

Mechanical birth-related trauma to the neonate: an imaging perspective - Apeksha Chaturvedi, *University of Rochester, USA*

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Abstract

The process of birth, whether spontaneous or assisted, is inherently traumatic for the newborn. Birth-related injuries encompass both mechanical and hypoxic-ischemic events. This review focuses mostly on mechanical trauma sustained by the neonate owing to the forces of labor and delivery. For conciseness of this review, birth-related hypoxic-ischemic injuries to the neonate will not be separately addressed. Trauma related to birth may affect several organ systems of the neonate (ESM_1). The exact incidence of mechanical trauma of birth may be somewhat underestimated. Incidence is 0.82%, prevalence has been estimated at 9.5 per 1000 live birth. Less than 2% of neonatal deaths result from birth trauma.

Birth-related trauma can occur without identifiable risk factors; however, it is more common in context of predisposing fetomaternal risk factors. Risk factors can be fetal (macrosomia-birth weight > 4500 g, malpresentation or shoulder dystocia (defined as passage of more than 60 s between the delivery of the head and body, resulting in requirement of additional obstetric maneuvers for delivery of fetal shoulders); maternal (diabetes, primiparity, small pelvis); or obstetric (epidural analgesia, induced or instrumental delivery).

Injuries to the head and face extracranial scalp: The different layers of scalp are skin, subcutaneous connective tissue, galea aponeurotica, loose areolar connective tissue and periosteum. Normal anatomy of the scalp is depicted with illustrations. Hemorrhages may occur within different layers of the scalp and meninges. The main categories of scalp hemorrhages include caput succedaneum, subgaleal hemorrhage and cephalhematoma. These traumatic extracranial lesions each have their unique clinical presentation and course (ESM_2). The diagnosis is usually clinical; imaging plays a supplemental role. Majority of these hemorrhages spontaneously resolve with little clinical consequence. However, extensive blood loss into the subgaleal space can occasionally occur, which necessitates blood transfusion and surgical evacuation of the hematoma.

Skull: The neonatal skull is composed of multiple partially ossified bony and cartilaginous components separated by sutures, synchondroses and fontanels. During its passage through the birth canal, the fetal head undergoes “molding” according to maternal pelvic dimensions. When the head is the presenting body part, the frontal and occipital bones are compressed, leading to parietal bones being displaced outward, resulting in a step-off between the coronal and lambdoid sutures and slight widening of the squamous suture. With the less common breech, brow or face presentations, however, the parietal bones are pressed inward. In either instance, if the deformation occurs rapidly or severely, the falx, tentorium or bridging veins may tear, leading to intracranial hemorrhages. Similarly, the process of molding may lead to distortion of synchondroses at the skull base, with long-term consequences such as basilar impression, atlanto-occipital assimilation or nuchal impression.

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Intracranial Traumatic Birth-related intracranial hemorrhages can occur both into the extra-axial spaces and within the cerebral or cerebellar parenchyma. Besides large parenchymal bleeds, small cortical contusions and shear or axonal injuries may also be seen with birth-related trauma.

Based on a study of asymptomatic neonates following full-term spontaneous vaginal birth, the prevalence of intracranial hemorrhage was estimated to be 26%. These hemorrhages were not associated with signs of overt trauma. The majority of these hemorrhages were found to be subdural and infratentorial. These were found to be without clinical consequence. Also, these hemorrhages were all of the same age. The pterion is a large, relatively unprotected sutural confluence, which makes this site vulnerable for injury. MR is superior to CT for evaluation of extracerebral and posterior fossa hemorrhages. Susceptibility weighted imaging is especially useful for delineation of both intra- and extraaxial hemorrhages. Supratentorial intracerebral hemorrhages are well seen and can be dated with both CT and MR, although ultrasound can be useful for initial bedside evaluation.

Face: Retinal hemorrhages are seen among one-quarter of otherwise normal deliveries, but instrumental delivery and cord around the neck have been identified as risk factors. Spontaneous vaginal delivery, prolonged second stage of labor and neonatal intracranial hemorrhage can exacerbate these hemorrhages. In one prospective study, all detected birth-related retinal hemorrhages resolved by 1 month of age. Coexistence of these hemorrhages with skull fractures/intracranial hemorrhages secondary to mechanical birth trauma can lead to confusion with nonaccidental trauma.

Passage through the birth canal may lead to facial trauma including mostly abrasions of the face, although traumatic luxation of the nose and neonatal nasal septal deviation have been reported as a consequence of birth-related trauma.

Injuries to the spinal cord and neck: Spinal cord injuries are rare conditions, which may occur in context of difficult delivery characterized by excess traction, rotation and hyperextension. Breech presentation complicated by entrapped fetal head has been found to be responsible for many reported cases. Vertebral fractures or spinal dislocations can be associated. A lateral radiograph of the spine should be obtained to demonstrate vertebral fracture/subluxation. The neonate can present with hypotonia, quadriplegia or paraplegia; plain radiographs, ultrasound and MRI can aid diagnosis. Hematomyelia, disruption of the spine, extraspinal hematoma and malalignment may be seen by the initial radiograph/bedside ultrasound and MR can further facilitate assessment of edema, ischemia or hemorrhage.

Visceral injuries: Of the visceral organs affected by trauma, injuries to the liver, spleen, kidney, adrenals and trachea have been described. Neonatal adrenal hemorrhage is rare and can be an important manifestation of birth-related mechanical trauma, found in only 0.2% of newborns.

Tracheal rupture can be anterior subglottic or distal tracheal in location. This rare and potentially fatal entity can occur in context of dystocic birth, and should be promptly suspected in neonates who develop subcutaneous emphysema or pneumomediastinum shortly after birth. Bronchoscopy should be expeditiously performed and open surgical repair undertaken if necessary, especially in cases of distal tracheal rupture.

Conclusion: Mechanical trauma related to birth can affect different organ systems of the neonate. While often of little clinical consequence, traumatic events can lead to cosmetic deformity, functional impairment and in extreme circumstances, even death. Imaging is important for detection, assignment of prognostic significance and follow-up, making it important for radiologists to be familiar with the imaging manifestations of these entities and their sequelae.

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