Birth Trauma

13

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Contents

13.1 Introduction

Due to the intrinsic nature of the mechanical forces involved and the bony boundaries of the birth passage, the process of birth is naturally traumatic for the infant. Even under optimal conditions, injuries such as greenstick fracture of clavicle and subdural haemorrhages are seen in children born by normal spontaneous vaginal delivery. Furthermore, subdural haematoma has been documented in utero even before the initiation of labour. Added to this are the trauma caused by the mechanical forces applied by the obstetrician in delivering the baby. It is no surprise that the exact cause of a particular trauma in a newborn, with associated emotional and medico-legal sensitivities, may at times be far from clear or certain.

The risk factors for birth injuries include macrosomia, prematurity, instrumental delivery, breech and other abnormal presentations, prolonged second stage of labour and precipitous delivery. These risk factors are well recognised and efforts such as decreased use of forceps and more pre-emptive Caeserean sections have helped in reducing the incidence of birth trauma over the years. However, as mentioned above, due to the nature of labour itself, the overall incidence of birth injuries still remains at over 1% in most studies.

Birth trauma caused by intrinsic and applied mechanical forces during labour are discussed in this chapter, in order of anatomical location. We have focussed mostly on the diagnosis and management of the most common mechanical injuries reported during labour.

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13.2 Head

Head trauma could be classified, according to its location, into three categories: extracranial, cranial or intracranial. Extracranial injuries include skin lacerations secondary to blood sampling, and haemorrhage in between various extracranial anatomical layers secondary to rupturing of blood vessels or bony fractures. Cranial injuries are usually related to fractures of skull bones, either linear or depressed. The most common intracranial injuries are those where veins are ruptured within the subdural space leading to subdural haematoma; epidural and subarachnoid haemorrhages are also seen, though less frequently.

13.2.1 Extracranial Haematomas

Extracranial haematomas can be classified according to their anatomical location. These include caput succedaneum, subgaleal haemorrhage and cephalhaematoma.

13.2.1.1 Caput Succedaneum

Caput succedaneum is due to rupture of blood vessels within the dense connective tissue underneath the skin and can be secondary to birth trauma itself or due to vacuum or forceps delivery. Purpura and ecchymosis of the overlying skin are common, and the suture lines do not restrict the swelling. The bleeding is usually minimal due to the tamponading effect of the dense connective tissue. These haematomas resolve spontaneously within a few days.

13.2.1.2 Subgaleal Haemorrhage

Subgaleal haemorrhage is secondary to rupture of emissary veins within the loose connective tissue between the galea aponeurotica and the periosteum. The bleeding can also sometimes result from a bony fracture. It is seen in up to 6.4 per 1,000 forceps deliveries, and the bleeding can continue for 2–3 days and result in significant loss of blood due to the lack of resistance by the loose connective tissue. Other risk factors include prolonged second stage of labour, foetal distress and macrosomia. It presents as a firm to fluctuant mass that crosses the suture lines. It is estimated that each 1 cm increase in the head circumference correlates to 38 ml of blood loss. Treatment is largely supportive including serial blood tests and fluid replacement. A full blood count is necessary to establish the extent of blood loss and a coagulation screen is required following transfusion of blood and large volume of fluids. Bilirubin levels may increase due to reabsorption of large haematomas in neonates, and this needs to be monitored closely. The overall mortality is reported to be in the range of 14–22% when there is excessive blood loss, and surgery may be required in severe cases to cauterize the bleeding vessels.

13.2.1.3 Cephalhaematoma

Cephalhaematoma is by far the most common extracranial haematoma and is due to the rupture of blood vessels beneath the periosteum. It is seen in approximately 2.5% of newborns and is associated with forceps and breech deliveries. The swelling does not cross the suture lines due to the periosteal attachments to the bone, and purpura or ecchymosis is not a feature of cephalhaematoma. A small percentage (5%) is associated with bony fractures. Rapid expansion and excessive blood loss are rare, but can occur if the periosteum ruptures. Cephalhaematoma usually resolves over a few weeks and no treatment is necessary. However, if rapid expansion with signs of sepsis is noted, infection of the haematoma should be suspected; aspiration of fluid for diagnosis and treatment may be necessary in such situations (Fig. 13.1).

Fig. 13.1 Large cephalhaematoma

13.2.2 Cranial Injuries

Cranial injuries usually consist of linear fractures of parietal bones. As it is the case with most birth injuries, such fractures can occur even in uncomplicated spontaneous vaginal deliveries. Additional risk factors include forceps delivery and prolonged labour. Depressed fractures are seen infrequently, and such depressed fractures are mostly of the ‘ping-pong ball’ type that is due to inward buckling of the resilient neonatal calvarial bones. Again most of the cranial injuries could be managed conservatively. In the absence of neurological deficits or signs of raised intracranial pressure, surgery is not indicated for the treatment of depressed bony fractures. However, non-surgical interventions such as elevation of the depressed segment with digital pressure or a breast pump have been utilised successfully in the past. When there are signs and symptoms of raised intracranial pressure such as apnoea, seizures, focal neurological deficits, lethargy and hypotonia, neurosurgical intervention is necessary to evacuate any haematoma and to elevate the fractured segment.

13.2.3 Intracranial Haemorrhage

Intracranial haemorrhage is seen less frequently than extracranial haemorrhage and the prevalence of symptomatic intracranial haemorrhage in term infants is approximately 5–6 per 10,000 live births. Again, intracranial injuries have been documented in infants born by normal vaginal deliveries, but the incidence is higher with risk factors such as forceps delivery, prolonged labour and macrosomia. The most frequent intracranial haemorrhage is subdural haemorrhage (75%); epidural haemorrhage is rare and subarachnoid haemorrhage is usually associated with preterm infants and asphyxia.

13.2.3.1 Subdural Haemorrhage

Subdural haemorrhage is seen in 8–10 per 10,000 forceps deliveries and the prevalence has decreased over the years with the reduction in the use of forceps. It is seen in 6% of all uncomplicated vaginal deliveries and has even been documented in some infants before the initiation of labour. Subdural haemorrhage commonly results from the tearing of the tentorial and interhemispheric veins. Studies have shown that in asymptomatic children the haemorrhage resolves spontaneously within 4 weeks and results in no long-term developmental abnormalities. Significant bleeding can lead to volume depletion and raised intracranial pressure, and the infant exhibits the following symptoms: apnoea, seizures, focal neurological deficits, unequal pupils, eye deviation, bulging fontanelle, lethargy, hypotonia, drowsiness and coma. Though these symptoms are usually seen within 24 h of birth, on occasions it may take up to a few days to fully develop, as the bleeding can be slow and continuous. Cranial ultrasound is useful in the diagnosis of subdural haemorrhages, but is operator dependent. CT scan is the diagnostic procedure of choice in suspected cases, and MRI scan may be useful to gain added information in selected cases. Most children with subdural haemorrhage are asymptomatic and could be treated conservatively following diagnostic imaging. However, a small percentage will have symptoms; posterior fossa bleeds are more symptomatic and may lead to brain-stem compression. These symptomatic infants will require surgical evacuation of their haematoma. Progressive hydrocephalus is a well-known complication of subdural haemorrhage in some, and symptomatic and asymptomatic children must be monitored with serial head circumference measurements on a centile chart. When detected, ventriculoperitoneal shunt insertion is indicated to drain the Cerebrospinal fluid (CSF) into the peritoneal cavity. Though a majority of children with subdural haemorrhage meet their developmental milestones well, a significant proportion (up to 30% in one study) show mild to severe developmental delay as they grow older. When the bleeding is within the posterior fossa, developmental delay is seen in up to 50% of infants.

13.2.3.2 Subarachnoid Haemorrhage

Subarachnoid haemorrhage is caused by rupture of the bridging veins of the subarachnoid space in preterm infants. Though seen in 1 in 10,000 spontaneous vaginal deliveries, the prevalence increases to 3 per 10,000 in forceps deliveries. Symptoms are that of raised intracranial pressure in an infant seen within the first 1–2 days of life. Cranial ultrasound, CT scan and CSF sampling may all help in the diagnosis. As with subdural haemorrhage, most subarachnoid haemorrhages also resolve spontaneously with no long-term morbidity, and do not need surgical intervention. Progressive hydrocephalus is a known complication of subarachnoid haemorrhage and should be monitored for in the recovering infant. If seen, ventriculoperitoneal shunting is necessary. Hypoxic injury to the brain tissue must also be monitored for in those with large subarachnoid bleed.

13.2.3.3 Epidural Haemorrhage

Epidural haemorrhage is rare and is usually associated with cephalhaematoma or skull fracture. It is usually due to a direct injury to the middle meningeal artery, which is not protected within a bony groove in the newborns, and can on occasions be very large. Skull X-rays and CT scan are useful in the diagnosis of this injury. Unlike those with subdural haemorrhage, most infants with epidural haemorrhage are symptomatic and will need neurosurgical intervention. Aspiration of the haematoma, without surgery, has also been reported to be successful in the treatment of epidural haemorrhage.

13.3 Injuries to Peripheral Nerves

These injuries are usually caused by excessive traction or direct compression of nerves during the delivery. The nerves most commonly involved are the brachial plexus, facial nerve, and the phrenic nerve. The outcome of treatment from these injuries is usually good. This type of nerve injury was first classified by Seddon into three categories and was later expanded into the following five categories by Sunderland:

1. First-degree injury or neuropraxia—involves a temporary conduction block with demyelination of the nerve at the site of injury; complete recovery is normal and takes up to 12 weeks.
2. Second-degree injury or axonotmesis—severe trauma causing proximal and distal axonal degeneration. The endoneurial tubes are intact and the recovery is complete, with axonal regeneration occurring at a rate of 1 mm per day.
3. Third-degree injury—same as a second-degree injury but more severe, with disruption to the endoneurial tubes. As with second-degree, the regeneration is complete, but the regenerating axons may not reinnervate their original motor and sensory targets.
4. Fourth-degree injury—larger area of axon is damaged and this precludes any axons from advancing distally during regeneration. Surgery is necessary to restore neural continuity.
5. Fifth-degree injury—complete transection of the nerve, and surgery is again necessary for recovery of function.

13.3.1 Brachial Plexus Injury

Brachial plexus injury could either affect the entire plexus or some part of it. It is by far the most common injury and is reported in 0.1–0.3% of all live births. Risk factors include large birth weight (maternal diabetes), prolonged second stage of labour, forceps delivery, shoulder dystocia and malpresentation. It is believed to occur due to excessive downward traction on the head so as to dislodge an impacted shoulder. However, brachial plexus injury has been reported on the opposite side, in the posterior shoulder, in up to 40% of affected infants. It has also been reported after normal uncomplicated vaginal deliveries, and in infants born by elective Caesarean sections. The explanation for some of these injuries may lie in the overall traumatic nature of birth and the significant mechanical forces involved during normal labour, and may not simply be attributable to the techniques employed by the midwife or obstetrician during labour. Brachial plexus injury has been divided into three main types depending on the site of the injury within the brachial plexus: Erb's palsy, Klumpke's palsy and injury to the entire plexus.

13.3.1.1 Erb's Palsy

The upper brachial plexus injury was first described by Erb in 1874, and is by far the most common type (90%) of birth-related peripheral nerve injury. The injury is to the C5-C6 nerve roots resulting in the affected arm hanging limply adducted and internally rotated at the shoulder, and extended and pronated at the elbow with flexed wrist and fingers in the typical 'waiter's tip' posture (Fig. 13.2). This is the result of paralysis of the deltoid, supraspinatus, infraspinatus, brachioradialis and supinator brevis muscles. On the affected side the Moro, biceps and radial reflexes are absent, while the grasp reflex is preserved. Associated phrenic nerve injury should be excluded.

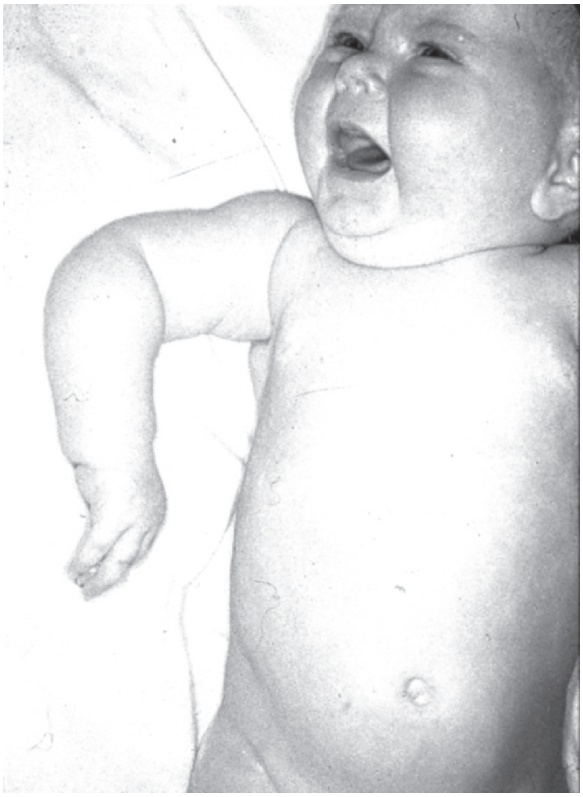

Fig. 13.2 Erb's palsy with 'waiter's tip position of the right arm

Most neonates will make a complete or partial recovery on conservative treatment alone, as this type of nerve injury is mostly of the first and second degree according to Suderland's scale. Initial conservative treatment includes immobilization of the affected arm underneath the sleeve for 1 week. After 1 week of rest, the arm is put through passive range-of-motion exercises at the shoulder, elbow and wrist to prevent contractures. The prognosis is excellent when antigravity muscle movements are seen within biceps and shoulder abductors by 3 months of age. If by 3 months no movements are documented within these muscle groups, then specialised neurosurgical opinion should be sought, in view to reconstructive surgery. The recovery is somewhat guarded following surgical correction in children with Erb's palsy.

13.3.1.2 Klumpke's Paralysis

Injury to lower plexus including C8-T1 nerve roots was later described by Klumpke in 1885. This lower plexus injury is uncommon. It results in paralysis of the intrinsic muscles of the hand and flexors of the wrist and fingers. The grasp reflex is absent. The same trauma that causes lower plexus injury may also lead to injury of the cervical sympathetic fibres. Injury to cervical sympathetic fibres may result in ipsilateral Horner's syndrome. Treatment is again conservative, but the recovery rates are poorer than for Erb's palsy. Again surgical exploration must be sought early, when no recovery is noted after 3–6 months of age. In all children considered for surgery, electrodiagnostic studies and CT or MRI scan must be carried out preoperatively. Advanced microsurgical techniques combined with nerve grafting from the dural nerve can improve the functional outcome in some children.

13.3.1.3 Injury to Entire Brachial Plexus

Injury to the entire brachial plexus results in flaccid arm with absence of sweating, sensation, and deep tendon reflexes. X-ray of the upper arm and shoulder should be performed to exclude the possibility of bony injuries. Children with injury to the entire brachial plexus have severe nerve disruption and get worse on conservative management. Early neurosurgical opinion and surgical exploration should be considered for these children as well.

13.3.2 Facial Nerve Injury

Facial nerve injury is usually unilateral and is secondary to compression of the nerve against stylomastoid foramen or the ramus of the mandible. Compression could be either with forceps or against the sacral promontory. It is seen in approximately 0.06–0.7% of all live births. Most injuries are simple swelling of the axons secondary to the compression, and disruption of the axons is rarely seen. The affected side of the face would have absent or decreased forehead wrinkling, a persistently open eye, a decreased nasolabial fold and flattening of the corner of the mouth. Spontaneous complete recovery within a month is seen in >90% of infants. Therefore, the initial treatment consists of protecting the affected eye from drying out with application of artificial tears, until full recovery is documented. Because of the high incidence of spontaneous recovery, surgery should only be considered for those with no signs of recovery after 1 year.

13.3.3 Phrenic Nerve Injury

Phrenic nerve injury arises from C3–C5 nerve roots and is the motor supply to the ipsilateral diaphragm. Injury to this nerve usually results from excessive traction of the neck muscles, and leads to paralysis of the ipsilateral diaphragm. Most of these injuries (up to 75%) occur together with brachial plexus injury, or fracture of the clavicle, and are unilateral. The most common cause of phrenic nerve injury is a difficult breech delivery. Clinically, the infant may show respiratory distress and decreased air-entry on the affected side. Chest X-ray will show a raised hemidiaphragm with mediastinal shift to the opposite side (Fig. 13.3). Atelectasis of the lower lobe of lung on the affected side with pneumonia may be present. Ultrasound may confirm paralysis by demonstrating paradoxical movement of the affected hemidiaphragm. Treatment is again conservative with oxygen, physiotherapy and antibiotics when indicated. If the respiratory distress is significant, continuous positive airway pressure ventilation should be considered. Surgery is indicated when no improvement is seen after 2 weeks of mechanical ventilation or 3 months of conservative treatment. Surgical options include plication of the diaphragm or, rarely, excision and artificial patch repair of the diaphragm as employed in the repair of large congenital diaphragmatic hernias.

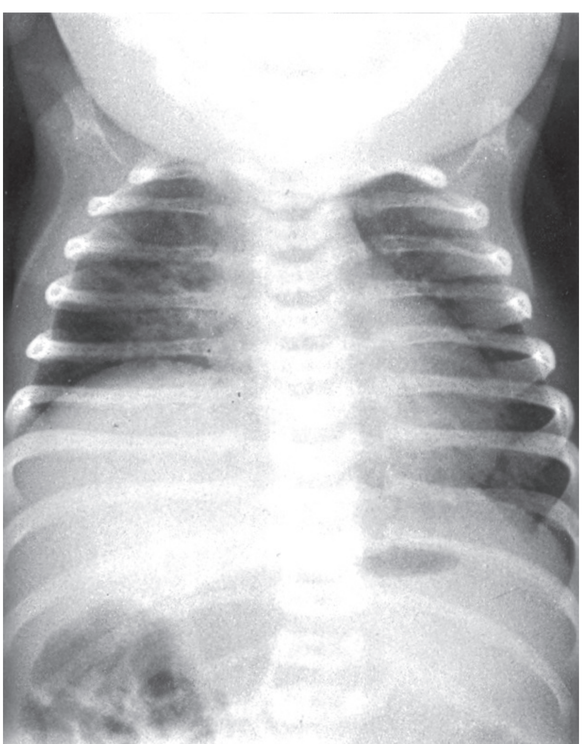

Fig. 13.3 Elevated right diaphragm due to phrenic nerve analysis

13.3.4 Spinal Cord Injury

This is an extremely rare injury. Due to the incomplete mineralisation of the vertebrae and lax ligaments in a newborn, the spine could potentially stretch more than the spinal cord, and thereby result in an injury to the cord. Damage to the upper cervical cord is common and is associated with rotation of the head during vertex delivery with forceps. Lower cord injury occurs during breech delivery, when the head is trapped secondary to cephalopelvic disproportion. Injury above the level of C4 will result in paralysis of the diaphragm due to phrenic nerve injury and cause apnoea. When the injury is below the level of C4, the following signs and symptoms will be present: absent spontaneous movement, absent tendon reflexes and lack of response to painful stimuli below the level of the injury. The bladder will be atonic and distended while the anal sphincter will be atonic and patulent. The outcome, in general, is very poor for these infants. Early management should consist of strict immobilization of the head, neck and spine. Ultrasonography and MRI scan will reveal the extent of injury and may help in determining the prognosis. X-rays alone are usually not helpful. Treatment should be supportive including ventilation and passive range of movements to prevent pressure ulcers and pain relief. The overall outcome in this group of children is poor resulting in early death, severe disability and ventilator dependency.

13.4 Abdominal Organ Injuries

Trauma to abdominal organs is uncommon during birth. The organs most commonly affected are the liver, spleen, adrenal gland and kidney. Risk factors include hepatosplenomegaly, breech presentation, macrosomia, prematurity and coagulation disorders. Proposed mechanism of injury to the liver and spleen include: direct trauma by the rib cage secondary to thoracic wall compression; thoracic wall compression causing a pulling effect on the ligamentous attachments to the liver and spleen with consequent tearing of the parenchyma; and trauma secondary to instrumental compression of the organs. Subcapsular bleeds are common, but organ rupture with intra-abdominal bleed is also seen. Clinical signs and symptoms are that of an intra-abdominal bleeding with pallor, shock, abdominal distension and abdominal discoloration. Adrenal haemorrhage may present as a flank mass. When suspected, abdominal ultrasound, CT and abdominal paracentesis could all help in the diagnosis. Blood tests should include full blood count, coagulation screen and cross match. Treatment is supportive with fluid replacement and/or transfusion as indicated by the severity of the blood loss. When supportive treatment fails or the infant becomes haemodynamically unstable, explorative laparotomy must be undertaken. In splenic injury, every attempt must be made to preserve the spleen before considering splenectomy to overcome the active bleeding.

Risk factors for adrenal haemorrhage include prolonged labour, asphyxia, prematurity, septicaemia, renal vein thrombosis and haemorrhagic disease of the newborn. The right side is involved in 70% of cases, with bilateral involvement seen in 5–10% of cases. The classical adrenal haemorrhage presents within the first 4 days of life as a flank mass with fever and jaundice or anaemia. Ultrasound is useful in the diagnosis, and a rim of suprarenal calcification may be seen on abdominal radiograph 2–4 weeks later. Management is the same as above with supportive transfusion followed by laparotomy in severe cases.

Renal traumas are rare and are usually seen in the background of congenital renal anomalies. Investigations such as renal ultrasound, CT scan, DMSA or MAG3 scan may be necessary to assess the injury and any underlying congenital abnormality, following supportive management for the bleeding. Long-term follow-up may be necessary as renal trauma could lead to scarring of the renal parenchyma.

13.5 Fractures

13.5.1 Fracture of Clavicle

This is the most frequently fractured bone during birth and is seen in 0.3–3% of newborns. The vast difference in the reported incidence is due to the fact that a majority of these fractures go unnoticed due to lack of external findings. A majority of these fractures are of the greenstick type are not even recognized at the time of discharge of the infant from hospital. Risk factors are the same as for most birth traumas, and are sometimes seen in uncomplicated normal deliveries as well. The most common finding is reduced movement of the affected arm, but discolouration and bony deformity are also seen infrequently. A normal X-ray will confirm the diagnosis (Fig. 13.4). Treatment is usually conservative for incomplete fractures. When complete fracture is noted, the arm should be immobilized for 7–10 days. Differential diagnoses include brachial plexus injury, fracture of humerus, and shoulder dislocation. Erb's palsy and phrenic nerve injury must be excluded. Recovery is complete in most infants.

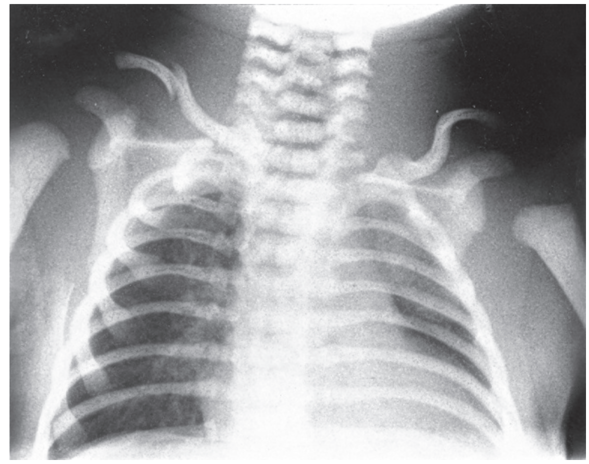

Fig. 13.4 Fractured right clavicle

13.5.2 Long Bone Fractures

Fractures of humerus and femur are uncommon, but are associated with breech presentation, low birth weight and traction during delivery. Swelling, pain and decreased movement of the limb may be present. A normal X-ray will confirm fracture of long bones. However, high index of suspicion of epiphyseal injuries must be borne in mind. These epiphyseal injuries will not show up on plain X-rays, and when suspected ultrasonography for accurate diagnosis must be done. Treatment consists of immobilisation and splinting of the joint. For displaced fractures, closed reduction and casting may be necessary. Proximal femoral fractures need Pavlik harness or spica cast for a period of time.

Further Reading

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