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Identifying Pediatric Skull Fracture Using Point-of-Care Ultrasound

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A case involving a 10-month-old infant with a nonecchymotic scalp hematoma demonstrates the effectiveness and utility of point-of-care ultrasound to identify skull fractures in pediatric patients presenting with blunt head trauma.

Evaluating pediatric patients presenting to the ED with head trauma can be a challenging task for emergency physicians (EPs). Specifically, identifying a nondisplaced skull fracture is not always possible through physical examination alone.[1] However, point-of-care (POC) ultrasound permits rapid identification of skull fractures, which in turn assists the EP to determine if advanced imaging studies such as computed tomography (CT) are necessary.

Case

A previously healthy 10-month-old male infant presented to the ED with his mother for evaluation of rhinorrhea, cough, and fever, the onset of which began 24 hours prior to presentation. The patient's mother reported that the infant continually tugged at his right ear throughout the previous evening and was increasingly irritable, but not inconsolable.

Initial vital signs at presentation were: blood pressure, 95/54 mm Hg; heart rate, 146 beats/min; respiratory rate, 36 beats/min, and temperature, 101.8°F. Oxygen saturation was 96% on room air. The physical examination was notable for an alert well-appearing infant who had a tender nonecchymotic scalp hematoma superior to the right pinna, clear tympanic membranes, crusted mucous bilaterally at the nares, nonlabored respirations, and wheezing throughout the lung fields. A POC ultrasound scan performed over the hematoma demonstrated a right nondisplaced parietal skull fracture (**Figure 1**).

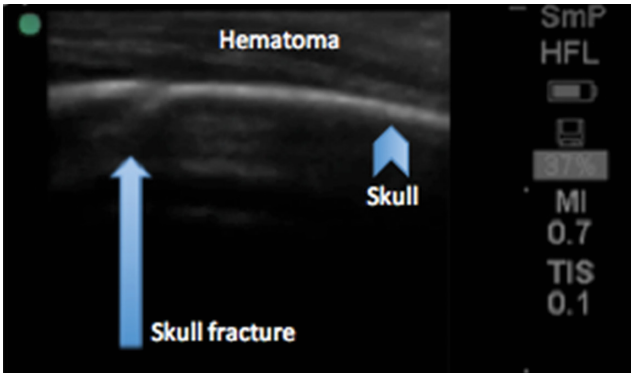

Figure 1. Point-of-care ultrasound image utilizing a high-frequency linear transducer demonstrates the patient's right nondisplaced parietal skull fracture.

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Imaging Technique

To evaluate for skull fractures using POC ultrasound, the area of localized trauma must first be identified.[2,3] Evidence of trauma includes an area of focal tenderness, abrasion, soft-tissue swelling, and hematoma.[2,3] The presence of any depressed and open cranial injuries are contraindications to ultrasound. In which case, a physician should consult a neurosurgical specialist and obtain a CT scan of the head.

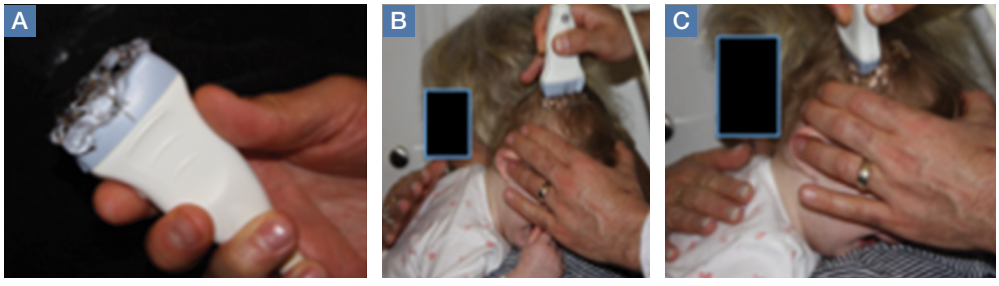

Figure 2. Photos show (**A**) a high-frequency linear transducer with copious gel, required for imaging a localized trauma site; and (**B**) demonstration (on a model) of the correct probe placement of the high-frequency linear transducer in (**C**) two perpendicular planes to scan for localized trauma.

A high-frequency linear probe (5-10 MHz) is used to scan the area of localized trauma; this should be performed in two perpendicular planes using copious gel and light pressure (**Figures 2a-2c**). Skull fracture on ultrasound will appear as a cortical irregularity that is distinguishable from normal skull suture lines. If a cortical disruption is identified, the contralateral side should be scanned to distinguish the fracture from skull suture lines.[2] Suture lines can be distinguished from a nondisplaced fracture because suture lines can be followed back to the associated fontanelle.[3]

Discussion

Closed head trauma is one of the most common pediatric injuries, accounting for roughly 1.4 million ED visits annually in the United States.[5] Four to 12% percent of these minor traumas result in an intracranial injury,[2] and the presence of a skull fracture is associated with a 4- to 20-fold increase in risk of underlying intracranial hemorrhage.[3]

Clinical assessment alone is not always reliable in predicting skull fracture and intracranial injury, especially in children younger than 2 years of age.[2,3] Ultrasound is safe, noninvasive, expedient, cost-effective, and well tolerated in the pediatric population for identifying skull fractures,[3] and can obviate the need for skull radiographs[4] or procedural sedation. Moreover, POC ultrasound can serve as an adjunct to the Pediatric Emergency Care Applied Research Network head injury algorithm for head CT use decision rules if the fracture is not palpable on examination.

Several prospective studies and case reports have demonstrated the usefulness of POC ultrasound in diagnosing pediatric skull fractures in the ED.[1-4] Two of the four cases published represented cases in which the EP identified an undisclosed nonaccidental trauma through POC ultrasound. Rabiner et al,[3] estimates a combined sensitivity and specificity of 94% and 96%, respectively. It is important to remember that intracranial injury can still occur without an associated skull fracture. As our case demonstrates, POC ultrasound is a useful tool in risk-stratifying minor head trauma in children.

Case Conclusion

The head CT study confirmed a nondisplaced, oblique, and acute-appearing linear fracture of the right parietal bone extending from the squamosal to the lambdoid suture. There was no associated intracranial hemorrhage. The patient was admitted to the hospital for a nonaccidental trauma evaluation. The Department of Children and Family Services was contacted and the patient was discharged in the temporary custody of his maternal grandmother.

Summary

Point-of-care ultrasound is a useful diagnostic tool to rapidly evaluate for, and diagnose skull fractures in pediatric patients. Given its high sensitivity and specificity, ultrasound can help EPs identify occult nondisplaced skull fractures in children.

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