Techniques in Regional Anesthesia and Pain Management (2009) 13, 150-153

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Techniques in
Regional Anesthesia
& Pain Management

Ultrasound-guided zygapophysial nerve and joint injection

Michael Gofeld, MD

From the University of Washington Medical Center for Pain Relief, Seattle, Washington.

KEYWORDS:
Ultrasound-guided;
Lumbar zygapophysial joint;
Medial branch block

Diagnostic and therapeutic lumbar zygapophysial (facet) nerve and joint interventions are probably the most commonly performed injections in pain management, and routine fluoroscopy guidance is required. Imaging is necessary to ensure precise needle position and to exclude an intravascular injection. Because the procedure is considered a low-risk intervention, use of ultrasound (US) guidance is thought to be an attractive alternative to fluoroscopy mainly because the former renders no ionizing radiation to the patient and medical personnel. In addition US-guided procedures are essentially "office-based" and do not require a radiology suite or operating room.
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In the past decade, ultrasonography has been introduced in regional anesthesia to visualize paraspinal and neuroaxial structures. For instance, distance to the epidural space can be measured by ultrasound (US) in obstetrical anesthesia.[1,2] Furthermore, preprocedure spinal sonography may prevent inadvertent dural puncture by revealing an aberrant anatomy of the ligamentum flavum.[3] US-assisted paravertebral block technique was also developed.[4] However, US applications in chronic spinal pain imaging and guidance remain in a developmental stage.

Diagnostic and therapeutic lumbar zygapophysial (facet) joint and nerve interventions are probably the most commonly performed injections in pain management, and routine fluoroscopy guidance is required.[5] Imaging is necessary to ensure precise needle position and to exclude an intravascular injection. US guidance may be an attractive alternative to fluoroscopy, eliminating radiation exposure and allowing an office-based procedure setting.

Scanning technique

Usually a 3- to 8-MHz curvilinear array is used while a patient is positioned prone with a pillow under the abdomen. US scanning of the spine requires particular sequence in image acquisition to obtain an optimal view of the soft tissues (paraspinous muscles, ligaments, dura) and vertebrae. Longitudinal scanning starts from the sacrum with the transducer positioned at the midline. In patients with scoliosis, medial or lateral tuning may be required to obtain the optimal view (Figure 1). Skin marks are made alongside the transducer (Figure 2) that help to localize spinal levels and to provide "reference points." Once the longitudinal midline images are obtained, the transducer is gently shifted laterally until a "saw-tooth" hyperechoic line is seen (Figure 3). This bony structure represents the zygapophysial joints; however, the joint space cannot be seen on this view. Shifting the probe further laterally reveals a hyperechoic dotted line. These are the transverse processes with the hypoechoic soft tissue between them (Figure 4). The most caudal wide bone shadow in this view typically represents the sacrum.

Axial scanning starts from the sacral level at the midline. The first distinct midline bone protuberance is the S1 median crest of the sacrum (Figure 5). The transducer is then moved cephalad until a deep hyperechoic structure is seen. This normally corresponds to the L5/S1 intrathecal space. In fact, this structure is none other than a signal enhancement when it passes the cerebrospinal fluid and reflects from the ventral dura. Sometimes, particularly in young patients, two hyperechoic lines can be seen: the posterior dura and the ventral dura. Cephalad to it, a midline hyperechoic signal—the

Address reprint requests and correspondence: Michael Gofeld, MD, University of Washington Medical Center for Pain Relief, 4225 Roosevelt Way NE, Suite 401, Seattle, WA 98195.
E-mail address: gofeld@u.washington.edu.

1084-208X/$ -see front matter Published by Elsevier Inc.
doi:10.1053/j.trap.2009.07.002

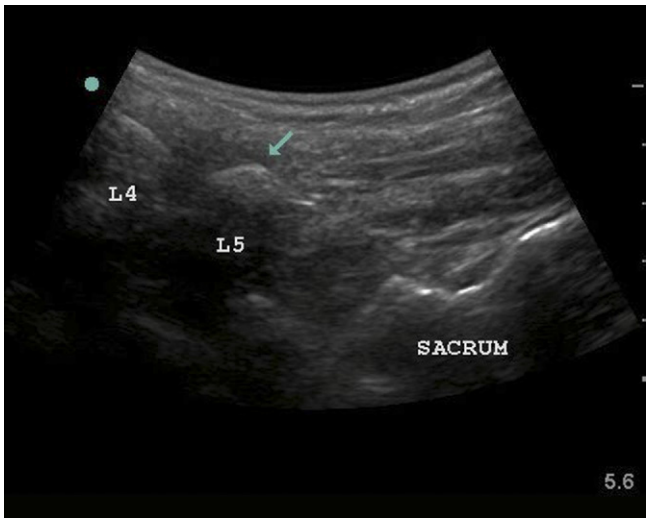

Figure 1 Sonographic long-axis view of the lumbar spine showing the spinous processes of the L3, L4, and L5 vertebrae and the sacrum. (Color version of figure is available online.)

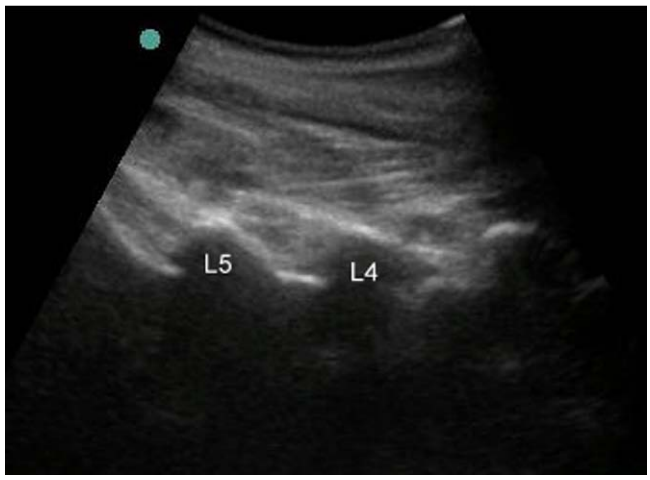

Figure 3 "Saw-tooth" line of lumbar laminae. Note: it is located deeper than the similar line of spinous processes and there is a continuity of hyperechoic bone signal between "peaks." (Color version of figure is available online.)

L5 spinous process—is seen. It is advisable to continue cephalad scanning and identify all lumbar spinous processes and correlate those with the previously performed skin marks. This "double-check" will prevent a wrong level injection. When the transducer is firmly positioned at the desired level, it is slightly shifted laterally. A three-step shadow of the lumbar vertebra will become evident: the most superficial bone structure is the spinous process, with the zygapophysial joint positioned just inferiorly and lateral to it, and the transverse process located further inferiorly and laterally (Figure 6). Fine-tuning of the probe will allow to "open up" the joint or to visualize the angle between the superior articular and transverse processes. The latter is the anatomical target for the medial branch block (L1-L4) or the dorsal ramus block at L5. At L5/S1 level, the sacral ala and not the transverse process is seen.

Figure 2 Transducer positioned in the midline: skin marks corresponding to L3, L4, and L5 spinal levels. (Color version of figure is available online.)

Injection technique

Lumbar (L1-L4) zygapophysial medial branch and L5 dorsal ramus nerve block

Skin is prepped and draped in a usual sterile fashion. The US transducer is covered by a sterile transparent adhesive or sleeve. The patient is positioned prone with a pillow under the abdomen to diminish the lumbar lordosis.

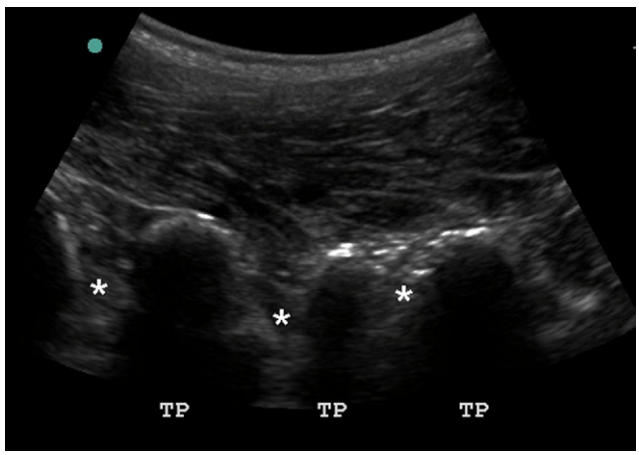

Figure 4 "Dotted" hyperechoic line of transverse processes with the hypoechoic intertransversarius muscle between them (asterisks). (Color version of figure is available online.)

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