Ultrasound-guided Sciatic Nerve Block: Posterior Approach

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INTRODUCTION

The sciatic nerve blockade is routinely done for surgery and pain management of the lower extremity and is one of the commonly used techniques in our practice. When performed in a systematic manner, it is associated with a high success rate.1,2

It is particularly well suited for surgery on the knee, calf, ankle and foot. It provides complete anaesthesia of the leg below knee with the exception of the medial strip of skin, which is innervated by the saphenous nerve. When combined with femoral nerve or lumbar plexus block, anaesthesia of almost entire leg is achieved.

Ultrasound-guided sciatic nerve block has been described in the recent past.3 Sciatic nerve can be blocked using ultrasound at different levels along the posterior aspect of thigh. This includes gluteal, subgluteal and popliteal approach. Each approach is discussed in detail with description of sonoanatomy and block technique.

GLUTEAL APPROACH

Anatomy

The sciatic nerve is the largest nerve in the human body. It originates from the lumbosacral plexus (L4-5 and S1-3) and provides sensory and motor innervations to the lower extremity. The sciatic nerve exits the pelvis via the greater sciatic foramen below the piriformis muscle. In the gluteal region, the sciatic nerve is deep to the gluteus maximus muscle (GMM) and superficial to the inner muscle layer (superior and inferior gemellus muscles, obturator internus muscle and quadratus femoris muscle).

It courses down the midline of the posterior thigh and branches into tibial and common peroneal nerves before entering the popliteal fossa.

At the level of the ischial spine, the sciatic nerve lies on top of the ischial bone and lateral and posterior to the ischial spine. Pudendal vessels lie immediately medial to the sciatic nerve and serve as an important landmark in identification of the sciatic nerve.

Positioning, Probe Placement and Needle Orientation

Position the patient in semi-prone position (Sims’ position) with the hip and knee flexed. Transducer is kept over the gluteal region to capture the short axis view of sciatic nerve. Landmarks (Fig. 1) are according to classic approach as described by Labat in 1924.

Probe Settings, Needle Choice, Gain and Focus

After skin and transducer preparation, place a curved, low frequency 2 to 5 MHz transducer firmly on the marked point. Optimise the machine imaging capability, select appropriate depth (usually >4 cm from the skin surface), focus range and gain. 8 to 10 cm 22G insulated block needle is used. Nerve stimulator can be used as an adjutant to confirm the needle tip proximity with the nerve. 20-30 ml of local anaesthetic is prepared for injection.

Scanning Technique and Nerve Localisation

Sciatic nerve is usually difficult to identify, as it is thin and wide in this region. Systematic approach in correctly identifying the structures (bone, muscle and vessels) is the key to successfully locate the sciatic nerve.

To start with, identify the bony structures. The structure of interest is the ischial spine. Locate the ischial bone, which appears as a continuous long curved hyperechoic line with the associated bony shadow underneath (Fig. 2A). Move the transducer caudally, until the bony shadow disappears on the medial aspect (Fig. 2B). Now, move back the transducer slightly cephalic again to locate the ischial spine medially, i.e. the widest portion of the bony segment with the hyperechoic line extending medially, the ischial spine (Fig. 2C).
Note the bony segment on the medial aspect at the level of the ischial spine (Fig. 2C) is widest as compared to the bony segments cephalad (Fig. 2A) and caudad (Fig. 2B).

Next step is to identify the muscle groups. Locate the bulky GMM under the variable thick layer of adipose tissue. Locate the fascia separating the GMM and the innermost muscle layer, which lies just superficial to the ischial bone at the level of ischial spine. The innermost muscle layer can be thin and difficult to visualise. The most consistent in the sonoanatomy is the fascia separating the GMM and the innermost muscle group. The sciatic nerve is expected to lie in this plane engulfed by the fascia.

Next step is to look for the pulsating pudendal vessels immediately medial to the nerve. The pudendal vessels are consistently located medial to the sciatic nerve and serve as a guide in confirming the identification of the sciatic nerve (Fig. 3). Other vascular structure that may be visible adjacent to the nerve on colour Doppler mode is the inferior gluteal artery. These vessels must be avoided while performing the block.

Localisation of the sciatic nerve in this region can be challenging because of the required depth of penetration. If the above-mentioned steps cannot visualise the nerve, it is recommended to identify the nerve in the subgluteal region (where it is easier to visualise) and then trace it cephalic to the gluteal region.

Needling Technique and Local Anaesthetic Injection

Ultrasound-guided sciatic nerve block in the gluteal region is challenging to perform due to various reasons: (1) it requires a deep beam penetration using a lower frequency curved probe due to the depth involved: (2) the overlying layer of adipose tissue in the buttock may range from 1 to 4 cm; (3) the sciatic nerve may be quite flat and wide in the short axis view; (4) visualisation of the block needle is difficult because of the steep angulation required for block performance.
Both, in plane (IP) and out of plane (OOP) approaches are acceptable. For the IP approach, the needle is inserted from the lateral aspect of the transducer directed medially, inline with the transducer. Observe the needle pass through the GMM to reach the sciatic nerve just above the ischial bone. It may be difficult to visualise the shaft of the needle and tissue movement is often the only indication of needle trajectory. Needle to nerve contact is indicated by the nerve movement. Nerve stimulator can also be used to confirm the needle tip proximity with the sciatic nerve. 20 ml of local anaesthetic is injected and pattern of spread is observed in real time. The needle tip position may be changed during the injection to optimise the local anaesthetic spread around the nerve circumferentially.

In the OOP approach, the needle is inserted from caudal to cephalic direction at the midpoint of the transducer. Needle tip position cannot be seen and hydro-dissection is required to estimate the needle tip. Aim to deposit the local anaesthetic on both lateral and medial aspect of the nerve. Catheter may be inserted through this approach but chances of dislodgement are high with our experience. Catheter technique is better suited for the more distal approach, the subgluteal approach.

**SUBGLUTEAL/INFRAGLUTEAL APPROACH**

The sciatic nerve is blocked at a level distal to the gluteal region where GMM is thinnest. This location is more easily accessible and also convenient for catheter technique.

**Anatomy**

The sciatic nerve at this level lies at almost mid-point of two easily palpable bony landmarks; greater trochanter and ischial tuberosity. At this level, it is deep (anterior) to the GMM and superficial (posterior) to quadratus femoris muscle. The nerve lies within a palpable groove and is more superficial than in the gluteal region.

**Positioning, Probe Placement and Needle Orientation**

Position the patient semi-prone with the limb to be blocked uppermost. Mark the greater trochanter (GT) laterally and the ischial tuberosity (IT) medially. The midpoint marks the approximate location of sciatic nerve (Fig. 4). This block can be performed with either OOP or IP approach.

**Probe Settings, Needle Choice, Gain and Focus**

Skin and transducer preparation is done as routine. Place a curved 5 MHz transducer over the subgluteal region in a transverse plane to capture the best short axis view of the sciatic nerve. Optimise the machine imaging capability by selecting the appropriate depth of field (usually within 6-7 cm), focus range (usually within 4-6 cm) and gain. 8 to 10 cm, 22G insulated needle is routinely used. Nerve stimulator can be used if desired or if the view of the nerve is not optimal.

**Scanning Technique and Nerve Localisation**

Sciatic nerve can be viewed easily by systematically scanning and recognising the anatomical structures; bone, muscles and vessels. Scan and recognise the structures from superficial (skin) to deep and from medial to lateral.

First, identify the bony structures; ischial tuberosity on medial aspect and greater trochanter on lateral aspect casting the typical curved hypoechogenicity with hyperechoic line. Next, identify the adipose tissue of variable thickness overlying the GMM superficially and quadratus femoris muscle deeper to it. Note the fascia separating the superficial GMM and deeper quadratus femoris muscle.

The sciatic nerve is seen as a hyperechoic, thin triangular shaped structure found inside hyperechoic fascial plane separating the GMM and quadratus femoris muscle (Fig. 5).

Sciatic nerve can be thin and wide and may not be easily appreciated. It is important to delineate the fascial plane between the two muscles to appreciate the hyperechoic structure as sciatic nerve.

Visualisation can be difficult in the transverse (short axis) view as the nerve is thin and wide. It is helpful to scan the sciatic nerve longitudinally along its long axis. In the long axis view, the nerve appears as a broad hyperechoic band like structure due to large medio-lateral spanning. It is useful to scan and trace the course of the sciatic nerve from distal to proximal (i.e. from the popliteal fossa to the subgluteal region). Nerve tracing is often easier with the

![Fig. 4: Landmarks for subgluteal approach, in-plane approach is demonstrated: GT—greater trochanter, IT—ischial tuberosity](image-url)
patient lying in prone position as the nerve is in its anatomical location compared to the lateral decubitus position.

**Needling Technique and Local Anaesthetic Injection**

Ultrasound-guided sciatic nerve block in the subgluteal/infragluteal region is easier compared to the gluteal approach due to various reasons: (1) the nerve is relatively superficial; (2) overlying layer of adipose tissue is less; (3) nerve is more hyperechoic and fascial plane is easier to identify; (4) quadratus femoris muscle is more easily identifiable providing a good interface between the nerve and GMM.

Both IP and OOP approaches are acceptable. For the IP approach, the direction of the needle is from lateral to medial, inline with the transducer. Tissue movement is often the only indication of needle trajectory and needle to nerve contact is indicated by the nerve movement. Nerve stimulator can be used to confirm the needle tip proximity with the sciatic nerve.

The OOP approach can be used for both the single shot and catheter techniques. The needle is inserted from caudal to cephalic direction. Both hydro-location and nerve stimulation will help determine the needle tip position.

With either approach, 20 to 30 ml of local anaesthetic injection under direct ultrasound observation is usually sufficient. Circumferential spread of hypoechoic local anaesthetic solution around the nerve is desirable but seldom achieved with single needle placement. Moving the needle around the medial and lateral ends of the nerve (multipoint injection) often gives a more satisfactory block compared with a single point injection. Extent of spread of hypoechoic fluid around the nerve can be observed by scanning the nerve proximally and distally.

The subgluteal/infragluteal region is a convenient location for catheter placement and continuous sciatic nerve block. Catheter can be easily anchored in this region compared to the gluteal region with less risk of dislodgement.

Another convenient location to block the sciatic nerve is proximal to popliteal fossa where it is more superficial compared to the gluteal and subgluteal approach.

**POPLITEAL APPROACH**

**Anatomy**

The sciatic nerve in the popliteal fossa is bordered superolaterally by the long head of the biceps femoris muscle and superomedially by the semimembranosus (SMM) and semitendinosus (STM) muscles. The sciatic nerve branches into common peroneal nerve and the tibial nerve at variable location along its course in the distal thigh. Popliteal sciatic nerve block is indicated for procedures below knee, foot and ankle. It is also a preferred site for catheter insertion for post-operative analgesia. It is preferred over the gluteal and subgluteal approach for the surgery on foot and ankle as there is no hamstring weakness with this block.

**Positioning, Probe Placement and Needle Orientation**

Sciatic nerve at this location can be blocked in both prone and supine position. Prone position has been used in this article to describe the nerve block. Position the patient prone and place a pillow under the ankle to support the leg. Mark the popliteal crease, biceps femoris laterally and SMM and STM medially. Estimate and mark the tip of popliteal fossa, which is usually 6 to 8 cm proximal to the popliteal crease. At this point, sciatic nerve is expected to divide into tibial and common peroneal nerve (Fig. 6). This block can be performed in both OOP and IP approach.

![Fig. 5: Subgluteal approach, sciatic nerve appears as triangular structure within the fascia: GT—greater trochanter, IT—ischial tuberosity](image)

![Fig. 6: Sciatic nerve branching in the popliteal fossa, in-plane approach demonstrated: STM—semitendinosus, SMM—semimembranosus, BF—biceps femoris](image)
Ultrasound-guided Sciatic Nerve Block: Posterior Approach

**Probe Settings, Needle Choice, Gain and Focus**

Skin and transducer preparation is done as routine. Place a linear 38 mm, 7 to 10 MHz transducer, 6 to 8 cm proximal to the popliteal crease to capture the short axis view of the popliteal sciatic nerve. Machine imaging is optimised, by selecting the appropriate depth (usually 4-5 cm), focus range (usually within 2-3 cm) and gain. 6 to 8 cm, 22G insulated needle is used. 20 ml of local anaesthetic is prepared for injection.

**Scanning Technique and Nerve Localisation**

Perform a systematic anatomical survey of structures from superficial (skin) to deep and from medial to lateral. First, identify the femur that is deep and casts a hypoechoic bony shadow with hyperechoic lining. Next, identify the popliteal vessels that are superficial to the femur. Colour Doppler can be used to identify the artery and vein. The popliteal vein is usually found collapsed by the pressure of the transducer. Lifting the pressure of the transducer will bring the popliteal vein in view. It is important to locate the popliteal vein in order to avoid any intravascular injection of local anaesthetic.

Note the muscle groups medially (SMM and STM) and laterally (biceps femoris muscle). Move the transducer proximally while keeping the popliteal artery in view at all times. At about 6 to 8 cm from the popliteal crease, the sciatic nerve is seen as a hyperechoic structure, always posterior (superficial) and lateral to the artery (Fig. 7). Visualisation of sciatic nerve can be improved by angulating the transducer beam caudally towards the foot, thereby bringing the angle of incidence of beam with nerve at 90°.

Scan the posterior aspect of thigh both proximally and distally to assess the branching of the sciatic nerve. A point should be marked at which the sciatic nerve branches into its tibial and common peroneal components. The block should be conducted anywhere above this marked point of division. Nerve visualisation is significantly improved once local anaesthetic is injected due to enhanced contrast between the hyperechoic nerve and the hypoechoic fluid collection.

**Needling Technique and Local Anaesthetic Injection**

Ultrasound-guided sciatic nerve block in the popliteal region is a relatively superficial block. Both IP and OOP approaches are acceptable. The OOP approach is commonly used for single shot and catheter placement. In OOP approach, needle is inserted from distal to proximal direction, i.e. caudally to cephalic. Aim to place the needle on either side of the nerve. In the IP approach, needle is always inserted from lateral to medial direction to avoid the popliteal artery in the way of the needle. Electrical stimulation of the sciatic nerve is optional.

20 ml of local anaesthetic is usually sufficient for a satisfactory block. Observe the spread of local anaesthetic in real time to see circumferential spread of hypoechoic local anaesthetic solution around the nerve (‘donut sign’). Repositioning of the needle is usually required to achieve a circumferential spread and complete block.

**REFERENCES**


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**Fig. 7:** Sciatic nerve is postero-lateral to the popliteal vessels shown in colour Doppler: STM—semitendinosus, SMM—semitendinosus, BF—biceps femoris