Continuing education

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Ultrasound guided sciatic nerve blockade – subgluteal and popliteal approaches

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Abstract

Sciatic nerve blocks are commonly performed regional anaesthetic blocks used for lower limb surgery. The two most common sciatic nerve blocks are briefly reviewed in this article, with particular reference to ultrasound guidance.

Keywords: subgluteal and popliteal sciatic nerve block; ultrasound; regional anaesthesia

Introduction

Regional anaesthesia has been associated with enhanced recovery [1,2], reduction in chronic pain [3], and reduction in opioid consumption post operatively [4,5]. For this reason, regional anaesthetic techniques are now a major component of multimodal analgesia and are part of the acute pain management regimen, particularly in trauma and orthopaedic surgeries [6]. Ultrasound-guidance has dramatically transformed regional anaesthetic delivery allowing for both real-time needle visualisation as well as definitive visualisation of local anaesthetic spread, and it may allow more rapid block onset [7,8]. As part of enhanced recovery pathways, sciatic nerve blocks facilitate ambulatory surgery, where there is evidence to suggest that they reduce opioid consumption [9]. They can be used in combination with femoral and obturator nerve block for anaesthesia in high-risk patients undergoing lower limb surgery and so offer an alternative to general anaesthesia in this vulnerable group [10].

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Sciatic nerve block was first described as a landmark block by a French surgeon, Victor Pauchet, in 1920, which paved the way for Beck (1963), Raj's (1963) and Winnie's (1975) variations [6]. The introduction of ultrasound has allowed for more streamlined and targeted approach at multiple points along its course, tailored to each individual case. This is particularly useful where there is obesity or the presence of external fixation devices which prevent identification of key landmarks [10]. Moreover, the sciatic nerve is subject to significant anatomical variation of up to 15% and thus ultrasound is a superior technique than landmark in these instances [11,12].

This article will briefly discuss the relevant anatomy and sonoanatomy of the sciatic nerve and will focus on the two most commonly performed ultrasound guided sciatic nerve block techniques; posterior proximal subgluteal and distal popliteal approaches.

Anatomy

A derivation of the sacral plexus, the sciatic nerve is the largest in the body and arises in the posterior thigh in the lumbosacral region. It is formed in the pelvis from the anterior rami of spinal nerves L4 to S3. It exits the pelvis via the greater sciatic foramen, directly below the piriformis and then travels in the posterior compartment of the thigh and subdivides into common peroneal nerve (CPN) and tibial nerve (TN), usually at the upper angle of the popliteal fossa [10]. In 8% of cases, high division of the sciatic nerve occurs within the pelvis and not after it exits the pelvis. TN continues in the posterior compart-

ment to the foot, while CPN travels in the lateral and anterior compartments of the lower limb to the foot.

Sensory supply of the sciatic nerve is to the posterior thigh, lateral and posterior leg, and dorsum and sole of the foot and the motor supply to the muscles of the posterior thigh (hamstrings semitendinosus and semimembranosus, long head of biceps femoris as well as adductor magnus with obturator nerve). TN supplies motor function to the posterior leg and foot for knee flexion and ankle plantarflexion (popliteus, gastrocnemius, soleus, plantaris, posterior tibialis, long head of biceps femoris) as well as toe flexion, while CPN supplies muscles of the anterior leg and foot including short head of biceps femoris, fibularis longus and brevis and tibialis anterior muscles.

The sciatic nerve supplies the femoral head and part of the shaft along with obturator and saphenous nerves, while CPN and TN supply tibia and fibula, most of the knee joint and ankle joint.

Indications for sciatic nerve block

Sciatic nerve blocks provide both analgesia and anaesthesia for below knee surgery, knee surgery involving the posterior compartment and foot and ankle surgery [13]. They can be used alone or in combination with ipsilateral lumbar plexus blockade or femoral nerve blockade to provide surgical anaesthesia or analgesia to the entire lower limb [10,13].

Sonoanatomy and internal landmarks

Figure 1 below depicts the appearance of the sciatic nerve in the subgluteal view. The nerve appears as a flat, narrow hyperechoic structure between the ischial tuberosity and greater trochanter, with gluteus medius above and quadratus femoris below.

The sciatic nerve is subject to significant anisotropy so that any small deviance from a perpendicular angle of insonation leads to dramatic changes in the appearance of the nerve. This is more important for the subgluteal approach where the overlying muscle, subcutaneous tissue and fat may lead to difficulty in identifying the nerve. It is important to adjust the angle of insonation to ensure adequate visualisation of the nerve and its distinction from surrounding structures. This should be done with either very slight tilt or sliding of the ultrasound probe.

In the popliteal view, the sciatic nerve becomes more oval (fig 2). One can see popliteal vein and artery deep to it. Colour doppler should be used to identify these important structures, as their depth may render them difficult to identify.

As the ultrasound probe moves about 1 to 3 cm distally, one can see the CPN and TN beginning to emerge as distinct nerves within a common sheath (fig 3). This sheath, known as Vloka's perineural sheath, is the part of the sciatic nerve sheath that surrounds CPN and TN just below their bifurcation. For the optimum approach, local anaesthetic is deposited within this sheath, but outside the nerves. This ensures a single insertion point technique that will cover both nerves. This bifurcation can occur at various points usually between 5-10cm above the popliteal crease and so dynamic scanning from proximal to distal, first identifying the popliteal artery, vein and the sciatic nerve, then identifying the two nerves and tracing them until they begin to become distinct, is the ideal approach to identifying these structures.

As the probe continues towards the popliteal fossa, there is a clear bifurcation of the CPN and TN. The popliteal vein and artery begin to move more medially (fig 4).

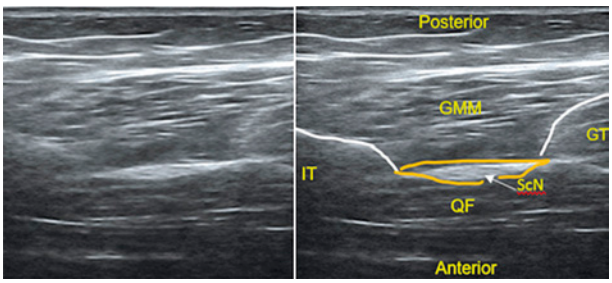

Fig 1. Sonoanatomy of the sciatic nerve at the subgluteal fold, IT, Ischial Tuberosity, GMM, Gluteus maximum muscle, GT, Greater trochanter, ScN, Sciatic nerve, QF quadratus femoris.

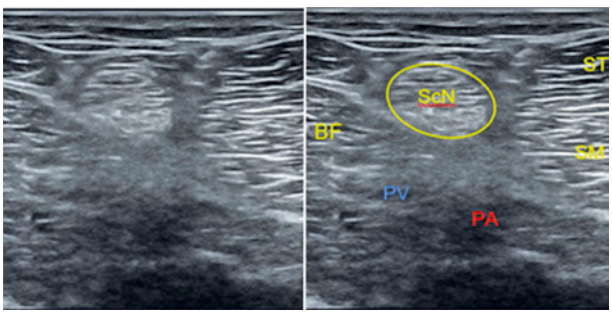

Fig 2. Sonoanatomy of sciatic nerve above the popliteal fossa ScN Sciatic nerve, BF, Biceps Femoris, ST, Semitendonosus, SM, semimebranosus, PV, popliteal vein, PA, popliteal artery.

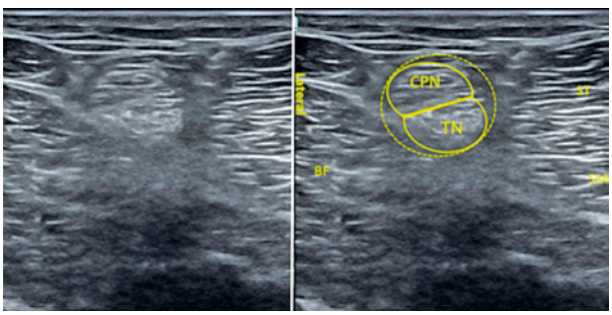

Fig 3. Ultrasound image acquired just as sciatic nerve begins to bifurcate. CPN, common personal nerve, TN, Tibial nerve.

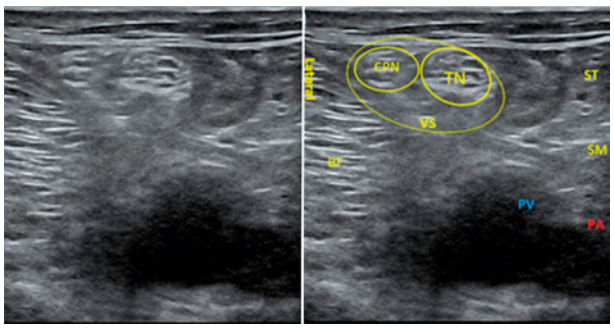

Fig 4. Sonoanatomy of sciatic nerve after bifuration. CPN, common peroneal nerve, TN tibial nerve, BF, biceps femoris muscle, PV popliteal vein, PA popliteal artery, VS Vloka's perineural sheath.

Equipment (same for both subgluteal and popliteal approaches)

The equipment is the same for both approaches. The blocks require an ultrasound machine with low-frequency [2-8 MHZ], curvi-linear [phased array] transducer probe, or higher frequency linear probe [8-12 MHZ], choice of which is dependent on patient anatomy. An 80 mm or 100 mm, standard short bevel, 21- or 22-gauge, insulated stimulating needle will be necessary. All other equipment will be as standard for any block including intravenous access and standard Association of Anaesthetists monitoring.

Subgluteal approach

The subgluteal approach to the sciatic nerve confers an increased motor blockade compared to its popliteal counterpart, and more extensive analgesia [14,15]. Due to its deeper location at this point, the proximal sciatic nerve may be more difficult to visualise. For this reason, it can be performed with low frequency, a curvi-linear array probe, although a standard linear probe can be used for smaller patients. The needle technique remains the same for both probes and thus an individualised approach to probe choice is recommended based on patient size and ability to position adequately to ensure optimum view.

Patient positioning

This block can be performed with the patient lateral or prone, with the operative side facing uppermost (fig 5a). Limbs are slightly flexed at the hip and knee in the lateral position. Alternatively, it can be performed in the supine position, with leg raised and supported by a pillow.

Technique and needle insertion

The ultrasound probe is placed in the transverse orientation in the subgluteal space (fig 5a). An in plane or out of plane approach can be used to deposit local anaesthetic in a ring like fashion around the nerve [fig 5b,c]. The needle is directed from lateral to medial in the in plane approach. Single shot or catheter techniques can be used.

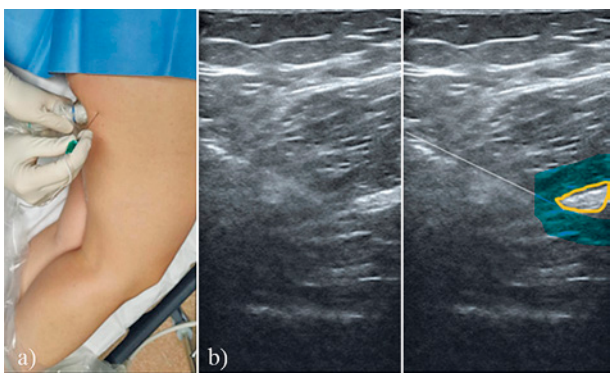

Fig 5. (a) Position of patient and ultrasound probe. Leg slightly flexed at hip and knee and ultrasound probe placed in subgluteal fold, (b) Image acquisition and needling technique from lateral to medial to encircle sciatic nerve with local anaesthetic. Local anaesthetic is deposited above and below the nerve, encircling the nerve (c).

Popliteal Approach

Patient positioning

Popliteal sciatic nerve block can be performed supine (fig 6a), lateral or prone (fig 6b,c), with knee flexed and the probe placed under popliteal fossa. Patient positioning depends on patient size, presence of fixation devices and practitioner preference.

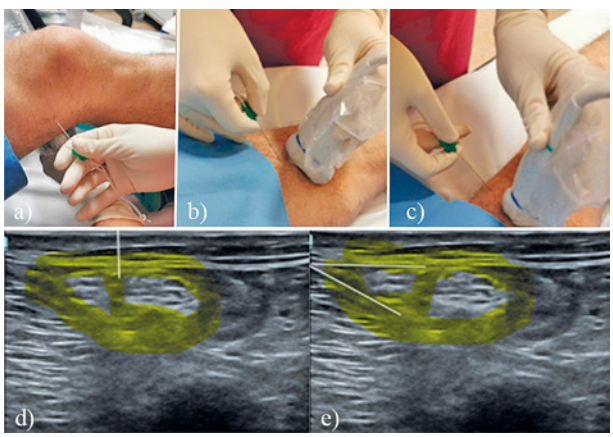

Fig 6. (a) Supine positioning and needle placement for popliteal sciatic nerve block, (b) prone out-of-plane and (c) in plane approaches to popliteal sciatic block. Simulated out of plane (d) and in plane (e) needling for popliteal block and 'double doughnut' sign (yellow shading) of local anaesthetic encircling CPN and TN within Vloka's sheath.

Needling technique

As the transducer moves more distally, the popliteal artery and vein move deeper, and so it is important to always visualise these structures to avoid accidental injury (fig 4). Dynamic scanning allows visualisation of these nerves just at the bifurcation. The endpoint for local anaesthetic infiltration is complete encircling of the nerves known as 'double doughnut' sign. (fig 6d,e).

Complication

Although complications are rare, they can be potentially serious, and one must take great care to avoid them. These include nerve injury, catheter infection, bleeding, haematoma, accidental vascular injection and local anaesthetic toxicity. Although intraneural injection occurs with both nerve stimulation and ultrasound guided techniques, fortunately it does not usually lead to nerve damage [16].

Current Trends and Future Directions

Paediatric sciatic nerve block

Ultrasound guided sciatic nerve blockade can safely be performed in paediatric practice. The use of ultrasound in this population has been shown to increase the success and duration of sensory blockade when compared to nerve stimulation alone [17]. The variation in landmarks based on age and weight in this population means that ultrasound can offer a very useful and safe approach for lower limb analgesia in children.

iPACK

Despite the utility of sciatic nerve block for posterior lower limb analgesia, complete blockade will lead to motor weakness in the immediate post operative period [18]. As early mobilisation is the cornerstone of postoperative rehabilitation for lower limb surgery, regional anaesthesia enthusiasts continue to seek motor sparing analgesic modalities. iPACK- first described by Sanjay Sinha in Connecticut, is one such approach that is gaining some attention for its ability to provide analgesia to the posterior compartment of the knee, whilst avoiding motor weakness [19]. It aims to provide analgesia to the posterior sensory articular branches of sciatic nerve, avoiding the motor branches of CPN and TN, and thus avoiding post operative foot drop. Still in its infancy, one systematic review and meta-analysis with trial sequential analysis has shown its analgesic benefits up to 12 hours post total knee arthroplasty [20], but it is yet to be studied extensively for other lower limb surgeries.

Conclusion

Ultrasound has become standard for sciatic nerve blockade. This article has described 2 posterior approaches to ultrasound guided sciatic nerve block. While many landmark techniques have been described, and indeed other ultrasound approaches namely anterior and transgluteal, the approaches described here offer a practical approach to the sciatic nerve, allowing for easy identification of the nerve at two separate locations. Ultrasound guided sciatic nerve blocks are safe, reliable, and easy to perform and can offer an excellent adjunct for lower limb surgery.

Conflict of interest: none.

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