Spinal ultrasound for lumbar puncture in infants: To see or not to see

To the Editor
Lumbar puncture (LP) in infants is a widespread technique in emergency, critical care, and perioperative settings. This procedure includes a spinal tap for diagnosis (cerebrospinal fluid [CSF] analysis or intrathecal pressure measurement), treatment (intrathecal chemotherapy), or anesthesia (spinal block), and epidural block for analgesia or anesthesia.[1-4]

Technical failure of spinal tap can involve a failed puncture or dry tap (no collection of CSF) or a traumatic puncture
or bloody tap (collection of CSF with >1,000 red blood cells/mm³). Failure is closely associated with the paucity of CSF, which can also cause epidural or subdural vessel puncture if the needle is inserted too deeply or repeated attempts are made. The consequences are greater discomfort, longer hospital stays, and higher costs. The failure rate can go up to 50–65%. Risk factors for technical failure are <3 months of age, operator inexperienced, puncture with stylet, patient movement, and no use of local anesthesia.[1,2,4–6]

Traditionally, LP has been and still is performed by anatomical landmarks or under fluoroscopic guidance if the former failed. The main limitations of the fluoroscopic guidance are worse visualization of bone structures with incomplete ossification, inability to visualize nerve structures (i.e., dural sac, conus medullaris, and nerve roots), and exposure to ionizing radiation.[4]

The infant’s spine has the following characteristics: cartilaginous lumbar spine with incomplete ossification of posterior bone elements and without lumbar lordosis until the first year of life; cranial migration of the dural sac (from S4 to S2) and conus medullaris (from L3 to L1) during the first year of life; dural sac with higher compliance, lower pressure, and larger CSF volume; and arachnoid membrane with higher elasticity and poorer adherence to the dura mater. All this implies that infants present an optimal acoustic window; however, also fewer interspaces to safely perform an LP and greater difficulty to cross the arachnoid membrane, especially if the dural sac is collapsed.[3,4,7,8]

Bedside spinal ultrasound (US) before an LP allows to identify reference anatomical structures (i.e., dura mater, dural sac, nerve roots, and conus medullaris); to locate the most suitable target interspace (i.e., the one with enough CSF and without spinal cord); and to estimate the depth from the skin to the posterior dura mater (for epidural block), to the subarachnoid space (for spinal tap), and to the anterior dura mater (maximum safe depth).[Figure 1] The success rate is greater than 80% and up to 50% higher than the LP anatomical landmarks. Moreover, the US is especially useful in those situations where CSF is potentially difficult to obtain, such as collapsed dural sac (i.e., dehydration associated with sepsis, vomiting, or fasting) or compressed dural sac (i.e., epidural or subdural hematoma after failed LP). Additionally, it allows taking measures to increase LP success, such as performing previous rapid intravenous rehydration or choosing an interspace with larger CSF volume and without epidural or subdural hematoma. Although several previous studies have not shown clear evidence of its benefits over the LP landmarks, US-assisted LP is a rapid and inexpensive procedure with a short learning curve and good acceptance among healthcare professionals.[4–8]

In conclusion, bedside spinal US imaging for LP in infants is a feasible and easy technique that provides safety (by avoiding both the conus medullaris and the anterior dura mater) and effectiveness (by locating the best puncture site and by measuring the length of needle insertion), reducing the risk of the dry or bloody tap. Therefore, its use should be promoted as a standard of care in daily clinical practice. Nevertheless, further research is required to support this statement.

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Conflicts of interest
There are no conflicts of interest.

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To the Editor,

High flow nasal cannula (HFNC) has been successfully used to treat acute hypoxemic respiratory failure (AHRF) inside and outside the intensive care unit (ICU). Use of HFNC became very popular for managing COVID19 pneumonia especially outside the ICU due to limited beds.

In 2016, Roca et al. described the Respiratory rate–Oxygenation (ROX) index which is the ratio of oxygen saturation on pulse oximeter/fraction of inspired oxygen (SpO2/FIO2) to respiratory rate (RR). ROX index is calculated at 2 h, 6 h, and 12 h. Roca et al. described ROX index in patients with AHRF with pneumonia who were initiated on HFNC. The landmark paper was a prospective study involving 157 patients who were initiated on HFNC out of which 44 patients (28%) failed HFNC and required intubation and mechanical ventilation. At 12 h, the best cutoff point for the ROX index was estimated to be 4.88 (area under the receiver operating characteristic curve (AUC) 0.74 [95% confidence interval (CI), 0.64–0.84]; P < 0.002).

During the pandemic when HFNC was used as a popular non-invasive ventilatory modality, ROX index was being increasingly utilized for ward and high-dependency admissions also in patients with COVID19 pneumonia.

In a validity study by Suliman et al., the authors enrolled 69 patients with COVID19 pneumonia and AHRF, and analyzed several variables including ROX index which could be responsible for intubation. They concluded that gender and ROX index were the only significant independent predictors of intubation. In this study, the cutoff point of the ROX index on the first day of admission was ≤25.26 (90.2% of sensitivity and 75% of specificity). This value was much more than suggested by Roca et al. and also from various other studies.

In an observational study by Ferrer et al., the authors included 85 patients having AHRF due to COVID19 and were initiated on HFNC. The authors observed that HFNC failed in 47 (55.3%) patients. Out of 47, 45 patients were initially managed with non-invasive ventilation (NIV). ROX index at 24 h was the best predictor of HFNC success (AUC 0.826, 95% CI 0.593–1.00, P = 0.015) with a cutoff point of 5.35.

Later, Chandel et al. performed a multicenter, retrospective, observational cohort study of 272 patients with AHRF due to COVID19 pneumonia who were initiated on HFNC in the beginning. They used ROX index to predict the success of HFNC therapy. On analysis, the authors concluded that ROX index can be used to predict intubation in patients initiated on high-flow oxygenation.