Chapter 1
History of Pediatric Neurosurgery

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Wherever the art of Medicine is loved, there is also a love of Humanity
Hippocrates (460–375 BC)

1.1 The Evolution of Neurosurgery from Ancient Greece to Modern Times

The history of neurosurgery must start when the human being first appeared on earth, and according to the history of medicine it is synchronous with the history of surgery. The first account of traumatic brain injury is found early in the Holy Bible, when Cain inflicted a fatal head injury on his brother Abel with the jawbone of an ass [1]. According to Greek mythology, and specifically cosmogony, the genesis of the Greek gods, Hephaestus struck Zeus on his forehead with an axe to relieve him of headaches. Immediately afterwards, Athena, the goddess of wisdom, emerged from her father's head. Pindar makes a clear reference to the genesis of goddess Athena in this way, inadvertently providing the first description of a neurosurgical intervention [2].

The Holy Bible provides two clear references to successful cardiopulmonary resuscitation, dating back to around 850 BC. The first is a description of how the prophets Elijah and Elisha gave life back to a boy who had apparently died, using the method of blowing air through his mouth and warming the boy with their own bodies [3]. Also in the Bible, the same method of blowing air through the mouth is used by the Jewish midwives Foa and Sephora to get newborn infants to cry [4].

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The technique of cranial trepanation has been known since prehistoric times. Its use was based on the belief that skull opening let out demonic elements that caused various neuro-psychiatric symptoms. The first documented evidence of such surgery in Greece dates back to the Minoan era findings (2000 BC), on the island of Crete, where skull drilling was performed for ritual and religious purposes [5]. In Ancient Greece, the use of analgesic techniques was widespread. During the Bronze Age, in the Aegean, a mixture of raw opium and anhydrous morphine with a maximum content of 20% was used as a primitive anesthetic, and as an analgesic to treat toothache in infants by rubbing it on their gums [6].

Pediatric reports can be widely found in the works of both Hippocrates and Galens. Hippocrates used a method similar to today's intubation to save sick children suffering from diphtherial membranes that blocked their air flow. This disease is rare today, as children now receive antidiphtherial vaccine in infancy, but in the past it was a common cause of respiratory distress in children. Hippocrates used thin tubes to relieve the young patients who were suffering from severe shortness of breath; he inserted these tubes between the jaws into the pharynx, so that the lungs could pump air, in a method very similar to modern intubation [7]. Regarding the treatment of hydrocephalus, he proposed a therapeutic approach through a cranial incision [8].

On traumatic brain injury, a famous quote of Hippocrates is "*No head injury is too trivial to be ignored*". He reported that midline head trauma is associated with increased mortality. In cases of skull fractures with hematoma, Hippocrates used a therapeutic approach through cranial perforation in order to remove the blood and create space for the brain. He recommended that the intervention be performed with maximun attention in children, because their skull bones are thinner than those of adults. In his works, Hippocrates described three cases of cranial procedures in children: (a) on a boy who had a head injury and developed a fever 12 days later due to wound infection. The inflammation spread to the surrounding tissues, and the boy had his skull drilled to improve his clinical picture, (b) on an 11-year-old boy, who suffered a fracture of the frontal bone and, because of bleeding, had his skull drilled, which resulted in improvement, and (c) on a 12-year-old girl, who suffered a compressed fracture and was treated immediately with skull drilling. In the following days, the trauma got infected and the patient developed focal convulsions [9].

As treatment for spinal disorders, Hippocrates recommended forciblet stretching in a horizontal position or hanging the patient by the armpits in order to stretch the spine. Today we know that spinal abnormalities represent the most common non-traumatic musculoskeletal disorders in childhood. Myelomeningocele is a congenital malformation, and the skeletal remains of people suffering from myelomeningocele dating back at least 3,000 years have been found in archaeological excavations. Myelomeningocele was described by both Hippocrates and Aristotle [10]. In Ancient times, medical care for infants with congenital abnormalities was almost non-existent, and infanticide was recommended, with most infants who were born with severe deformities being left to die unattended.

During the Roman period, the famous Greek doctor Asklipiadis, a friend of Cicero, Crassus and Marcus Aurelius, was the first to report a tracheotomy on a young man who was being carried in a funeral procession. Asklipiadis noticed that the youth appeared to be still alive and resuscitated him by this method [11].

Soranos the Ephesian (98–138 A.D.) would deal systematically with pediatrics; in his work, there is extensive reference to the nutrition and hygiene of infants and descriptions of pediatric diseases [12]. During the Byzantine era, which began with the establishment of the capital of the Eastern Roman Empire in Constantinople in 324 AD, Paul of Aegina (625–690 AD) made an important contribution to neurosurgery with his work on nerve injuries, hydrocephalus, and the diagnosis and treatment of skull and spinal fractures [13].

In spite of the fact that the ancient Greeks and Byzantines made significant contributions to medicine and surgery [13], in modern Greece, Pediatrics was recognized as a separate specialty only in 1878, and the first pediatric hospital operated on the premises of the Municipal Nursery of Athens. The first reference to pediatric neurosurgery in modern Greece is in 1882, when a 7-year-old boy was injured in the frontal area and underwent surgery, performed by a surgeon of that time who removed bone fragments and left the wound to heal.

At the beginning of the twentieth century, The "Aghia Sophia" Children's Hospital, founded in 1900, was the only pediatric hospital in Greece. At that time, child mortality was very high, and the Pediatric specialty in Greece was still at its very beginnings. Christos Daskalakis from Smyrna reported the excision a meningocele in the cervical spine of a 52-day-old infant on April 18, 1903 [14]. Christidis from Monastiri, reported the case of congenital encephalomyelomeningocele in a 5-month-old infant, presenting with a mass in the occipital region equal in size to the infant's head, which he operated on under general anesthesia. At a meeting of the Medical Society of Athens in 1925, Konstantinos Mermigas described in detail the treatment of a 2.5-year-old child suffering from spina bifida ("meningocele"): "*sac excision, the liquid had formed a mass at the child's head, his neck was stitched, the soft tissues were rearranged in order to close the surgical wound*" [15]. In the early 1960s, Stamatios Komninos established the first pediatric neurosurgery department at the 'Aghia Sofia" Children's Hospital in Athens. Neofytos Prodromou was the following Director for 30 years.

1.2 The Evolution of Neurosurgery in Europe

In 1517, a European surgeon, Hans von Gersdorff, described a cranioplasty, constructed with a mixture of oil and wine on wood, which was compressed until it hardened. Gersdorff rightly noted that it should not be pressed hard, because that would become fatal [16]. The first printed paper on head injuries was "*Tractatus de fractura calve sive cranei*", written by Jacopo Berengario da Carpi (1460–1530). In

this text, published in 1518, Berengario proposed several methods of treating fractured skulls, the relevance of which can be debated today: "*When large parts of the skull are removed, the wound should be sprinkled with chopped dried pumpkin (Frustulum cucurbitae siccae), which accelerates healing. The smaller defects are covered with "flesh" [carne].*" [17].

The Englishman James Yong (1647–1721) described the case of a child who survived a severe traumatic brain injury that presented with a compound skull fracture and brain tissue issuing from the wound [18]. In 1667, Thomas Willis reported the first case of a stroke in a child "Pediatric hemiplegia", after which a series of cases of pediatric stroke was reported by Osler, Sachs, Peterson and Freud [19]. The predictive method, the first modern (twentieth century) evaluation of children with ischemic stroke, was written by Ford and Schaffer, who focused on causes, outcome and quality of life in children that survived. [20]

In 1800, Samuel T. Söemmerring (1755–1830) was the first to describe the sutures of the skull. He argued that the role of skull sutures was to allow the brain to grow, and that if sutures close prematurely, abnormal growth of the head would occur. In fact, he described a case of lambdoid synostosis [21]. Later, in 1894, Wheaton first described two infants with craniosynostosis associated with fusion of the toes and feet. The Carpenter syndrome was first described by Carpenter in 1901 and later published in 1909 [22]. It is characterized by craniosynostosis. Heart abnormalities have been reported in one third of patients. Over the last 50 years, more than 65 syndromes, including craniofacial syndromes, have been described as craniosynostosis disorders, and the neurosurgical treatment of craniofacial syndromes has undergone many changes.

The term "syringomyelia" was coined by D'Angers, in 1827, from the Greek syrinx, or tube. In Greek mythology, Syrinx was a nymph who turned herself into a reed to save herself from Pan's amorous pursuits. From this reed, Pan shaped his music pipes. Today, syringomyelia is a wider term used for the development of a fluid-filled cyst within the spinal cord. It is usually associated with a variety of pathological conditions, but it is more commonly seen with posterior fossa brain abnormalities, such as type 1 Chiari malformation [23].

1.3 Period 1840–1940: The Century of the Most Important Changes

The first pediatric hospital in Europe was founded in Paris in 1802 and later, in 1855, the first in the USA [24]. During this period, major advances in anesthesia resulted in great changes in surgery. Pediatric anesthesia was first applied on July 3, 1842, when Crawford W. Long administered anesthesia to Jack, an 8-year-old boy, who needed to have his toe amputated. He was anesthetized with the use of diethyl ether on a towel [25]. In Russia, in 1847, F.I. Inozemtsev performed operations on two children aged 10 and 14 years whom he anesthetized using ether [26]. John Snow (1813–1858) in his book entitled "Chloroform and other anesthetics", reported

that chloroform was used in some newborns cases, and that by June 30, 1857, he had administered chloroform to 186 infants with no side effects [27]. In 1858, the method of cardiopulmonary resuscitation by Silvester and Howard was introduced in clinical practice [28].

Regarding the anatomy of neurosurgical conditions, in 1862, when autopsy was established, Freidrich Daniel Von Recklinghausen was the first to diagnose the disease named after him, on autopsy studies in people with multiple heart and brain tumors [29]. Intracranial aneurysms in children were rarely encountered. One of the first cases of pediatric aneurysm was recorded by the German pathologist Eppinger in 1871. He described a 15-year-old boy who collapsed during strenuous exercise while the "disease" gradually progressed to weakness of the lower limbs over the next 3 days, and the boy died. Postmortem examination showed rupture of an aneurysm from the right anterior cerebral artery. A few years later, Edvard Bull described the first case of death in a 17-year-old girl who presented with a severe headache. Autopsy revealed rupture of a cerebral aneurysm [30].

On the topic of head trauma, on March 20, 1879, Sir William Macewen, a Scottish surgeon, operated on and drained a subacute hematoma a in a nine-year-old boy, who had fallen from height. Six days later, the child presented with convulsions that led to loss of consciousness. This pioneer surgeon made a frontal skin incision and drilled in the area above the coronary suture, where the fracture line was visible. On July 27, 1879, the same surgeon re-operated for a local relapse of a large tumor in the orbit of a 14-year-old girl, which caused unilateral seizures. Macewen is considered a pioneering neurosurgeon. He was the surgeon who successfully combined the technique of anatomical localization and practice of neurosurgery [31].

A 22-month-old infant presented to the Glasgow Royal Infirmary, where Macewen worked, on June 24, 1887 with symptoms suggesting a brain disorder, with facial nerve palsy and ear discharge. He made an incision above the mastoid, and the surface of the brain was observed to be eroded, softened and ulcerated. The cavity was rinsed with borate solution, and a drainage tube was inserted, which was removed on the sixth day, when the wound had filled with granulation tissue. In 1893, Macewen published his book entitled: "Pyogenic infectious diseases of the brain and spinal cord: Meningitis, cerebral abscess, infectious venous thrombosis" [32]. In this book, a series of 19 patients with 82 brain abscesses, of which 21 were successfully drained by surgery was reported. He described the infectious diseases of the meninges of the brain and spinal cord. This work represented a comprehensive review of knowledge about brain abscesses in the nineteenth century. Through his work, Macewen made it clear that he had extensive insight and could diagnose these disorders accurately, despite the absence of modern diagnostic studies and surgical techniques.

Walter Dandy described how the urologist Victor Darwin, in 1910, used a cystoscope to remove the choroid plexus in two infants with hydrocephalus. One infant died, but the other lived for 5 years [33].

On the topic of spinal cord tumors Charles Elsberg in 1911 reported a strategy for surgical intervention and management of intramedullary tumors. As the first step, only myelotomy was performed, then, after waiting a long time for the tumor

to partially come out through the myelotomy and separate to some extent from the spinal cord, an extensive resection was performed. These first attempts to manage tumors surgically showed poor results, and the rate of neurological sequelae of surgery on intramedullary neoplasms was unacceptably high [34]. This led to more conservative treatment that included biopsy, decompression, and subsequent radiotherapy, regardless of the histological diagnosis. In 1922, Walter Dandy, who is considered a pioneering neurosurgeon, employed a cystoscope to visualize the ventricles, and used for the first time the term "ventriculoscopy" [35]. William Jason Mixter made the first successful endoscopic third ventriculostomy in 1923. Ventriculoscopy was mainly used for choroid plexus coagulation and third ventriculostomy for the treatment of hydrocephalus [36]. This technique met with various difficulties, such as inappropriate endoscopes, and the high morbidity and mortality rates discouraged neurosurgeons from using endoscopy.

Returning to Boston from England in 1929, Franc D. Ingraham, with his extensive clinical and research background, focused on the rapidly growing area of neurosurgery for children, together with Harvey Cushing. Ingraham created the first pediatric neurosurgical unit in the world, located at Boston Children's Hospital, and he is recognized as the founder of pediatric neurosurgery [37].

1.4 Period 1940–1960

After 1940 and following World War II, pediatric surgery developed rapidly. Surgeons started to go beyond the usual pediatric surgical procedures, such as tonsillectomy, appendectomy and simple orthopedic surgery. In parallel, bioethics made an appearance in the late 1940s, largely as a response to the atrocities committed by Nazi doctors in the concentration camps during World War II. The trials of these doctors in Nuremberg from 1946 to 1947 resulted in the formulation of the Nuremberg Code, outlining a list of requirements for ethical behavior in the field of research on humans, which have subsequently been updated [38].

The evolution of pediatric surgery necessitated a different management of anesthesia for newborn infants and children, and scientific research focused on how to prevent fear and psychological trauma in the child by administering pre-anesthesia. Not only were new techniques of anesthesiaapplied (oral, intravenous, intramuscular, rectal), but also new anesthetic drugs were discovered. A milestone in pediatric anesthesia was the withdrawal of ether, which was a flammable gas, and the introduction of halothane in 1955. A basic prerequisite was control of the child's airway and ventilation, achieved by the use of muscle relaxants and other sedatives, especially for cardiac surgery [39] Basic principles of pediatric anesthesia were established, such as the application of pediatric endotracheal tubes, the use of delivery systems and new non-explosive gases, anesthetic drugs and muscle relaxants, which enabled surgeons to perform complex surgery, even in premature neonates with congenital disorders. Concurrently, in the 1940s, vaccines for the influenza A virus and for diphtheria were developed.

Carl List, in 1941, described the neurological syndromes associated with developmental abnormalities of the occipital bone, atlas, and spinal cord. Pediatric neurosurgery was developed from that time, based on the concomitant advent of adult neurosurgery. In several countries, neurosurgeons such as Harvey Cushing, Walter Dandy, Kenneth McKenzie were operating, and their work was focused mainly on treating hydrocephalus and brain tumors. In 1949, Nulsen and Spitz revolutionized the treatment of hydrocephalus by introducing the ventricle drainage valve [40].

Progress has been particularly rapid since the 1950s. Breakthroughs of note at that time were the introduction of abdominal peritoneal drainage for hydrocephalus, and the recognition and effective treatment for the Chiari malformation and spinal cord tethering. The Society for Research into Spina Bifida and Hydrocephalus was founded in 1957.

1.5 Period 1960–1980

The anatomical, physiological and emotional differences between adults and infants and children, as well as the different pharmacodynamics of the anesthetic agents, contributed to the consolidation of pediatric anesthesia as an autonomous specialty. The administration of pre-anesthesia, the elimination of explosive anesthetic agents, mainly ether which was replaced by halothane, but also the introduction of endotracheal intubation and intravenous anesthetics and muscle relaxants, paved the way for the development of anesthesia covering all fields of pediatric surgery, including neurosurgery. Techniques of monitoring vital functions were developed, together with perioperative fluid management, which allowed major and lengthy operations to be performed.

In 1960, there was a revival of interest in neuroendoscopy, largely due to developments in visual imaging, with Harold Hopkins being a pioneer in the field. Hopkins, a British physicist, played a key role in the development of two important types of endoscopic systems [41]. Successful surgical removal of tumors from the spinal cord was established by Greenwood, and the introduction of the operating microscope, perfection of bipolar coagulation and microsurgery enabled neurosurgeons to treat intramedullary tumors. Because the majority of these tumors are histologically benign, complete or near complete resection is likely to lead to long-term survival, without serious morbidity [42].

In 1964, the German geneticist Rudolph Pfeiffer described a craniofacial syndrome of variable severity in children, which also presented wide thumbs and great toes and soft tissue syndactyly of the hands. The Pfeiffer syndrome may involve premature fusion of any combination of cranial sutures. Craniofacial surgery techniques were developed by the French surgeon Paul Tessier in 1967 at the Necker Hospital in Paris to correct the deformities of the Apert and Crouzon syndromes with favorable results [43]. Surgery to separate Siamese twins was also performed.

The European Society of Pediatric Neurosurgery (ESPN) was founded after the first European meeting of the Pediatric Neurosurgery Conference in Vienna in 1967.

The American Society of Pediatric Neurosurgeons (ASPN) was founded in 1978. Similar organizations were established in Japan (1973), Mexico (1999) and Australia (2002). The creation of these associations reflects the increasing focus on child neurosurgery all around the world [44]. During the 1970s and 1980s, pediatric neurosurgical departments appeared in most of the largest cities in the United States and Canada. Anthony J. Raimondi played a major role in founding the International Society of Pediatric Neurosurgery (ISPN) in Chicago in 1972.

In the 1970s, the use of computed tomography (CT) and later of magnetic resonance imaging (MRI) brought great changes in pediatric neurosurgery, and epilepsy surgery evolved [45]. In 1971, cortical dysplasia, which is increasingly recognized as the most important cause of intractable epilepsy in children, was first described Taylor and colleagues [46]. Hoffman identified a group of tumors that involve mainly the fourth ventricle, which had a better prognosis than the more common lesions.

1.6 Period 1980–present

The first fetal surgery was performed in the 1980s. The proposed optimal age for surgery was on fetuses ≤26 weeks of gestation. The fetal treatment of hydrocephalus was first reported in 1981 by Birnholz and Frigoletto, who performed a series of ultrasound-guided percutaneous cephalocenteses as an adjunct to delivery of a fetus with massive cranial enlargement [47]. Recent advances in surgical techniques for the management of spinal dysraphism and brain tumors are enormous. Since the introduction of CT and MRI, the development of functional MRI and MR spectroscopy have provided great improvements in imaging of the child's nervous system. The technology of surgical microscopes has greatly advanced, new shunt systems, such as programmable valves, have become available, and in the late 1980s, stereotactic radiosurgery became an important treatment option for children. New intraoperative devices, such as the ultrasonic surgical aspirator, have been introduced, and radiosurgery has provided a new therapeutic approach to the management of deep-seated malignant lesions. Baclofen pumps, vagal nerve stimulators, and deep brain stimulation are starting to be developed. All these advances hold great promise for the future of pediatric neurosurgery. During the past decades, the number of full-time pediatric neurosurgeons increased all over the world.

References

1. The Holy Bible. Genesis 4:1–16
2. Kennedy-Quigley S. Visual representations of the birth of Athena/Menrva: a comparative study. Etruscan Stud. 2001;8, Article 5, p. 65–78.
3. The Holy Bible. Kings 19:19–21.
4. The Holy Bible. Exodus 1:15–17.
5. Tsouros AD. Research on prehistoric bones. The Acharnes Skull. 1974 Athens, I:55–60.

6. Tzedakis G, Minoans MH. Ancient archeological museum. Athens: Kapon Publications; 1999. p. 262–8.
7. Tsoucalas G, Sgantzos M. Hippocrates (ca 460–375 bc), Introducing Thoracotomy Combined With a Tracheal Intubation for the Parapneumonic Pleural Effusions and Empyema Thoracis. Surg Innov. 2016 Dec;23(6):642–3.
8. Oldman KT, Paul MC, Foglia RP. Surgery of infants and children: scientific principles and practice. Philadelphia: Lippincot-Raven; 1997.
9. Panourias IG, Skiadas PK, Sakas DE, Marketos SG. Hippocrates: a pioneer in the treatment of head injuries. Neurosurgery 2005 Jul;57(1):181–189; discussion 181–9.
10. Smith GK. The history of spina bifida, hydrocephalus, paraplegia, and incontinence. Pediatr Surg Int. 2001;17:424–32.
11. Durbin CG Jr. Techniques for performing tracheostomy. Respir Care. 2005 Apr;50(4):488–96.
12. Karamperopoulos D. Sorano's pediatrics. History of Greek pediatrics. Athens. 2009;1:147–58.
13. Missios S, Bekelis K, Roberts DW. Neurosurgery in the Byzantine Empire: the contributions of Paul of Aegina (625-690 AD). J Neurosurg. 2014 Jan;120(1):244–9.
14. Panagopoulos Dimitrios. "The History of Pediatric Neurosurgery. A Brief Historical Overview". EC Paediatrics 7.12(2018):1162–1163.
15. Mermigas, K. Title of report. Archives of the P and A Kyriakou Children's Hospital date. History of Pediatrics of University of Athens.1879–1915.
16. Di Matteo B, Tarabella V, Filardo G, Viganò A, Tomba P, Marcacci M. The traumatologist and the battlefield. J Trauma Acute Care Surg. 2013;74:339–43.
17. Parent A. Berengario da Carpi and the Renaissance of Brain Anatomy. Front Neuroanat. 2019 Feb 13;13:11.
18. Yong J. Wounds of the brain proved curable…London: JM for Henry Faithorn and John Kersey, 1682
19. Molnár Z. Thomas Willis (1621–1675), the founder of clinical neuroscience. Nat Rev Neurosci. 2004 Apr;5(4):329–35.
20. Ford FRSA, Schaffer AJ. The etiology of infantile acquired hemiplegia. Am Med Assoc Arch Neurol Psychiatry. 1927;18:323–47.
21. Pearce JMS. Samuel Thomas Soemmerring (1755–1830): the naming of Cranial Nerves. Eur Neurol. 2017;77(5–6):303–6.
22. Hidestrand P, Vasconez H, Cottrill C. Carpenter syndrome. J Craniofac Surg. 2009 Jan;20(1):254–6.
23. Medow J, Sansone J, Iskandar BJ. Syringomyelia and Hydromyelia. In: Albright Leland A, Pollack IF, Adelson DP, editors. Principles and practice of pediatric neurosurgery. 2nd ed. New York; Stuttgart: Thieme. 2008.
24. Nichols B et al. One century of paediatrics in Europe (section: development in pediatric hospitals in Europe). In History of paediatrics 1850–1950. Nestle Nutrion Warkshop Series, 22. New York NY: Raven Press; 1991, p. 27.
25. Downes J. Historic origins and role of pediatric anesthesiology in child health care. Pediatric Clin North Am. 1994 Feb;41(1):1–14.
26. Robinson JA. Treatise on the inhalation of the vapour of ether for the prevention of pain of surgical operations. London: Webster & Co.; 1847. p. 16.
27. Chloroform and other Anesthetics, edited, with a Memoir, by B. W. Richardson, 8vo, London, 1858.
28. Silvester HR. A new method of resuscitating still-born children, and of restoring the persons apparently drowned or dead. BMJ. 1858;2:576–579, 31.
29. Ruggieri M, Praticò AD, Serra A, et al. Early history of neurofibromatosis type 2 and related forms: earliest descriptions of acoustic neuromas, medical curiosities, misconceptions, landmarks and the pioneers behind the eponyms. Childs Nerv Syst. 2017;33:549–60.
30. Ozgur BM, Khoo LT, Levy ML. Pediatric Intracerebral aneurysms. In: Albright LA, Pollack IF, Adelson DP, editors. Principles and practice of pediatric neurosurgery. 2nd ed. New York; Stuttgart: Thieme. 2007.

31. Macewen W. Intra-cranial lesions, illustrating some points in connexion with the localization of cerebral infections and the advantages of antiseptic trephining. Lancet. 1881;2:541–3. 581–583
32. Macewen W. Pyogenic infective discases of the brain and spinal cord: menigitis, abscess of brain, infective sinus thrombosis. Glasgow: James Maclehose & Sons; 1893.
33. Dandy WE. An operative procedure for hydrocephalus. Bull Johns Hopkins Hosp. 1922;33:189–90.
34. Elsberg CA, Beer R. The operability of intramedullary tumors of the spinal cord. A report of two operations with remarks upon the extrusion of intraspinal tumors. Am J Med Sci. 1911;142:636.
35. Blitz AM, Ahmed AK, Rigamonti D. Founder of modern hydrocephalus diagnosis and therapy: Walter Dandy at the Johns Hopkins Hospital. J Neurosurg. 2018 Oct;1:1–6.
36. Walker ML, MacDonald J, Wright LC. The history of ventriculoscopy: where do we go from here? Pediatr Neurosurg. 1992;18(4):218–23.
37. Cohen AR. Boston children's hospital and the origin of pediatric neurosurgery. Childs Nerv Syst. 2014 Oct;30(10):1621–4.
38. Czech H, Druml C, Weindling P. Medical ethics in the 70 years after the nuremberg code, 1947 to the present. Wien Klin Wochenschr. 2018 Jun;130(Suppl 3):159–253.
39. Fortuna A. Fortuna Anibal de Oliviera: the history of pediatric anesthesia. Balliers Clin Anesthesiol. 2000;14:625–39.
40. Aschoff A, Kremer P, Hashemi B, Kunze S. The scientific history of hydrocephalus and its treatment. Neurosurg Rev. 1999 Oct;22(2–3):67–93.
41. Abd-El-Barr MM, Cohen AR. The origin and evolution of neuroendoscopy. Childs Nerv Syst. 2013 May;29(5):727–37.
42. Tudor KI, Tudor M, Buca A, Cambi-Sapunar L, Tudor L, Dujmović D, Carija R, Sucević D, Carić D. Elektrokirurgija, temelj suvremenih dosega operacija tumora mozga—prigodom 80. Obljetnice [Electrosurgery, the cornerstone of current achievements of brain tumor surgery—on the occasion of 80th anniversary]. Acta Med Croatica. 2008 Feb;62(1):33–40.
43. Ghali GE, Sinn DP, Tantipasawasin S. Management of nonsyndromic craniosynostosis. Atlas Oral Maxillofac Surg Clin North Am. 2002 Mar;10(1):1–41.
44. Albright AL. The past, present, and future of pediatric neurosurgery. Matson lecture, May 4, 2004. J Neurosurg. 2004 Nov;101(2 Suppl):125–9.
45. Cardinale F, Lo Russo G, Munari C. Cenni di storia moderna della chirurgia delle epilessie del lobo temporale [Short account of modern history of surgery in temporal lobe epilepsy]. Chir Ital. 1996;48(6):4–8.
46. Taylor DC, Falconer MA, Bruton CJ, Corsellis JA. Focal dysplasia of the cerebral cortex in epilepsy. J Neurol Neurosurg Psychiatry. 1971 Aug;34(4):369–87.
47. Birnholz JC, Frigoletto FD. Antenatal treatment of hydrocephalus. N Engl J Med. 1981 Apr 23;304(17):1021–3.