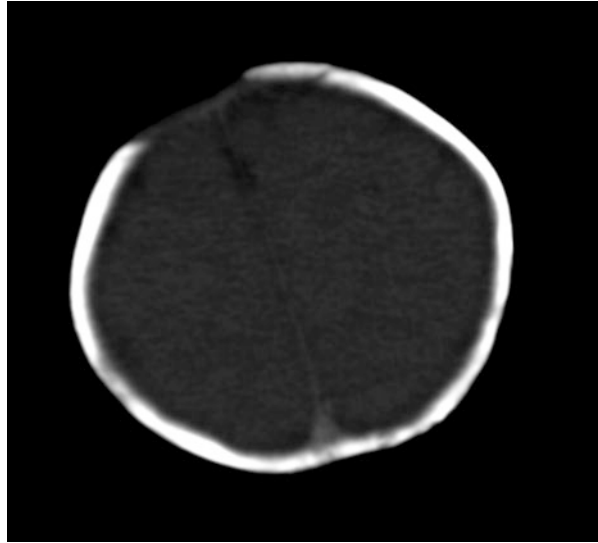
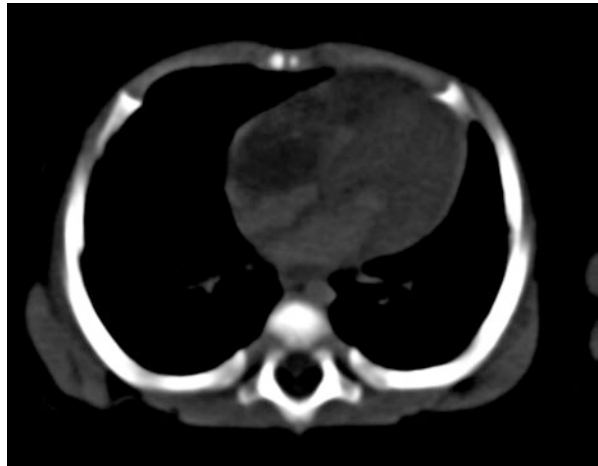
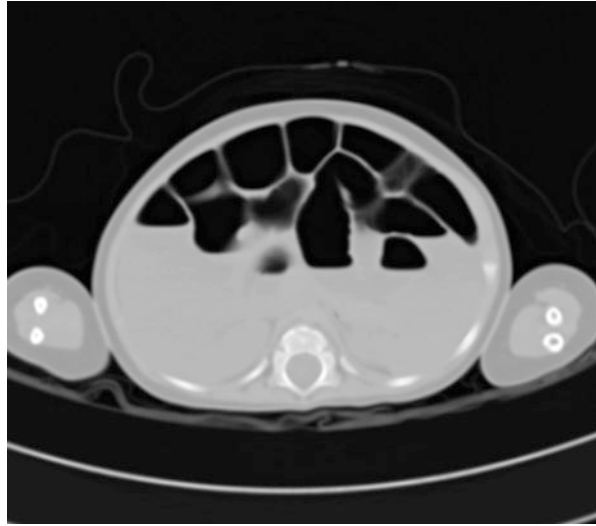


Fig. 21.3 Normal post-mortem change #2 on unenhanced CT. Age at death: 12 months. Gravity-dependent hyperdensity within the chambers of the heart



- Vessel wall changes: hyperdensity of the thoracic aorta wall (Fig. 21.6); collapsed abdominal aorta; thrombosis of the portal vein (Fig. 21.7), suprahepatic veins, or aorta; and calcification of the umbilical arteries or the ductus arteriosus.
- Changes due to pre-imaging specimen collection: pneumoperitoneum and/or gas or blood effusion from cardiac puncture and infiltrates and air in the soft tissues of the leg from intraosseous access during resuscitation attempts (Fig. 21.8). Conversely, in the absence of any puncture, pneumoperitoneum strongly suggests traumatic visceral injury [13].

Fig. 21.4 Normal post-mortem change #3 on unenhanced CT. Age at death: 10 months. Gaseous gastrointestinal tract distension



21.3.3 MRI

T1 and T2 relaxation times change after death, which explains the loss of gray-white matter differentiation observed in post-mortem T1- and T2-weighted images. The brain's cortical structures have a much higher T2 signal intensity post-mortem than in live age-matched controls (Fig. 21.9) [14]. Hence, an unusual signal should not be erroneously interpreted as pathological when it reflects only a normal death-related change.

Normal post-mortem changes must be taken into account to prevent false positives. In practice, the biggest limitation of 1.5 T post-mortem MRI is in the diagnosis of congenital anomalies of the heart and gastrointestinal tract (intestinal atresia and malrotation and pancreatic abnormalities). Spatial resolution high enough to diagnose congenital heart defects might be possible using a very strong (9.4 T) magnetic field [15]. Such malformations must be recognized, however, as they can be abuse-related or part of the differential diagnosis (e.g., an apparent life-threatening event due to undiagnosed congenital heart disease).

The recent development of a post-mortem MR scoring system that correlates well with autopsy findings has improved recognition of maceration-related phenomena [16].

Fig. 21.5 Normal post-mortem change #4 on unenhanced CT. Age at death: 11 months. Cerebral intravascular gas bubbles (a) accompanied by gas bubbles in the heart (b)

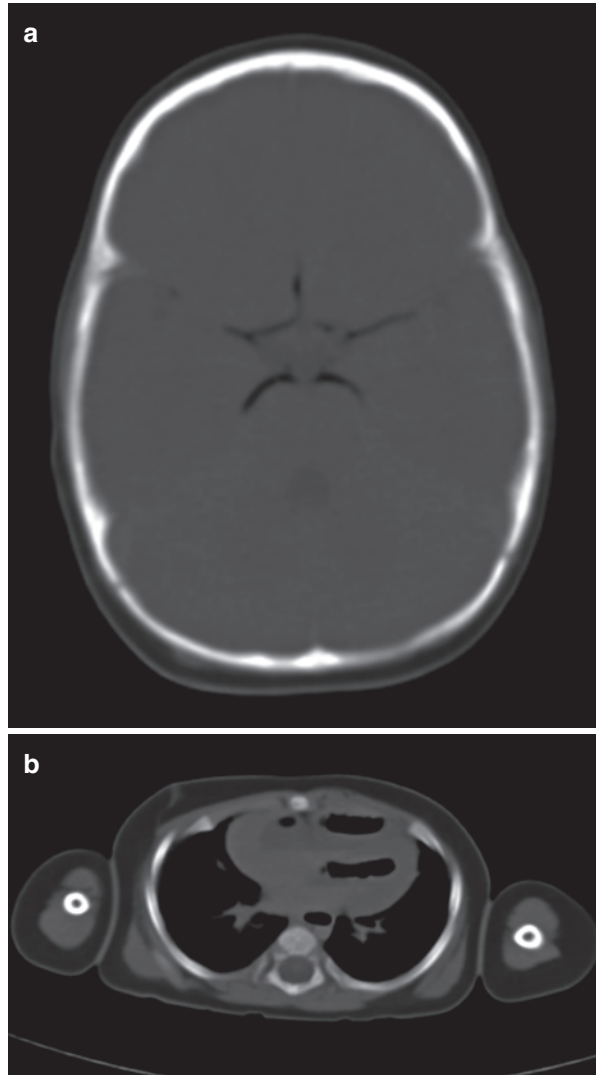


Fig. 21.6 Normal post-mortem change #5 on unenhanced CT. Age at death: 12 months. Hyperdense wall of the thoracic aorta

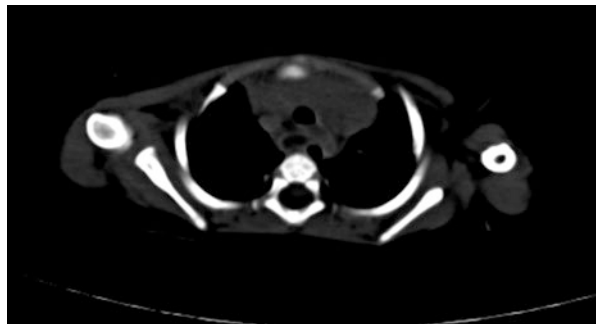


Fig. 21.7 Normal post-mortem change #6 on unenhanced CT. Age at death: 14 months. Hyperdense thrombosed portal vein

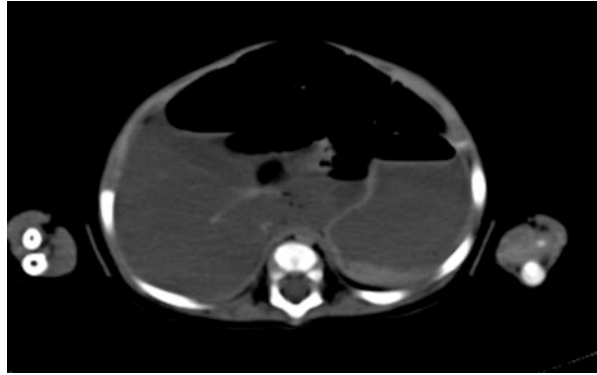
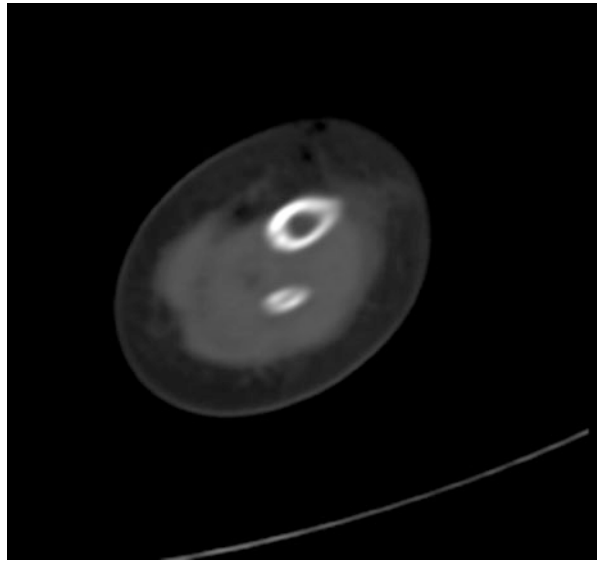


Fig. 21.8 Normal post-mortem change #7 on unenhanced CT. Age at death: 10 months. Infiltrates and air in the soft tissues of the lower leg after intraosseous puncture during resuscitation attempt



21.4 Dating

Post-mortem imaging adds nothing to in vivo imaging in terms of dating. Histologic data are unquestionably more reliable (see “Autopsy and Histological Findings” chapter) [17]. We will simply reiterate here the importance—as with in vivo imaging—of finding different-age lesions, which are a key argument in the diagnosis of recurrent abuse.

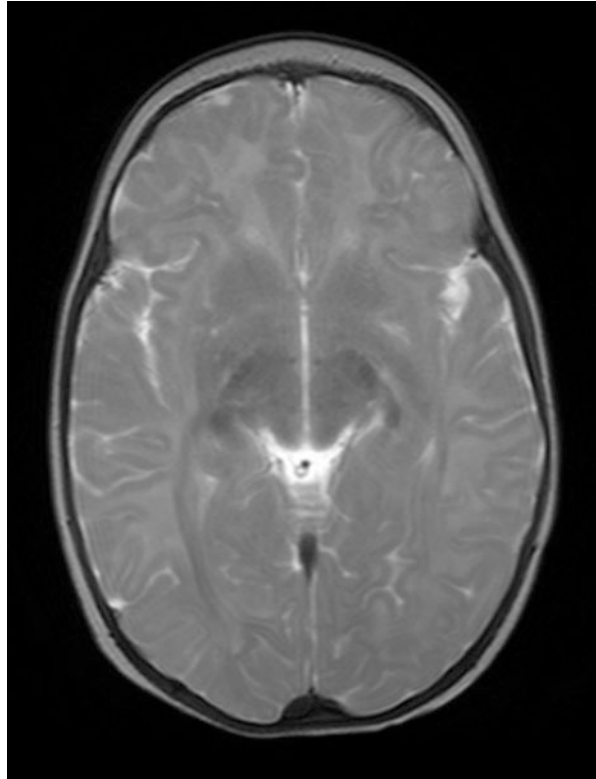


Fig. 21.9 Normal post-mortem change on MRI. Age at death: 12 months. Loss of gray-white matter differentiation on a T2-weighted image

21.5 Best Practices

Whole-body imaging is being performed increasingly often when abuse is suspected in the unexpected death of an infant or child [18]. Such imaging may help diagnose abuse that went unsuspected in the initial investigation. CT and MRI have their respective advantages and disadvantages; ideally both techniques should be done, if local conditions permit.

Greater prospective experience is needed to determine what role imaging studies should play in the post-mortem diagnostic strategy. With virtual autopsy still in its infancy, the predictive value of these techniques—analyzed jointly in a multidisciplinary way—needs to be determined. In other words, if the CT and MRI scans are interpreted as normal, can autopsy be deferred? Or if the CT and/or MRI are interpreted as abnormal, can autopsy be limited to targeted ultrasound-guided or laparoscopic organ biopsies, as some recent publications suggest [14]?

Key Points

- Virtual autopsy offers a nondestructive way to analyze the entire body using any imaging modality but primarily radiography, CT, and MRI.

- There should be a detailed, written procedure for everyone involved in transporting bodies for virtual autopsy.
- Familiarity with normal post-mortem changes on imaging—which can be diagnostically misleading—is essential.
- Normal post-mortem venous thrombosis, which renders the superior sagittal sinus hyperdense on unenhanced brain CT, should not be mistaken for a subdural hematoma.
- An unusual signal in the brain parenchyma may be due to normal post-mortem changes.
- The child's entire medical record should be reviewed, in particular to look for specimen collection that might affect the interpretation of post-mortem images.

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Caroline Rey-Salmon, Ophélie Ferrant,
and Catherine Adamsbaum

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The authors provide the reader with some essential points about assessment strategies and recommendations when there is suspicion of abuse: indications leading to hospitalization and complementary examinations, along with general principles for drafting the medical certificate.

C. Rey-Salmon (✉) • O. Ferrant
Unité Médico Judiciaire —Versailles, Paris, France
e-mail: caroline.rey@aphp.fr

C. Adamsbaum
Imagerie Pédiatrique—CHU Bicêtre, 78 rue du Général Leclerc, 94270 Le Kremlin Bicêtre,
France
e-mail: catherine.adamsbaum@aphp.fr

Table 1 Indications for hospitalization

Serious physical lesions
Infant under 9 months with traumatic lesions
Traumatic lesions without clear and consistent explanation
Risk of reiteration linked to the context
Significant emotional restraint on the child or those around him
Suspicion of sexual assault with alleged perpetrator living with victim
Suspicion of sexual assault with pregnancy discovery
Suspected of sexually transmitted disease

22.1 Multidisciplinary Assessment Strategy

22.1.1 Indications for Hospitalization

The first duty of any physician, general practitioner, or specialist is to protect the child. The indication of hospitalization is to be assessed individually but the following general rules can be applied:

- Broad indications for hospitalization for any child who has been mistreated or likely to have been (Table 1).
- In the case of an infant, hospitalization is the absolute rule, to avoid the risk of death if the violence continues.

Most often, parents, even when they themselves perpetrate the violence, agree to hospital care if it is presented as an aid. Doctor must provide explanations to parents that lean in this direction, avoiding making hospitalization be perceived as a sanction. In case of refusal of hospitalization when the child is in immediate danger or when the parents threaten to remove the child from the hospital, in France, a report must be sent urgently to the prosecutor in order to admit or maintain the child in the hospital against the parents' will.

22.1.2 Elements of a Multidisciplinary Assessment

While the diagnosis of traumatic injuries is generally simple, on the other hand, diagnosis of abuse is often much more complex. In the absence of a "specific marker," the diagnosis stems from a number of converging arguments (Table 2).

22.1.3 Multidisciplinary Review

The number and diversity of the information to be collected always requires a moment dedicated to bringing the multidisciplinary elements together, at the end of which the decision to appeal to an administrative or judicial authority can be taken. This review, to be held within a short time frame—ideally less than 72 h—makes it possible to

Table 2 Key elements for assessing a potentially abused child

– Lesion characteristics: location, association, repetition, and progression during hospitalization
– Elimination of differential diagnoses
– General somatic aspect and that of contact with the child, being attentive not to make a hasty judgment: some abused children may have a falsely reassuring presentation
– Observation of the child, his or her behavior and interview data if this is possible depending on age
– Explanations provided by the parents or other persons in charge of the child and compatibility with the forensic findings
– Delays in seeking healthcare
– The family’s medico-social background and that of the child’s siblings (early separation, placement, unexpected death, etc.)
– Systematic review of all other children in the patient’s environment: the siblings and the children found within the community of care (nursery assistant, family crèche, etc.)

share available information and avoid basing the decision on a single professional’s opinion. The review meeting often gives rise among caregivers to strong emotional resonance aroused children suspected of abuse. It enables identification of any contradictory movements within the team, which invites individual’s to clarify positions and expectations about the child’s situation. It should be recalled that the assessment of a potential abuse is often accompanied by inhibitions in the classical objective medical diagnostic procedure. Evoking, confirming, checking, and carrying out such a diagnosis is permanently, consciously or not, an approach hampered by nonmedical implications. The potentially dramatic consequences of a diagnostic error, both by default and by excess, weigh enormously in the medical process.

22.2 Recommendations for Imaging

22.2.1 In a Young Child Under 2 Years of Age, Imaging Recommendations When There Is a Suspicion of Abuse Are the Following [1–8]

If abuse is suspected, the imaging performed must be of excellent quality, and it is recommended to use radiologists accustomed to pediatric radiology, especially for young children. The radiologist in charge of the child must have knowledge of current recommendations [4, 9, 10]. It is preferable to delay the realization of imaging of the skeleton by a few hours, if necessary, under cover of hospitalization. The primary role of the radiologist, often at the forefront in this context, is to ensure and validate the quality of imaging performed, including skeletal and brain images [1]. It is always desirable to keep a digital archive of all the imagery carried out, as well as all reports.

The drafting of radiological reports must be descriptive. The conclusions must be clear and the degree of diagnostic uncertainty regarding inflicted injuries must be stated in terms such as “possible,” “probable,” or “highly probable” [11].

Table 3 Sample report information

– Name and address of the recipient
– Name, capacity, and address of writer
– Administrative information concerning the family: address, composition, ages, professions, etc
– Mode(s) of child custody
– Chronological description of the facts concerning the minor
– Descriptive initial medical certificate and results of the main complementary examinations
– Explanations given by the persons in charge of the child regarding the lesions observed and compatibility between the lesions and the explanations
– Description of the danger to the child and hypothesis (s) about the origin of the lesions
– In the event of a report, mention of the seriousness of the situation justifying direct recourse to the Public Prosecutor's office
– Contacts already made mentioning the names, qualities, and addresses of other professionals who may be contacted or involved (child services, nursery, drop-in center, attending physician)
– Details of the planned medical follow-up
– Request for information on the follow-up given
– Date, signature

NB: It is important to always specify the origin of the information found in the report (the parents, the social worker, etc.) in order to remove any ambiguity for the recipient

It is essential that the radiologist take direct, personal, emergency contact with the emergency doctor or the pediatrician in charge of the child, in order to ensure that the report is properly understood and therefore that the child's potential situation of danger is as well.

1. Systematic X-rays of the complete skeleton performed on separate plates: focusing on the images centered on each segment, with exposure adapted for the perfect visibility of cortical bone, spongy bone, and soft tissue.

The quality of imaging must be extremely rigorous (see also chapter "Skeletal Injuries").

The following images are systematic:

- Frontal views of each limb segment.
- X-rays of the spine in full frontal view and profile; the profile focusing on the thoracic spine should include the sternum.
- Frontal view of the pelvis.
- Frontal views of the rib cage including the shoulder girdle and two oblique views of the thorax.
- Skull views will only be taken if one does not have good quality brain CT with 3D reconstructions.

Are widely recommended in addition:

- Profile of both knees and ankles.
- If, after this review, skeletal imaging is doubtful with normal or high clinical suspicion (e.g., bruises before the age of 6 months), it is necessary to perform additional exploratory imaging:

- Either a bone scan.
 - Or new x-rays of the entire skeleton (outside the skull and spine), after 10–15 days, the child being placed in safety [12–15].
2. Neuroimaging [16] (see chapter “Inflicted injuries of brain and spinal cord”)
 - Brain CT including 3D reconstructions of the skull.
 - MRI is widely advised in addition, in search of hypoxo-ischemic parenchymatous lesions, and for the study of the cervical spine.
 - In the absence of neurological symptoms (with report of suspicious bruises or fractures), MRI is recommended over a scan to look for subclinical lesions (such as parenchymal scars).
 3. Abdominal ultrasound is widely recommended.
 4. All children under 2 years old and living in the same conditions as the index case must be examined in the same way as soon as the diagnosis of maltreatment is confirmed.
 5. The new modalities (MRI whole body, whole-body scanner) are not currently validated [17].

22.2.2 In Children Over 2 Years of Age

The imaging can theoretically be narrowed based on the signs of appeal and the context. In practice, the full assessment is often carried out until the age of 5.

22.3 Recommendations for Biological Exams

A biological assessment is recommended to eliminate differential diagnoses. This assessment is always decided based on the clinical examination and may be more or less extensive depending on the situation and history.

22.3.1 Ecchymosis and Hematoma

Blood count, platelet count, bleeding time, PT, APTT, coagulation factors including factor XIII and Willebrand factor [18].

22.3.2 Subdural Hematomas and Suspicion of Shaken Baby Syndrome

Systematic tests: blood count, hematocrit, electrolytes, lactate dosing, hemostasis tests with first-line PT, APTT, fibrinogen.

The main differential diagnosis is accidental cranial trauma, but in this case the clinical history must be perfectly consistent.

Rarer medical diagnoses sometimes apply, which does not exclude the possibility of added maltreatment.

- Congenital coagulation disorders (hemophilia, Willebrand) or acquired ones (thrombocytopenia)
- Glutaric aciduria: diagnosis by chromatography of urinary organic acids
- Menkes disease: diagnosis by determination of serum copper and ceruloplasmin [19].

22.3.3 Biological Assessment Before Autopsy in Case of Unexpected Death of an Infant [20]

- Two blood cultures by two different punctures.
- Blood count and platelet count.
- CRP.
- Lumbar puncture.
- Cytobacteriological examination of urine.
- Bacteriology on specimens from the nose, pharynx, trachea (if possible after reintubation), stools.
- Virology: immunofluorescence on nose, pharynx, trachea (RSV, influenza, parainfluenza, adenovirus) and PCR (enterovirus), stool.
- Toxicology: blood, urine, and serum for the profile of plasma acyl carnitines. It is recommended that freezing be carried out for further analysis of the blood, serum, cerebrospinal fluid, and urine. Similarly, a blood sample is taken from the blotter.
- It is unnecessary to perform blood ionogram (except calcemia), blood glucose, and blood gases, the results of which are unreliable in post mortem.

22.4 Recommendations for Writing the Medical Certificate

Writing of a descriptive initial medical certificate is part of routine practice in pediatric emergency departments. It is important to know the rules that apply to writing this certificate as it engages one's medical responsibility and could be presented in court.

The following points may help the writer of the certificate, and it is always desirable to keep a copy of the medical certificate in the patient record.

The medical certificate is dated the day of writing, indicating the identity of the doctor (name, surname, title, address), the patient's identity, and, in case of requisition, the requesting authority. The certificate must mention the alleged facts, and it is advisable to write in the conditional tense, since the doctor cannot attest to a situation of which he was not a direct witness. The delay between the alleged facts and the medical examination may be noted. The practitioner should be careful to indicate only the child's background that may be related to the facts.

1. *Ensuring that the child is protected* is essential. The safety of the child must be ensured, and it is sometimes necessary to hospitalize or prolong hospitalization for a few days.

2. *Having the necessary competence.* The drafting of the medical certificate requires competence in the sought-after medical field. In the field of sexual assaults, in particular, it is necessary to call on a colleague with experience.
3. *Having an objective perspective of the situation of the child and his family.* It is essential not to be influenced by what has already been said or written, to ensure an objective medical approach.
4. *Having all the necessary medical documents.* The physician must have all the information necessary to prepare his report. The health record provides an overall picture of how the child is being followed, a history of traumatic injuries, or symptoms that could be pertinent in this context, such as prior vomiting labeled “acute gastroenteritis” but without diarrhea or fever and which could correspond in reality to an episode of intracranial hypertension linked to subdural hematomas. The practitioner should also reconstruct a height and weight chart and the head circumference chart, complete biological or radiological assessment if necessary, and discuss the findings of the reports in the light of all the available data, with specialized pediatric radiologists or biologists or any other specialist depending on the clinical picture.
5. *Examining the child.* The clinical examination must be exhaustive. A child who has been slapped must have a tympanic examination. Endobuccal examination is routine in infants. The examination of the genitals is an integral part of the medical examination. Photographs with metric landmark are recommended and can be very useful.
6. *Providing an objective description of the lesions.* The report is based on the exact and accurate description of the symptoms and lesions presented by the child.

For each lesion, the physician indicates its type, color, shape, size (width, length, and depth), and location if possible with respect to obvious anatomic landmarks. Elementary injuries are contusions (abrasion, bruising, hematoma), wounds, sprains, fractures, and burns (cf. abuse-related burns). The certificate must be descriptive and should not interpret or date the injury. If there is no visible damage, this must be mentioned as the negative elements are as important as positive [21].

7. *Compare available statements with the findings.* It is useful to compare the declarations of the persons in charge of the child with the forensic findings to identify possible discrepancies, improbabilities, or inappropriate comments. These elements must be mentioned in a factual manner because the provision of proof of abuse and the obtaining of a confession are exclusively a matter for the courts.
8. *Drawing a conclusion.* It is necessary to express the findings in simple words, intelligible by all. Let us not hesitate to say that we have arguments in favor of inflicted trauma (or non-accidental trauma). Let us not hesitate to say, if that is the case, that we cannot answer the questions asked in the current state of affairs and that we advocate additional examinations.
9. *Knowing that doubt must benefit the child.* It is necessary to take the time to observe the evolution of the lesions during hospitalization or placement in order to have a more precise idea of the child’s situation. Of course, for parents who are not abusers, this separation is painful, even if they are most likely able to understand it. On the other hand, leaving a young dependent child at the mercy

of the abuser can result in serious injuries or death. In a series of 129 expertises in the context of suspected shaken baby syndrome, 47% of children had presented traumatic injuries in the prior weeks or months, for which an accidental explanation had been too easily accepted by physicians [22].

10. *Example of a medical certificate*

I, the undersigned, Dr. CR, under prior oath to assist in justice in honor and conscience, certify that I examined at the Hotel Dieu Hospital on March 15, 2013, and at the request of Mr. SR, 5th district police commander, a teenager posing as N.A., born on November 2, 2000, accompanied by her father.

Anamnesis: N. claims to have been assaulted in the school playground on March 14, 2013, at 12:30 by a group of three girls her age. She reports having received kicks in the legs, being punched in the face, and being scratched. N. tells us she had not seen a doctor since the facts.

History: No history was revealed that could interfere with the facts of the case.

Complaints: Pain in the left eye and right leg.

Physical examination: Weight, 49 kg; height, 154 cm size; right-handed; blood pressure, 11/7; heart rate, 68/min

- Bluish bruising 2 cm in diameter facing the right horizontal branch of the mandible
- Left periorbital hematoma, nonocclusive with conjunctival hemorrhage
- Two linear superficial cutaneous excoriations 4 cm long and 6.5 cm long on the left side of the neck, compatible with scratches
- Two bluish bruises of 4 × 2 cm and 3 cm in diameter on the outside of the right leg in the lower half

No other traumatic lesion macroscopically visible on this day.

Findings: The injuries found were consistent with the allegations.

An ophthalmologic examination is recommended. The results of this review are likely to change the duration of total disability.

22.5 Reporting

In each pediatric unit, a protocol for reporting child abuse should be considered and validated. Currently, there are no European directives governing the form of these documents. We offer the following framework.

If a report is filed, medical team should work with the parents. The team must reconcile the obligation to provide information, the protection of the minor, and the effectiveness of the investigation. This approach, which requires high availability and listening skills, is at best carried out by one of the physicians responsible for the structure accompanied by another member of the team. Reports sent without support to the parents lead to a crisis of confidence, and it is essential to highlight the need to denounce a situation of danger for their child, whoever is responsible.

Despite all these precautions, the result may still be a split between the parents and the medical team.

Key Points

- Know the current recommendations from scientific societies regarding examinations to undertake in cases of suspected neglect.
- Conduct a multidisciplinary review of the child's situation.
- Understand the precise context of the medical report.
- Provide accurate descriptions of lesions with photographs.
- Maintain a complete archive of the documents for the judicial inquiry.

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The subject of child maltreatment is an uncomfortable one for paramedical staff, nurses, as well as for radiologists, nursing assistants, and other caregivers as soon as they are directly confronted with a case. The aim of this chapter is to highlight the challenges of the caregiver's position based on the experience of a childcare nurse who has practiced for many years in a pediatric medicolegal unit. Pediatric caregivers are trained to provide care to children who are suffering while taking the parents into consideration as well. Thus, if the abused child naturally arouses the empathy of the caregiver, it may be invasive. Nothing prepares caregivers to confront a parent¹ who could possibly be abusing a child. What position should caregivers take? What should they say? How should they act? These challenges are compounded by the fact that in

¹ The term "parent" is used in a broad sense to refer to adults accompanying the abused child in the medical community (lawful parent, natural parent, adopted parent, a person with authority over the minor, etc.).

P. Vasseur
UMJ Hôtel Dieu (APHP), 1 place du Parvis Notre Dame, 75004 Paris, France
e-mail: patricia.vasseur@aphp.fr

the vast majority of cases, the caregiver intervenes without knowing who is the perpetrator of the abuse if abuse is proven. It is therefore easy to develop a climate of mistrust of parents.

Thus, this chapter is meant to be practical, discussing problems in the field and analyzing everyday situations in order to help caregivers to position themselves adequately and effectively.

23.1 Caregiver Challenges

Child maltreatment affects all social groups, but, in the public's mind, it affects disadvantaged groups as a priority. Because of this stereotype, the more the caregiver can identify himself professionally and socially with the parent, the less he will consider the possibility of violence by a simple defense mechanism. In other words, to admit that someone who resembles us can be abusive raises the idea that this type of behavior could affect one's own family sphere.

Moreover, excessive media coverage of certain cases, especially those of pedophilia, encourages the idea that the danger comes from outside. However, the majority of cases of sexual violence are of an intrafamilial nature. For young children in particular, the abuser is almost always a member of the family or a known to the family, such as a friend, a neighbor, or a childcare professional, to name just a few possibilities.

Little is taught about child abuse in nursing schools. Caregivers lack academic knowledge, and each has to cope on their own, influenced by their own personal experiences. For example, some caregivers tend to overestimate the incidence of child maltreatment, while others, even after 20 years of pediatric experience, say they have never seen cases. Moreover, given the frequent occurrence of child maltreatment, some caregivers may have been victims of physical, sexual, and/or psychological abuse in their childhood. The confrontation with a victim can then be experienced as intolerable, or, on the contrary, it could be overinvested.

Caregivers' reactions can also change over time. In particular, the fact of becoming a parent can make the care of an abused child unbearable because of the anxiety induced by what could happen to one's own child.

These challenges help to better understand certain attitudes adopted by health professionals in a more or less conscious way. These attitudes can take many forms, concern the child and/or the parents or both.

- Denial: The caregiver considers that the violence does not exist. If the child is old enough to express himself/herself, the caregiver does not listen to him/her or evade the obvious allusions that the child is trying to make. The inconsistent explanations provided to explain a medical finding are not called into question. Denial contributes to delaying the diagnosis of abuse.
- Projection: The caregiver becomes overwhelmed by his story and his personal concerns: "This child could be my son, my daughter, to whom the same thing could happen." It becomes quickly impossible for the caregiver to provide suitable support.

- **Overinvestment:** This frequent attitude can be explained by the insidious valorization of the caregiver. "That poor child, it's terrible what happened to him. His parents are monsters and I'll take care of him." The caregiver takes care of the abused child to the detriment of the others. The child, even if he is old enough to do so, is even invited to accompany the caregiver in their job (distribution of the meal, medicines, etc.) or even medical provision. This behavior is very deleterious for the child, who has already suffered a family breakdown, because he experiences a strong temptation to "cling" to this figure of substitution, who is only transitory.
- **Omnipotence:** The caregiver replaces the investigators. Once there is a suspicion of ill-treatment, he questions, draws conclusions, and thinks he finds the culprit to obtain confessions. However, the caregiver is not a professional able to analyze the facts, and the perpetrator is not necessarily the person accompanying the child. The caregiver's opinions are based only on interpretations, impressions, and assumptions, which by definition are not objective. For example, "the mother looked embarrassed; the father had a strange expression." The "rogue" investigation has several negative effects, such as blurring "true confessions." Furthermore, it is very harmful to the caregiving relationship, which should remain neutral and benevolent.
- **Judgment:** The caregiver assumes the role of judge and seeks to make the perpetrator pay for the suffering endured by the child. This can lead to genuine harassment from one or more caregivers: accusing glances, icy silence, avoidance behavior, evasive or terse answers to parental requests, malicious whispering, etc. This attitude is again explained by a defense mechanism. Again, the message given to the child is very harmful, "looks at how bad your parent is, he cannot take care of you with love and kindness like I can."

These attitudes are human but are not professional and do not help the child, his family, or the medical team [1].

Caregiver reactions depend on the individual's life experience, maturity, and professional experience, and they could change over time. In practice, caregivers often have to experience this type of reaction personally before they can find the right position and distance.

How can we avoid such human attitudes in the face of such a difficult situation? Sharing information within a team, discussions during transmission, and multidisciplinary meetings often conducted with psychologists make it possible to identify the caregiver's own difficulties in a given situation and to pass the relay to another caregiver who may be more experienced or simply more available at the needed time. Adopting an empathic attitude requires being able to detach oneself from one's own experience and personal representations in order to focus on the other person to better listen and understand them. The main concern is the child, but the child is still part of a family constellation, present or not, which must be taken into consideration for subsequent care, especially if the abuse is intrafamilial.

The main purpose of care in a child abuse situation is to protect the child, to evaluate the resources (helpers, parents to support, etc.), and to establish the connection between professionals and the family.

On the basis of everyday experiences, feedback from certain families, and health-care teams, a number of approaches can help, even if there are no universal instructions for use.

23.2 In a Pediatric Emergency Care Unit

In a pediatric emergency care unit, it is difficult to detect traces of physical violence intentionally inflicted, the daily reality being children and teenagers consulting for various accidental traumas: bruises, hematomas, sores, sprains, and various fractures. Caregivers must first and foremost provide emergency care, and their first thought is not abuse. To be effective, it is often enough to observe, to be vigilant, and to trust common sense when certain observations attract the attention [2].

In general, suspicion arises when the caregiver is surprised: the explanations given do not correspond to the injuries observed, the versions provided by the parents fluctuate according to the interlocutor and the moment, or are incoherent. The child refuses to explain what happened, even when seen alone. The caregiver initially gives a precise and objective description of the injuries and specifies the circumstances reported. He or she should quickly communicate any doubts to the medical team.

Frequently, an abusing parent or one who has witnessed violence against his/her child from a spouse will come to the emergency room on the pretext of some innocuous injury in the hope that the caregivers suspect violence and help them get out of this situation.

For example, a father arrives at the emergency unit one morning with his 4-year-old daughter: "I was just smoking and ash flew onto my daughter's cheek and burned it." On examination, the appearance of the burn resembles a cigarette burn. Moreover, this wound is crusty, seems to date already a day or 2 ago, and does not seem as recent as what was suggested.

The examination in this kind of case offers a gateway to initiating dialogue about parental concerns.

The abusive parent may conceal physical traces. The child, at an age to do so, could also hide his wounds or gives fanciful explanations to justify them because he is caught in a conflict of loyalty—the bad parent could also be good on other occasions.

More rarely, the child may reveal violence that he or she can no longer bear.

Moussa, a 12-year-old boy, arrives one morning in the emergency room, accompanied by police officers. He explains that his father regularly strikes him with a belt or electrical cables. After suffering in silence for years, he no longer can and threatens to denounce his father to the police. The father, probably by bravado, encourages him to file a complaint and strikes him all the more. After*

the violent episode, Moussa goes alone to the police station where he denounces what he is suffering. The examination revealed skin lesions and a fracture of the ankle.

The caregiver must listen to the child, and it is recommended, at first, to see alone when the child is old enough to express himself. If the child refuses to speak, the caregiver, even if he has a doubt about abuse, must simply leave the door open, explaining to the child that he can be helped at the time he wishes.

It is always essential to write detailed and objective reports. If nothing is certain at some point, the accumulation of such transmissions may become illuminating later.

With respect to the parents, it is necessary to emphasize tactfully the inconsistencies between the allegations and the findings in order to elicit further explanations. If there is significant doubt or the physical examination is revealing, the doctor will inform them of the need to report to the authorities. This can cause aggressiveness or can relieve the parent.

A child protection/social services doctor calls the emergency unit to signal the imminent arrival of a 4-year-old child accompanied by his parents for a face hematoma that would be due to a fall. The social services doctor is worried because for several months, he regularly noted bruising on the child. In studying the child's record, the emergency physician realizes that this child has repeatedly come to the unit for various traumas. The parents came to consult for injuries that did not require emergency care. Their relief at the announcement that an official report would be made showed that the repeated use of care facilities was "calls for help" that had not been understood as such until then.

The range of situations encountered can be very wide, from the couple of parents who torture a child by justifying these injuries as an undiagnosed illness to the lone parent in difficulty, who no longer controls his or her violence and asks for the help of professionals.

It is important to bear in mind that the best way to be effective is to observe and listen to the child and his or her accompanying adult(s). This attitude helps position and protect the child if necessary.

When sexual abuse is encountered in the emergency room, it is most often a child under 5 years of age brought by a mother who is suspicious of a sexual assault. In the context of conflicting separations, there is sometimes great anxiety among mothers who interpret nonsignificant physical signs, including abdominal pain, as evidence of rape. This situation often destabilizes caregivers, especially when the mother introduces herself with her little girl, claiming that the father has abused the girl. It is then a question of keeping calm and recording the mother's concerns, first of all. The mother should be seen alone, if possible. The child will be examined later by an experienced doctor or in a medicolegal unit. Poor questioning of a child may interfere with the subsequent questioning by investigators.

23.3 In a Hospitalization Context

The child may be hospitalized for evaluation or for proven abuse requiring care.

23.3.1 Hospitalization for Evaluation

Evaluating does not mean judging or investigating but collecting objective elements that may lead to a decision to report after a multidisciplinary assessment [3].

Emma is a 4-month-old baby, hospitalized in general pediatrics following a fall from the changing table. Considering the young age of the parents (18 and 19 years old), the decision is made to keep the child in observation for a few days to distinguish between an awkward moment and abuse.

For Monique, a 50-year-old nurse with no children, the parents are incompetent, and she would not be surprised if they were abusive because: “At that age, children should not be allowed to have children.”

Charlotte, her 22-year-old colleague, found, on the contrary, that these young parents are of good will, always present and eager with their child, surrounding him with warmth and care despite a certain clumsiness.

Who is wrong? Who is right? Each one projects herself in this situation, according to her age and experience.

With Monique, the parents are uncomfortable; impressed by her mastery of the gestures of care and by herself-assurance, they become awkward. With Charlotte, who is open and friendly, their gestures are more assured because they feel confident. The correct distance probably lies between these two behaviors.

A negative, suspicious, or distant attitude prevents a good evaluation. Being interested in the child, valuing parents, listening to them, and taking the time to talk to them and respond to their questions always gives a fairer picture of reality. In any situation, one must be careful to base oneself on objective facts and resist a “feeling,” which will always be subjective.

One of the most difficult assessments to make is that of a “shaken babies.” Most often, the perpetrator of the violence is not known when the child arrives in the service, which can lead to a climate of suspicion because the responsible person has not been designated. Caregivers often find it difficult to position themselves, and evaluation can turn into a pseudo-investigation where all the actions are monitored.

This testimony of Mr. and Mrs. M., parents of a little girl hospitalized following a subdural hematoma, collected 2 years after the facts at an expert meeting, illustrates the difficulty caregivers face finding the right position.

Our little girl Alice was shaken by her nurse when she was 4 months old, and she was hospitalized for several days in a pediatric hospital. This hospitalization was one of the most painful memories of that time. We experienced very challenging things. Our baby was lying in bed with a tube coming out of his head; we were distraught. We could not sleep with her because the doctors forbade it, and it was a heartbreak every night to leave her, only able to see her the next day. An inquiry was opened and it took several weeks for the nurse to confess that she was responsible for the violence. My wife and I spent a day in custody, but that was not the hardest. Outside of our concern about our child’s health, the most painful part was how the caregivers treated us. Alice was in a glass room just in front of the nursing station where the caregivers were. We felt their gaze weigh on us all day. Most of the time, no one came to see us in the room without having to, and we had to insist to get

answers about how our daughter was doing. We knew that we had done nothing, and that they looked at us as if we were guilty. The only one who was warm with us and spoke to us as normal people was a student nurse intern.

She told us about our daughter, what she had eaten, what she had done during our absence, if she had slept ... little things that mattered to us. Above all, she told us about our daughter's attitude when she saw us, how much she smiled and giggled when she recognized us. All of a sudden, we were no longer suspects but parents.

In this case, the innocence of the parents was proved, but even if one of them had shaken this baby, the fairest attitude would have been that of the student.

23.3.2 Hospitalization Awaiting Placement

In case of physical abuse, a child must be hospitalized for protection. This hospitalization may last a few days or weeks before it is decided whether the child returns home or goes into foster care. In some cases, as decided by the magistrate, parental visits are prohibited or limited. Caregivers will thus spend a lot of time with this young patient, who needs more attention because of his isolation. While it is normal for caregivers to spend more time with a child who does not have visits, care must be taken to ensure that there is no emotional overinvestment.

Charlotte is a 3½-year-old girl, hospitalized in a general pediatric unit following physical abuse by her stepfather. Her mother, who seems to have been present, did not denounce him. The violence required a stay in resuscitation and then hospitalization in the service awaiting placement in foster care. The team was particularly moved by this little girl and her story. Visits were prohibited. Charlotte was particularly attached to Josephine, a childcare assistant. She was a young woman of about 30 who had tried unsuccessfully to have a child. As the days went by, the young woman spent more and more time with the little girl, to the detriment of the other six children she is in charge of. When the foster family picked up the girl at the time of her release, it is a heartbreak for both the child and the caregiver.*

For the child who has already suffered a break with his family, leaving the person who has been caring for him for several weeks is a new trial. The child can “choose” from the team a person whom he or she trusts and becomes attached to. To limit the trauma of separations, this link must be framed and verbalized. It is essential to explain to the child in an appropriate way the reason for his hospitalization and separation from his family. Gradually, caregivers must prepare him for discharge from the hospital and for future placement. It is possible to explain to him that other people will take care of him and that with time, it may be possible to maintain regular links with his family.

The relationship with the parents is most often maintained even if the child is placed in a nursery, in a home, or in a foster family. There may be mediated visits and a gradual return in the family with an educational follow-up. Whatever the facts, the abusive parent remains the parent. The situation may change over time, with the priority always being to protect the child.

The caregiver-care receiver relationship must be built at a proper distance, with kindness and in a relationship of trust, always beneficial for the child's care. Crossing certain limits can have consequences that are difficult to predict at the outset.

Emma is an 11-month-old girl, repeatedly hospitalized for breaking the weight curve, vomiting, and other unexplained symptoms. Numerous investigations had been made. She was currently being fed through parenteral nutrition.*

Emma's mother was at her daughter's bedside day and night, inspiring respect by her devotion, her patience with all the necessary care, even the most unpleasant for the child. Charming with the staff, she has forged friendship with Fanny, a nurse in the unit, and Fanny was invited to eat at the parents' home.

All was well until Sabrina, one of her colleagues, entered the room one afternoon. Emma's mom had just left the room where the little girl was asleep. The nurse found a liquid of doubtful color going through the tubing, immediately stops the IV and aspirated the product in question.

Tests would show that it was a per os drug that had been pounded and injected.

The mother then accused the nurse of having injected something into her daughter, taking advantage of her absence of a few minutes; she swore that when she left the room, everything was normal and that, for her, that was the only explanation possible.

This was a case of Munchausen syndrome by proxy and the nurse's responsibility was quickly ruled out.

A personal relationship in a medical context can have serious consequences on the overall care within the team. In addition, medical confidentiality may be more difficult to preserve.

23.4 In Medicolegal Units

Medicolegal units are places where specialized forensic examinations can be conducted. The minor, accompanied by a relative—usually one of the parents—comes to the unit with a requisition, and the child has already been heard by an investigator. A space reserved for minors can be set up, and the nurses tailor care to the child's level of development.

23.4.1 Intake of Young Children

The intake interview allows the nurses to introduce themselves, explain the examination, and explain to the parent or the accompanying person that they will be present during the examination, if the child wants them to be. Having to explain a forensic examination, especially gynecological examination, to a child often worries the caregiver [4]. It is enough to explain in simple terms to the child that he or she "is going to see a doctor who will look everywhere to check that everything is okay." These few words are often enough to inform and reassure.

First, the parent is received by the doctor alone, while the child is in the waiting room in the presence of the nurse. The parent can then freely express himself or

herself, without the child witnessing it. Play time in the waiting room is a time for building trust required for the medical examination to take place with the minimum of apprehension. It is about getting to know the child without trying to extort revelations.

The child and the nurse then join the parent for the medical exam. No questions are asked about the facts. The child may, however, speak about them if she/he so wishes. The attitude to adopt toward the child is identical whether the facts are proven or not. Management is tailored to the child's age and stage of psycho-emotional development. The child always remains a patient before being a victim.

The child may show anxiety and reluctance, which makes the examination more difficult. Even several months after the event, the examination may require a long period of preparation and a lot of patience and gentleness so as not to reactivate the previous trauma.

Regarding the parent, here again a neutral and benevolent attitude is indispensable, and the parent's words must be received with attention and respect.

23.4.2 Intake of Teenagers

The intake interview is mainly directed to the young person, explaining to the parent or the accompanying person that they will be seen at the end of the forensic examination, in the presence of the adolescent, to discuss the forensic findings and answer questions.

Taking care of a young person is a delicate matter, especially in the context of sexual assault. The victim has the feeling of being "forced to undergo" the gynecological and/or anal examination requested by the investigators. This constraint and lack of information are the main obstacles to the proper conduct of the examination. Everything plays at the time of intake, and it is important that the nurse explains the process of the examination and specifies that no action will be taken without detailed explanations and without consent. In case of a formal refusal, the teenager's choice will be respected. In daily practice, thanks to this welcome and personalized care, it is rare for a teenager to refuse the exam.

As for the younger child, the medical examination is complete; it can give rise to discussions that go beyond the legal process (puberty, sexuality, contraception, etc.).

Sometimes teenage girls make up stories of sexual assault to get out of a difficult situation. Although it is not the role of the caregiver to "extract a confession" from a teenager who recounts a fanciful story, it is quite possible to express surprise, which sometimes allows the teenager to start talking freely. The most common reasons for false allegations are the justification for a pregnancy and the explanation given for a delay or absence from home. Attracting the attention of relatives or getting revenge can also be motivations.

Adolescent girls can also conceal a perpetrator, either when they are not in a clear position regarding sexual intercourse (the girl did not refuse, by timidity or weakness, of the relationships she does not really desire) or because the perpetrator is a member of the family. These situations are complex, and the caregiver's attitude

must be open and adapted to each case while respecting the young person. Again, the purpose is not to investigate but to explore the possibility of suffering or unsaid events, of which updating could be useful to the young person and his/her family.

23.5 In Schools

School-based caregivers are often on the frontline collect youth revelations. In adolescence in particular, it is often easier to express acts of violence outside the family. Even when there is a relationship of trust with parents, it may be difficult to talk to them about sexuality for fear of hurting, worrying, being misunderstood, or rejected. And even more so if the violence takes place within the family.

While a teenager seeks to protect a revelation by attempting to confine the confidant in the trap of professional secrecy, the adult, destabilized, could fail to warn the young person of the obligation to report. The latter can then be experienced as a real betrayal by the young person. It is therefore necessary to be particularly clear about the future of certain shared information.

Estelle is 13 years old. After many visits to the infirmary for various illnesses—headaches, abdominal pain—she once confided in the school nurse that during the last vacation with her father, 7 months before, something happened that really troubled her. She was camping, alone with him. One night while he was in bed, her father caressed her genitals and then introduced a finger. The next day, he pretended that nothing had happened. He never started again, but since when she sees him, she feels ill at ease.*

Her parents were separated, and she saw little of her father. Estelle was unable to talk to her mother about the facts because she was ashamed of what had happened and thought that her mother would not believe her.

When she left the infirmary, she had the nurse promise to tell no one.

The latter immediately informed the director of the establishment who alerted the police. A few hours later, police come to fetch Estelle. After questioning, she had to sleep in a foster home before the scheduled gynecological examination the next morning. Upon arrival at the medicolegal unit, the teenager was still angry, she felt betrayed by the nurse who had promised not to say anything.

She refused to be examined, retracted her statement, and refused dialogue with caregivers.

All these real situations help to understand the complexity of the caregiver's position. For professionals, it is important to share these situations as a team and to seek advice from people specialized in this area, in reference centers. Sharing situations with teams also limits the vicarious trauma.

It is very important for pediatric caregivers to know the reality of abuse, to focus on the child, and to do the best for the child and his/her family, knowing one's own limits, depending on one's sensitivity and one's own history and passing the case onto someone else if necessary [5].

**Names have been changed to protect the privacy of the patients.*

Key Points

- The context of child abuse often puts caregivers in an uncomfortable situation, of which it is important to be aware.
- The caregiver-patient relationship must seek an adequate distance and build in benevolence regardless of the violence of the situation.
- Identification by the caregiver of incoherent or fluctuating explanations is essential to the diagnosis of abuse and should be shared with the entire medical team.
- Generally speaking, when abuse is suspected, the caregiver must share all information gathered with the medical team. This sharing is beneficial for the child's care and helps the caregiver maintain a balanced attitude.
- Investigation should be done exclusively to investigators and judges. Overly intense interrogation in medical settings can interfere with the facts and affect the quality of the caregiving relationship.
- The caregiver must take into account and respect the child's family constellation for further support, especially if abuse is intrafamily.
- Caregivers should be very clear about the future of confided secrets, especially in cases of sexual assault.
- The caregiver's role is primarily to protect the young person.

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