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Editorial

Point of Care Ultrasonography in Pediatric Emergency and Critical Care in Low and Middle-Income Countries

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Radiology is an integral part of diagnostic investigations in children. Pediatric radiology plays an important role among the available diagnostic modalities to identify the exact cause of illness and guide proper management in the acute settings. Developing countries face many difficulties in providing adequate radiological facilities in every part of the country because of limited trained medical personnel, cost of the set-up, and inadequate government investment in the health sectors. Many new and easily go to modalities in the western world are considered too high-tech for the developing world. Therefore, point of care ultrasound (POCUS) is a great boon for the low resource settings even in the most rural areas in low and middle-income countries (LMICs) because of easier transformation, installation and user friendly in comparison to other diagnostic modalities. In addition, it can be performed at the bedside. In my opinion, POCUS is not used to its limit in LMICs due to the lack of proper exposure and trainings of clinicians to ultrasound.

Radiation protection is very important in the pediatric population. Theoretically since the child has a long life to live, the chance of having a manifestation of harmful side effects of radiation is higher in children. The risk of radiation is 10 - 11 times higher in the pediatric population than in the adult population. Each imaging study in the pediatric population should be guided with the three principles of radiation protection i.e. Justification, Optimization, and dose limitation. As Low As Reasonably Achievable (ALARA) principle should be followed strictly. X-rays and Computed tomography should be preferred only when the benefit outweighs the risk.

With regards to radiation dose, complex technical aspects of CT and MRI including the human resources especially in LMICs, POCUS is one of the best imaging modalities for children in the emergency and critical care setup.

Applications of US in emergency and critical care

1. **Focused assessment with sonography with trauma (FAST) scan:** In cases of trauma or high impact injuries, FAST scan is the ultrasound (US) protocol to assess pericardial, peri-hepatic, peri-splenic and pelvic spaces. The extended version of the FAST scan is e-FAST which includes surveys of the anterior and lateral pleural spaces (thoracic view) to evaluate for pneumothorax or pleural effusion, assumed to be a hemothorax in trauma patients. In a hemodynamically unstable patient, a positive e-FAST may indicate immediate interventions (tube thoracostomy, pericardial window and diagnostic laparotomy).

2. **Cranial US:** Identification of the haemorrhages (epidural, subdural, intra-ventricular and intra-parenchymal) in neonates can be a part of the initial work-up in emergency and critical care as the natural foramina of the skull are open during this period. Any neonates with clinical history of seizures, decreased Glasgow coma scale, and cranial injuries can be evaluated with US.

3. **Pleural and cardiac emergencies:** US can identify free fluid within the bilateral pleural space, pneumothorax, atelectasis and peripheral consolidations. In addition, we can look into the pericardial space which could help the clinicians for emergent diagnosis of tamponade and management to decrease further morbidity as well as mortality. This is quite an important aspect in bedside evaluation in the limited resource settings.

4. **Abdominal and pelvic US:** US is the first go-to diagnostic modality for abdomen and pelvis in children. It plays a vital role in the emergency and critical settings to identify the free fluid within the abdomen and pelvis and identify the visceral organs injuries (liver, pancreas, spleen and bilateral kidneys). Acute appendicitis is the most common surgical emergency in children and trained pediatric radiologists can diagnose with ease. Other acute emergency conditions that can be diagnosed through US in children are intussusception, small bowel obstruction, diverticulitis, pyloric stenosis, testicular trauma/torsion, acute pancreatitis, liver/spleen infections, cholecystitis, cystitis, nephrolithiasis, ureteric calculus and pyelonephritis. In addition, localized visceral or intra-peritoneal collections/abscesses can be easily identified through US. POCUS performed by trained pediatric emergency physicians can be crucial in reducing time to diagnosis and definitive treatment thereby decreasing morbidity and prolonged hospital stay. Though not commonly performed for the swallowed radiolucent foreign bodies, focused US can be a valuable tool in the hands of experienced pediatric radiologist.

5. **Musculoskeletal ultrasound:** US plays an important role in identification of joint effusion, hemarthrosis and abscesses. Experienced radiologist can also detect subtle cortical fracture, periosteal reaction, muscle tears and tendon ruptures. Fractures are visualized with US using a high frequency linear probe that can identify millimetric interruptions in the hyperechoic line of the bone cortex. Focal soft tissue collection either it may be traumatic or infective can be easily detected through US. Identification of the radio-opaque as well as radiolucent foreign bodies can also be done through focused US.

6. **Procedures in emergency rooms and intensive care units:** Procedures under US guidance can improve the rate of successful peripheral and central intravenous access especially in those patients who are difficult to access, decreasing the amount of time to perform the procedure, the number of punctures and needle redirections. Aspiration of paracentesis, thoracentesis, incision and drainage of abscesses, arthrocentesis, lumbar puncture, biopsies, and other procedures can be done accurately through US guidance.

Conclusion

POCUS can be a valuable asset in the emergency as well as critical care units in pediatric population in rural as well as urban limited resource setups of LMICs. Thus, clinicians should be encouraged and trained for the POCUS in emergency and critical care units in order to lower the radiation dose in children and decreased the time for diagnosis and initiate active management early as possible. Proper governmental plans and investments should go hand in hand for upliftment of standards of care in LMICs.

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