Ultrasound-guided sciatic nerve block: description of a new approach at the subgluteal space

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Sciatic nerve block is frequently used for anaesthesia or analgesia during orthopaedic foot surgery and there are several different approaches to the sciatic nerve. This report describes a new approach to the sciatic nerve using ultrasound. Local anesthetic was injected into the ‘subgluteal space’ under ultrasound guidance which was effective in producing sciatic nerve block in a small series of five patients. The anatomy, sonographic features, technique of identifying the subgluteal space, and potential advantages of this approach to the sciatic nerve are discussed.


Keywords: anaesthetic, techniques, regional, sciatic; nerve, nerve block, ultrasound guided, subgluteal

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Case report

We performed ultrasound-guided SNB for anaesthesia in five ASA physical status I–III patients (27–64 yr old, weight 55–74 kg) who were scheduled for orthopaedic foot surgery. No premedication was prescribed to any of these patients. The patients were positioned laterally, with the side to be anaesthetized uppermost and with the hip and knees flexed (Fig. 1). The lateral prominence of the greater trochanter and ischial tuberosity were then identified, and a line was drawn between these two landmarks using a skin marking pen (Fig. 1). The sciatic nerve was scanned at this location using a low-frequency, 5–2 MHz, curved array probe (C60e, 5–2 MHz) and a Micromaxx ultrasound system (Sonosite Inc., Bothell, WA, USA) with tissue harmonic imaging (THI) and image capturing capabilities. A
liberal amount of ultrasound gel was applied to the skin over the area to be scanned for acoustic coupling and the ultrasound probe was positioned parallel to the line previously drawn with its orientation marker directed laterally (i.e. directed towards the greater trochanter, so as to provide a transverse scan of the subgluteal space and the sciatic nerve). A ‘scout-scan’ (pre-intervention scan) was performed to identify the sciatic nerve in the subgluteal space and to optimize the ultrasound image before the intervention. The ultrasound image was optimized by making the following adjustments on the ultrasound unit: (a) selecting a scanning preset, (b) setting an appropriate scanning depth, (c) selecting the ‘General’ (mid range) frequency range as the ultrasound probe used was a broadband probe, (d) selecting the THI option, and (e) finally, the ‘gain’ was adjusted manually to obtain the best possible image (Fig. 2). On a sonogram, the ‘subgluteal space’ was seen as a hypoechoic area between the hyperechoic perimysium of the gluteus maximus and the quadratus femoris muscles (Fig. 2). It extended from the greater trochanter laterally to the ischial tuberosity medially. The medial limit of the subgluteal space was difficult to see. At this level, the sciatic nerve was seen as an oval hyperechoic nodule approximately 1.5–2 cm in diameter within the subgluteal space (Fig. 2).

Under aseptic precautions, a 100-mm, 21-gauge insulated nerve block needle (Stimuplex® A, B. Braun Melsungen AG, Germany) connected to a nerve stimulator (Stimuplex® HNS11, B. Braun) delivering a current of 1 mA at a frequency of 1 Hz was inserted in the long axis (in plane) of the ultrasound beam (Fig. 1) and advanced slowly towards the sciatic nerve under real-time ultrasound guidance. As the needle was advanced in the long axis of the ultrasound beam, it was possible to see the advancing needle in most cases. However, when the needle could not be seen, the position of the needle tip could only be inferred by jiggling the needle and looking for tissue movement on the ultrasound scan. Once the block needle was in contact with the sciatic nerve (identified by observing nerve movement) or in the subgluteal space close to the sciatic nerve, a positive motor response (dorsiflexion or plantar flexion) of the foot was observed in all except one patient (patient 5, aged 64 yr, motor response was only obtained at a current of 2 mA). The final position of the needle in the subgluteal space was confirmed in all five patients by injecting 2–5 ml of saline through the needle and observing a distention of the subgluteal space [i.e. separation of the perimysium of the gluteus maximus and quadratus femoris muscle on the ultrasound image].
In two patients, although the needle was seen to be in contact with the sciatic nerve and there was a positive motor response in the foot-to-nerve stimulation, the test injection of saline only spread posterior to the perimysium of the gluteus maximus muscle. This indicated that the tip of the needle was not in the subgluteal space and was easily rectified by advancing the needle a little further after which the typical distention of the subgluteal space to the saline test injection was seen on the ultrasound image. Occasionally, a subtle pop was felt as the needle tip traversed the perimysium of the gluteus maximus muscle and entered the subgluteal space.

After negative aspiration through the needle, 25–30 ml of lignocaine 1% and ropivacaine 0.25% with epinephrine 1:400 000 was injected incrementally over 2–3 min while observing the distribution of the local anaesthetic in real time on the ultrasound scan. Distention of the subgluteal space (seen in all patients, Fig. 3) and circumferential spread of the local anaesthetic around the sciatic nerve (in four patients, Fig. 3) was noted (see video at www.aic.cuhk.edu.hk/usgraweb). Longitudinal scan of the sciatic nerve in between the greater trochanter and ischial tuberosity after the local anaesthetic injection also demonstrated longitudinal spread of the local anaesthetic on either side of the sciatic nerve. Complete anaesthesia, adequate for surgery over the foot, developed in all patients within 15–20 min after the injection of local anaesthetic. There were no complications directly related to the SNB or to the local anaesthetic injection, and recovery from the anaesthesia was uneventful.

Discussion
Sciatic nerve block is frequently used for anaesthesia or analgesia during orthopaedic foot surgery, and several different approaches to the sciatic nerve have been described in the literature. In this report, we have demonstrated that the subgluteal space, where the sciatic nerve is located, is a well-defined anatomical space and can be identified using ultrasound at the level of the greater trochanter and ischial tuberosity. We have also shown that local anaesthetic injected into the subgluteal space under ultrasound guidance is effective in producing SNB.

The technique of ultrasound-guided SNB at the subgluteal space, as described in this report, should be distinguished from, and not confused with, the technique of posterior subgluteal SNB described by Di Benedetto and colleagues. The two techniques are different: (a) ultrasound guided vs landmark technique and (b) local anaesthetic is also injected into two different locations along the course of the sciatic nerve. While we inject the local anaesthetic into the subgluteal space, defined as the space between the gluteus maximus and quadratus femoris muscle at the level of the greater trochanter and ischial tuberosity, Di Benedetto and colleagues perform their subgluteal SNB technique caudal to the inferior border of the gluteus maximus muscle. Another approach to the sciatic nerve that is comparable to the one that we describe, as far as injecting the local anaesthetic into the subgluteal space, is the lateral approach described by Guardini and colleagues. However, this modified lateral approach is performed with the patient in the supine position.

Fig 2 Transverse sonogram between the greater trochanter and ischial tuberosity showing the hypoechoic subgluteal space between the hyperechoic perimysium of the gluteus maximus and the quadratus femoris muscle. The sciatic nerve is seen as a hyperechoic nodule in the medial aspect of the subgluteal space (reproduced with permission from www.aic.cuhk.edu.hk/usgraweb).
position, using nerve stimulation, and the landmarks described introduce, the needle along the inferior border of the quadratus femoris muscle.5

The sciatic nerve (L4,5, S1-3) arises from the sacral plexus and exits the pelvis through the greater sciatic foramen, between the piriformis and the superior gemellus muscles (Fig. 4), to enter the subgluteal space below the piriformis muscle.4 It then descends over the dorsum of the ischium, lying on the dorsal surface of the gemellus superior muscle, tendon of obturator...
internus, gemellus inferior muscle, and quadriceps femoris muscle (in a cranial to caudal relation, Fig. 4) before it enters the hollow between the greater trochanter and the ischial tuberosity and then on to the posterior compartment of the thigh. The anterior surface of the gluteus maximus muscle covers the upper part of the sciatic nerve and immediately distal to its lower border (infragluteal position), the sciatic nerve is fairly superficial. In between the greater trochanter and ischial tuberosity, the subgluteal space is a well-defined anatomical space between the anterior surface of the gluteus maximus and the posterior surface of the quadratus femoris muscle. On a sonogram, the subgluteal space is seen as a hypoechoic area between the hyperechoic perimysium of the gluteus maximus and quadratus femoris muscles. It extends from the greater trochanter laterally to the ischial tuberosity medially. The sciatic nerve is seen as an oval hyperechoic nodule, approximately 1.5–2 cm in diameter in an average adult within the subgluteal space (Fig. 2). The medial limit of the subgluteal space is often difficult to see using ultrasound. This may be because of the attachment of the semimembranosus, semitendinosus, and biceps femoris muscles to the ischial tuberosity (Fig. 5). Other structures that are present in the subgluteal space include the posterior cutaneous nerve of the thigh, inferior gluteal vessels and nerve, vein to the short and long head of biceps femoris, the comitans artery and vein of the sciatic nerve, and the ascending branch of the medial circumflex femoral artery. The anatomical relations of the above structures are shown in Figure 5. Occasionally, pulsations of the inferior gluteal artery can be seen medial to the sciatic nerve in the subgluteal space.

Although the subgluteal space covers a wide area anterior to the gluteus maximus muscle, we have found that it is best seen using ultrasound at the level of the greater trochanter and ischial tuberosity and in relation to the quadratus femoris muscle. The quadratus femoris muscle is a quadrangular muscle, about 4 cm in height and attached to the posterior surface of the greater trochanter and ischial tuberosity. Two lines extended laterally along the upper and lower border of the quadratus femoris muscle will intersect the femur about 1 cm above and 3 cm below the point of maximum lateral prominence of the greater trochanter. The plane of the subgluteal space at this level is therefore parallel to and posterior to the plane of the quadratus femoris muscle. Moreover, as the ischial tuberosity is slightly caudal and dorsal in position relative to the greater trochanter, the plane of the subgluteal space is also slightly oblique (15–20°) to the coronal plane at this level.

The ability to identify a potential space along the proximal course of the sciatic nerve using ultrasound is unique and may offer several advantages over existing methods for SNB. We have found that it is relatively simple to insert a block needle under ultrasound guidance into the subgluteal space. This is confirmed by injecting 2–3 ml of saline through the needle and observing a distention of the subgluteal space (i.e. separation of the perimysium of the...
gluteus maximus and quadratus femoris muscle, on ultrasound imaging). Local anaesthetic injected into the subgluteal space readily spreads to and around the sciatic nerve. It is also easy to pass a catheter into the subgluteal space when a continuous SNB is planned (unpublished data). In theory, the subgluteal injection should also block the posterior cutaneous nerve of the thigh, which is an advantage when anaesthesia over the posterior aspect of the thigh is warranted. There are no major blood vessels in the subgluteal space and thus vascular complications related to the SNB may also be reduced. Currently, we use nerve stimulation in conjunction with ultrasound imaging for SNB at the subgluteal space, but we envisage that, with experience, it may be possible to perform an ultrasound-guided SNB at the subgluteal space without using nerve stimulation. This will be particularly useful in young children as the majority of SNB in this age group is performed under general anaesthesia when the use of a neuromuscular blocking agent makes nerve stimulation impractical.

In conclusion, the subgluteal space, where the sciatic nerve is located, is a well-defined anatomical space. It can be identified using ultrasound at the level of the greater trochanter and ischial tuberosity as a hypoechoic area between the perimysium of the gluteus maximus and the quadratus femoris muscles. Local anesthetic injected into the subgluteal space under ultrasound guidance is effective in producing SNB. Considering the potential advantages of performing SNB at the subgluteal space, future studies should compare this technique with other proximal approaches to the sciatic nerve.

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References
2 McCartney CJ, Brauner I, Chan VW. Ultrasound guidance for a lateral approach to the sciatic nerve in the popliteal fossa. Anaesthesia 2004; 59: 1023–5