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Posterior approach to the sciatic nerve in the popliteal fossa for lower limb surgery☆

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Abstract

Background and objectives: To evaluate success rate, acceptance and complications of sciatic nerve (SN) block at the popliteal fossa (popliteal block, PB) for ambulatory or inpatient orthopedic and vascular surgical procedures. *Methods:* A retrospective study was carried out in 312 patients who received a PB for vascular and orthopedic lower leg surgery. A single injection, posterior approach technique with 40 ml of either 0.5% ropivacaine or 1% mepivacaine was used. Data collected included demographic and clinical variables. *Results:* Observed success rate was 95.5%. Acceptance of anesthetic procedure among outpatients was high (94.1%). There were no intraoperative or postoperative complications. For ambulatory surgery patients, the postoperative stay was 130 ± 25 min. *Conclusions:* PB was a useful anesthetic technique for minor foot and ankle surgery. The single-injection, posterior approach obtained a high success rate without untoward events. It was well accepted by patients and proved to be suitable for ambulatory surgery.

Keywords: Lower limb surgery; Popliteal block

1. Introduction

Among regional anesthesia techniques for the lower limb, the sciatic nerve (SN) block is a well established procedure. Several approaches to the blockade of the SN have been proposed [1]. SN block in the popliteal fossa (popliteal block, PB) is not widely used by anesthesiologists [2] although it is a valuable technique for surgical procedures below the knee and may have advantages when compared with other anesthetic techniques [1]. Orthopedic or vascular lower leg surgery may induce severe and prolonged postoperative pain, which requires large doses of parenteral opioids [3]. For this reason, the prolonged and effective postoperative analgesia observed after a SN block is also useful.

The purpose of the present retrospective study was to evaluate success rate, acceptance and complications of PB for minor foot and ankle surgery in the setting of the clinical anesthetic practice of a general hospital.

2. Methods

The study was carried out in a medical center with 175 surgical beds serving a population of some 230 000 people. A retrospective review of an anesthetic database was done. Out of 13 852 anesthetics administered between 1 October 1999 and 31 December 2001, we identified every patient >18 years who received a PB for orthopedic or vascular lower leg surgery. If necessary, additional information was obtained from medical charts. A review of nurses' observations in the post-anesthesia care unit and in the day case unit was also done. Data collected included demographic (sex, age

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and ASA physical status) and clinical variables (type and duration of surgery, inpatient versus ambulatory surgery, duration of hospital stay in day case surgery, success rate, use of intraoperative sedation, intraoperative or postoperative anesthetic complications, type of local anesthetic and patient satisfaction). Planned (inpatient or ambulatory) and urgent surgical procedures (all inpatients) were included. Exclusion criteria were patient refusal, neurologic or neuromuscular disease and infection at the injection site.

All anesthetic procedures were performed by staff anesthesiologists and all followed the same technique. Patients were premedicated with 1–2 mg IV boluses of midazolam, and intraoperative sedation or analgesia with incremental IV midazolam boluses (1 mg) and/or IV fentanil boluses (50 μg), at anesthesiologist's discretion. Our technique has been described elsewhere [4], according to Rorie et al. [5]. With the patients in the prone position, the injection site was the upper vertex of the popliteal fossa. The appropriate nerve was identified by observing motor responses in the foot using a short-beveled, Teflon-coated needle (Stimuplex, B. Braun) connected to a nerve stimulator (Stimuplex NHS 11, B. Braun) using 0.3 mA, 2 Hz current. 40 ml of either 1% mepivacaine or 0.5% ropivacaine was used. The saphenous nerve was also blocked in all patients. When the tourniquet was employed (100 mmHg > systolic arterial blood pressure), it was placed below the knee.

Once the anesthetic had been administered, sensory and motor block assessments were made every 5 min until surgical incision. If the patient presented insufficient sensory block or none whatsoever 20 min later, it was attributed to a technical failure. In this case or when persistent pain during surgery, an alternative anesthetic was considered. The incomplete blocks that were sufficient for surgery were considered successful.

All patients scheduled for outpatient surgery were interviewed by telephone by a nurse (blind to the anesthetic technique) 24 h after the operation to assess their satisfaction with the anesthetic technique by questioning: *Are you satisfied with the anesthetic procedure*? If the answer was *no*, they were asked: *what is the reason*?

3. Results

During the specified time period, 312 patients received a PB. Anesthetic procedures were performed by 19 anesthesiologists of variable experience with the technique. No patients refused this block during the study period.

Patient demographics and surgical procedures are shown in Table 1. 59 patients (18.9%) were premedicated. Intraoperative sedation was administered in 38 patients (12.2%) with anxiety or discomfort. Successful block was achieved in 298 cases (95.5%). In 14 patients (4.5%), PB was considered a technical failure; this group included two cases of failure to localize the SN.

Table 1
Demographic and surgical data

Sex (M/F)	72 (23%)/240 (67%)
Age (years)	54 ± 16
ASA physical status	
1	121 (38.8%)
2	168 (53.8%)
3	23 (7.4%)
Surgeries	
Duration (min)	34 ± 12
Orthopedic	
Bunionectomy and correction of toe deformities	259 (83%)
Orthopedic material removal	14 (4.5%)
Reduction and internal fixation	6 (1.9%)
Ankle arthroscopy	4 (1.3%)
Soft tissue surgery	3 (1%)
Others	14 (4.5%)
Vascular	
Amputation	8 (2.6%)
Others	4 (1.3%)
Surgical setting	
Urgent surgery	9 (2.9%)
Programmed procedures	
Inpatient	70 (25.3%)
Ambulatory surgery	233 (74.7%)
Local anesthetic	
Mepivacaine	160 (51.3%)
Ropivacaine	152 (48.7%)

Values expressed as n (percentage) or mean ± S.D.

No intraoperative or postoperative complications were noted. Time to initiation of sensory block was 6.6 ± 4.2 min (mean ± standard deviation (S.D.)). All the patients scheduled for outpatient surgery who received a PB ($n = 230$) could leave the hospital. The duration of their postoperative stay was 130 ± 25 min and the total hospital stay was 6.9 ± 2 h (mean ± S.D.). On the follow-up interview, 16 ambulatory patients (5.1%) considered the technique unsatisfactory: fifteen complained of the pain caused by the nerve stimulator needle insertion and one patient complained of a sensory block that lasted over 24 h (PB with ropivacaine).

4. Discussion

The results of this study showed that the single injection, posterior approach to the PB provided reliable surgical anesthesia for lower leg orthopedic and vascular procedures. In addition, there was a high acceptance of the anesthetic technique with no major intraoperative or postoperative complications. It also proved to be a suitable technique for ambulatory surgery. The retro-

spective collection of data is a limitation of our study: it may contain missing data points, it may not accurately measure the outcomes of interest and the informational content may no necessarily be useful. However, it has proved to be a useful tool in clinical research: databases reflect typical clinical practice and facilitate assessment of rare outcomes [6].

In our series, both mepivacaine and ropivacaine produced rapid, effective and safe anesthesia but postoperative analgesia was significantly more long-lasting in group ropivacaine (15.2±5.1 h) than in group mepivacaine (5.7±1.8 h) (mean±S.D.) [4]. This is a definite advantage in these kinds of surgical procedures (such as hallux valgus repair), which are usually accompanied by moderate to severe postoperative pain. After knowing the results of the quoted study, most anesthesiologists of our department now use ropivacaine. One patient was distressed by the prolonged ropivacaine block; this shows the need to inform patients about the expected duration of effect. No anesthetic causes precluded discharge of patients scheduled for ambulatory surgery who received a PB.

Among regional techniques for lower limb, the SN block is a well established procedure and several different block approaches along its pathway have been described. The classic posterior approach of Labat is the most frequently used technique by anesthesiologists in the US [1,7]. This technique and other proximal SN blocks require the identification of multiple landmarks.

Different posterior and lateral approaches to the SN at the popliteal fossa have been described [2,8,9]. In contrast to SN in pelvis, the anatomic references in PB are virtually constant. Moreover, there is usually less amount of adipose tissue in the popliteal region than in the gluteal or subgluteal regions and this could be an advantage in obese patients [10]. Saphenous nerve block was done routinely since branches of this nerve occasionally reach distal foot territory [11].

The SN is composed of independent medial and lateral divisions that are physically but not functionally joined by a common connective tissue sheath. The tibial nerve (TN) and common peroneal nerve (CPN) are bundled together with multiple layers of connective tissue, which remain as they diverge from the epineural sheath of the SN, but they do not exchange fibers [12]. These sheaths may limit the exposure to the local anesthetic when the injection is made distal to the division of the SN. That is why some investigators have suggested a double-injection technique, in which both branches are separately identified and anesthetized [13], and others have suggested injecting a large volume of local anesthetic to increase the spread within the epineural sheath to reach both the TN and the CPN [14].

The level at which the SN divides into the TN and the CPN has been suspected as a possible cause for incomplete block of the SN at the popliteal fossa [15]. In their interesting study, Vloka et al. [16] showed that the TN and the CPN divide at variable distances (60.5± 27.0 mm, range 0–115 mm) above the popliteal fossa crease. So, when performing PB, insertion of the needle 100 mm above the popliteal crease is more likely to result in placement of the needle proximal to the division of the SN than placement at 50–70 mm, according to classical teaching. In all our patients we have inserted the needle as proximal as possible (upper vertex) above the popliteal crease using a midline approach trying to avoid muscle trauma. Singelyn et al. [17] reported 625 PB with a high success rate inserting the needle 10 cm above the popliteal crease.

Incomplete sensory block of the foot after PB may be also related to the motor block that is elicited when the block is performed [15]. Thus, we have also proved in our group of patients that technical failure rate decreases when evoked motor responses corresponds to the SN branch that innervates the surgical territory. The possible evoked motor response are: eversion, inversion, plantar flexion, or dorsiflexion of the foot. A dorsiflexion or eversion identifies the CPN and a plantar flexion the TN. Inversion is caused by the action of two muscles (tibialis posterior and tibialis anterior) which are innervated, respectively, by the TN and the deep peroneal nerve, a branch of the CPN. Therefore, in the case of an elicited inversion of the foot, the needle tip is located very close to both branches of the SN or to the SN itself before it divides into TN and CPN.

Precise nerve localization using low current intensity nerve stimulation (0.3 mA) was probably essential to achieve the high success rate in our series. In fact, one of the major determinants of the success of any regional block is the distance of the needle tip to the nerve. The popliteal fossa is filled with fat so diffusion of injected local anesthetic may be impaired [1], and there are no structures that, as occurs with other regional blocks, convey or restrict local anesthetic location. Thus, the injected volume will have an erratic and unpredictable distribution (Fig. 1). Paqueron et al. [13] concluded that, using the same local anesthetic volume (20 ml), the SN block when both components were identified provided a greater success rate compared with a single-injection technique. However, the success rate they achieved with a two-stimulation technique was similar to our study and to others that used a single-injection technique injecting a higher volume [3,4,17]. The use of high volumes (40 ml) probably ensures exposure of both divisions of the SN to the local anesthetic (Fig. 2). Schirmek and Deusch [18] found an increasing percentage of patients with complete anesthesia after successive injections of local anesthetics, using a catheter introduced in the popliteal fossa. Moreover, Paqueron et al. did not report how many attempts were necessary to localize the nerve, but is very probable that with the

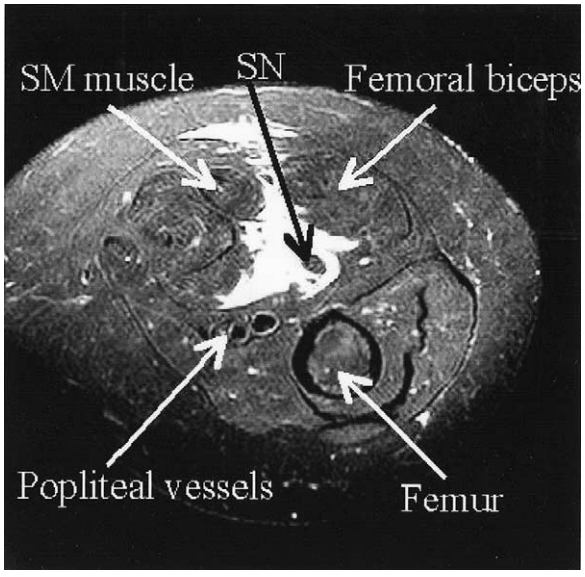

Fig. 1. Magnetic resonance imaging (MRI) at the distal level of the thigh (90 mm above popliteal crease) 5 min after injection of 40 ml of local anesthesia. The arrow indicating the SN shows the direction of the stimulation needle with the posterior approach. The white area shows the diffusion of local anesthetic in the popliteal fossa fat. SM, Semimembranous.

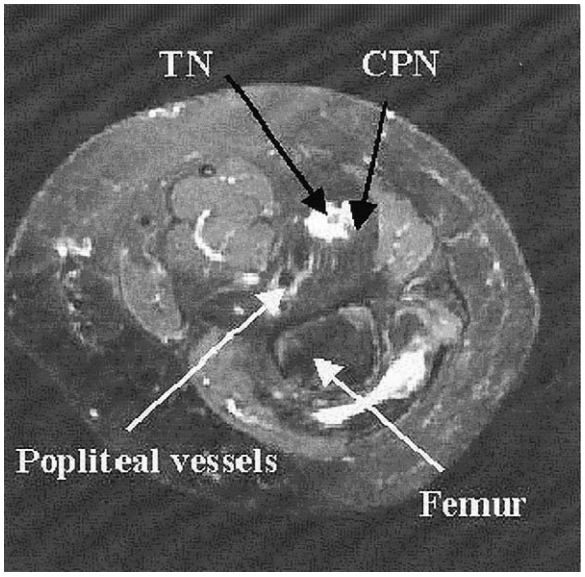

Fig. 2. MRI 63 mm distal to Fig. 1 image. The white area shows the local anesthetic surrounding the TN and the CPN. The use of high local anesthetic volume increases the probability of its impregnation and diffusion along both SN components trajectory distally to the injection site.

double-injection technique more time and attempts were necessary to perform the block and in our study, we have shown that the main complaint of the patients was the pain caused by the needle insertion.

In conclusion, single-injection, posterior approach PB was a useful anesthetic technique for minor foot and ankle surgery. We obtained a high success rate in ambulatory and inpatient surgeries without untoward events. Needle insertion as proximal as possible, high above the popliteal crease, use of low current intensity nerve stimulation, elicitation of an appropriate muscular response and, as with many other lower extremity peripheral nerve blocks, injection of high volume seemed to be the key in making the single-injection block highly successful. It was well accepted by patients and proved to be suitable for ambulatory surgery.

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