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ULTRASOUND GUIDED ANKLE BLOCK

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The ankle block is a relatively safe, simple to perform peripheral nerve block which can provide both anesthesia and post-operative analgesia for a wide variety of surgical procedures involving the foot. It is a useful block in the day case setting as it avoids the need for general anesthesia and preserves motor function of the leg, therefore facilitating ambulation and early discharge of patients. One major drawback of regional anesthesia however is the inherent failure rate, even in expert hands. Overall success rate of the ankle block has been reported to be between 89 and 100%.[1-4] Failure can be reduced by blocking all five nerves that supply the ankle, rather than 'selective blockade' based on the site of surgery.[2] Another factor that may influence success is the method of nerve localisation.

ULTRASOUND GUIDED ANKLE BLOCK

INTRODUCTION

The foot is innervated by five nerves - the posterior tibial (PTN), superficial peroneal, deep peroneal and sural nerves (which originate from the sciatic nerve) and the saphenous nerve (a branch of the femoral nerve). The cutaneous supply of these nerves is shown in Figures 1-3. Despite the nerves actually being variable in position, traditional ankle blocks rely solely on a blind approach, using only anatomical and vascular landmarks to deposit local anesthetic near where the nerves are usually situated.[5,6] The superficial peroneal, sural and saphenous nerves have a purely cutaneous distribution, and are blocked by simple subcutaneous infiltration in the appropriate location. In contrast, the PTN and deep peroneal nerves innervate deep structures, including both bone and muscle.[5] Because the PTN supplies an extensive area, block of this nerve is crucial for a successful ankle block. It can however be challenging to find. When using the posterior tibial artery as a guide, Wassef reported only a 30% success rate of PTN block when the artery was palpable.[7] This fell to 0% when the pulse was impalpable. Doty and colleagues demonstrated that use of a nerve stimulator can increase the success of the PTN block.[8]

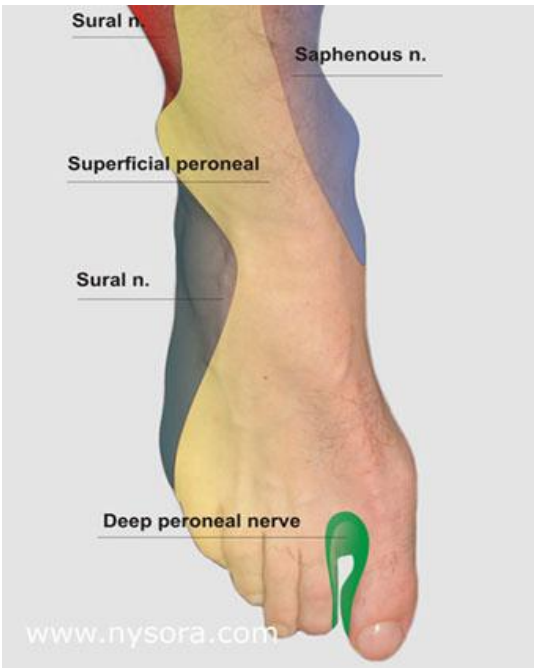

Figure 1. Sensory innervation of dorsum of foot

Figure 2. Sensory innervation of lateral aspect foot

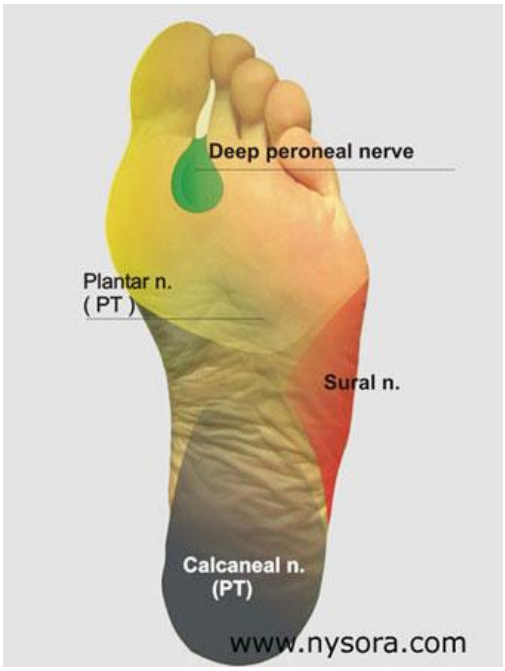

Figure 3. Sensory innervation of plantar aspect of foot

Ultrasound is an alternative method of nerve localisation which is growing in popularity. Ultrasound allows direct visualisation of the relevant anatomy and real time imaging of needle advancement and local anesthetic spread.[9] As yet, there are no prospective outcome studies demonstrating that ultrasound guided ankle blocks are superior to traditional anatomical methods of nerve localisation. Retrospective analysis in our institution has revealed that using ultrasound combined with neurostimulation to localise the PTN has increased the overall success rate of ankle blocks to 96%, from 74% when using anatomical methods alone.[10] Ultrasound has been shown to reduce both the number of needle passes and patient discomfort in certain blocks.[11]

The ankle block involves several injections and can be painful for the patient. Anecdotally, ultrasound has allowed us to use less sedation, which may be a further benefit in the ambulatory care setting. This article describes our technique of ultrasound guided posterior tibial and deep peroneal nerve block. We do not routinely use ultrasound to block the superficial nerves at the ankle, although as ultrasound technology and image resolution continue to improve reports of the use of ultrasound to facilitate block of these nerves may emerge. The indications and contraindications for ankle block, choice of local anesthetic and complications have been described elsewhere and are therefore not addressed.[6]

Positioning

The patient is positioned supine with a bolster under the ankle to be blocked. This allows access to all five nerves.

Figure 4. Linear probe and 'hockey stick' probe

Equipment

A high frequency (10-15Mhz), linear probe should be selected. Although the 'hockey stick' transducer is smaller, satisfactory images can usually be obtained with the standard probe (Figure 4). For PTN block a 22 gauge, 50mm stimulating needle connected to a nerve stimulator can be used. This allows the identity of the PTN to be confirmed if necessary. Four 10ml syringes are prepared

containing local anesthetic, two with long (1 ½ inch) 25G hypodermic needles attached, one with a short (5/8 inch) 25G hypodermic needle and one connected to the 22G stimulating needle. Our choice of anesthetic is a 50:50 mixture of 2% lidocaine and 0.5% bupivicaine. No adrenaline should be added when performing an ankle block. The skin should be cleaned with an appropriate solution such as 2% chlorhexidine in 70% isopropyl alcohol solution. Drugs for sedation such as midazolam, fentanyl and propofol should also be available. Standard monitoring, as for all nerve blocks, is applied and intravenous access secured.

Scanning Technique, Nerve Localisation and Needle Placement

The anatomy of these nerves has been described in more detail elsewhere and should be reviewed prior to performing nerve blockade.[5]

Figure 5. Probe positioning for posterior tibial nerve block

Posterior tibial nerve

The foot is externally rotated and the probe placed transversely, slightly cephalad and posterior to the medial malleolus, where contact with the skin is not obstructed by bone (Figure 5). The image is optimised by selecting an appropriate level for both the depth and focus (usually 1-2cm), and then adjusting the gain. The round, hypoechoic, pulsatile posterior tibial artery is then identified, using Doppler if required. The PTN is generally located posterior to the artery, and at this location is hyperechoic with a typical honeycomb appearance (Figure 6).[12] The tendons of tibialis posterior and flexor digitorum longus are also hyperechoic and to distinguish between these and the PTN, the nerve can be traced proximally in the leg. The tendons also move with ankle flexion. Finally, if there is doubt, the PTN can be stimulated to elicit a confirmatory motor response (the commonest response is plantar flexion of some or all toes).[8]

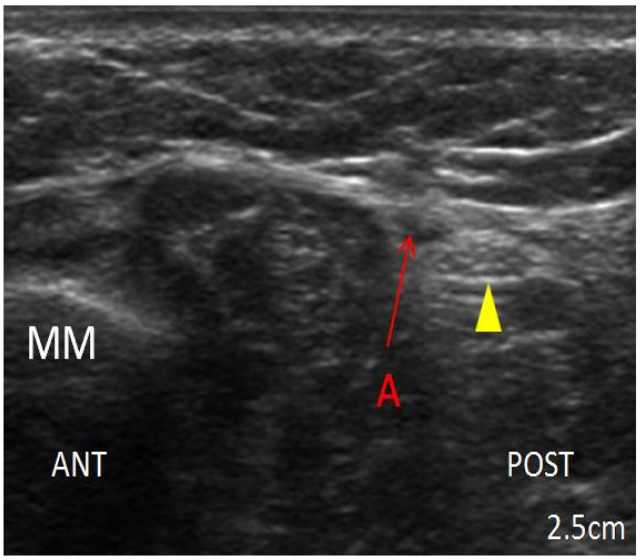

Figure 6. Posterior tibial nerve (arrow) at right ankle. A = posterior tibial artery. MM = proximal edge of medial malleolus/tibia

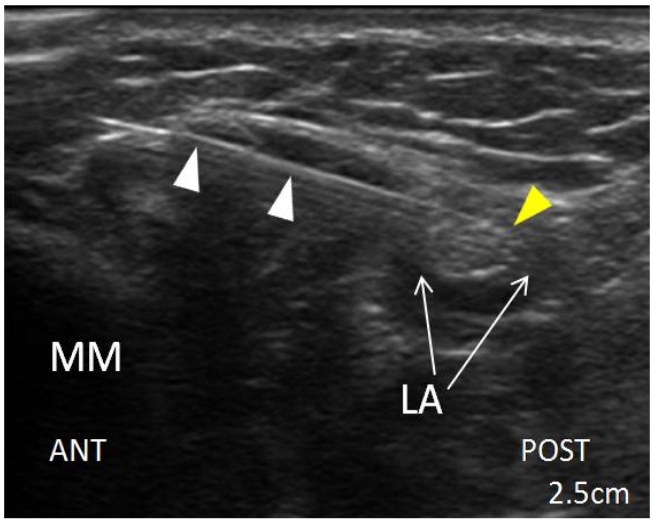

Figure 7. Local anesthetic (LA) around deep aspect of posterior tibial nerve (yellow arrow). The needle, in plane (white arrows), is in position to inject further LA to complete circumferential spread

Following nerve localisation, a 22G stimulating needle is inserted either in or out of plane to contact the nerve. If the in-plane approach is chosen, it is generally easiest to approach from lateral to medial, purely for ergonomic reasons. The in-plane approach however usually requires navigation of the needle around the artery however before reaching the nerve. 6-10mls of local anesthetic is injected, repositioning the needle as required to ensure circumferential spread (Figure 7).

Deep peroneal nerve

As with the PTN, the deep peroneal nerve is deep to the fascial planes. Using the same linear, high frequency probe the dorsalis pedis artery is identified on the dorsum of the foot in the short axis view between the two malleoli. The deep peroneal nerve generally lies lateral to the extensor hallucis longus tendon but is small and can be difficult to visualise (Figure 8). We therefore use the short (5/8 inch), 25G needle and insert this out of plane on either side of the dorsalis pedis artery to contact the bone. The needle is then withdrawn 1-2mm and 3-4 ml of local anesthetic injected on each side of the artery.

Superficial peroneal, saphenous and sural nerves

These nerves are all superficial and are blocked in the traditional manner by subcutaneous infiltration as described elsewhere.[6] We use the long (1 ½ inch) 25G needle, and inject up to a further 20ml in total. Although we have visualised some of these nerves with ultrasound (Figure 9), they are often not discrete at this level, but rather several branches, and it is therefore not our routine practice to use ultrasound to assist in blocking these nerves at the level of the ankle.

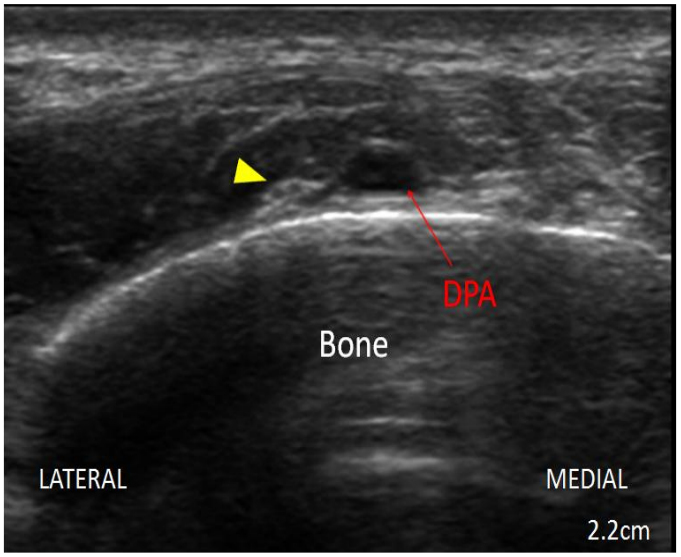

Figure 8. Deep peroneal nerve (arrow) lateral to dorsalis pedis artery (DPA). Image taken at the intermalleolar level of left foot.

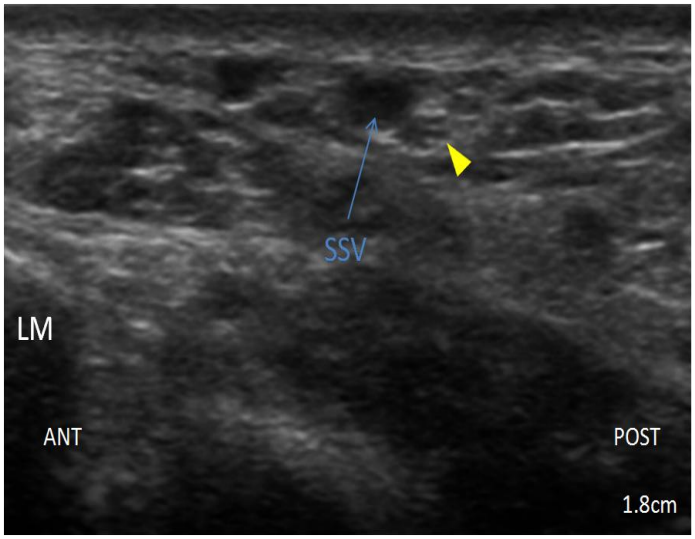

Figure 9. Sural nerve at level of lateral malleolus, left ankle.

Summary

In summary, ultrasound can be used to localise the PTN and also to facilitate deep peroneal nerve block. We have shown retrospectively that ultrasound combined with neurostimulation improved ankle block success rates at our institution. Overall, however further work is required in the form of prospective, randomised studies to confirm if using ultrasound for ankle block offers any advantage.

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