# 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/mm$^3$). 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]

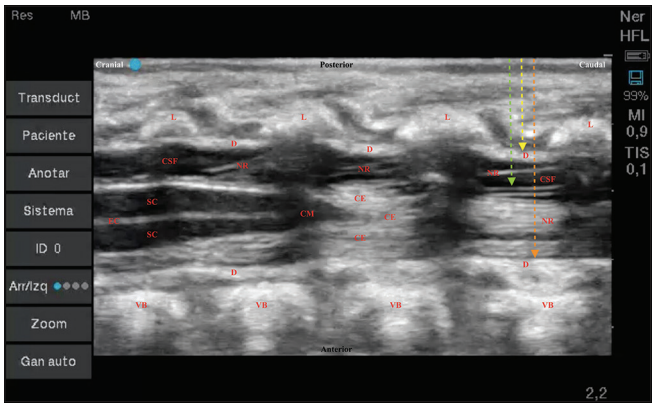


**Figure 1: Lumbar spine sonoanatomy in a 2-month-old infant. CE: cauda equina. CM: conus medullaris. CSF: cerebrospinal fluid. D: dura mater. EC: ependymal canal. L: lamina. NR: nerve root. SC: spinal cord. VB: vertebral body.Green arrow: skin – subarachnoid space (spinal tap). Yellow arrow: skin-posterior dura mater (epidural block).Orange arrow: skin-anterior dura mater (maximum safe depth)**

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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## References

1. Olowoyeye A, Fadahunsi O, Okudo J, Opaneye O, Okwundu C. Ultrasound imaging versus palpation method for diagnostic lumbar puncture in neonates and infants: A systematic review and meta-analysis. BMJPaediatr Open 2019;15;3:e000412.
2. Kessler D, Pahalyants V, Kriger J, Behr G, Dayan P. Pre-procedural ultrasound for infant lumbar puncture: A randomized clinical trial.

AcadEmerg Med2018;25:1027-34.
3. Kil HK. Caudal and epidural blocks in infants and small children: Historical perspective and ultrasound-guided approaches. Korean J Anesthesiol2018;71:430-9.
4. Pierce DB, Shivaram G, Koo KS, Shaw DW, Meyer KF, Monroe EJ. Ultrasound-guided lumbar puncture in pediatric patients: Technical success and safety. Pediatr Radiol2018;48:875-81.
5. Neal JT, Kaplan SL, Woodford AL, Desai K, Zorc JJ, Chen AE. The effect of bedside ultrasonographic skin marking on infant lumbar puncture success: A randomized controlled trial. Ann Emerg Med2017;69:610-9.e1.
6. Gorn M, Kunkov S, Crain EF. Prospective investigation of a novel ultrasound-assisted lumbar puncture technique on infants in the pediatric emergency department. AcadEmerg Med2017;24:6-12.
7. Muhutsami P, Robinson AJ, Shroff MM. Ultrasound guidance for difficult lumbar puncture in children: Pearls and pitfalls. Pediatr Radiol2017;47:822-30.
8. Meyers AB, Chandra T, Epelman M. Sonographic spinal imaging of normal anatomy, pathology and magnetic growing rods in children. Pediatr Radiol 2017;47:1046-57.



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