Title

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Journal

Journal canadien d'anesthésie, 57(7)

ISSN

0832-610X

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Publication Date

2010-07-01

DOI

10.1007/s12630-010-9317-1

Can J Anesth/J Can Anesth
DOI 10.1007/s12630-010-9317-1

CASE REPORTS/CASE SERIES

Efficacy of an ultrasound-guided subsartorial approach to saphenous nerve block: a case series

Efficacité d'une approche sous-sartoriale guidée par ultrason pour l'anesthésie du nerf saphène interne: une série de cas

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Received: 22 January 2010 / Accepted: 14 April 2010

Abstract

Purpose *The saphenous nerve, a branch of the femoral nerve, is a pure sensory nerve that supplies the anteromedial aspect of the lower leg from the knee to the foot. There is limited evidence of the effectiveness of ultrasound-guided techniques to block the saphenous nerve. We therefore undertook a retrospective case series to investigate the efficacy of an ultrasound-guided subsartorial approach to saphenous nerve block.*

Methods *During a four-month period, all patients receiving a subsartorial saphenous nerve block for lower extremity surgery at our institution had their medical records reviewed. Patient demographics and data were recorded, including block characteristics, intraoperative anesthetic management, pre-block, post-block, and postoperative pain scores, as well as postoperative analgesic dosing. Preoperative block success was defined by minimal intraoperative analgesic administration and a pain score of 0 in the postanesthesia care unit not requiring analgesic supplementation. Postoperative block success was defined by reduction of pain score to 0 without need for additional analgesic dosing.*

Results *Thirty-nine consecutive patients were identified as receiving an ultrasound-guided subsartorial saphenous nerve block. Overall, this ultrasound-guided technique was found to have a 77% success rate.*

Conclusion *This case series shows that an ultrasound-guided subsartorial approach to saphenous nerve blockade is a moderately effective means to anesthetize the anteromedial lower extremity. The success rate is based on stringent criteria with an endpoint of postoperative analgesia. A randomized prospective study would provide a more definitive answer regarding the efficacy of this technique for surgical anesthesia.*

Résumé

Objectif *Le nerf saphène interne, une branche du nerf fémoral, est un nerf purement sensitif qui innerve la partie antéromédiale de la jambe, du genou jusqu'au pied. Il existe peu de preuves quant à l'efficacité des techniques guidées par ultrason pour l'anesthésie du nerf saphène interne. Nous avons donc entrepris une revue rétrospective d'une série de cas afin d'examiner l'efficacité d'une approche sous-sartoriale guidée par ultrason pour l'anesthésie du nerf saphène interne.*

Méthodes *Pendant une période de quatre mois, les dossiers médicaux de tous les patients ayant bénéficié d'un bloc sous-sartorial du nerf saphène interne pour une chirurgie du membre inférieur à notre institution ont été revus. Les données démographiques et des renseignements sur ces patients ont été recueillis, dont les caractéristiques du bloc, la prise en charge de l'anesthésie peropératoire, les scores de douleur pré-anesthésie, postanesthésie et postopératoire, ainsi que la posologie analgésique postopératoire. La réussite du bloc en période préopératoire a été définie par une administration peropératoire minime de substances analgésiques et un score de douleur à 0 ne nécessitant aucun apport analgésique supplémentaire à la salle de réveil. La réussite du bloc en période postopératoire a été définie par la*

Support was provided solely from institutional and departmental sources (Harbor-UCLA Medical Center).

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Published online: 29 April 2010

réduction du score de douleur à 0 sans avoir recours à un apport analgésique supplémentaire.

Résultats *On a identifié trente-neuf patients consécutifs ayant bénéficié d'un bloc du nerf saphène interne sous-sartorial guidé par ultrason. Dans l'ensemble, la technique guidée par ultrason a connu un taux de réussite de 77 %.*

Conclusion *Cette série de cas montre que l'approche sous-sartoriale guidée par ultrason pour l'anesthésie du nerf saphène interne est une manière modérément efficace d'anesthésier la partie antéromédiale du membre inférieur. Le taux de réussite est fondé sur des critères rigoureux et le critère d'évaluation était l'analgésie postopératoire. Une étude prospective randomisée offrirait une réponse plus définitive quant à l'efficacité de cette technique pour l'anesthésie chirurgicale.*

The saphenous nerve, a branch of the femoral nerve, is a pure sensory nerve that supplies the anteromedial aspect of the lower leg from the knee to the foot. Blockade of conduction of the saphenous nerve is performed when regional anesthesia is administered for lower extremity surgery, often in combination with a popliteal sciatic nerve block.[1] It can also be utilized independently for procedures involving only the medial aspect of the distal leg.[2] In a recent study, Benzon *et al.* compared the success rates of five different non-ultrasound approaches to the saphenous nerve block (perifemoral, transsartorial, block at the medial femoral condoyle, below-the-knee field block, and blockade at the level of the medial malleolus), and they found that the transsartorial approach was best able to provide sensory blockade to the medial aspects of the leg and foot, with a success rate of 100% for the medial leg and 80% for the medial foot ($n = 10$).[3]

The use of ultrasound has recently been advocated as a means to facilitate the administration of the saphenous nerve block. Gray and Collins described the use of ultrasound for the paravenous approach to the saphenous nerve block, which is performed distal to the tibial condyle.[4] Krombach and Gray utilized ultrasound to perform the transsartorial approach to saphenous nerve block approximately 5 to 7 cm proximal to the popliteal crease,[5] and Tsui and Ozelsel described a slightly more proximal approach 10 to 12 cm above the popliteal crease, using the femoral artery as the main landmark.[6] Manickam *et al.* conducted a small descriptive study to evaluate their ultrasound-guided technique at the distal adductor canal in the distal third of the thigh, and they found that the saphenous nerve was blocked successfully in all 20 of their patients, though success was determined solely by pinprick in the sensory distribution 30 min post-block.[7]

Effective blockade of the saphenous nerve has been performed even more proximally as a non-ultrasound technique; this was described previously as the subsartorial approach.[8,9] However, there is a high degree of difficulty associated with reliably locating the surface landmarks relevant to this technique.[3] At our institution, the saphenous nerve is commonly anesthetized using an ultrasound-guided subsartorial approach at the mid-thigh level. Since evidence regarding the effectiveness of ultrasound-guided techniques to block the saphenous nerve is limited, we undertook a retrospective review of a small series of patients in a single tertiary care institution to determine the efficacy of this technique.

Methods

After obtaining Institutional Review Board approval, a retrospective chart review was performed for all patients who received a subsartorial saphenous nerve block at Harbor-UCLA Medical Center from July 1, 2009 to October 31, 2009. Forty-five consecutive cases were identified and included in a database if they met the following criteria: aged 18 to 64, American Society of Anesthesiologists physical status I to III, and elective foot, ankle, or leg surgery below the knee. As this was a convenience sample, data were collected from all patients known to have undergone an ultrasound-guided subsartorial block, and no power or sample size calculation was performed. All 45 patients met the inclusion criteria. Patients were excluded from the study if they had a history of chronic pain or drug abuse, or preexisting neuropathy that was characterized as moderate to severe. Forty-two patients remained after exclusion criteria were applied.

At our institution, the subsartorial approach for saphenous nerve blockade is performed with the patient supine, the lower extremity externally rotated at the hip, and the knee slightly flexed. The mid-thigh area is prepped with 2% chlorhexidine in 70% isopropyl alcohol, and a sterile ultrasound sleeve is mounted over the 8-12 MHz linear probe (SonoSite® Micromaxx®, Bothwell, WA, USA). The ultrasound probe is placed on the medial aspect of the leg at the midpoint between the knee and the inguinal crease, perpendicular to the skin with the ultrasound beam directed to obtain a cross-sectional view of the femoral artery in short-axis. The sartorius muscle provides a useful landmark and is identified as an elliptical structure. Deep to the sartorius muscle, the saphenous nerve is visualized as a highly hyperechoic structure medial to the femoral artery (Figure 1). After local skin infiltration with 2% lidocaine 1 to 3 mL, a 22-gauge 2-inch short-bevelled echogenic stimulating needle (EchoStim®, Havel's Inc., Cincinnati, OH, USA) is advanced under direct ultrasound visualization

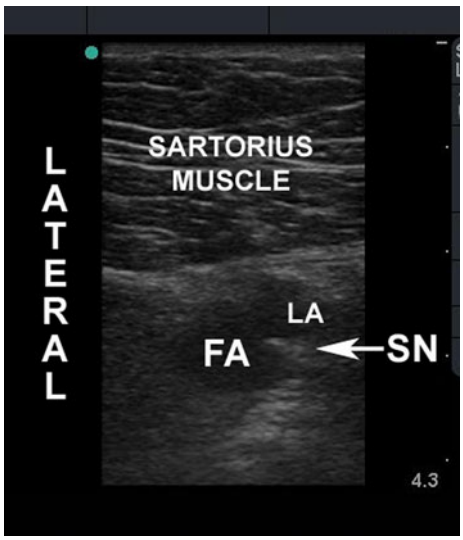

Fig. 1 Ultrasound image obtained during subsartorial saphenous nerve block at the mid-thigh level. FA = femoral artery; SN = saphenous nerve circumscribed by local anesthetic (LA)

Fig. 2 Ultrasound probe and needle orientation (in-plane approach) for the subsartorial saphenous nerve block of the left thigh

with an in-plane approach (Figure 2). Initially, the needle is inserted lateral to the femoral artery and is advanced so that the needle tip approaches the medial aspect of the artery where the saphenous nerve is located, slightly superficial to the artery. An optional nerve stimulator (Stimuplex®, B. Braun Medical Inc., Bethlehem, PA, USA) at a 0.9 mA and 2 Hz setting may confirm vastus medialis and/or patella tendon capture. After negative aspiration, 10 to 20 mL of local anesthetic is injected incrementally.

Upon reviewing the medical records, it was found that one of the patients who reported severe pain in the postanesthesia care unit (PACU) specifically complained of pain only over the lateral leg along the distribution of the sciatic nerve, but denied pain over the medial leg that receives sensory innervation from the saphenous nerve. A second patient who received preoperative regional anesthesia needed intraoperative conversion from monitored anesthesia care (MAC) to general anesthesia (GA) after the surgeons decided to harvest a bone graft from his iliac crest. A third patient who also had preoperative nerve blocks was converted intraoperatively from MAC to GA when the surgery was changed from a below knee amputation to an above knee amputation. These three cases were subsequently eliminated, yielding a total of 39 patients.

Patient demographics were recorded, including age, sex, ASA physical status classification, and type of surgery. Pre-block and post-block pain scores were recorded (verbal rating system [VRS]; 0 = no pain to 10 = worst pain imaginable). At our institution, pain scores of 1 and 2 are considered mild, pain scores of 3 to 5 are considered moderate, and pain scores of ≥ 6 are considered severe. Pain scores are routinely ascertained pre-block and 30 min post-block and recorded for all patients. Though sensory and motor testing is typically performed after all blocks, usually the results are not recorded. Details of the regional anesthetic were also recorded, including the type of local anesthetic and the volume of local anesthetic delivered.

In the situation of a preoperative nerve block, the details of the block are typically communicated to the in-room provider who administers intraoperative anesthesia according to his/her discretion. If MAC is administered, the anesthesia provider usually requests that the tourniquet be placed below the knee, and if GA or neuraxial anesthesia is provided, the tourniquet is typically placed above the knee. However, the location of the tourniquet is usually not documented in the anesthesia record. For all preoperative nerve blocks, the anesthesia record was examined for the type of anesthesia given by the intraoperative provider and for any analgesic medication required. Finally, PACU notes were reviewed for VRS pain scores as well as for the amount of analgesic medication administered to the patient. At our institution, postoperative VRS scores are often the sole documented determinants of block success. The duration from block administration to entrance to the PACU was recorded.

A preoperative block was deemed successful if: 1) the patient received either MAC or GA intraoperatively with the anesthesia record documenting minimal opioid administration ($\leq$ fentanyl 200 µg or opioid equivalent); and 2) the patient denied pain (VRS score = 0) in the PACU and did not require supplemental analgesic medication aside from meperidine $\leq$ 25 mg, which typically is given at our institution for shivering. A postoperative block was deemed effective if the patient's VRS score was reduced to 0 within 30 min of injection without additional analgesic dosing. If a nerve block was found to be unsuccessful, a further assessment of the anesthesia record and

PACU nursing notes was made to determine the details concerning block failure.

Results

Demographic information and type of surgical procedure are presented in Table 1. Ultrasound was used in 39/39 (100%) of the cases. While the nerve stimulator was utilized in 35/39 (90%) of the cases, capture of the vastus medialis or patella tendon was only elicited 23% (8/35) of the time with current intensity $\leq$ 0.9 mA at the mid-thigh. The saphenous nerve was anesthetized with 0.5% ropivacaine in 17 (44%) of the patients, 0.5% bupivacaine in 15 (38%) of the patients, 2% lidocaine with epinephrine 1:200 K in two (5%) of the patients, and a combination of the lidocaine plus ropivacaine or bupivacaine in five (13%) of the patients. The average anesthetic volume administered was 14 $\pm$ 5 mL. Twenty-nine of the 39 (74%) blocks were performed by a resident supervised by an attending anesthesiologist, while the remainder of the blocks was performed by an attending physician. No adverse events were reported. The average duration from nerve block administration to PACU was 272 $\pm$ 117 min. Twenty-one percent (8/39) of the patients received outpatient surgery, and they were discharged home the same day. Pre-block, post-block, and postoperative patient pain scores are reported in Table 2. Ten (28%) of the patients receiving preoperative nerve blockade reported pre-block VRS scores of 0 secondary to chronic conditions or injuries that were non-painful.

According to criteria previously established, the subsartorial saphenous nerve block was found to have an overall 77% (30/39) efficacy rate (Table 3). Preoperative blocks had a 78% (28/36) efficacy rate, and 16 of these cases were performed under MAC (Table 3). In eight preoperative cases, it was noted in the anesthesia record that the patient complained of pain in the operating room, either after testing the block prior to onset of surgery or intraoperatively; these cases were recorded as unsuccessful blocks. In two of the cases, neuraxial anesthesia was subsequently administered. Though these blocks were considered unsuccessful, these patients reported no postoperative pain (Table 2).

Table 1 Patient demographics

Sex (M/F)	25/14
Age (yr)	42 $\pm$ 14
Height (cm)	170 $\pm$ 13
Weight (kg)	82 $\pm$ 18
BMI ($kg \cdot m^{-2}$)	28 $\pm$ 6
ASA physical classification	
I	17 (44%)
II	13 (33%)
III	9 (23%)
Surgical procedure	
surgical procedure involving foot	10 (26%)
surgical procedure involving ankle	24 (61%)
surgical procedure involving leg below the knee	5 (13%)

Data are numbers (%) for discrete variables, means $\pm$ SD for continuous variables

ASA = American Society of Anesthesiologists; BMI = body mass index; SD = standard deviation

Table 2 Verbal rating scale (VRS) pain scores

Preoperative blocks (n = 36)			
	Pre-block pain score	*Post-block pain score*	*Postoperative pain score*
VRS 0	10 (28%)	34 (94%)	30 (83%)
VRS 1-2	2 (6%)	2 (6%)	0 (0%)
VRS 3-5	14 (39%)	0 (0%)	2 (6%)
VRS 6-10	10 (28%)	0 (0%)	4 (11%)
Postoperative blocks (n = 3)			
	Pre-block pain score		*Post-block pain score*
VRS 0	0 (0%)		2 (67%)
VRS 1-2	0 (0%)		0 (0%)
VRS 3-5	0 (0%)		1 (33%)
VRS 6-10	3 (100%)		0 (0%)

Data are numbers (%) for discrete variables

Table 3 Success rate of ultrasound-guided subsartorial saphenous nerve block

All Blocks (n = 39)	
Successful Block	30 (77%)
Unsuccessful Block	9 (23%)
Preoperative Blocks (n = 36)	
Successful Block	
Total	28 (78%)
MAC	16 (44%)
GA	12 (33%)
Unsuccessful Block	8 (22%)
Postoperative Blocks (n = 3)	
Successful Block	
Reduction of VRS scores to 0	2 (67%)
Unsuccessful Block	
Reduction of VRS scores to 1-2	0 (0%)
Reduction of VRS scores to 3-5	1 (33%)
Reduction of VRS scores to 6-10	0 (0%)

Data are numbers (%) for discrete variables

MAC = monitored anesthesia care; GA = general anesthesia; VRS = verbal rating scale

Discussion

This case series shows that our ultrasound-guided subsartorial technique to saphenous nerve blockade is a moderately effective approach to anesthetize the anteromedial lower extremity, yielding an overall 77% success rate. These incidence rates are similar to those reported in the literature by Benzon *et al.* for the transsartorial and perifemoral approaches to anesthetize the medial leg (100%, 70%, respectively, $n = 10$) and medial foot (80%, and 30%, respectively, $n = 10$).[3] Our findings are also consistent with van der Wal *et al.*'s larger trial that reported a success rate of 80% for his transsartorial approach to saphenous nerve blockade using a loss of resistance technique ($n = 60$).[10] While our success rate is lower than Manickam *et al.*'s ultrasound-guided study evaluating the transsartorial perifemoral approach (100%, $n = 20$), their efficacy rate was determined by pinprick in the sensory distribution 30 min post-block.[7] On the other hand, our efficacy rate included evaluation in the postoperative period approximately 272 ± 117 min after nerve blocks were performed, and the threshold of block success in our study was based on highly stringent criteria with an endpoint of postoperative analgesia. We did not count a block successful unless the patient denied all pain in the PACU. In instances of partial nerve blockade, the deeper distributions of the nerve may never become anesthetized, and at the onset of surgery, an inadequate block would be identified with surgical incision and dissection. Moreover, partial nerve blockade would not provide complete postoperative analgesia.

The 77% success rate may have been influenced negatively by several factors. First, the majority of the blocks were performed by anesthesiology residents with limited experience with regional techniques; this practice setting may possibly lead to an underestimation of true efficacy. Second, none of our patients received surgery solely in the saphenous nerve distribution. All of our patients received a popliteal sciatic block in conjunction with the saphenous nerve block. Since our evaluations were retrospective, in most cases, we were unable to delineate the distribution of pain intraoperatively and postoperatively, because it was not described routinely in the anesthesia record or in the PACU notes. In one case, the patient reported significant postoperative pain; however, the pain was localized solely in the distribution of the sciatic nerve, and the patient denied pain over the saphenous distribution. This case was not included in the summary data (described above).

After entering the adductor sheath, the femoral nerve continues as a purely sensory saphenous nerve. Previously described ultrasound-guided techniques have focused on blocking the saphenous nerve within the adductor canal or distal to it.[4-7] On the other hand, our technique initially involves identifying the femoral artery at the mid-thigh level as the surrogate landmark, and then identifying the nerve bundle in proximity to the femoral nerve. At this subsartorial location, the saphenous nerve may run with at least two additional nerves, the infrapatellar nerve[11] and the nerve to the vastus medialis.[12] While Tsui and Ozelsel[6] and Manickam *et al.*[7] first identify the femoral artery, they subsequently scan distally to the point where the femoral artery becomes the popliteal artery and block the saphenous nerve slightly proximal to this location. However, we prefer to block the saphenous nerve while it still lies in conjunction with the nerve to the vastus medialis and the infrapatellar nerve, using nerve stimulation of the vastus medialis and/or the patella tendon as a possible additional objective endpoint. An elicited motor twitch is helpful to the novice learning this technique. We found that nerve stimulator capture was obtained in only 23% (8/39) of the cases. While Manickam *et al.* reported that none of their 20 cases had an elicited motor response,[7] our technique blocks the saphenous nerve more proximally (mid-thigh *vs* distal third) where the nerve to the vastus medialis and the infrapatellar nerve run in closer proximity to the saphenous nerve.

One concern regarding our technique is that partial motor block of the upper leg may result with anesthesia of the nerve to the vastus medialis. This outcome might prohibit early discharge of ambulatory patients, although all of the outpatients in our study were discharged on the day of surgery. We were unable to assess the nature of motor blockade in our retrospective analysis. However, Bouaziz *et al.* found that the femoral nerve was not anesthetized and quadriceps muscle strength was preserved when the saphenous nerve was blocked using a subsartorial approach.[9] A prospective study comparing the different ultrasound-guided techniques to anesthetize the saphenous nerve would help clarify the effect of each approach on motor blockade and same-day discharge. A potential benefit of the described subsartorial approach is its relative simplicity to teach and to perform. A further potential benefit of this subsartorial approach is that it can be a valuable substitute for the traditional femoral nerve block at the groin in cases requiring only blockade of the distal branches of the nerve where access to the groin is difficult, i.e., obesity, large pannus, skin infection/maceration, prior femoral bypass surgery, femoral vessel catheterization, or hernia repair.

There are several limitations to consider. We were unable to determine the efficacy rate of our technique to provide surgical anesthesia - we could only provide an efficacy rate for postoperative analgesia. In our study population, 44% (16/36) of the cases receiving preoperative blocks were performed under MAC, indicating successful surgical anesthesia. However, this percentage

likely underestimates the frequency of successful surgical anesthesia, given the fact that intraoperative anesthesia management was performed at the discretion of the in-room provider. It may have been the plan of the intraoperative provider to administer a general anesthetic whether or not the patient had received preoperative regional anesthesia. There are several other reasons why a high number of concurrent general anesthetics were performed at our institution, including the insufficient "soak" time before the start of surgery and patient preferences for GA. Since we were unable to standardize the intraoperative management, we were unable to ascertain an accurate efficacy rate for surgical anesthesia from the unsupplemented block.

Given the nature of the retrospective review, a further limitation was our inability to standardize the type and amount of local anesthetics given for the block. Finally, the number of anesthesiologists performing the block represented a confounding variable that we were unable to control. A randomized controlled trial comparing the different techniques to anesthetize the saphenous nerve would help to resolve these issues.

This case series reports the efficacy rate of an ultrasound-guided subsartorial approach to saphenous nerve blockade from a single institution. A 77% success rate is comparable with that reported from other centres and other studies. A randomized controlled trial comparing different ultrasound-guided approaches to anesthetizing the medial aspect of the lower leg would provide a more definitive answer regarding the efficacy of this method for achieving surgical anesthesia.

Competing interests None declared.

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