Imaging Article

Ultrasound Imaging for Popliteal Sciatic Nerve Block

Avinash Sinha, M.B.Ch.B., F.R.C.A. and Vincent W. S. Chan, M.D., F.R.C.P.C.

Background and Objectives: Ultrasound is a novel method of nerve localization but its use for lower extremity blocks appears limited with only reports for femoral 3-in-1 blocks. We report a case series of popliteal sciatic nerve blocks using ultrasound guidance to illustrate the clinical usefulness of this technology.

Case Report: The sciatic nerve was localized in the popliteal fossa by ultrasound imaging in 10 patients using a 4- to 7-MHz probe and the Philips ATL HDI 5000 unit. Ultrasound imaging showed the sciatic nerve anatomy, the point at which it divides, and the spatial relationship between the peroneal and tibial nerves distally. Needle contact with the nerve(s) was further confirmed with nerve stimulation. Circumferential local anesthetic spread within the fascial sheath after injection appears to correlate with rapid onset and completeness of sciatic nerve block.

Conclusions: Our preliminary experience suggests that ultrasound localization of the sciatic nerve in the popliteal fossa is a simple and reliable procedure. It helps guide block needle placement and assess local anesthetic spread pattern at the time of injection. Reg Anesth Pain Med 2004;29:130-134.

Key Words: Popliteal, Catheter, Ultrasound, Anatomy, Local anesthesia.
Ultrasound Imaging for Popliteal Sciatic Nerve Block

Popliteal artery, which was commonly 3 to 4 cm deep to the skin (Fig 1). In some cases, the vein was seen but easily compressed by the probe. Also seen were the biceps femoris muscle laterally and semitendinosus and semimembranosus muscles medially. The femur appeared as a dense hyperechoic line found deep to the neurovascular structures.

After local anesthetic skin infiltration, a 3.5-inch, 17-gauge insulated Tuohy block needle (Arrow, Reading, PA) was inserted below the midpoint of the probe perpendicular to the ultrasound beam (Fig 2). In this orientation, the needle was seen in cross section on ultrasound as a hyperechoic "dot" without full image of the needle shaft. Only needle and thigh tissue movement was observed in real time. Once the needle was deemed in contact with the nerve on ultrasound, foot dorsiflexion or plantar flexion was sought using a nerve stimulator (Stimuplex; Braun Medical, Bethlehem, PA) until optimal stimulation was obtained at less than 0.5 mA. A 20-gauge stimulating catheter (Stimucath; Arrow) was then advanced 4 to 5 cm beyond the needle tip. After catheter stimulation with 0.5 to 1 mA, 15 mL of 1.5% lidocaine with epinephrine 1:200,000 and 15 mL of 0.5% bupivacaine were injected incrementally over 2 to 3 minutes.

In the transverse view, local anesthetic spread was examined after injection of 5 mL, 10 mL, 20 mL, and 30 mL to examine local anesthetic spread. Circumferential spread (Fig 3A, video [see video clip in this article at www.rapm.org]) was noted in 8 patients resulting in rapid onset (within 10 minutes) and complete anesthesia in the foot within 20 minutes. In contrast, spread seen only to one side of the nerve, not encompassing the whole nerve, was associated with a partial block (Fig 3B). We could also capture a longitudinal view of the sciatic nerve and the overlying stimulating needle by rotating the probe vertically from the horizontal position and scanning the nerve along its long axis (Fig 4).

Discussion

The use of popliteal nerve block to relieve pain after foot and ankle surgery is gaining popularity and can speed hospital discharge in outpatients. The provision of a perineural catheter and local anesthetic infusion can further extend the period of pain control well beyond that following the single injection technique. Reduced opioid consumption, reduced opioid-related side effects, and improved patient satisfaction are benefits recently reported. Unfortunately, the failure rate of single-shot popliteal blocks may be as high as 21% with many requiring supplementation. It is conceivable that ultrasound imaging may improve the accuracy of nerve localization and needle placement. Direct visualization of nerve location and local anesthetic spread may also reduce block failure rate and shorten onset time. Furthermore, imaging can help prevent accidental puncture to vessels and other neighboring structures.

Achieving consistent, interpretable ultrasound images of nerves and the block needle requires some degree of technical skill and correct ultrasound probe orientation. Using the classical popli-
teal block approach,19 we advance the needle in the posterior thigh while the ultrasound probe is positioned horizontally. In this orientation, we can only infer needle position through associated movement, as the needle moves perpendicular to the ultrasound beam. If visualization of the needle shaft is desired, the ultrasound probe must have a longitudinal orientation to the nerve (probe now vertical) so that the beam is aligned with the long axis of both the needle and the sciatic nerve (Fig 4).

The point at which the sciatic nerve divides above the popliteal crease is highly variable (0-115 mm, mean of 61 mm ± 27 mm).20 This can be a cause for difficult localization of both the peroneal and tibial nerves using the nerve stimulation technique. To prevent incomplete anesthesia, a double injection technique has been advocated to anesthetize individually both components of the sciatic nerve.20 With ultrasound scanning, we were able to identify precisely the point at which the sciatic nerve divides in each of the 10 patients. Distally, we could also examine the spatial relationship between the common peroneal and tibial nerves. We found the 2 nerves situated side by side (Fig 5A) in 9 patients but, unexpectedly, atop one another (Fig 5B) in 1 patient. This later orientation would make it difficult, if not impossible, to individually localize both branches of the sciatic nerve with the conventional nerve stimulation technique. Ultrasound visualization of the sciatic nerve and its terminal branches at the time of nerve block shows the optimal site of needle placement. This is a significant advantage over conventional “blind” approaches.

Anatomical studies show the presence of an adventitial sheath enveloping the sciatic nerve and its divisions and dye spread within this sheath in cadavers.21 Our observation of local anesthetic spread around the nerves and extensive spread proximally along the nerves lends support to the adventitial sheath concept (Fig 6). We have observed both symmetrical circumferential (Fig 3A) and asymmetrical spread (Fig 3B) around the nerves. Our preliminary observation suggests that faster block onset and greater success happen with circumferential local anesthetic spread along the course of the nerve. To optimally assess local anesthetic spread, it is necessary to scan the nerve both distally and proximally and not at a single-nerve location. Extensive proximal local anesthetic spread after a 30-mL injection can also account for successful

![Fig 3](https://example.com/fig3.png)

**Fig 3.** (A) Transverse sonogram showing circumferential local anesthetic spread around the sciatic nerve after a 30-mL injection. (B) Transverse sonogram showing incomplete local anesthetic spread. Abbreviation: LA, local anesthetic.

![Fig 4](https://example.com/fig4.png)

**Fig 4.** Longitudinal view of the sciatic nerve with the overlying stimulating needle (arrows). Abbreviations: ceph, cephalad; caud, caudad.
block of both the peroneal and tibial divisions, despite injection at the site of stimulation of only one division. Conceivably, if ultrasound visualization during local anesthetic injection can identify the extent of circumferential and proximal spread, it is not necessary to block nerves individually, thus avoiding multiple attempts and, potentially, nerve injury.

Advanced ultrasound technology today yields high-quality anatomical images with distinct clarity. Our preliminary ultrasound experience of scanning the sciatic nerve and its branches in the popliteal fossa is encouraging. As for other peripheral nerves, we believe ultrasound imaging of the sciatic nerve will prove valuable for nerve localization clinically and can possibly predict block success and completeness. Whether ultrasound is useful for localizing the sciatic nerve in deeper locations of the lower extremity is not known at the present time and warrants future studies.

Acknowledgement

The ultrasound machine was on loan from Philips Medical Systems Canada.

References


