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SHORT ABSTRACT

Uses and Abuses of Ultrasound in the Pediatric Emergency Room

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Ultrasound (US) is a highly effective technique in the pediatric emergency room (ER), given its great versatility, lack of ionizing radiation and excellent diagnostic performance in the pediatric population. It is the foremost technique in pediatric abdominal emergencies, but it should also be the go-to technique in almost all other pediatric emergencies. US can be used as an extension of the clinical examination in the emergency room, as it provides immediate answers to simple questions (fluid/no fluid, urinary tract dilation/no dilation). It is also a more sophisticated technique, allowing the user to make complex diagnoses, often without the need for further imaging. However, even ultrasound has its barriers in the pediatric emergency room. A thorough knowledge of its limitations and of common and uncommon artefacts will limit errors.

US is commonly used to identify joint effusion and to characterize various superficial "lumps and bumps" when a musculoskeletal emergency occurs. US is also accurate in identifying fractures and may be used to examine the areas a child can point out as painful. In case of doubtful X-rays and persisting pain, US may be used to search for missed fractures. It is also useful to identify typical pediatric fractures, such as Salter-Harris I (fracture of the epiphyseal plate), which may be difficult to diagnose on X-rays. US is an accurate tool to identify foreign bodies and guide superficial interventions.

In neurological emergencies, US is limited by the lack of access to the brain beyond the age of closure of the anterior fontanelle. In infants, especially premature babies, it is however highly sensitive to the presence of brain hemorrhage and ventricular dilation. US is not the mainstay in head trauma, even in infants, as it may miss small peri-cerebral hematomas, with no or little mass effect. False positives for peri-cerebral fluid collections are also possible, because of the reflections of the US beam on the bony edges of the fontanelle (**Figure 1**).

Radiologists are used to examining the chest through X-rays and CT, but in the pediatric population US may replace these techniques in several clinical settings. Given the small size of the pediatric chest, US excludes pneumonia with great accuracy, identifies the presence of pleural fluid and is the best technique to analyze the structure of pleural effusion (**Figure 2**). The US characteristics of pneumonia, pleural effusion and pneumothorax should be well understood by the user,

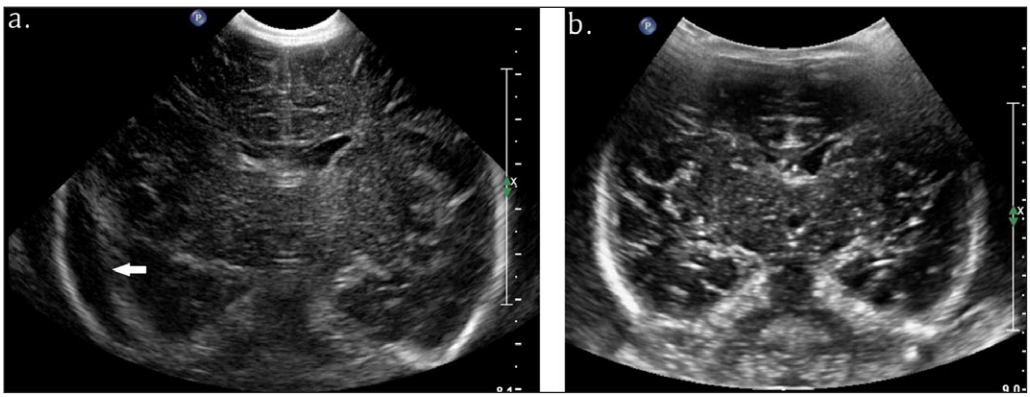

Figure 1: Ultrasound of a 4-day-old with perinatal asphyxia. **a.** US with micro-convex C8-5 MHz probe: mirror-image artifact of extra-cranial fluid creating the image of subdural hematoma in the right temporal region (arrow). **b.** Repeat US with convex C5-1 MHz probe demonstrates absence of subdural hematoma.

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Figure 2: Ultrasound of suspected pneumonia in a 2-year-old child. **a.** US demonstrates lung consolidation and heterogeneous pleural fluid, consistent with empyema. **b.** Color Doppler US distinguishes between consolidated lung parenchyma (containing branching vessels) and thick pleural fluid (avascular).

to avoid confusion with adjoining structures, such as the mediastinum, stomach, bowel etc. In case of thoracic deformation, US rapidly distinguishes anatomical variants of the rib cartilages from abnormal masses or rib fractures.

In conclusion, most pediatric emergencies benefit from a first-line US approach, provided that anatomical limitations and sources of error are well understood. Using US before all other techniques is an effective way to limit radiation exposure in the pediatric emergency room.

Competing Interests

The author has no competing interests to declare.

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