

Using Ultrasound to Assist Neonatal Lumbar Puncture: A How to Guide

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Background

Lumbar puncture (LP) is a key diagnostic procedure used in the emergency department to evaluate cerebrospinal fluid (CSF) for disease; its major application in neonatal care is to evaluate for bacterial meningitis. To conduct a lumbar puncture, a needle is inserted between the spinous processes of the lumbar vertebrae into the subarachnoid space where CSF can then be removed for testing. Lumbar punctures in the neonatal period can be challenging given the incredibly small window for needle entry between the vertebrae. In recent years, emergency physicians have begun to utilize ultrasound to identify key anatomical landmarks before performing lumbar puncture in an attempt to improve the overall success rate of the procedure.

The utilization of ultrasound before lumbar puncture has proven to be advantageous in multiple studies, with a higher success rate particularly in younger children.^[2]

Supplies

- Ultrasound Machine
- Ultrasound Gel
- Ultrasound Probe Cover
- Hockey Stick Probe (Figure 1)
- Marking Pen



Figure 1: Hockey Stick Ultrasound Probe

Patient Positioning

The neonate should be placed in either the upright (Figure 2) or lateral decubitus position (Figure 3).



Figure 2: Neonate in the Upright Position



Figure 3: Neonate in the Lateral Decubitus Position

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Images

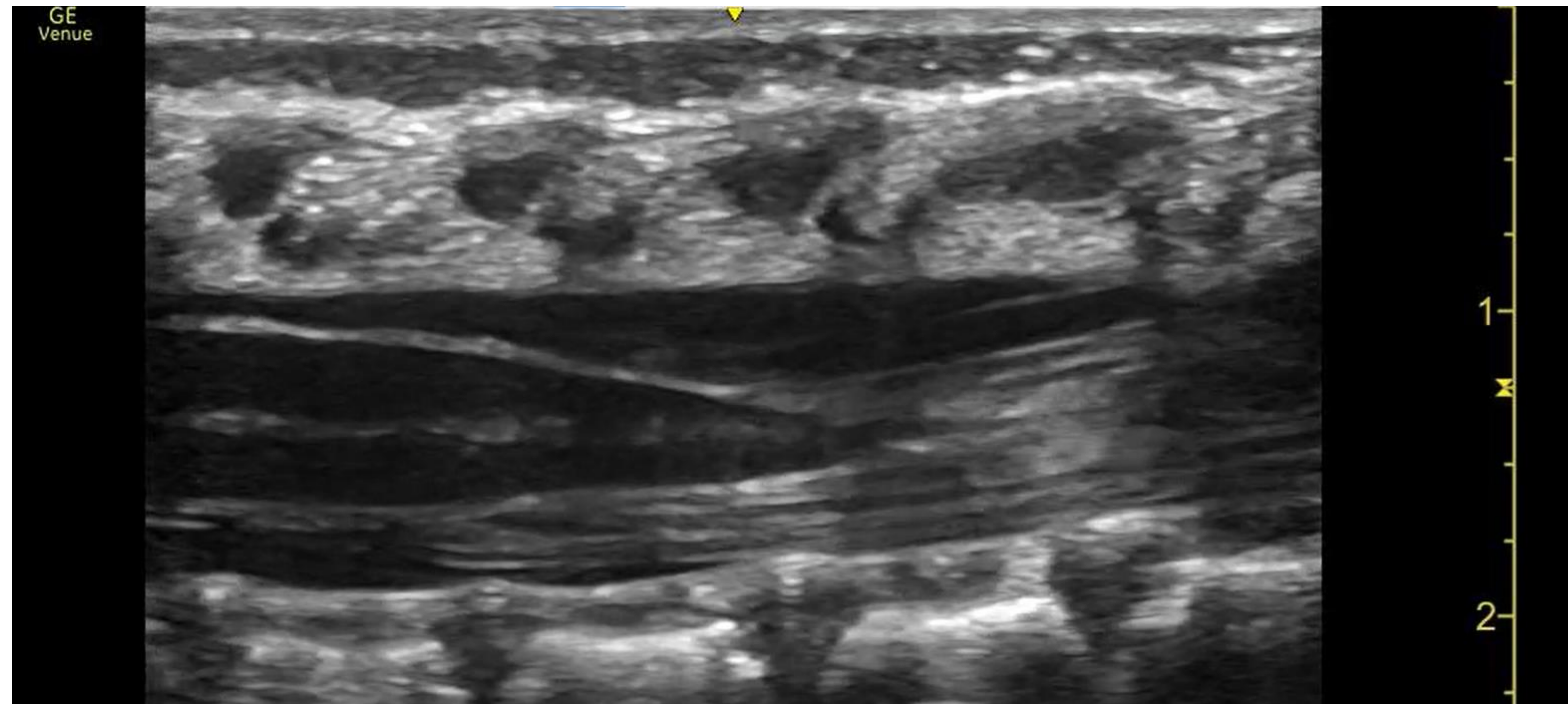


Figure 4: Neonatal Spinal Cord in Longitudinal View



Figure 5: Neonatal Spinal Cord in Transverse View

Ultrasound Technique

For a neonatal lumbar puncture, a high frequency linear transducer probe is recommended, but the “hockey stick” linear probe, in particular, has a higher frequency and smaller footprint for better resolution of superficial structures. In the upright or lateral decubitus position, start by identifying the L4-5 intervertebral space by palpating the superior aspects of the iliac crests and following this level to midline. For the transverse view, the probe is placed perpendicular to this landmark over the spinous process with the probe marker to the patient’s right. The spinous process should appear as a rounded structure with a hyperechoic rim and posterior shadowing. With the spinous process in the middle of the screen, use a skin marker to denote the anatomical midline. For a longitudinal view, rotate the probe 90° at midline so that it is now parallel to the spine with the probe marker toward the patient’s head. In this view, the spinous processes should appear as ‘tombstones’ next to each other. The spaces between the structures are the intervertebral spaces for needle insertion. Place the intervertebral space of choice in the middle of the screen and mark the skin at the center of the probe. The intersection of these two markings is your ideal site for needle insertion. When inserting the needle, ultrasound may also be used dynamically to track the needle in real-time. The probe is kept in a longitudinal position just lateral to the midline. The needle tip can be seen passing through the intervertebral space and the ligamentum flavum. Once a release in resistance is felt, the needle should be checked for CSF every 1-2mm until it successfully reaches the subarachnoid space.

Pearls & Pitfalls

Pearls

- Utilize the hockey stick linear transducer probe as your probe of choice. This provides a smaller footprint and higher resolution for these neonates.
- Mark the skin with a surgical marker or other ink that will not be easily removed with betadine.

Pitfalls

- Mistaking transverse processes for spinous processes. As close to the midline as possible, slide the probe slowly caudally to identify the cauda equina (collection of nerve roots) or rotate the probe 90 degrees for the longitudinal view, and fan the probe to identify the midline vertical row of spinous processes.
- Not picking the widest intervertebral space for needle insertion. If all spaces are narrow, consider a paramedian approach.
- Underestimating or overestimating depth of needle insertion. This can be measured on the screen beforehand.

Conclusion

Ultrasound as an adjunct to lumbar punctures has also been shown to reduce the incidence of traumatic LP.^[4] Furthermore, the application of ultrasound in LP procedures has resulted in fewer needle passes as well as decreased levels of pain experienced by the patient.^[1] In addition to improved success rates, ultrasound is readily available in emergency departments nationwide, and the majority of clinicians agree that the technique is easily performed.^[3] Competency training does not seem to be a barrier to its application, as even novice ultrasound users can acquire adequate lumbar images after only a brief training class.^[5] The objective of this guide is to educate clinicians on how to perform an ultrasound guided LP in a neonate. In theory this will translate to increased success rates of the procedure, less pain for the neonatal patient, and overall increased parental satisfaction.

References

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