Ultrasound for Lumbar Spinal Procedures

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KEYWORDS

• Ultrasound • Ultrasonography • Interventional spine • Interventional pain
• Spine injections • Epidural • Facet • Medial branch block

KEY POINTS

- Ultrasound-guided spine interventions are becoming more frequently used.
- Ultrasound guidance can be used for several spine procedures, including facet injections, medial branch blocks, epidural injections, and sacroiliac joint injections.
- Advantages and disadvantages should be weighed carefully when deciding between ultrasound and other methods of visualization, such as fluoroscopy and computed tomography (CT).
- Interventionalists should be aware of limitations of ultrasound, particularly when spinal vasculature may be at risk.
- Further studies are needed to further evaluate safety and efficacy of ultrasound-guided procedures in comparison to fluoroscopy and CT.

INTRODUCTION

Image-guided injection techniques are an integral part of multimodal pain management, and ultrasonography has become an increasingly valuable and promising tool for performing these procedures. The increase in the use of ultrasound guidance has led to an increasing interest in the study of ultrasound-guided interventional spine procedures. Several studies have investigated the novel use of ultrasound for lumbosacral pain management procedures with favorable outcomes.

The successful practice of ultrasound-guided injections requires a thorough understanding of basic ultrasound principles and lumbosacral spine sonoanatomy. Several other key factors include appropriate identification of bone, soft tissue, and neural

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structures, defining essential ultrasound views, and successfully tracking the needle in real time. This article provides an overview of ultrasound-guided spine procedures and review of literature describing the methodology and feasibility of sonography for various lumbar spine injections, including medial branch blocks (MBBs), facet joint injections, epidural steroid injections, and sacroiliac (SI) joint injections.

BASIC ULTRASOUND PRINCIPLES

An ultrasound beam is generated when multiple piezoelectric crystals positioned along the surface of the transducer rapidly vibrate, creating an electrical field.[1] The sound waves that are produced are then reflected, refracted, and scattered while penetrating tissues of various acoustic impedance.[1] An image is subsequently displayed when some of the mechanical or sound energy that is returned to the transducer is converted into electrical energy.[1,2] Objects that appear lighter are termed "hyperechoic" and indicate higher signal intensity, whereas objects that appear darker are termed "hypoechoic" and indicate lower signal intensity.

Image quality is dependent on the angle of the ultrasound beam and is best when perpendicular to the target. High-frequency ultrasound is also associated with better resolution but varies inversely with depth of tissue penetration.[2] There are 2 scanning approaches used when performing ultrasound-guided injections: (1) The in-plane approach allows for complete visualization of the needle during its trajectory, but may be more challenging because the beam must be accurately aligned with the needle. (2) The out-of-plane approach depicts the needle as a bright dot, which may be difficult to localize and does not produce an image of the needle in its entirety.

LUMBOSACRAL SONOANATOMY

A low-frequency curved array transducer (2–6 MHz) is commonly used to visualize the lumbosacral spine and its neuraxial structures with depths that range from 5 to 7 cm. Bony structures that are identifiable with ultrasonography include spinous processes, transverse processes, vertebral laminae, articular processes, facet joints, and the posterior aspect of the vertebral bodies. Soft tissue structures, such as lumbar nerve roots, paraspinal muscles, ligamentum flavum, and posterior dura can also be visualized.[3]

Many lumbar procedures begin with a long-axis view to determine appropriate spinal levels. Then, the transducer is translated to the affected side to visualize lamina, facet joints, and transverse processes (**Fig. 1**). Once appropriate targets and levels

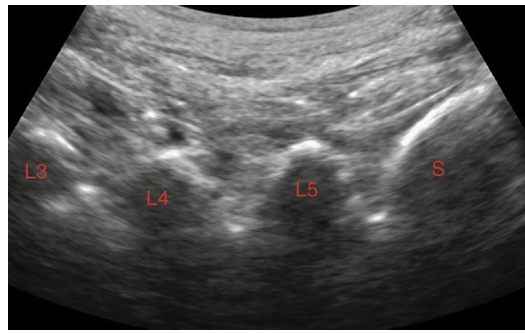

Fig. 1. Paramedian longitudinal view, lumbar spine. Lamina appear as a sawtooth pattern: (*left*) cranial; (*right*) caudal. S, sacrum. (*Courtesy of* Allen S. Chen, MD, MPH, New York, NY.)