Birth Injuries in Neonates: Diagnosis and Management

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Objectives
- Describe common birth injuries
- Delineate current evaluation and management

Introduction
- Impairment of the neonate’s body function or structure due to an adverse event that occurred at birth.
  - Avoidable, or unavoidable
- Occur despite skilled and competent obstetric care
  - Prolonged labor or with an abnormal presentation.
- Include injuries related to use of intrapartum monitoring:
  - FHR, fetal scalp blood for acid-base assessment
- Do Not Include injuries related to amniocentesis, intrauterine transfusions and neonatal injuries after resuscitation procedures

Incidence of birth injuries
- 1981—birth injuries ranked 6th for neonatal death. 23.8 deaths per 100,000 live births
- 1993—birth injuries ranked 11th for neonatal death. 3.7 deaths per 100,000 live births
- 2009—no mention in the leading causes of death

Risk factors

<table>
<thead>
<tr>
<th>Risk Factors for Traumatic Birth Injury</th>
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<tbody>
<tr>
<td>Rigid birth canal</td>
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<tr>
<td>- Preterm twins</td>
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<tr>
<td>- Order multiplex</td>
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<tr>
<td>- Small maternal pelvis</td>
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<tr>
<td>Failure of adequate birth canal dilatation</td>
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<tr>
<td>Brachial palsy</td>
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<tr>
<td>Perineal delivery</td>
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<tr>
<td>Long time pushing in use of birth canal</td>
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<tr>
<td>Macrosomia</td>
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<tr>
<td>Epidemiologic disproportion</td>
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<tr>
<td>Shoulder dystocia</td>
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<tr>
<td>Abnormal presentations (face, brow, transverse)</td>
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<tr>
<td>Use of vacuum or forceps, difficult rotation</td>
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<tr>
<td>Prematurity</td>
</tr>
</tbody>
</table>

Rosenburg et al, Neoreviews 2003

Risk Factors – Macrosomia
- Retrospective 1995–97
- Compared macroscopic infants (4000–4499 g, 4500–4999 g, and >5000 g infants) with a normoscopic control infants weighed 3000 to 3999 g.
- Maternal risk factors for macrosomia: nonsmoking, advanced age, married, DM, HTN and previous macroscopic infant or pregnancy loss.
- Risks of labor complications, birth injuries, and newborn morbidity rose with each gradation of macroscopic birth weight
- Infant mortality rates ↑↑ infants>5000 g.
- BWt >4500 g more predictive of neonatal morbidity
- BWt >5000 g better indicator of infant mortality risk

(Am J Obstet Gynecol 2003;188:1372–8.)
Risk factors – Macrosomia

- Weight 4000-4500 gms birth injuries risk increase 2 fold
- Weight 4500-5000 gms risk increases by 3 fold
- Weight > 5000 gms risk increases by 4.5 fold


Risk Factors: Forceps or Vacuum Extraction

- 1989–1993 data
- Neonatal mortality was comparable between vacuum and forceps
- Vacuum delivery associated with a lower risk of birth injuries, neonatal seizures and need for assisted ventilation
- Vacuum extraction was more likely than forceps to be complicated by postpartum haemorrhage and shoulder dystocia
- Risks of ICH, difficulty with feeding, and retinal haemorrhage were comparable between both modes of delivery.
- Sequential use of vacuum and forceps was associated with an increased risk of need for mechanical ventilation in the infant and third and fourth degree perineal tears.

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Demissie et al, BMJ 2004

Risk Factors: For ce ps or vacuum extraction

- Neonatal outcomes among term, nonanomalous singletons in breech presentation
- Mode of delivery
- Composite neonatal mortality and morbidity (death, assisted ventilation, convulsions, or specific birth injury)
- Vaginal deliveries increased from 2.7% in 2003 to 3.9% in 2011, and cesarean deliveries in labor increased from 8.7% to 9.8%.
- Composite neonatal mortality and morbidity rates at ≥37 wks after vaginal delivery were higher
- Neonatal mortality and morbidity rates were also higher after caesarean delivery in labor.
- C-Section associated with reduction in short-term adverse outcomes (perinatal mortality, serious neonatal morbidity)
- no significant difference in long-term maternal or child morbidity or mortality.

Demissie et al, BMJ 2004
Soft tissue injuries

`Erythema and abrasions`
- Injuries when dystocia to presenting part
- When forceps are applied, injury to the site of application and linear in orientation
- Resolution in few days with no therapy
- Affected areas should be kept clean to minimize risk for secondary infection.

`Observed with tight nuchal cord, precipitous delivery or breech presentation.`
- Caused by sudden increase in intrathoracic & venous pressures and tightening of nuchal cord
- **DDX:**
  - Neonatal Thrombocytopenia: localized distribution of petechiae, absence of subsequent crops of new lesions, and normal PLT
  - Infections: Other signs and symptoms.
  - DIC: excessive and persistent bleeding from a variety of sites. Distributed over the entire body
- If the petechiae are caused by trauma, neither corticosteroids nor heparin should be used. No specific treatment is necessary.
- Traumatic petechiae usually fade within 2 or 3 days.

Petechiae
- Usually present on head, neck and upper portion of the chest and lower portion of the back
- Underlying hemorrhagic disorder
- Platelet count needs to be measured and followed
- No specific treatment necessary

http://newborns.stanford.edu/PhotoGallery/Petechiae4.html

Ecchymoses/bruising
- Common in traumatic and breech delivery
- Incidence is increased in premature babies
- Can cause significant hyperbilirubinemia
  - May reflect blood loss severe enough to cause anemia and, rarely, shock.
- No specific therapy needed. Phototherapy for jaundice as needed
- Spontaneous Resolution ~ 1 week

Subcutaneous fat necrosis
- Occurs from ischemia to adipose tissue
- Firm, indurated nodules and plaques on the back
- Self limiting—in 6–8 wks
- Watch Ca levels up to 6 months
Soft tissue injuries—Lacerations

- Inflicted with a scalpel during C-section
- Scalp, buttocks, and thighs
- Superficial: butterfly adhesive strips.
- Deeper, more freely bleeding wounds: sutured with the finest material available
  - Rarely require suturing in the delivery room.
- Wound left uncovered unless in an area of potential soiling
  - Protective plastic.
- Rapid Healing; sutures removed after 5 days.

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<tr>
<th>Anterior</th>
<th>Lateral</th>
<th>Medial</th>
<th>Posterior</th>
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<tbody>
<tr>
<td>Caput</td>
<td>32%</td>
<td>18%</td>
<td>5%</td>
</tr>
<tr>
<td>Succedaneum</td>
<td>35%</td>
<td>12%</td>
<td>3%</td>
</tr>
</tbody>
</table>

Caput Succedaneum
- Edematous swelling of the scalp above periosteum
- Causes—
  - Prolonged engagement of head or vacuum extraction
  - Extends across the suture lines
  - Benign condition and resolves within few days
  - Rarely, hemorrhagic caput may present with shock and require blood transfusion

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Cephalhematoma
- Subperiosteal collection of blood due to rupture of vessels beneath the periosteum
- It does not cross the suture lines
- Usually it does not cause significant blood loss
- 1–2% of all deliveries and forceps or vacuum extraction deliveries are the causes
- Resolve over the course of 3–4 weeks

Complications of cephalohematoma:
- Infection and sepsis
  - E. coli; present as erythematous, fluctuant masses
  - CT or MRI
  - Needle aspiration, I & D, debridement of the necrotic skull, prolonged ABX
- Calciﬁed cephalohematoma: present for months. Skull deformities
  - Often disappears over 3 to 6 months.
  - Persistent calciﬁcation: ‘surgical excision.
  - Rarely may result in blood loss severe enough to require transfusion.

DDX:
- Subgaleal hematoma
- Caput Succedaneum
- Cranial meningocele: pulsations
Subgaleal Hemorrhage

- Collection of blood between epicranial aponeuris and periosteum of skull
- Incidence—
  - 4/10000 in non instrumented deliveries
  - 64/10000 in vacuum extraction deliveries
- Can result in 20–40% blood loss
- Mortality is about 12–14% from shock and coagulopathy
- Early recognition is crucial

Subgaleal Hemorrhage

- fluid wave
- “Handling a water balloon”.
- Very fluctuant, shifting mass without discernable limitations.
Subdural hematoma
- Most common intracranial hemorrhage in neonates
- Hematoma between dura and arachnoid membrane
- Common location: tentorial & interhemispheric
- Symptomatic by 24–48 hours of life
  - respiratory depression, apnea, and/or seizures
  - signs of neurologic dysfunction: irritability and altered tone and level of consciousness.
  - Rarely: increased intracranial pressure, increase in HC, tense fontanelle, apnea, bradycardia, and coma
- Diagnosis by Computed tomography (CT)
- Treatment:
  - conservative if no signs of herniation.
  - Surgical evacuation if signs of herniation

Subdural hematoma
- Treatment:
  - conservative if no signs of herniation.
  - Surgical evacuation if signs of herniation
- Serial HCt to assess for ongoing blood loss
- Volume replacement
- Investigation of a congenital coagulopathy

Subarachnoid hemorrhage
- 2nd most common ICH in neonates
- Caused by rupture of bridging veins in subarachnoid space
- Symptoms appear at 24–48 hours
- Diagnosis by CT
- Treatment is conservative
- Rarely requires surgery

Epidural hemorrhage
- Very rare in neonates
- Caused by injury to middle meningeal artery
- Linear skull fracture most of the time
- Presents with hypotonia, seizures, bulging fontanelles and change in loc
- Diagnosis—CT
- Treatment
  - conservative if no signs of herniation
  - surgical evacuation if signs of herniation

Term baby born with right side subdural hemorrhage
(Image: MRI—Children’s Mercy Hospital, Kansas City)

Posterior fossa subdural hematoma

Subarachnoid hemorrhage

Epidural hemorrhage
Intraventricular Hemorrhage

- Usually associated with premature delivery
- Reported as a consequence of birth injury in term infants.
- 4% in one study in healthy asymptomatic term infants
- Risk of IVH increases with operative deliveries, (highest in combined vacuum- and forceps-assisted deliveries)

Neurologic injuries

- Facial nerve injury
  - Incidence is 0.5–1% of live births
  - Usually occurs due to compression of facial nerve by forceps, rarely from agenesis of facial nerve nucleus (Mobius syndrome)
  - Mandibular branch of facial nerve most commonly affected causing less movements on affected side
  - Traumatic facial palsies resolve in 2–3 weeks of birth

Facial nerve injury

- Loss of nasolabial fold
- Partial closing of eye
- Inability to contract the lower facial muscles on affected side
  - “drooping” mouth.
- When crying, the mouth is drawn over to the unaffected side

What is the diagnosis?

This infant has asymmetric crying facies 22q11
Brachial plexus injury
- Involves paralysis of upper arm muscles following trauma to spinal roots C5 to T1
- 4 forms
  - Erb Duchenne—injury to C5–6, most common
  - Klumpkes – C8 to T1
  - Total arm paralysis—if all nerve roots are involved
  - Horner’s syndrome- miosis, ptosis and enophthalmos,
    - damage to sympathetic outflow via nerve root T1

Management of brachial plexus injury
- Conservative management
  - Physical therapy
- Nerve reconstruction
  - nerve root avulsion
  - between 6–9 months
- Botulinum toxin injections
  - Improves range of motion
- Pain management

Phrenic nerve injury
- Often associated with brachial plexus injury
- Most often with breech delivery and lateral extension of neck with avulsion of C3–5 nerve roots
- Clinical signs: recurrent episodes of cyanosis followed by respiratory distress
- Treatment – conservative for 30 days and then surgery is the treatment of choice

<table>
<thead>
<tr>
<th>Group</th>
<th>Affected nerve roots</th>
<th>Rate of full spontaneous recovery (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>C5 and C6</td>
<td>~90</td>
</tr>
<tr>
<td>II</td>
<td>C5, C6, and C7</td>
<td>~65</td>
</tr>
<tr>
<td>III</td>
<td>C5, C6, C7, C8, and T1</td>
<td>&lt;50</td>
</tr>
<tr>
<td>IV</td>
<td>C5, C6, C7, C8, and T1 with Horner’s syndrome</td>
<td>~0</td>
</tr>
</tbody>
</table>
Neurologic injuries

Phrenic nerve injury
  ‣ Medical treatment.
    - Infant positioned on the involved side
    - O2
    - IV fluids
  ‣ Absence of definite improvement after 1: candidates for plication of the diaphragm, or diaphragmatic pacing.

Prognosis
  ‣ Spontaneous recovery
  ‣ Susceptibility pneumonia

Fractures

Clavicle fracture
  ‣ Most common fracture in newborns
  ‣ Incidence is about 1–1.5% from birth trauma
  ‣ Risk factors
    - Operative delivery
    - Shoulder dystocia
    - Higher birth weight
    - Increased maternal age
  ‣ Diagnosis:
    - Displaced fracture in newborn period
    - Non displaced in days to weeks
  ‣ Treatment: conservative

Humerus fracture
  ‣ Incidence: 0.2/1000 deliveries
  ‣ RF: shoulder dystocia, macrosomia, C section, breech and LBW

Femur fracture
  ‣ Incidence: 0.13/1000 deliveries
  ‣ RF: shoulder dystocia, macrosomia, C section, breech and LBW

Clavicle fracture
  ‣ Incidence of depressed fracture: 3.4/100000 births
  ‣ Linear and Depressed
  ‣ Depressed fracture: increased possibility of intracranial process
  ‣ Neuroimaging and Neurosurgery consultation
  ‣ If fracture depression is <1cm with no neurodeficit, can be managed conservatively

Skull fracture
  ‣ Incidence of depressed fracture: 3.4/100000 births
  ‣ Linear and Depressed
  ‣ Depressed fracture: increased possibility of intracranial process
  ‣ Neuroimaging and Neurosurgery consultation
  ‣ If fracture depression is <1cm with no neurodeficit, can be managed conservatively

Dupuis et al., 2005, Am J Obstet Gynecol

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Subconjunctival and retinal hemorrhages, lid edema are minor injuries and resolve without affecting the newborn.

Significant ocular injuries—hyphema, vitreous hemorrhage, orbital fracture, lacrimal duct injury and disruption of descemets membrane of cornea.

Ophthalmologic consultation if suspicion of significant injuries.

Points to remember:
- Incidence of birth injuries has dramatically decreased in last 2 decades.
- Macrosomia and instrumental deliveries are major risk factors for birth injuries.
- Subgaleal hemorrhage is an emergency and close monitoring and aggressive resuscitation is the key.
- Forceps is the most common cause of facial nerve injury and is usually self limiting condition.
- Erb’s palsy is the most common brachial plexus injury and management is conservative until 3–4 months of life.
- Shoulder dystocia is a major risk factor for brachial plexus injury.
- Management of clavicle, skull fracture (unless neurodeficit), humerus and femur fracture is conservative.
- Planned C-section for breech presentation decreases mortality and morbidity.
Posterior fossa hematoma can cause brainstem compression leading to respiratory compromise and needs close monitoring.