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A New Anterior Approach to the Sciatic Nerve Block

Jacques E. Chelly, M.D., Ph.D., Laurent Delaunay, M.D.†*

Background: **Although several anterior approaches to sciatic nerve block have been described, they are used infrequently. The authors describe a new anterior approach that allows access to the sciatic nerve with the patient in the supine position.**

Method: **Sciatic nerve blocks were performed in 22 patients. A line was drawn between the inferior border of the anterosuperior iliac spine and the superior angle of the pubic symphysis tubercle. Next, a perpendicular line bisecting the initial line was drawn and extended 8 cm caudad. The needle was inserted perpendicularly to the skin, and the sciatic nerve was identified at a depth of 10.5 cm (9.5–13.5 cm; median and range) using a nerve stimulator and a 15-cm b-beveled insulated needle. After appropriate localization, either 30 ml mepivacaine, 1.5% (group 1 = knee arthroscopy; n = 16), or 15 ml mepivacaine, 1.5%, plus 15 ml ropivacaine, 0.75%, (group 2 = other procedures; n = 6) was injected.**

Results: **Appropriate landmarks were determined within 1.3 min (0.5–2.0 min). The sciatic nerve was identified in all patients within 2.5 min (1.2–5 min), starting from the beginning of the appropriate landmark determination to the stimulation of its common peroneal nerve component in 13 cases and its tibial nerve component in 9 cases. A complete sensory block in the distribution of both the common peroneal nerve component and the tibial nerve component was obtained within 15 min (5–30 min). A shorter onset was observed in patients who received mepivacaine alone compared with those who received a mixture of mepivacaine plus ropivacaine (10 min [5–25 min] *vs.* 20 min [10–30 min]; $P < 0.05$). Recovery time was 4.6 h (2.5–5.5 h) after mepivacaine administration. The addition of ropivacaine produced a block of a much longer duration 13.8 h (5.2–23.6 h); $P < 0.05$. No complications were observed.**

Conclusions: **This approach represents an easy and reliable anterior technique for performing sciatic nerve blocks. (Key words: Peripheral nerve block; lower extremity surgery; mepivacaine; ropivacaine.)**

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ALTHOUGH the combination of sciatic nerve and 3-in-1 blocks is an alternative to general or neuroaxial blocks for patients undergoing surgery of the lower extremities,[1,2] sciatic nerve blocks are performed infrequently. Recent surveys have indicated that sciatic nerve blocks are the least performed by anesthesiologists.[3–5] Reasons for this situation include lack of adequate training and the claim that sciatic blocks are difficult to perform. Several approaches have been described that depend on the position of the patient. The sciatic nerve can be approached with the patient supine or in the Sims position. In the supine position, the sciatic nerve can be accessed laterally or anteriorly. The posterior approach was first described by Labat[6] in 1930 and improved by Winnie.[7] Although the posterior approach is the most commonly performed, it necessitates patient repositioning, which limits its use in patients with compromised mobility caused by severe arthritis, obesity, or trauma. In 1959, Ichiyanahi[8] described a lateral approach of the sciatic nerve block. Today, this approach is performed commonly in children.[9] The anterior approach, as first described by Beck[10] in 1963, may be difficult to perform because the appropriate femoral anatomical landmark, *e.g.*, the greater trochanter, is not easily identified in obese patients. In addition, its identification may be extremely painful in patients with lower extremity fractures. Therefore, its use also has been limited. More recently, Raj *et al.*[11] described a lithotomy approach with different landmarks (the midpoint of a line drawn between the greater trochanter and the ischial tuberosity) that allows more reliable access to the sciatic nerve after anterior flexion of the legs. In patients with limited mobility, the flexion of the leg requirement also represents an important limitation. Therefore, the usefulness

* Professor, Director of Regional Anesthesia and the International Regional Anesthesia Research Center at the Medical School, Department of Anesthesiology, The University of Texas Medical School-Houston.

† Staff Anesthesiologist, Clinique Générale, Annecy, France.

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Address reprint requests to Dr. Chelly: Department of Anesthesiology, The University of Texas Health Science Center at Houston, 6431 Fannin, MSB 5.020, Houston, Texas 77030-1503. Address electronic mail to: jchelly@anes1.med.uth.tmc.edu

of this approach is limited in patients with severe hip and knee arthritis and trauma.

To perform sciatic nerve blocks while the patient is in the supine position, we developed a new anterior approach that necessitates neither repositioning nor identification of the greater trochanter. We studied the feasibility of this new anterior approach in 22 patients. Because the patients enrolled in this study underwent either knee arthroscopy (short procedure) or lower extremity surgeries estimated to last about 2 h, we also studied the onset and duration of two local anesthetic solutions; *i.e.*, 1.5% mepivacaine for knee arthroscopy and a mixture of 1.5% mepivacaine and 0.75% ropivacaine (volume/volume) for the longer procedure.

Methods

This prospective clinical study was approved by the Institutional Review Board of The University of Texas Medical School-Houston. After preoperative evaluation and discussion of anesthetic options, informed consent was obtained. Except for two patients, the blocks were performed preoperatively in the recovery room. In two patients, the sciatic nerve block was performed after the first hour of recovery after total knee replacement and rodding of the tibia. In these two cases, patients also consented preoperatively. Twenty-two patients were included and separated into two groups according to the surgical indication: knee arthroscopy (group 1; n = 16), and other procedures (group 2; n = 6), including anterior crucial ligament reconstruction (1), tibial plateau reconstruction (1), rodding of the tibia (1), total hip replacement (1), total knee replacement (1), and partial menisectomy (1). The sciatic nerve blocks were performed immediately after a paravascular 3-in-1 block[1] in 20 patients, and after a paravascular 3-in-1 block followed by the placement of a femoral catheter to be used postoperatively for continuous infusion of 0.2% ropivacaine at a rate of 12–16 ml/h to provide postoperative analgesia in the patients scheduled for either total knee or hip replacement.[12]

After placement of the proper monitors (blood pressure, electrocardiography, pulse oximetry), a peripheral intravenous catheter was established for the infusion of Ringer's lactate, and baseline vital signs were recorded. Oxygen was delivered *via* face mask. Patients were then sedated as follows: 50–100 μg intravenous fentanyl combined with 1.0–4.0 mg intravenous midazolam or propofol 20–30 mg intravenously, or both.

Fig. 1. Anatomic landmarks for the anterior approach to the sciatic nerve.

Anatomic Landmarks

With the patient supine and the lower extremity in the neutral position, a line was drawn between the inferior border of the anterosuperior iliac spine and the superior angle of the pubic symphysis tubercle. From this anterosuperior iliac spine–pubic symphysis line, a perpendicular dissector line was drawn in the middle and extended 8 cm caudad (fig. 1) to define the site of introduction of the needle. During sterile conditions, a 15-cm insulated b-beveled Stimuplex needle (B-Braun/McGaw Medical, Bethlehem, PA) connected to a Stimuplex-Dig nerve stimulator (B-Braun/McGaw Medical) was introduced perpendicularly to the skin after subcutaneous local anesthesia with 1 ml lidocaine, 1%, (Astra USA, Inc., Westboro, MA). The needle on its way to the sciatic nerve might come in proximity to the femoral nerve[13] (fig. 2); therefore, the nerve stimulator was initially set-up to deliver a current of 1.0 mA. At a depth of 3–5 cm, movements of the patella were observed. Because patella movements might represent the motor response to the stimulation of the femoral nerve, the current was decreased to 0.6 mA. If patella movements ceased, the needle was introduced 2 cm deeper, with the current of the nerve stimulator increased to 5 mA. Within a depth of 9.5–13 cm, the sciatic nerve was identified *via* the motor response related to the stimulation of its common peroneal nerve component (dorsiflexion or eversion of the foot) or its tibial nerve component (plantar flexion and inversion of the foot and flexion of the toes).

The current was then decreased, and the needle orientation was optimized to obtain the same response with a current equal to or lower than 0.7 mA (moved slightly medially, laterally, or deeper according to the

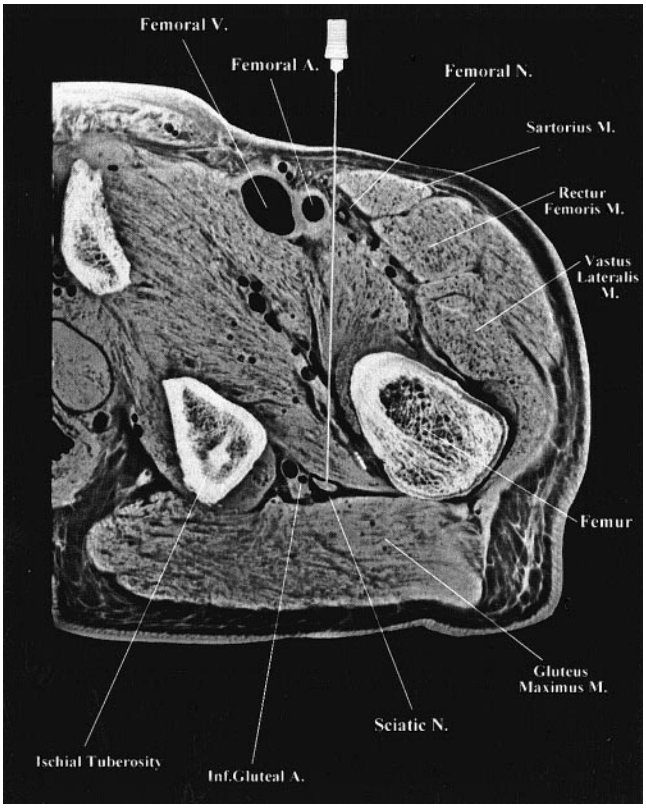

Fig. 2. Computed tomography scan of the thigh 1 cm above the lesser trochanter showing the relation among the femoral artery (A), vein (V) and nerve (N), the sartorius muscle (M), and the 15-cm insulated needle introduced perpendicular to the skin using our proposed landmarks.[23]

need). To satisfy postoperative analgesic requirements, group 1 patients received 30 ml mepivacaine, 1.5%, (Astra USA, Westboro, MA), whereas group 2 patients who required longer postoperative pain control received 15 ml mepivacaine, 1.5%, plus 15 ml ropivacaine, 0.75%, (Astra USA, Westboro, MA). After injection of a 1-ml test dose to verify that the injection was not neuronal (acute pain elicited by the injection), the solution of local anesthetics was injected slowly after negative blood aspiration, aspirating after every 5 ml to confirm that the needle remained extravascular.

If the patella movements were maintained at 0.6 mA, the insulated needle was reoriented slightly medially. If the needle ended its course on the femur, it was retracted to the level of the skin (failed attempt), after which the skin was pulled 1 or 2 cm medially and the needle reintroduced vertically. At completion of the local anesthetic injection, patients were monitored for another 45 min before transfer to the holding areas, where they waited until the time of surgery.

The intensity of the sensory and motor block was assessed every 5 min up to 45 min after being performed and every hour after surgery until sensory function recovered in either the common peroneal or tibial territory to determine the recovery time. Preoperatively and postoperatively, a three-level scale was used to evaluate the intensity of the sensory and motor block (no block, partial and complete block). In each case, the surgery was conducted in the absence of general anesthesia. The sensory block was assessed by application of ice to the dorsal aspect of the foot (common peroneal nerve) and to the plantar aspect of the foot (tibial nerve). The sensory block was considered complete if the patient did not feel the cold. Patients were asked to perform a dorsi and plantar flexion to assess the intensity of the motor block (normal motor function, partial block, and complete block). The motor block was considered complete when a motor block was observed in both the common peroneal and the tibial territories. The duration of the sensory and motor block was defined as the time between the performance of the block and the recovery of sensory and any motor function, respectively.

An unpaired *t* test was used to compare the demographic data between groups and are presented in table 1. In addition, the Mann–Whitney rank-sum test was performed to compare between groups the times to onset and completeness of the sensory and motor blockades. α was set at 0.05. Data are presented as the median (range).

Results

Table 1 shows patient demographics. Determination of the appropriate landmarks required 1.1 min (0.4–2.0 min). The sciatic nerve was identified in all patients within 2.9 min (1.2–6.1 min) after two (one to three) attempts, and the sciatic nerve was found at a depth of 10.5 cm (9.5–13 cm). In 13 patients, the common peroneal nerve was first stimulated, whereas stimulation of the tibial nerve was elicited in 9 patients. The current before injection was decreased to 0.5 mA (0.5–0.7 mA).

A complete sensory block developed faster in the common peroneal than in the tibial territory. After 5 min, a complete common peroneal sensory block was observed in 50% of patients and in all patients after 20 min. In contrast, 10 min was necessary for a complete sensory block in the tibial territory in 50% of the patients and in all patients within 30 min ($P < 0.05$). In these conditions, the overall onset time for a complete sensory

Table 1. Patient Demographics

	Group 1	Group 2	Overall
Age (yr)	53 (19–69)	50.5 (40–76)	53 (19–76)
Weight (kg)	72 (53–87)	76 (68–95)	72 (53–95)
Height (cm)	170.5 (160–185)	175 (172–185)	172.5 (160–185)
Duration of Surgery (min)	19 (15–28)	75* (65–155)	19 (15–155)
N	16	6	22

Data are median (range).

* $P < 0.05$.

block in both the common peroneal and the tibial territories was 12.5 min (5–30 min). However, the onset time varied according to the anesthetic solutions. It was 10 min (5–25 min) after administration of mepivacaine alone and 20 min (10–30 min) after administration of the combination of mepivacaine and ropivacaine ($P < 0.05$), indicating that with mepivacaine alone the onset was shorter. The overall duration of the block was 5.0 h (2.5–23.6 h). The block lasted 4.6 (2.5–5.5 h) with mepivacaine alone compared to 13.8 h (5.2–23.6 h) after the mixture of mepivacaine and ropivacaine ($P < 0.05$).

A complete common peroneal and tibial motor block was observed in 50% of patients after 20 min. The common peroneal and tibial motor blocks were completed in all patients after 45 min. In these conditions, the overall onset time for a complete motor block in both the common peroneal and the tibial territories was 25 min (5–45 min). The onset time did not vary with the anesthetic solutions. The overall duration of the motor block was 4 h (2.3–22.6 h). The motor block lasted 3.8 h (2.3–5.5 h) with mepivacaine alone compared with 11.4 h (4.4–22.6 h) after the mixture of mepivacaine and ropivacaine ($P < 0.05$). Also, there was no hemodynamic compromise.

No blood aspiration, paresthesia, or sensory and other motor deficits were observed during and after the performance of these sciatic nerve blocks.

Discussion

These data show that this new anterior approach is effective for blocking the sciatic nerve. By using the proposed anatomic landmarks and a nerve stimulator, the sciatic nerve was identified in all patients, and a sensory and motor block was obtained in all patients. Using the anterior approach as described by Beck,[10] Manani *et al.*[14] reported a 14% rate of failure. However, it is important to recognize that we used a nerve stimulator, whereas Manani *et al.*[14] used a paresthesia technique. Davies and McGlade[15] reported that for a posterior approach to the sciatic nerve the use of paresthesia resulted in less than 50% positive identification of the sciatic nerve *versus* 92% with a nerve stimulator. Therefore, the identification of the sciatic nerve is greatly facilitated by the use of a nerve stimulator.

The combination of sciatic and 3-in-1 blocks is particularly appropriate for lower extremity surgery necessitating the use of a tourniquet.[12] Furthermore, the use of a single-injection sciatic block in combination with a continuous femoral nerve block or a continuous lumbar plexus block is especially useful for total knee replacements.[12] In this regard, Allen *et al.*[16] recently reported that, in a group of 15 patients, the block of the sciatic nerve was not necessary for postoperative pain control in patients who underwent total knee replacement. In our group of patients, a sciatic nerve block was performed after total knee replacement because of pain in the posterior aspect of the knee. The effectiveness of the sciatic nerve block in controlling pain[17] suggests that, in contrast to the concept developed by Allen *et al.*,[16] blockade of the sciatic nerve may be important in patients undergoing total knee replacement. Therefore, it appears that additional data are necessary to determine the role of sciatic nerve blocks in postoperative pain control after total knee replacement.

It is established that the time of onset for sciatic nerve block using a posterior approach is approximately 20–30 min.[18] This is most likely related to the large size of the nerve, necessitating more time for diffusion of the local anesthetic solution. Our data indicate that a similar time requirement exists with our anterior approach. However, the onset and duration of the blocks also depend on the local anesthetic mixture. Thus, the onset and duration of the blocks were shorter with mepivacaine compared with the onset and duration when ropivacaine was added. These data confirmed the data already published regarding the duration of sciatic nerve blocks with mepivacaine[19] and ropivacaine.[20]

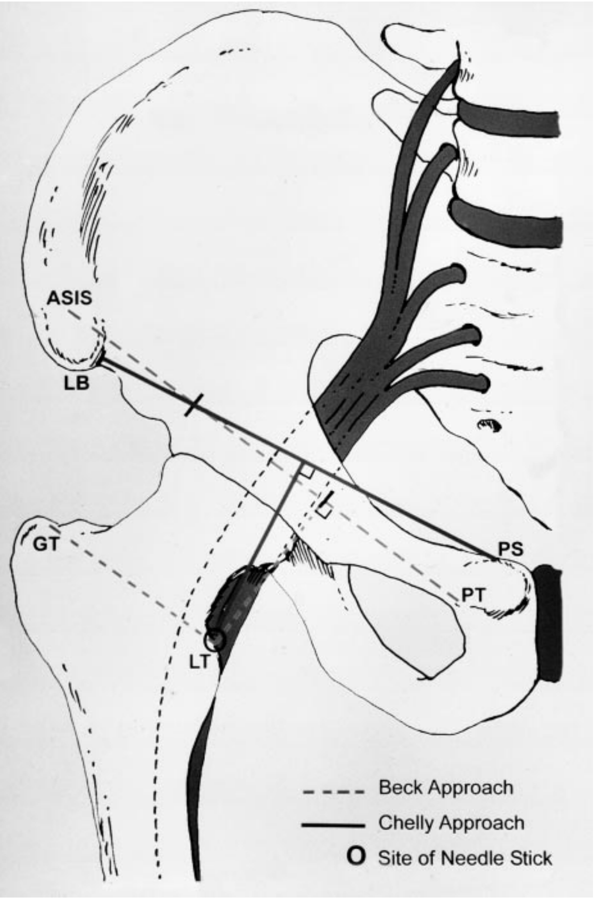

Fig. 3. Comparisons of our anatomic landmarks and those described by Beck.[10] ASIS = anterosuperior ischemic spine; GT = greater trochanter; LT = lesser trochanter; PT = pubic tuberosity; PS = pubic symphysis; LB = lower border.

The short onset time combined with a block of several hours duration, favors the performance of these blocks at some interval from surgery. This is especially interesting when considering that Pavlin *et al.*[21] showed that the use of peripheral nerve block as the sole anesthesia technique reduces the duration of hospital stays for outpatient procedures by approximately 1 h. Even a delay between the performance of the block and the beginning of surgery is unlikely to affect the effectiveness of these blocks.

In 1963, Beck[10] first described anatomic landmarks that allowed localization of the sciatic nerve *via* an anterior approach based on the identification of the greater trochanter. As previously indicated, the greater trochanter is not always easy to identify in obese patients, and attempts to locate it may be very painful for trauma patients. Our approach does not necessitate using femoral landmarks and is based on the use of pelvic landmarks that are easily identified, even in obese and trauma patients; *i.e.*, the lower border of the anterior superior iliac spine and the superior angle of the pubic symphysis tubercle. It is especially interesting that the anterior approach originally described by Beck[10] and our description, using different pelvic landmarks, identify the same site for introduction of the needle (fig. 3).

In many patients, two attempts were necessary for the identification of the sciatic nerve. With the first attempt, the needle ended its course on the femur. Although this first attempt was counted as a "failed" attempt, it is important to recognize that it allowed an estimate of the depth at which the sciatic nerve could be found during the next attempt. Therefore, the distance between the skin and the sciatic nerve equals the distance between the skin and the femur plus the estimated thickness of the femur (3 or 4 cm). Furthermore, at the level of the lesser trochanter, the position of the sciatic nerve is known to be medial and posterior to the femur.

Hadzic *et al.*[22] demonstrated that if the needle is above the lesser trochanter, an internal rotation facilitates the location of the sciatic nerve, whereas an external rotation facilitates an approach of the sciatic nerve below the lesser trochanter. Although this rotation technique was not necessary in this group of patients, it has been used successfully in other patients, especially the internal rotation, suggesting that with our proposed landmarks the sciatic nerve is approached from above the lesser trochanter.

Conclusion

This easy and reliable anterior technique for performing sciatic nerve blocks is an alternative to the more traditional approaches, especially in patients with limited mobility. This approach should therefore facilitate the performance of sciatic nerve blocks.

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