Traumatic Birth Injuries

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Objectives

• Describe the delivery conditions that increase the risk for birth trauma.
• Explain why subgaleal hemorrhage can be a medical emergency.
• Describe the risk factors and outcomes for brachial plexus palsy.

Birth Trauma

• Injuries to the infant that result from mechanical forces (ie, compression, traction) during the birth process are categorized as birth trauma.
• Factors responsible for mechanical injury may coexist with hypoxic-ischemic insult; one may predispose the infant to the other.
  • Injury may occur during labor, delivery, or during resuscitation in the delivery room.

Birth Trauma

• Incidence of birth injuries:
  – 2%: Singleton vaginal deliveries in a cephalic position
  – 1.1%: Cesarean delivery
    » BMJ. 2004;329(7456):24
  – Traumatic birth injury can result in physical and neurodevelopmental handicap in neonates.

Predisposing Factors

1. Macrosomia:
   – Fetal weight >4000 g: increased incidence of birth injuries.
     • Two-fold greater in infants weighing 4000 to 4900 g
     • Three times greater with births weights between 4500 to 4999 g
     • 4.5 times greater with a birth weight greater than 5000 g
   • The incidence of birth injury was 7.7 percent in infants with birth weights greater than 4500 g

Predisposing Factors

2. Maternal obesity:
   – Maternal obesity (defined as a BMI > 40 kg/m2) is associated with an increased risk of birth injuries.
     • May be due to the greater use of instrumentation during delivery
     • Increase risk of shoulder dystocia (LGA infant)

3. Abnormal fetal presentation:
   – Breech presentation with vaginal delivery is associated with an increased risk of birth injury.
     • Cesarean delivery reduces the morbidity associated with vaginal delivery of breech infants.
Predisposing Factors:

4. Operative Vaginal Delivery

Morbidity and Mortality data by delivery type for the US, 1995-1998 (rates are /10,000 deliveries)  
Demissie K et al. BMJ 2004, 329:24

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Unassisted delivery</th>
<th>Forceps delivery</th>
<th>Vacuum delivery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neonatal death</td>
<td>3.7</td>
<td>5.0</td>
<td>4.7</td>
</tr>
<tr>
<td>Birth injuries</td>
<td>21.4</td>
<td>109.1</td>
<td>76.1</td>
</tr>
<tr>
<td>Neonatal seizures</td>
<td>5.0</td>
<td>8.7</td>
<td>6.5</td>
</tr>
<tr>
<td>Assisted ventilation &lt;30 minutes</td>
<td>147</td>
<td>293</td>
<td>250</td>
</tr>
</tbody>
</table>

Neonatal morbidity and mortality data by delivery type, New Jersey 1989-1993, rates per 10,000 deliveries

Scalp and face injuries occur on average in 16% of vacuum deliveries and 17% of forceps deliveries

Birth Trauma: Predisposing Factors

5. Other maternal factors:
- Small maternal stature.
- Maternal pelvic anomalies.

Extracranial Injuries
- Extracranial injuries occur during delivery and are due to edema or bleeding into various location within the scalp and skull

Caput Succedaneum (Term Baby)
- Edema or swelling of soft tissue over presenting part of the head
- Is soft and superficial, crosses suture lines
- Disappears in 48 to 72 hours
- Firm, constant pressure in one spot is the easiest way to elicit the characteristic pitting edema of caput
- Related scalp injuries occur in 20% to 40% deliveries
**Caput Succedaneum (Term Baby)**

Maximal at birth, with rapid resolution over the next 24 - 48 hours.

**Caput Succedaneum (Preterm Baby)**

Complications in infants with caput succedaneum:
- Necrotic lesions resulting in long-term scarring and alopecia.

**Cephalhematomas**

Cephalohematoma is a subperiosteal collection of blood caused by rupture of vessels beneath the periosteum.

- Usually located over the parietal or occipital bone.
- Non transilluminant, non pulsatile and non compressible swelling.

**Cephalhematomas**

Incidence:
- 1% to 2% of spontaneous vaginal deliveries
- 6% to 10% of vacuum extractions (range 1%–26%)
- 4% of forceps deliveries

Vacuum extraction has a stronger association with cephalhematoma compared with forceps.
- Metal cups are more likely to cause cephalhematoma than silastic cups or the Omni cup.
- Vacuum extractions at mid- or low station are associated with a higher incidence (13.11% and 13.56%) when compared with vacuum applied at the outlet (6.81%).

*Johansen R.B., Menon B.K. Cochrane Database Syst Rev. 2000;CD000824*
*Attalah G et al. BJOG 112. 1510-1515. 2005*
Cephalhematomas

• Complications:
  – Anemia
  – Jaundice
  – Infection
  – Underlying skull fracture (5% (unilateral) and 18% (bilateral))
  – Leptomeningeal cyst

• Outcome:
  – Disappear in 2 weeks to 3 months
  – No therapy is necessary

Cephalhematomas: X-ray Findings

• Significant deformities of the skull may occur when calcification or ossification of the cephalohematoma occurs.
• Case reports have demonstrated successful surgical excision of these calcified or ossified hematomas

Calcified Cephalhematoma

Surgery if severe deformed skull for aesthetic purpose:
Removal of ossification +/− cranioplasty

J Craniofac Surg. 2006 Sep;17(5):970-9

Subgaleal Hemorrhage

• Accumulation of blood beneath the scalp in subaponeurotic space
• Subgaleal space extends anteriorly to the orbital margins, posteriorly to nuchal ridge and laterally to temporalis fascia
• Overall incidence: 1 in 2,000 births and increases to 1 in 200 in vacuum assisted deliveries
• Subgaleal hemorrhage with loss of 20 to 40% of a neonate’s blood volume (= loss of 50 to 100 mL) will result in hypovolemic shock, DIC, multiorgan failure and neonatal death in up to 25% of cases
SGH: Diagnosis
- Boggy swelling with ballotable fluid wave over the scalp soon after delivery
- May cause pitting edema, discoloration of scalp and eye lids
- Cardiovascular collapse in severe cases
  - Every cm increase in HC = 40 ml of blood in the subaponeurotic space
  - Subaponeurotic space can accommodate up to 260 ml of blood (= total blood volume)

SGH: Clinical Presentation
- Pallor
- Tachycardia
- Tachypnea
- Mottling
- Hypotonia
- Delayed capillary refill
- Hypotension
- Multiorgan damage due to hypoperfusion, shock, and asphyxia

SGH: Management
- Volume resuscitation with PRBCs, FFP, and normal saline as appropriate for ongoing bleeding.
- Correction of coagulopathy.
- Rarely surgical evacuation of the hematoma to relieve brain compression.

Criteria for Determining the Severity of SGH

<table>
<thead>
<tr>
<th>Head Size</th>
<th>Jaundice</th>
<th>Hypovolemia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild</td>
<td>&lt; 1 cm</td>
<td>Absent</td>
</tr>
<tr>
<td>Moderate</td>
<td>1-3 cm</td>
<td>Present</td>
</tr>
<tr>
<td>Severe</td>
<td>&gt;3 cm</td>
<td>Present</td>
</tr>
</tbody>
</table>

Chadwick et al; J Peds, 1996

SGH: Management
- Minimum 8 h observation
- Hourly recording of vital signs, head circ, location and characteristics of swelling
- Hemoglobin measurement as soon as possible and every 4 – 8 hrs
- Coagulation studies
- Imaging by CT or MRI
- Bilirubin levels

Facial Injuries: Ocular Injuries
- Minor ocular trauma, such as retinal and subconjunctival hemorrhages, and lid edema, are common and resolve spontaneously without affecting the infant.
- Resolution of a retinal hemorrhage occurs within one to five days and a subconjunctival hemorrhage within one to two weeks.
Ocular Injuries

- Significant ocular injuries include:
  - Hyphema (blood in the anterior chamber)
  - Vitreous hemorrhage
  - Orbital fracture
  - Lacrimal duct or gland injury
  - Disruption of Descemet's membrane of the cornea (which can result in astigmatism and amblyopia).
- Prompt ophthalmologic consultation should be obtained for patients with, or suspected to have ocular injuries.

Soft Tissue Injuries

- Abrasions
- Bruising
- Lacerations
- Petechiae
- Fat Necrosis

- Seen over presenting part
- Associated with difficult labor and abnormal fetal presentation
- Actual bleeding may be present in the soft tissue
- Swelling generally disappears in 48 to 72 hrs
- Development of severe hyperbilirubinemia.
  - F/U within two days of the hospital discharge is recommended for infants with significant bruising in order to assess them for progressive jaundice

Lacerations

- Most common birth injury associated with cesarean delivery.
- Study of 3108 cesarean deliveries Am J Obstet Gynecol 2004 Nov;191(5):1673-7, the fetal laceration rate was ~ 3%.
  - The lacerations occurred most often on the presenting part of the fetus, typically the scalp and face
  - 78% of the lacerations took place when the cesarean delivery was performed emergently.
  - The majority of fetal lacerations are mild, requiring repair with sterile strips only.
  - 3% are moderate or severe and require plastic surgery.
Lacerations

- Caused by scalpel blade during C-section, scissors during an episiotomy, rarely by forceps
- Suturing should be done under sterile conditions
- Plastic surgeon should be involved in lacerations of the face

Soft Tissue Injuries

Soft Tissue Injuries

- Scrotal Edema, Swelling and Bruising
  - Seen in breech deliveries
  - Resolves spontaneously
  - Urology opinion for severe scrotal swelling

Subcutaneous Fat Necrosis

- Areas of circumscribed induration with well defined margins, firm on palpation
- Commonly seen in the back and buttock, occasionally in the thigh and the cheek
- Symptomatic hypercalcemia at 3 – 4 wks
- Monitor serial calcium levels up to 6 months

Clavicular Fracture

- Incidence: 2.7 to 5.7/1000 live births
- Risk factors:
  - LGA infants
  - Shoulder dystocia
  - Instrumental deliveries
- Most frequently fractured bone during birth
Clavicular Fracture

- Physical Exam Findings:
  - Crepitus
  - Edema
  - Asymmetrical bone contour
  - Crying with passive motion
  - Decreased arm movement
  - Palpable bony deformity

The timing of the presentation and diagnosis of the clavicular fracture is dependent on whether the fracture is displaced or non-displaced.

- Displaced (complete) clavicular fractures:
  - Accompanied by physical findings in the immediate post-delivery period.

- Non-displaced clavicular fracture:
  - Asymptomatic
  - Diagnosis is delayed by days or weeks until there is a formation of a visible or palpable palpable bony deformity.

Diagnosis:
- Radiography

Treatment:
- No treatment for asymptomatic incomplete fractures
- Immobilization of the arm for 7–10 days
- Parenteral reassurance
- Gentle handling
- Recovery without sequelae

Long Bone Fractures

- Humeral fracture:
  - Most commonly fractured long bone
  - Incidence: 0.2 /1000 deliveries.

Clinical manifestations include:
- Decreased movement of the affected arm
- Decreased Moro reflex
- Localized swelling and crepitation
- Increased pain response with palpation and movement of the arm
- Evaluation for brachial plexus injury

Humeral Fracture

- The diagnosis is made by a plain radiograph of the arm.
- Treatment consists of immobilization of the affected arm with the elbow in 90 degrees flexion to prevent rotational deformities.
- Outcome is excellent with evidence of callus formation usually seen on radiography by 7 to 10 days.

Radiographs to confirm healing can be performed at three to four weeks post injury.

Femur Fracture

- The Pavlik harness is used to treat neonatal femoral fractures.
- Outcome is excellent with evidence of callus formation usually seen on radiography by 7 to 10 days.
Linear Skull Fracture
- Parietal bones most commonly involved
- Associated with extracranial and intracranial complications
- Dural tears may result in leptomeningeal cyst
- Diagnosis is made by radiography

Depressed Skull Fracture
- "Ping-pong" lesion
- Result of localized compression of skull
- Parietal bone is the most common site
- May be associated with intracranial hemorrhage

Depressed Skull Fracture: Complication

Neurologic Injuries
- Facial Nerve Injury
- Brachial Plexus Injury (BPI)
- Phrenic Nerve injury
- Spinal Cord Injury

Brachial Plexus Injury (BPI)
Incidence
- Ranges globally from 0.2-4% of live births.
- Worldwide prevalence is 1-2%, with the higher numbers being in underdeveloped countries.
- In the US, the prevalence is approximately 0.2%.
- Bilateral in 8 to 23% of cases
- Vertex presentation accounts for most cases (94-97%); breech presentations account for 1-2% of cases; and cesarean deliveries account for 1% of cases.

Lateral Neck Traction Injury
- BPI in babies may also be a result of abnormal growth through restricted limbs during gestation
- Trauma prior to, or during delivery
- Amniotic bands
- Congenital chicken pox.
**Brachial Plexus Injury**

<table>
<thead>
<tr>
<th>Incidence</th>
<th>Erb’s</th>
<th>Klumpke’s</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td>90%</td>
<td>1%</td>
<td>10%</td>
</tr>
<tr>
<td>Nerve roots</td>
<td>C5 and C6 (50%)</td>
<td>C5 – C7 (Erbs plus) (35%)</td>
<td>C5 to T1</td>
</tr>
<tr>
<td>PE finding</td>
<td>Asymmetric moro Grasp present (C5-C6) Biceps absent</td>
<td>Asymmetric moro Grasp absent Biceps present Horner’s syndrome</td>
<td>Reflexes absent</td>
</tr>
<tr>
<td>Arm position</td>
<td>“waiter’s tip”</td>
<td>Extended</td>
<td>Flaccid</td>
</tr>
</tbody>
</table>

**Erb’s Paralysis**

**Diagnosis:**
- Meticulous neurologic exam
- Radiographs of cervical spine, clavicles, and humerus
- Fluoroscopy
- Real-time ultrasound scanning
- Electromyographic studies 2 to 3 wks after injury

**BPI: Associated lesions**
- Fracture of the clavicle, humerus and shoulder dislocation
- Injury to the Phrenic n
  - Respiratory distress
  - Asymmetric chest motion
- Injury to the nerve root T1
  - Horner’s syndrome
    - Miosis
    - Ptosis
    - Anhydrosis

**BPI: Management**
- Arm should be held in a position of rest
- Passive exercises after first week
- Regular F/U until full recovery
- If the paralysis persists without improvement for 3-6 months:
  - Neuroplasty
  - Neurolysis
  - End-to-end anastomosis
  - Nerve grafting

**BPI: Prognosis**
- Full recovery: 75% - 90% of the cases
- Permanent impairment: 3 - 25% of the cases
- Poor prognosis: Coexisting Horner’s syndrome and Diaphragmatic paralysis
- Recovery in the first few weeks is a good indicator of final outcome
- Complete recovery is unlikely if no improvement is noted in the first 2 wks of life

**Erb’s Paralysis**

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- Electromyographic studies 2 to 3 wks after injury
BPI: Long-term Deficits

- Residual long-term deficits may include:
  - Progressive bony deformities
  - Muscle atrophy
  - Joint contractures
  - Impaired growth of limb
  - Weakness of the shoulder girdle
  - "Erb Engram" flexion of elbow and adduction of shoulder

Facial Nerve Injury

- Most common neonatal traumatic nerve injury (1% live births).
- 33% of facial nerve injuries occur in spontaneous delivery (Caused by pressure on the facial n).
- Seen after prolonged labor or forceps delivery (2.9 to 5/1000 forceps delivery).
- 75% of cases involve the left side due to higher prevalence of L transverse or L anterior occipital presentation.

Facial Nerve Injury

- Spectrum of signs:
  - Absence of nasolabial fold
  - Loss of wrinkling of the forehead
  - Impaired closure of the eye
  - Slight prominence of the cheek

Management of Facial Nerve Injury

- No specific therapy is indicated
- Sucking should be observed
- Eye should be protected with methylcellulose drops, eye patch if necessary
- Patient should be re-examined at around 10 days of age
- Electrodagnostic tests may be done
- Usually resolves spontaneously and does not require surgery.

Phrenic Nerve Paralysis

- 75% of cases have associated BPI
- Cervical roots involved: C-3 to C-5
- Clinical signs: Respiratory distress, diminished breath sounds on affected side
- Symptoms: First day of life
- Diagnosis: Chest fluoroscopy, ultrasound
**Phrenic Nerve Paralysis**

- **Management:**
  - Nonsurgical
    - Continuous positive airway pressure
    - Electrical pacing
  - Surgical plication
  - Prognosis: 10 to 20% mortality

**Spinal Cord Injury**

- Incidence: 0.14 per 10,000 live births
- Upper cervical cord injuries are more common and are associated with forceps rotation during vertex delivery
- Lower cervical and thoracic lesions usually occur during vaginal breech delivery, when the head is hyperextended or trapped
- Can occur following C-section delivery

**Spinal Cord Injury**

- **Clinical Findings:**
  - Decreased or absent spontaneous movements
  - Absent deep tendon reflexes
  - Absent or periodic breathing
  - Lack of response to painful stimuli below the lesion
  - Abdominal distension, bladder distension, loss of anal sphincter tone
- **Diagnosis:**
  - X-ray
  - Ultrasonography
  - MRI
- **Management:**
  - Head, neck, spine immobilization
  - Supportive care
  - Solumedrol
  - Surgical
- **Prognosis:** In general, poor

**Spinal Cord Injury**

- The usual causes of death are:
  - Recurring pneumonia
  - Progressive loss of renal function
- **Long term treatment includes:**
  - Nursing care to prevent skin ulcerations
  - Treatment of urinary and respiratory infections
  - Regular evaluations to identify obstructive uropathy

**Abdominal Injuries**

- Intra-abdominal birth trauma is uncommon and primarily consists of
  - Rupture or subcapsular hemorrhage into the liver, spleen, and adrenal gland.
  - The clinical presentation depends upon the amount of blood loss.
  - Infants with hepatic and splenic rupture may present with sudden pallor, signs of hemorrhagic shock, and abdominal distension and discoloration.
  - Infants with subcapsular hematoma may have a delayed or more insidious onset of symptoms of anemia, which include poor feeding, tachycardia, and tachypnea.
  - Unilateral adrenal hemorrhage may present as an abdominal mass.
**Abdominal Injuries**

- US is the best modality to diagnose intra-abdominal birth injuries and can be performed at the bedside.
- CT can also provide useful diagnostic information, but transport of a critically ill infant to the scanner is more difficult.
- The management includes fluid resuscitation with blood products and normal saline as appropriate.
  - FFP may be needed to correct any coagulopathy
  - Laparotomy for infants with hepatic or splenic rupture or if hemodynamically unstable

**Summary**

- The outcome of traumatic birth injury is related to the severity of the initial injury.
- All infants at risk for neurodevelopmental sequelae should be monitored closely for attainment of developmental milestones.