A Subgluteal Approach to the Sciatic Nerve in Adults at 10 cm From the Midline

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Background and Objectives: In 2003 we introduced the concept of a sciatic nerve block performed in the midgluteal area at a fixed distance from the midline in all adults regardless of gender and/or body size. The anatomic basis for that study suggested that a subgluteal block could also be accomplished in a similar fashion.

Methods: After informed consent, 20 patients were prospectively recruited. Patients were positioned in lateral decubitus. The needle insertion site was located in the subgluteal fold at 10 cm from the midline. The needle was advanced parallel to the midline until a sciatic nerve response was elicited. With a visible response at 0.5 mA, 30 mL 1.5% mepivacaine plus 1:200,000 epinephrine was slowly injected. Sensory anesthesia was tested on the plantar and dorsal aspects of the foot as well as the posterior thigh.

Results: Residents performed all blocks. The approach was 100% successful in locating the sciatic nerve with 3 attempts or less from a site located 10 cm from the midline. The block provided successful surgical anesthesia in 90% of the cases; 2 cases required local anesthetic supplementation. Only 3 patients developed anesthesia of the posterior thigh within 30 minutes of injection.

Conclusions: This report shows that a sciatic nerve block can be performed in the subgluteal area at 10 cm from the midline in adult patients of both sexes and various sizes. Anesthesia of the posterior thigh is not consistently accomplished with this approach. *Reg Anesth Pain Med 2006;31:215-220.*

Key Words: Subgluteal, Sciatic nerve block, 10 cm.

In 2003 we introduced a new technique for sciatic nerve block[1] based on our own anatomic studies as well as literature review that showed the trajectory of the sciatic nerve in the gluteal region is mostly parallel and at a fixed distance from the midline. How far from the midline the nerve runs is determined mainly by the location of the ischial tuberosity, which the nerve must clear before changing course to run vertically down into the thigh.

The information gathered during our original study suggested that a sciatic nerve block could be performed at 10 cm from the midline in the midgluteal area of adults as well as any point caudal as far down as the subgluteal fold (Fig 1). With the lower extremities in adduction, this measurement is fixed and not influenced by body weight because the nerve is intimately related to pelvic bony landmarks that bear a constant relationship with the midline. Distal to the subgluteal fold in the thigh, the location of the nerve with respect to the midline is influenced not only by the degree of hip abduction but also by the amount of fat present on the medial side of the thigh.

The midgluteal approach at 10 cm from the midline provides a simple approach to the sciatic nerve that also blocks the posterior cutaneous nerve of the thigh, which at this level runs in close proximity to the sciatic nerve. However, there are times when anesthesia of the posterior thigh is not necessary and/or the needle is not long enough to reach the sciatic nerve in the midgluteal area in which accumulation of adipose tissue is high. In those cases, a subgluteal approach can be a valuable approach.[2]

This study was designed to prove in the clinical setting what we had learned in the anatomy laboratory, that a sciatic nerve block could be performed in the subgluteal area at 10 cm from the midline in all adults without the need to identify any buried anatomic structure (e.g., ischial tuberosity and greater

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Accepted for publication January 12, 2006.

Presented in part at the ASRA Annual Meeting in Orlando, Florida, March 2004.

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1098-7339/06/3103-0007$32.00/0

doi:10.1016/j.rapm.2006.02.004

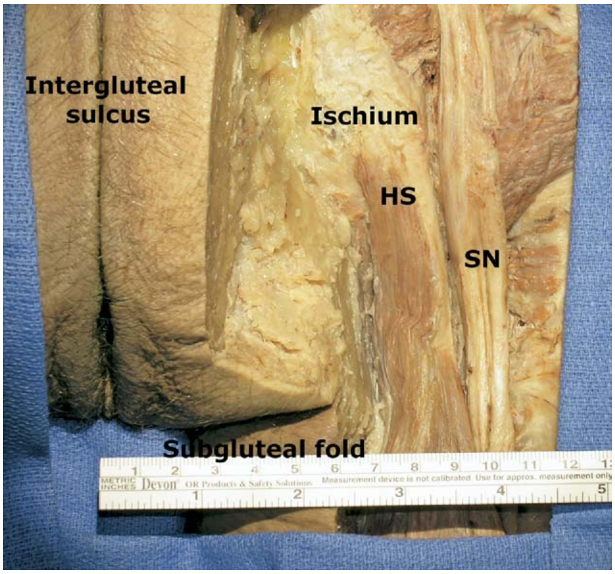

Fig 1. Embalmed cadaver of an adult male. The right buttock has been dissected to show the sciatic nerve in the subgluteal fold at about 10 cm from the midline. SN, sciatic nerve; HS, common origin of hamstring muscles.

trochanter). Secondarily, we also wanted to determine the rate of posterior thigh anesthesia.

Methods

After approval by our hospital institutional review board and written informed consent, we prospectively recruited 20 patients. Every consenting patient older than 18 years of age, American Society of Anesthesiologists I to III coming to the operating room for foot surgery, was considered a candidate for this study. Exclusion criteria included pregnancy, preexisting lower extremity neurologic condition, diabetes, and recent (past 48 hours) substance abuse.

The blocks were performed in the regional anesthesia room just before the patient coming to the operating room. Noninvasive blood pressure monitor, pulse oximeter, and electrocardiogram were applied, and an intravenous (IV) line was secured. Midazolam 1 mg IV and 50 μg of fentanyl IV were administered to every patient before starting the procedure. The operator was free to use more sedation during the case as deemed appropriate to a maximum of 2 mg of midazolam and 150 μg of fentanyl.

Every block was performed by residents under the supervision of an attending anesthesiologist by, using either a 10-cm, 21-G or a 15-cm, 20-G insulated needle (B Braun, Bethlehem, PA) connected to a nerve stimulator (Stimuplex HNS 11, B Braun). The nerve stimulator was equipped with fresh batteries and set to deliver an initial current of 1.5 mA, pulse duration of 0.1 ms, and stimulating frequency of 1 Hz.

The patient was placed in lateral decubitus position with both hips and knees flexed (as for a neuraxial block in the lateral position). Care was taken to have the patient adopt a true lateral position, meaning that a tangential plane at the buttocks would form a 90° angle with the bed. The operator sat behind the patient facing the patient's gluteal area. The needle entrance point was marked in the subgluteal fold at 10 cm from the midline (intergluteal sulcus) as shown in Figure 2. A small wheal of local anesthetic was raised at this point followed by an additional 2 mL of subcutaneous infiltration.

The insulated needle was introduced through the skin wheal and directed parallel to the patient's midline plane (parallel to the bed). A local motor response coming from direct stimulation of the gluteus maximus was usually observed before reaching the sciatic nerve. Any response from the sciatic nerve, including foot dorsiflexion, plantar flexion, eversion, or inversion, was considered appropriate, and once it was elicited, the nerve stimulator current was lowered. If the response was still visible at 0.5 mA and no paresthesia was present, a slow injection of 30 mL 1.5% mepivacaine plus 1:200,000 epinephrine was begun, alternated with frequent aspirations.

If no response from the sciatic nerve could be elicited, the needle was completely withdrawn to the subcutaneous tissue and redirected with an approximate 10° correction angle, first laterally and then, if necessary, medially using the same original insertion point. Each one of the reinsertions by

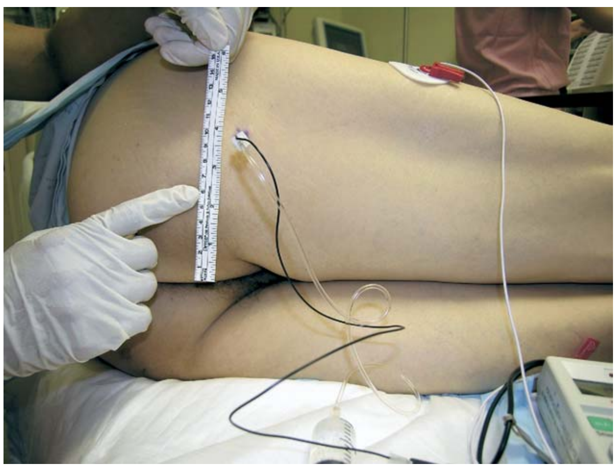

Fig 2. Subgluteal block on a 56-year-old man, 168 cm, 68 kg, BMI 24, shown at the end of injection. The operator shows how the needle entrance point was found.

definition was a new attempt. A saphenous block was performed in front of the medial malleolus with 4 mL 1% mepivacaine plain for surgeries involving the medial side of the foot.

A research assistant recorded the end of the injection as time zero and proceeded to evaluate sensory anesthesia by pinprick stimulation of the plantar and dorsal sides of the foot every 2 minutes by using a sterile 20-G needle. The testing was performed as needed to a maximum of 30 minutes. If the incision took place before 30 minutes, the testing was interrupted and the surgeon performed a check at incision time. The sensory testing of the posterior thigh was done once by pinprick stimulation 30 minutes after the end of injection and later in the recovery room.

Surgeons were not requested to hold back the start of surgery if the block had not developed completely; instead, they were asked to use local anesthesia for supplementation if necessary. General anesthesia was an option discussed at the moment of obtaining the anesthesia consent.

A block was considered successful if sensory anesthesia determined by pinprick stimulation developed within 30 minutes from the end of injection (or earlier if the surgical incision was performed below 30 minutes) and the patient was comfortable during surgery without the need for more than 2 mg midazolam and 150 μg fentanyl for the entire case. If local anesthesia supplementation was necessary and/or higher doses of sedation, including propofol, were used, the block was considered partial, and if general anesthesia was necessary, the block was considered a failure.

In the recovery room, the patient was given a short form to fill out regarding the time at which he/she felt the initial signs of anesthesia dissipation as well as the time when the anesthesia was completely resolved. The patient was also asked to choose 1 of 4 choices to describe his/her anesthesia care (satisfied, somewhat satisfied, somewhat dissatisfied, and unsatisfied) and to give any comments about his/her experience. This information was retrieved 24 hours later during our first postoperative visit or by telephone if the patient had been discharged.

Initial anesthesia dissipation was defined as the moment when the patient first felt that the effect of anesthesia was starting to wear off. Block resolution was defined as the moment when the patient felt that the sensation on her/his extremity returned to normal. In the postoperative period, the patients were actively questioned about dysesthesias or any other problems that could be related to the procedure. The patients were again contacted a week later for follow-up. If a problem was detected, the patient was followed up for as long as it was necessary.

Table 1. Population Demographics

	Mean ± SD	Range
Age (y)	43 ± 15	20-70
Height (cm)	168 ± 12	147-188
Weight (kg)	79 ± 23	50-134
BMI	28 ± 6	20-39

Abbreviation: BMI; body mass index.

The sample size for this study was based on our previous sciatic nerve study[1] in which a similar number of patients produced a population with a wide dispersion of patient heights and weights. Statistical analysis was performed by using GraphPad InStat Software (Graph Pad Software Inc., San Diego, CA). A *P* value $<.05$ was considered significant.

Results

All original 20 patients recruited completed the study (12 female and 8 male). Table 1 shows the patient demographics. All 4 possible responses resulting from stimulation of the sciatic nerve were elicited, 6 in eversion (30%), 3 in inversion (15%), 7 in plantar flexion (35%), and 4 in dorsiflexion (20%). The mean depth at which the sciatic nerve was found was 8.5 ± 2.3 cm.

In 10 patients (50%), the sciatic nerve was found on the first attempt. In 7 patients (35%), it took 2 attempts (original attempt plus 1 reposition attempt). The remaining 3 patients (15%) required 3 attempts (original attempt plus 2 reposition attempts, 1 lateral and 1 medial). No patient required more than 3 attempts (including the reposition attempts). Anesthesiology residents of all levels performed the techniques under attending supervision.

Sensory block as assessed by pinprick stimulation developed faster on the dorsum of the foot (12.6 ± 4.1 minutes) than on the plantar side (16.7 ± 5.8 min, $p < .05$). Eighteen patients developed complete sensory block in both plantar and dorsum of the foot in less than 30 minutes and did not complain of pain or discomfort at incision or during the procedure. The surgical incision was performed in all cases in less than 39 minutes from the time of injection. Two patients who had developed sensory anesthesia on both sides of the foot within 20 and 24 minutes, respectively, complained of discomfort at incision time (at 28 and 29 minutes, respectively). In both cases, local anesthetic infiltration by surgeons was enough to supplement the block and surgery proceeded uneventfully. Both blocks were

Table 2. Block Characteristics

	Mean ± SD	Range
Onset anesthesia dorsum foot (min)	12.6 ± 4.1	6-20
Onset anesthesia plantar foot (min)	16.7 ± 5.8	6-28
Nerve depth (cm)	8.5 ± 2.3	5-14
Incision time (min)	29.2 ± 5.3	17-39
Initial anesthesia dissipation (h)	4.9 ± 1.4	2.5-7.5
Block resolution (h)	6.3 ± 1.5	3.5-8.0

considered to be partial. The 18 patients whose blocks were considered successful received ≤2 mg midazolam and 150 μg fentanyl for the entire case, including the doses used before starting the procedure. No patient received propofol or general anesthesia.

Only 4 patients (20%) developed posterior thigh anesthesia within 30 minutes. An additional 6 patients reported different degrees of subjective feelings of anesthesia of the posterior thigh on arrival to the recovery room. Ten patients (50%) did not develop anesthesia of the posterior thigh.

Twelve patients claimed to be very satisfied with the anesthesia care, and 8 patients were somewhat satisfied. No patient was dissatisfied with the procedure. More detailed information about the characteristics of the blocks is given in Table 2.

Complications

No acute complications occurred. Two patients reported dysesthesias in the lower extremity 24 hours after the block. One patient reported dysesthesia from the posterior thigh to the midcalf, which resolved in 5 days. A second patient reported dysesthesia in the lateral part of the leg radiating to the fifth toe that lasted for 12 days. Both patients recuperated completely, and after 2 weeks they had no symptoms. These 2 patients had had uneventful sciatic nerve blocks. No paresthesias were elicited during the procedures. The second patient was followed up in the pain clinic and treated with nonsteroidal anti-inflammatory drugs. These 2 cases of dysesthesias represent an incidence of 10% with a 95% confidence interval of 1.7% to 32%.

Discussion

We present here our clinical experience with a simplified approach to the sciatic nerve in the subgluteal area of adults, which represents a continuation of our previously published work on sciatic block at the midgluteal level. We have now successfully used the midgluteal approach in close to 400 cases, and it has become our standard sciatic technique.

The relatively small population studied is a limitation to our study. However, our study sample involves adult men and women of varied sizes, with heights ranging from 147 cm to 188 cm and weights going from 50 kg to 134 kg. It is reasonable to believe that a significant segment of the adult population in the United States falls within these parameters.

Our main goal was to show that a sciatic nerve block in adults could be performed at a fixed distance from the midline in the subgluteal area in a similar fashion to the midgluteal approach. This idea may not seem logical considering the enormous variability of buttock sizes in adults (Fig 3); however, the anthropologic and anatomic evidence[3,4] shows that the adult pelvis width is similar in all adults. Contrary to popular belief, male and female pelvises have similar total width[5] with the male pelvis having thicker bones[6] and the female "minor" pelvis being wider.[5] Hormone-dependent, sex-related, different patterns of fat deposition account for the perceived difference in pelvis size among the sexes.[3]

We met our goal satisfactorily. Our technique was 100% successful in finding the sciatic nerve from an entrance point located in the subgluteal fold at 10 cm from the midline. In 50% of the cases, the nerve was located at first attempt and in all cases within 3 attempts. We believe this is noteworthy for a technique that only requires a common measurement device and no identification of buried structures.

The surgical anesthesia success rate of 90% is similar to the one obtained by Raj et al[7] but not as

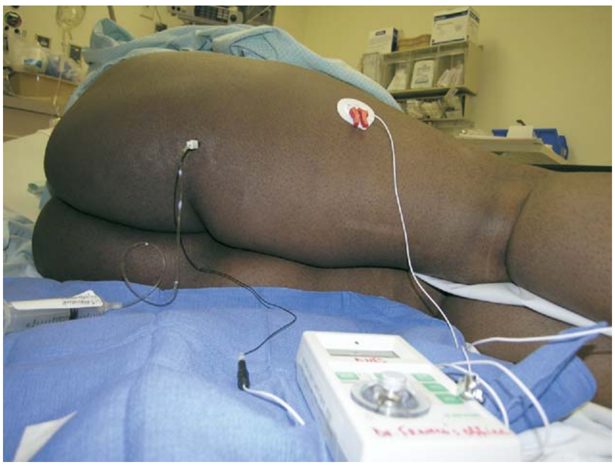

Fig 3. Subgluteal block on a 37-year-old man, 183 cm, 130 kg, BMI 39, shown at the end of injection. The nerve was found at 14 cm deep by using a 20-G, 15-cm needle. Despite significant difference in body size compared with patient shown in Figure 2, the nerve was also located at 10 cm from the midline.

high as other authors.[2,8] However, our proposed technique only differs from other subgluteal blocks in the way that the needle point is determined. After this point is defined by whatever technique, success depends on several other factors, among them, proximity to the nerve, type, and dose of local anesthetic and possibly type of response.[9] Two patients, who had developed anesthesia when tested by pinprick stimulation at 20 and 24 minutes, complained of discomfort after incision, performed in both cases in less than 30 minutes. Supplementation with local anesthetic by the surgeon made the blocks complete. Our sample size is insufficient to establish any relationship between type of response and block success.

Sciatic nerve block performed proximally in the midgluteal area also provides anesthesia of the posterior thigh. This area is supplied by the posterior cutaneous nerve of the thigh, a branch of the sacral plexus whose proximal trajectory in the gluteus is in close proximity to the sciatic nerve. The posterior cutaneous nerve of the thigh then runs a separate course from the sciatic nerve to pierce the fascia lata and become a superficial nerve at the level of the subgluteal fold. This anatomy explains why 50% of our patients did not developed thigh anesthesia and why an additional 30% only developed late and partial anesthesia in the recovery room, most likely because of cephalad spread of local anesthetic into the gluteal area. A second possible mechanism, diffusion of local anesthetic through the thick fascia lata, is less likely. These findings suggest that, in terms of anesthesia distribution, the subgluteal approach is more similar to a popliteal approach than to more proximal approaches in the gluteal area.

The sciatic nerve at the subgluteal level is relatively superficial compared with more proximal locations but only because the amount of adipose tissue decreases from the midgluteal to the subgluteal level and not because of different muscle layers at both sites. The subgluteal fold does not correspond with the lower border of gluteus maximus[10] but rather the lower border of the gluteus maximus crosses the subgluteal fold diagonally and extends significantly more caudal than the latter. As a result, the gluteus maximus muscle covers the sciatic nerve superficially both in the gluteal and subgluteal areas. Despite this relatively more superficial location, in our population the sciatic nerve was deeper than expected (8.5 ± 2.3 cm; range, 5-14 cm). This is significantly deeper ($P < .001$) than that reported by Di Benedetto et al.[2] (4.5 ± 1.3 cm). This might be related to the fact that our patient population was heavier (79 ± 23 kg vs. 73 ± 12 kg, $P = .13$) or to different patterns of fat distribution between the 2 populations.

We actively sought information on residual dysesthesia post block. Two of our patients reported areas of dysesthesia in the territory of the posterior cutaneous nerve of the thigh or in the superficial peroneal nerve. The first patient was a 51-year-old woman, body mass index (BMI) 23, whose block was performed in 3 attempts. The second case was a 23-year old man, BMI 33, whose block was performed at first attempt. These 2 patients recovered completely within 12 days. The identification of these 2 cases of dysesthesias only after specific questioning raises the possibility that this problem is being underreported in the literature.[11]

Another interesting point is how fast anesthesia completely wears off after the first signs of dissipation are felt by the patient (Table 2). This might not agree with the prevailing feeling that these blocks provide lasting analgesia, although we did not directly question our patients about first need for analgesia.

In summary, our limited clinical evidence shows that a subgluteal approach can be performed at 10 cm from the midline in all adults, regardless of gender or body habitus much the same way our midgluteal approach is done. The subgluteal approach does not appear to be a substitute for more proximal approaches when anesthesia of the posterior thigh is required.

The concept of performing a sciatic block, midgluteal or subgluteal, at the same distance from the midline in all adults regardless of gender and body size is provocative but requires confirmation in varied adult patient populations.

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