NEW METHODS CHILDREN WITH BIRTH TRAUMA.

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This activity reviews common birth-related injuries. The mechanism of injury, clinical features, and management of various birth-related traumatic events are described. An interprofessional team's role in the assessment, management, and prevention of birth-injuries is also highlighted.

Objectives:

- Describe the pathophysiology and clinical course of the common extracranial and intracranial hemorrhages.
- Review the mechanism of injury, clinical features, and prognosis of brachial plexus injuries.
- Outline the most common soft tissue injuries related to birth with a special emphasis on subcutaneous fat necrosis and its complications.
- Summarize the importance of an interprofessional team in the management and long term follow up of infants who sustain neurodevelopmental impairment from birth trauma.

Introduction. The National Vital Statistics Report defines birth injury as "an impairment of the neonate's body function or structure due to an adverse event that occurred at birth." These injuries include a wide range of minor to major injuries due to various mechanical forces during labor and delivery. Birth injuries are different from birth defects or malformations and are often easily distinguishable from congenital defects by a focused clinical assessment. Birth trauma rates have steadily declined over the last few decades due to refinements in obstetrical techniques and the increased use of cesarean delivery in cases of dystocia or difficult vaginal deliveries. The birth trauma rate fell from 2.6 per 1000 live births in 2004 to 1.9 per 1000 live births in 2012. The rates of instrumental deliveries have also gradually declined over the past three decades, reducing the number of both forceps and vacuum-assisted deliveries.[1]

Go to:

Issues of Concern. The risk factors associated with birth trauma can group into those related to the fetus, pregnancy, mother, or iatrogenic factors (use of instrumentation during delivery).[2][3]

- Fetal and pregnancy-related factors include:
    - Macrosomia (estimated fetal weight greater than 4000g)

- Macrocephaly
- Very low birth weight and extreme prematurity
- Fetal congenital anomalies
- Oligohydramnios and malpresentation, including breech presentation as well as other abnormal presentations (such as the face, brow, or transverse)

- Maternal factors may include:[4]
  - Maternal obesity,
  - Maternal diabetes,
  - Dephalopelvic disproportion
  - Small maternal stature
  - Primiparity
  - Dystocia and difficult extraction
  - Use of vacuum or forceps
  - Prolonged or rapid labor

The clinical management and prognosis of infants with birth injuries vary widely depending on the injury's type and severity. The common sites for birth trauma can include the head, neck, and shoulders. Other less common locations include the face, abdomen, and lower limbs. A summary of the common traumatic clinical conditions occurring related to birth is listed below.

Head Trauma

Head trauma can include superficial lesions, extracranial and intracranial hemorrhages, and fractures of the skull bones.

Caput Succedaneum: Caput succedaneum is a common scalp swelling in newborns. It is a subcutaneous swelling and edema of the scalp between the skin and the periosteum due to local venous congestion from the birth canal's pressure on the presenting part. The edema is above the plane of the periosteum, and hence the scalp swelling crosses suture lines. No intervention is required, and it typically resolves over the first few postnatal days. Rare complications include bruising of the skin over the swelling with necrosis resulting in scarring and alopecia, and rarely systemic infection.

Skull Fractures: Skull fractures from birth trauma are most often a result of instrumented vaginal delivery. These fractures could be linear or depressed and are usually asymptomatic unless associated with an intracranial injury. Plain film radiographs of the skull usually clarify the diagnosis. Still, computed tomography

(CT) or magnetic resonance imaging (MRI) of the brain is recommended if there is suspicion of intracranial injury or neurologic symptoms.

Extracranial Hemorrhages:

Cephalohematoma: Cephalohematoma is a localized sub-periosteal collection of blood resulting from the rupture of blood vessels traversing from the skull to the periosteum. Limited by the periosteal attachment to the underlying skull bones, the swelling does not cross suture lines and is often unilateral. It is more common in deliveries involving vacuum or forceps and occurs in up to 2.5% of all deliveries. [5] The usual course is a spontaneous resolution in 2 weeks to 3 months without intervention. However, complications such as calcification, deformities of the skull, infection, and osteomyelitis can occur.

Subgaleal hemorrhage: subgaleal hemorrhage is a collection of blood in the loose areolar tissue space between the galea aponeurotica and the skull's periosteum. The injury occurs when traction pulls the scalp away from the stationary bony calvarium, resulting in the shearing or severing of the bridging vessels. A difficult vaginal delivery resulting in the use of forceps or vacuum is the most common predisposing event in the formation of subgaleal hemorrhage. It has been estimated to occur in 4 of 10000 spontaneous vaginal deliveries and 59 of 10000 vacuum-assisted deliveries.[6] Since the subgaleal space is a significant potential space extending over the entire area of the scalp from the anterior attachment of the galea aponeurosis near the frontal bones to the posterior attachment at the nape of the neck, there is a potential for massive bleeding into this space that could result in acute hypovolemic shock, multi-organ failure, and death. Treatment includes supportive care with early recognition and restoration of blood volume using blood or fresh frozen plasma to correct the acute onset hypovolemia. The hemorrhage itself is not drained and allowed to resorb over time. A workup for bleeding disorders may be considered in selected cases if the degree of bleeding is out of proportion to the trauma at birth.

Intracranial Hemorrhages:

Traumatic intracranial hemorrhages include epidural, subdural, subarachnoid, intraventricular, and less frequently intracerebral and intracerebellar hemorrhages.

Epidural hemorrhage is rare in neonates and usually accompanies linear skull fractures in the parietal-temporal region following an operative delivery. Signs include bulging fontanelle, bradycardia, hypertension, irritability, altered consciousness, hypotonia, seizures. Diagnosis is via CT or MRI of the head, which shows a convex appearance of blood collection in the epidural space. Prompt neurosurgical intervention is necessary due to the potential to deteriorate rapidly.

Subdural Hemorrhage is the most common type of intracranial hemorrhage in neonates. Operative vaginal delivery is a major risk factor, and hemorrhage over the cerebral convexities is the most common site. Presenting signs/symptoms include bulging fontanelle, altered consciousness, irritability, respiratory depression, apnea, bradycardia, altered tone, and seizures. Subdural hemorrhages can occasionally be

found incidentally in asymptomatic neonates. Management depends on the location and extent of the bleeding. Surgical evacuation is reserved for extensive hemorrhages causing raised intracranial pressure and associated clinical signs.

Subarachnoid Hemorrhage is the second most common type of neonatal intracranial hemorrhage and is usually the result of the rupture of bridging veins in the subarachnoid space. Operative vaginal delivery is a risk factor, and the infants are typically asymptomatic unless the hemorrhage is extensive. Ruptured vascular malformations are a rare cause of subarachnoid hemorrhages, even in the neonatal population. Treatment is usually conservative.

Intraventricular hemorrhage even though most commonly seen in premature infants, can also occur in term infants depending on the nature and extent of the birth injury.[7]

Intracerebral and intracerebellar hemorrhages are less common and occur as a result of occipital diastasis.

Cranial Nerve injuries:

Facial nerve: Facial nerve is the most common cranial nerve-injured with a traumatic birth. It occurs in up to 10 per 1000 live births and is usually a result of pressure on the facial nerve by forceps or from a prominent maternal sacral promontory during descent. Clinical manifestations include diminished movement or loss of motion on the affected side of the face. Facial nerve palsy requires differentiation from asymmetric crying facies, which results from congenital hypoplasia of the depressor anguli oris muscle and causes a localized movement abnormality of the corner of the mouth. Although forceps delivery has a strong association, facial palsy can occur in the newborn without apparent trauma.[8] The prognosis in traumatic facial nerve injury is good, with spontaneous resolution usually noted within the first few weeks of life.

Peripheral Nerve and Spinal Cord Injuries

Brachial plexus injuries: These occur in up to 2.5 per 1000 live births and result from stretching of the cervical nerve roots during the process of delivery. These injuries are usually unilateral, and risk factors include macrosomia, shoulder dystocia, difficult delivery, breech position, multiparity, and assisted deliveries.[9]

- Injury involving the fifth and sixth cervical nerve roots results in Erbs-Duchenne palsy manifested by the upper arm's weakness. Adduction and internal rotation of the arm with flexion of the fingers are presenting symptoms; this is by far the most common form of brachial plexus injury.
- Injury to the eighth cervical and first thoracic nerves results in Klumpke's palsy manifested by paralysis of the hand's muscles, absent grasp reflex, and sensory impairment along the ulnar side of the forearm and arm.
- Injury to all the nerve roots can result in total arm paralysis.

- Injury to the phrenic nerve can be an associated feature of brachial palsy. Clinical manifestations include tachypnea with asymmetric chest motion and diminished breath sounds on the affected side.

The majority of brachial plexus injuries are stretch injuries, and treatment is conservative, with physical therapy playing a major role in the return of gradual function.[10] Rare, severe cases of brachial plexus injuries result in lasting weakness on the affected side.

Spinal cord: Spinal cord injuries are infrequent in the neonatal period and are usually a result of excessive traction or rotation of the spinal cord during extraction.[11] The clinical manifestations depend on the type and location of the lesion. Higher lesions (cervical/upper thoracic) are associated with a high mortality rate, and lower lesions (lower thoracic, lumbosacral) may result in significant morbidity with bladder and bowel dysfunction. Diagnosis is via ultrasonography or MRI of the spinal cord. The management aims towards presenting clinical symptomatology with cardiorespiratory stabilization as needed.

Skeletal injuries:

Most of the fractures resulting from birth trauma are associated with difficult extractions or abnormal presentations. Clavicular fractures are the most common bone fracture during delivery and can occur in up to 15 per 1000 live births. The clinical presentation is significant for crepitus at the site of fracture, tenderness, and decreased movement of the affected arm with an asymmetric Moro reflex. Clavicular fractures have a good prognosis with spontaneous healing occurring in the majority of infants. The humerus is the most common long bone to fracture during birth, which can be associated with a brachial plexus injury. The clinical presentation could be similar to a clavicular fracture with an asymmetric Moro reflex, inability to move the affected arm. Also, a significant deformity might be noted on the affected arm with swelling and tenderness at the fracture site. Rare conditions may involve a distal humeral epiphyseal separation due to birth trauma requiring expert orthopedic intervention.[12] In general, immobilization for 3 to 4 weeks is necessary and often heals well without deformities. Other fractures, such as femur fracture, rib fractures, can occur during birth but are rare. [13] On the other hand, femur fractures are extremely rare in newborns and may be seen in difficult vaginal breech extraction deliveries. Diagnosis is made by clinical exam with tenderness, swelling, and deformity of the thigh and confirmed further on plain radiographs. Orthopedic consultation is the recommendation for long bone fractures for appropriate immobilization.

Facial injuries:

Ocular injuries: Subconjunctival hemorrhages (SCH) are superficial hematomas seen under the bulbar conjunctiva, commonly seen in infants born after going through labor. It is suggested to be due to ruptured subconjunctival capillaries from venous congestion, occurring from increased back pressure in the head and neck

veins. This injury can result from either a nuchal cord or increased abdominal or thoracic compression during uterine contractions.[14] SCH is a benign condition in the newborn and resolves without intervention. A more significant ocular injury may occur with the use of instrumentation during delivery (forceps), resulting in corneal abrasions, vitreous hemorrhages, etc. that require immediate attention and referral to an ophthalmologist to prevent long term visual defects.[15][16]

Soft tissue injuries:

Soft tissue injuries resulting from birth trauma include petechiae, bruising, ecchymoses, lacerations, and subcutaneous fat necrosis. Subcutaneous fat necrosis is thought to result from ischemic injury to the adipose tissue and characterized by palpation of soft, indurated nodules in the subcutaneous plane. These lesions resolve gradually over a few weeks. Hypercalcemia is one of the complications; therefore, it is recommended to monitor serum calcium.[17] There are reports of accidental lacerations during cesarean section deliveries, with an Italian study showing a 3% incidence of accidental lacerations during cesarean sections, and a higher incidence in emergent deliveries compared to scheduled cesarean deliveries.[18]

Visceral injuries:

Birth trauma resulting in abdominal visceral injuries is uncommon and primarily consists of hemorrhage into the liver, spleen, or adrenal gland. The clinical presentation depends on the volume of blood loss and can include pallor, bluish discoloration of the abdomen, distension of the abdomen, and shock. Treatment is supportive with volume resuscitation and surgical intervention if needed.

Enhancing Healthcare Team Outcomes. Birth trauma in a newborn has a varied presentation depending on the type of injury sustained. The affected newborns may present with mild benign signs and symptoms to severe life-threatening signs and symptoms. Injuries occur at birth for various reasons, secondary to maternal, fetal, or external risk factors. The prognosis of the birth injuries also depends on the type and severity of the initial injury. A detailed physical exam of the newborn is warranted at birth to identify birth injuries and differentiate them from congenital malformations or birth defects. Extracranial hemorrhages typically heal well with occasional complications of hyperbilirubinemia, infections. Subgaleal hemorrhage requires careful clinical observation and monitoring due to the potential for life-threatening acute severe hypovolemia. If large, intracranial hemorrhages can result in focal neurological damage and required prompt intervention, including a neurosurgical evaluation. The prognosis of spinal cord injuries depends on the level of injury. Lesions below T4 have a comparatively better prognosis. Superficial soft tissue injuries generally heal well without any residual sequelae. The majority of brachial plexus injuries resolve within a few weeks, but physical therapy and close follow-up are mandated. Occasional cases of brachial plexus injuries can have long-lasting weakness or dysfunction (level III evidence).[18] The prognosis is also good for facial nerve injuries, with a complete recovery expected within a few weeks in a majority of infants.

A vital element in this context is the prevention of birth trauma in the first place using an interprofessional team involving obstetricians, neonatologists, pediatricians, radiologists, and specialty trained nurses. Advances in antenatal care have resulted in increased awareness of fetal malformations and malpresentation. Potential problems can be anticipated before delivery, thereby leading to improved preparation for a high-risk delivery. Hence pregnant women need to adhere to prenatal care recommendations for optimal outcomes. A coordinated educational effort involving the clinician, nurse midwife, and specialty-trained nurse reinforcing good prenatal efforts will decrease the incidence of untoward events. It is also important to acknowledge that not all birth-related injuries are iatrogenic or preventable. Infants who sustain birth injuries that place them at risk for neurodevelopmental impairment should be monitored closely by an interprofessional team to appropriately attain developmental milestones. This team should include a pediatrician, labor and delivery nurse, physical and occupational therapist, and a developmental-behavioral pediatrician supported by the clinical and nursing staff's coordination of care.

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