Neglected Spinal Cord, Brain Stem and Musculoskeletal Injuries Stemming from Birth Trauma

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ABSTRACT

Objective: A review of the medical literature was undertaken to determine cause, diagnosis, prognosis, treatment and prevention of injuries resulting from birth trauma. The primary focus was the neonate, though infant, child and adult were also considered because the effects of birth trauma can be life-long.

Data Source: A compilation of case studies and review articles were extracted from numerous “MEDLINE” literature searches. Key Terms included: Birth Trauma, Central Nervous System Injuries, Musculoskeletal Injuries, Stillbirth, Sudden Infant Death Syndrome (SIDS), Cerebral Palsy, Brachial Plexus Palsies (Erb's and Klumpke's), Neonatal-Infantile Respiratory Distress, Obstetric Accidents (Forceps, Vacuum Cup and Cesarean Deliveries), Subluxation, Chiropractic Treatment. American, British, Danish and German studies were included to show the universality of the problem.

Study Selection: Findings were selected on the basis of a clear connection between birth trauma and the resulting symptoms, syndromes and/or death.

INTRODUCTION

Although newborn spinal and brain stem injury was a documented factor in more than 10% of 50,000 neonatal deaths annually in the U.S. during the early 1960s (1), the incidence is less well known today. This was made apparent by a lack of current figures on this topic. The Statistical Abstract of the United States 1991 (2) does not address spinal and brain stem injury directly but does give separate figures for deaths related to this type of injury. Specific empirical data are not available, which, ironically, is one of the points suggesting the issue remains unaddressed. However, there is related research that indicates that newborn brain stem, spinal cord and other injuries stemming from birth trauma are prevalent today and that the problem warrants much more recognition than it is receiving.

An inherent difficulty of doing this research is the fact that we live in a litigious society (3) and obstetrics is a highly targeted area for malpractice suits. This hinders research on this topic. In some cases, for fear of drawing attention to possible instances of malpractice, there is a lack of completeness of patient notes (4, 5), which are both useful and necessary for case studies. With regard to causation, many obvious and some less obvious examples of birth trauma will be cited. The harmful effects that vary in severity will be described giving consideration to prevention and treatment.

Key Indexing Terms: Birth Injuries, Musculoskeletal System, Sudden Infant Death (SID).
DISCUSSION

Detailed studies have been completed from 1836 (6) to the present. Reports describing dislocations and fractures of vertebrae, hemorrhage with tearing of meninges and even “direct observation on decapitations of mature stillborn infants by linear tension” (7) demonstrate the newborn’s susceptibility to injury. Historically, gross trauma was the only subject of attention after newborn death. Upon detailed examination, autopsied newborns revealed many other less obvious iatrogenic maladies that would not have been detected and attributed to the death without further probing. With more advanced obstetrical techniques, the frequency of gross injuries decreased and unfortunately for the afflicted, the concern did as well. The trends in years of potential life lost reflect a decrease in deaths caused by birth trauma from 1980–1985 but this still remains one of the major causes of death in the first year of life (8). Textbooks and other references give little, if any, attention to the subject. Whereas “in times past decapitations were not rare” (1), fortunately they no longer occur with regularity. However, latent spinal and brain stem injuries that remain undiagnosed continue to be a serious problem today. Clinically, there are many injuries that do not attract attention at the time and therefore remain undiagnosed (9). These cases warrant attention because these injuries have lifelong if not life-threatening consequences.

Physical examination is objective, but often the results are misinterpreted. Radiography is inconclusive because the injuries are of soft tissue; neonatal vertebrae are cartilaginous and unfused, making fractures difficult to diagnose. Myelography carries risks of its own and is not accurate enough to offer an extensive view (10). Even computed tomography (CT) scans and ultrasound are not reliable for diagnosis of these injuries (10). Worst of all is ignorance. In most cases, brain stem and spinal cord damage were not even considered, much less observed (11–13). Repeatedly, respiratory distress was documented (11). Clinical investigators remain preoccupied with the cerebrum even though anencephalics can live for extended periods of time without their cerebrum (1). The brain stem houses the respiratory centers and other vital nuclei but these areas remain unexplored in most autopsy cases (11–13). Even with the knowledge that most neonates with intrapartum cord injuries die from respiratory failure, neonatal autopsies do not routinely include examination of the spinal cord and brain stem (7).

Autopsy procedures are highly individualized by each examiner and there are no particular guidelines for how neonatal autopsies should be handled. A medical examiner’s task is to determine the most likely cause of death and the manner in which it occurred, whether it be by natural causes, homicide or suicide. A seemingly obvious cause of death may not be traced to the original etiology but merely to the manifesting symptom. The shortcoming of this is indicated by a neonate suffering at birth from respiratory depression, leading to atelectasis or pneumonia and, subsequently, to death. As it now stands, the autopsy could be concluded after finding the atelectasis or pneumonia in the lungs with the diagnosis stated in reference to respiratory depression present at the time of birth. In such cases it would be important to check the brain stem for possible damage resulting from birth, because the centers for respiration are located in the brain stem. Although the cause of death may be malfunctioning lungs, the precipitating factor could be a damaged brain stem. The medical examiner’s task appears to be to satisfactorily locate the immediate cause of death. It is not always practical to probe every other possible etiology once a reasonable cause of death is established. This represents an unfortunate loss of potentially valuable research data. An accurate diagnosis is necessary for furthering the prevention of such injuries. Another distraction is the current preoccupation with morphological studies of the placenta in cases of stillbirth or early neonatal death.

One cannot find what one is not looking for. How can anyone take relief from fewer documented cases of injuries when the decline is very likely attributable to oversight, neglect and inadequate investigation (11–13).

The newborn’s vertebral column is not completely ossified and is easily distorted by the natural forceful uterine contractions. The added unphysiologic assistance of traction or torsion increases the susceptibility of the neonate to injury. The encasing structures of the central nervous system are able to stretch more than the less elastic neural tissues, thereby allowing cord lesions and transections to occur when excessive force is used during delivery (7, 14).

In breech deliveries, injury to the spinal cord results from excessive longitudinal traction, whereas torsion is usually the cause in cephalic presentation (7). Most cases of cord transection occur with breech delivery (14). More complex delivery procedures have a higher rate of birth trauma (15). Mid to lower cervical or upper thoracic levels are associated with breech deliveries whereas more superior lesions accompany cephalic deliveries.

The entire spinal cord and brain stem can be injured during the birthing process by the forces already described. The gross injuries are easily traced back to parturition, but the milder traumas yield defects that
may remain undiagnosed for a lifetime. Once again, a major symptom is respiratory distress. A lesion in the brain stem might be an obvious cause here, although the diagnosis of distressed neonates is often mislabeled as difficult labor or impingement of the umbilical cord during labor.

With long axis traction, the surrounding structures of the spinal cord such as vertebrae, ligaments and muscles stretch, whereas the less elastic spinal cord is held in the neural canal. Some of the structures anchoring the spinal cord in the neural canal are the brachial plexus in the cervicothoracic region, cauda equina in the lumbar region, filum terminale externum in the sacroccygeal region, and associated spinal nerves in all other regions. The type of injury depends on presentation of the infant, type and amount of force applied, and which structures fail first. If the cord and spinal nerves hold, the brain stem and cerebellum will be pulled against the foramen magnum (1). The brachial plexus may not allow the longitudinal stretch and, secondarily, the cord will be transected at that level, accounting for the region most often affected. The effect on the brachial plexus itself is not without consequences.

The brachial plexus innervates the arms supplying the muscles, skin and reflexes. The brachial plexus may be stretched or the spinal nerves may be avulsed from the cord (13, 16-26). Damage to the superior portion of the plexus (C5 and C6) results in Erb’s palsy, causing the infant to hold the upper extremity in adduction with internal rotation, extension at the elbow, and flexion at the wrist in the “waiter’s tip” position. Damage to the lower portion (C8 and T1) of the brachial plexus results in Klumpke’s palsy, which yields flexion and supination of the forearm, extension of the wrist and a “clawlike” deformity of the hand.

A 1986 study by Jackson et al. (25) found an incidence of 2.5 brachial plexus injuries per 1,000 live births, which coincides with the references quoted in that study. The reported incidence of seven references cited by that study ranged from .4-2.5 per 1,000 live births; these rates have not declined in the last few decades. A 1991 study cited seven more current references in which brachial plexus birth injury ranged from .57-2.6 per 1,000 live births (23). Much more evidence of brachial plexus palsy associated with birth trauma was found in literature comparing assisted vaginal delivery to obstetric forceps, vacuum cup and cesarean deliveries (13, 19-22, 24, 26, 27). Although these articles were using brachial palsies in part as a gauge for how traumatic the delivery was, the recommended treatment was nonsurgical management. As documented below, Horner’s syndrome often occurs with Klumpke’s palsy. In about 5% of Erb-Duchenne palsies, there is an associated phrenic nerve paralysis resulting in elevation of the diaphragm on the side of injury, which will affect respiration (25, 26).

Horner’s syndrome, which involves pupillary constriction, superior eyelid droop and dilated vessels as well as loss of sweating on the affected side of the face, may accompany brachial plexus injuries (16, 17, 23, 25, 26, 28). This occurs especially when fibers of the first thoracic root of the cervical sympathetic chain are damaged.

If the cord lesion is above C3, the diaphragm does not receive innervation and the infant will not be able to take its first breath, thus mandating artificial respiration. It should be emphasized that areas of the body below lesions in the cord will be paralyzed.

Lesions of the C3, C5 and C7 nerve roots affect the thoracic nerve innervating the serratus anterior muscles and result in scapular winging. Similarly, lesions in this area could also affect the dorsal scapular nerve, supra-scapular nerve and nerves to the longus colli and scalene muscles, leaving the muscles of the shoulder and anterior neck weakened.

Fractures of the skull (5, 22, 29) and vertebrae (30) occur with difficult deliveries but are not as common as clavicle fractures (19, 21, 22, 24-27). Vertebral fractures may often be missed because most occur through the cartilaginous vertebral endplates (30). This is an important injury to recognize early because the endplates are the active growth zone. If damaged, the vertebrae may fail to grow to a normal height or will develop asymmetrically resulting in spinal deformities such as scoliosis.

Ligament tears and associated effects such as vertebral joint blockages, fixations and subluxations are also documented results of birth traumas that have deleterious effects (13, 30-35). A myriad of problems are known to be effects of subluxations (joint dysfunction); for example, a general failure to thrive, sleeping disorders, eating disorders, lowered immune resistance, tonsillitis, enteritis, otitis and colic, to name just a few (19, 31, 32, 34, 36-38). Congenital torticollis, another musculoskeletal injury, often results from overstretching the sternocleidomastoid muscle in the neck (31, 32, 34).

Birth trauma to the central nervous system causes the most significant consequences because of the non-regenerative nature of neural tissue. Stillborns, early neonatal deaths, and lifetime impairments are the outcomes of brain stem and spinal cord injury (2, 3, 5, 8, 12, 24). Stillbirth and brain damage account for almost
half the malpractice claims filed against obstetricians (5). Respiratory depression or distress can be caused by damage to the reticular nuclei just dorsal to the inferior olives of the brain stem. Respiratory depression is multifactorial and accounts for a large percentage of neonatal deaths (2, 5, 8, 12, 13). Another condition with a similar theorized etiology is sudden infant death syndrome (SIDS) (11, 13, 29, 39–47). The vagus nerve has been implicated in SIDS since it is important in tidal volume, respiratory rate and respiratory reflexes (47). It is suggested that the permeability of the lung capillaries may be modified by the outflow of stimuli from the brain stem by way of the vagus nerves whereby plasma leaves the pulmonary vessels on a large scale as to induce edema of the lungs (13). Just as respiratory depression is involved with SIDS, so is altered cardiac rhythm. When the dorsal nucleus of the vagus nerve in the brain stem is jeopardized, so is the function of the heart, lungs, renal system and gastrointestinal tract. Cervical traction applied at birth may result in vagal aberration caused by pressure exerted on the hindbrain and vagal nucleus by the occiput. With cord lesions the sympathetic nervous system arising below the T1 cord level is cut off, but the parasympathetic nervous system remains active via the vagus nerve thus causing bradycardia to occur (48). Facial palsies, extracranial muscle imbalance and other cranial nerve deficits result from brain stem trauma affecting the corresponding cranial nerve nuclei (12). Other facial palsies and paralysis are associated with direct injury to the face by forceps (9, 21, 32). One autopsy study shows the cerebellar peduncles torn from the ventral portion of the brain stem (12). If the infant had survived it is likely that it would have been deaf and blind. Trends suggest a relatively greater incidence of abnormal motor development and decreased intelligence quotient (IQ) after dysfunctional labors than after normal labors (49). The abundance of children labeled as epileptics (12, 31, 50), or cerebral palsies (4, 12, 13, 24, 27, 51–55), are described as “being that way at birth” rather than a potentially more accurate description of “being that way from birth.” Although the cervical region of the spinal cord is most susceptible to birth trauma, other areas are also injured (30). Symptoms as odd as priapism, an unstimulated, constant erection, indicate damage to the sacral autonomic nervous system (7, 10, 56).

Vascular compromise is yet another possible result of birth injury during delivery. Vertebral arteries can be stretched axially or rotationally, cutting off blood supply or causing hemorrhage in the brain and spinal cord (40). If a stroke is not caused during delivery, it may occur afterward. Birth trauma destabilizing the neck will predispose the infant to verteobasilar artery insufficiencies (39). As one review of the literature points out, “the ‘pop’ or ‘snap’ often heard during delivery, and ascribed to a fracture is actually a rupture of the dura mater of the spinal cord” (16). Therefore, if transection of the cord is not the causative agent, the forthcoming hemorrhage and/or thrombosis of vessels will be. Spinal epidural and intracranial hemorrhage, and thrombosis of varying severity and distribution are reported often in the neonate (1, 11, 12, 19, 21, 24).

The number of reported studies of birth trauma, or lack thereof, is disappointing. Most of the research that includes birth trauma merely does so for ancillary reasons. Birth trauma is used as a gauge for which obstetric technique produces less casualties than the other, or as a side note for the reason a case study was done on the implantation of an artificial pacemaker in a 30-month-old baby (48), or because someone figured out how to make a nonmetallic respirator to keep a brain stem-injured infant alive while magnetic resonance imaging (MRI) was being done (56). Although these are noble studies, more needs to be done explicitly on the prevention and treatment of birth traumas. Neonates who die, or live and suffer lifetime maladies such as paralysis or cerebral palsy, gain little by attaching the right diagnosis to the cause. However, a more accurate diagnosis now may prevent future birth injuries from occurring, or at least contribute to a better prognosis for others. Most of the cases in this literature review were obstetric accidents, but it is important to recall that even a natural unassisted birth can be a traumatic experience and much can happen in utero prior to delivery.

Changes in obstetric techniques must be sought. For example, a 1990 study determined that there were more “preventable stillbirths” occurring than there were “nonpreventable” (3). Injuries such as pharyngeal or cervical esophageal perforation that are attributable to the physician’s finger being placed in the baby’s mouth could be prevented (26). Another technique in which manual pressure is applied to the suprapubic region of the mother to hasten delivery of the after-coming head may force the brain stem of the fetus into the posterior fossa and foramen magnum, thus causing injury (12).

The “specialists” cannot agree on which techniques are safest. Some reports indicate increased neonatal morbidity with use of midforceps and cite ample reasons for abandoning use of the midforceps procedure (3, 5, 27). Other reports show no increase in neonatal risks with midforceps delivery and conclude that it decreases maternal morbidity and mortality when compared with cesarean delivery (27). Still others have different preferences between vaginal and elective ce-
sarean deliveries (4, 20). Physician’s temperament rather than experience seemed to be a factor in yet another study (3).

Some of the birth traumas are not repairable either surgically or nonsurgically. However, many of the resulting conditions do respond favorably to nonsurgical treatment. Appropriate treatment can only begin after identifying the real cause. A remaining point is that if larger injuries can be missed, what about the numerous smaller injuries that are even less obvious and keep individuals from living the healthiest life possible?

Prevention of the birth traumas mentioned would obviously be the most beneficial approach. Since complete prevention is not possible and there is already an injured population that needs help, the treatment aspect must now be addressed. The nature of these birth traumas causes damage to the neural and musculoskeletal systems; therefore, a specialist in these areas is required.

Twelve percent of the children with severe spinal cord injuries develop posttraumatic spinal deformity and most can be managed with nonoperative therapy (30). Some of the complications most frequently overlooked are joint fixations, blockages and minor dislocations. These forms of injury are responsible for many and varied manifesting symptoms; as mentioned before, injuries or complications are missed for several reasons.

Static radiography or other diagnostic imaging are often not adequate for locating these musculoskeletal insults (57). The reason is that some factor is interfering with normal articular mobility; thus, the problem is a dynamic impairment of mobility rather than a static positional impairment (58). Specialists in chiropractic and manual medicine professions are trained to find these impairments of mobility with palpation and treat them with adjustments or manipulations. A German physician, Gutmann, using manipulation as the mode of treatment, has presented a few cases from more than 1,000 that, almost without exception, were successfully treated (31, 32, 36). The first case was a 10-month-old baby suffering torticollis from birth after suction delivery. Skull and facial asymmetry developed, and the baby could not sit or crawl. Cerebral disturbances of movement were diagnosed by the orthopedic institute treating the patient. Moderate dislocation of the occiput from atlas-axis was noted. The infant was given a manual impulse treatment in this region to correct the problem. The second treatment was after 4 months, and the parents reported that the child had literally made a great leap forward after each treatment. Motor responses and previously retarded mental and linguistic development proceeded normally and the facial asymmetry was completely gone after the second treatment. Clear improvements in posture and motor response were confirmed by collaborating colleagues during the 12 months following treatment. Recurrent rhinitis, bronchitis, tonsillitis, enteritis, persistent conjunctivitis, antalgia, restless sleep with crying out at night, unmitigated central seizures, cerebral spasms, disturbed motor responses, disturbance of appetite and overall inability to thrive are just some of the symptoms Dr. Gutmann successfully treated by manipulating the upper cervical and occiput region (31, 32, 36). Biedermann (34), in the surgical department of a German University treated more than 600 patients (less than 24 months old) from 1981–1990. Biedermann described kinematic imbalances due to suboccipital strain in newborns. The symptoms treated, source of the problems, and favorable results after only one manipulation were similar to those described by Gutmann.

CONCLUSION
A study of 604 children with a variety of symptoms such as infantile colic, gastrointestinal disturbances, otitis media, auditory disturbances, asthma, bronchitis, allergies, dermatological disturbances (59), enuresis (bed-wetting), headache, migraine, spinal and peripheral joint problems, motor-neurological disorders and other symptomatologies were all treated to completion with an average of 3.7 treatments (60). Using the studies already presented, and employing the basic tenets of neurology and the science of chiropractic, it should be evident that manipulation is a valuable resource to consider for treating musculoskeletal insults in the neonate and infant. The accompanying symptoms and syndromes are reported to respond well to this type of health care. Retrospective case reports including chiropractic in the treatment of otitis media (38), hyperactivity (61), seizure disorder (50), infantile colic (62), dyspnea-atelectasis (63, 64), cerebral palsy (55), Down’s syndrome (65) and autism (66) continue to suggest the diverse nature of ailments and the effectiveness of chiropractic adjustments (37). Unfortunately, case reports alone are not suitable evidence. Controlled studies must be undertaken to further substantiate case report findings. Research has shown the coexistence of upper respiratory tract infection and atlantoaxial joint fixation (67). Findings such as these support the contention that where symptoms first appear must not be the only areas assessed and treated by the physician. Many concur that the developing neuromusculoskeletal system should be monitored from birth and that the treatment should be manual for certain problems (31, 32, 36, 39).
The utilization of manipulative care in the perinatal environment should be further explored and documented through controlled studies, as manipulation may prove to be beneficial to this otherwise untreated population.

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