Continuous Popliteal Sciatic Nerve Block: An Original Technique to Provide Postoperative Analgesia After Foot Surgery

François J. Singelyn, MD, F. Aye, MD, and J. M. Gouverneur, MD

Department of Anesthesiology, UCL School of Medecine, St. Luc Hospital, Brussels, Belgium

Our study describes an original technique of continuous popliteal sciatic nerve block (CPSB) (Group A, 60 patients) and compares its analgesic efficacy after foot surgery with intramuscular (IM) opioids (Group B, 15 patients) and intravenous patient-controlled analgesia (IV PCA) with morphine (Group C, 45 patients). CPSB was performed using Singelyn's landmarks. The sciatic nerve was localized with a short-beveled needle connected to a peripheral nerve stimulator. A 20-gauge catheter was placed at the same depth as the needle with a Seldinger technique. Thirty milliliters of 1% mepivacaine with epinephrine 1/200,000 was injected and followed by a continuous infusion of 0.125% bupivacaine with sufentanil 0.1 μg/mL and clonidine 1 μg/mL at 7 mL/h for 48 h. Postoperative analgesia (intravenous [IV] propacetamol [PRO] and/or IM piritramide [DIPI]) was standardized. Postoperative pain score (PPS), supplemental analgesia, and side effects were noted. CPSB was easy to perform in 55 patients (92%). In Group A, highest and mean PPS were significantly lower, and the mean dose of PRO was reduced by 62% and 36% when compared with Groups B and C, respectively. Only 8% of patients required postoperative opioid in Group A compared with 91% and 100% in Groups B and C, respectively. No immediate or delayed complications other than postoperative technical problems (kinked or broken catheter 25%) were noted in Group A. In conclusion, CPSB is easy to perform, safe, and a more efficient technique than parenteral opioid for providing postoperative analgesia after foot surgery.

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Foot surgery often induces severe and prolonged postoperative pain that requires large doses of parenteral opioids (1,2). Traditional intramuscular (IM) opioids on an "as needed" basis often lead to ineffective postoperative analgesia (3–5). Intravenous patient-controlled analgesia (IV PCA) with opioids provides better pain control than IM therapy (5–7) but analgesic efficacy during movement has not yet been demonstrated, and patient satisfaction is related to the incidence of side effects (8). Continuous epidural analgesia would be an alternative technique to treat such pain. However, as L5-S1 segments are frequently unblocked, it is not considered a reliable analgesic method after foot surgery (9). This paper describes an original technique of continuous popliteal sciatic nerve block (CPSB) and assesses its analgesic efficacy after foot surgery.

Methods

After informed consent, 60 ASA class I or II patients scheduled for elective foot surgery (hallux valgus, metatarsal osteotomies, ankle arthrodesis, broken calcaneus, broken ankle) were included in this study.

With the patient in the prone position, CPSB was performed following Singelyn et al.'s (10) landmarks. The site of puncture was between the upper muscular borders of the popliteal fossa, in the midline, at least 10 cm above the popliteal skin crease (Figure 1). A 6-cm, 18-gauge short-beveled needle through a plastic cannula (Alphaplex® set; Sterimed, Püttlingen, Germany) and connected to a peripheral nerve stimulator was introduced at an angle of 45° to the skin and advanced in an anterior and cephalad direction. Its position was judged adequate when output less than 1 mA still elicited a slight motor response of the foot. The needle was then removed and a guide wire was introduced into the plastic cannula, caution being taken to place it at the same depth as the cannula. A

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Address correspondence and reprint requests to Francois J. Singelyn, MD, Department of Anesthesiology, St. Luc Hospital, Avenue Hippocrate 10/1821, B 1200 Brussels, Belgium.

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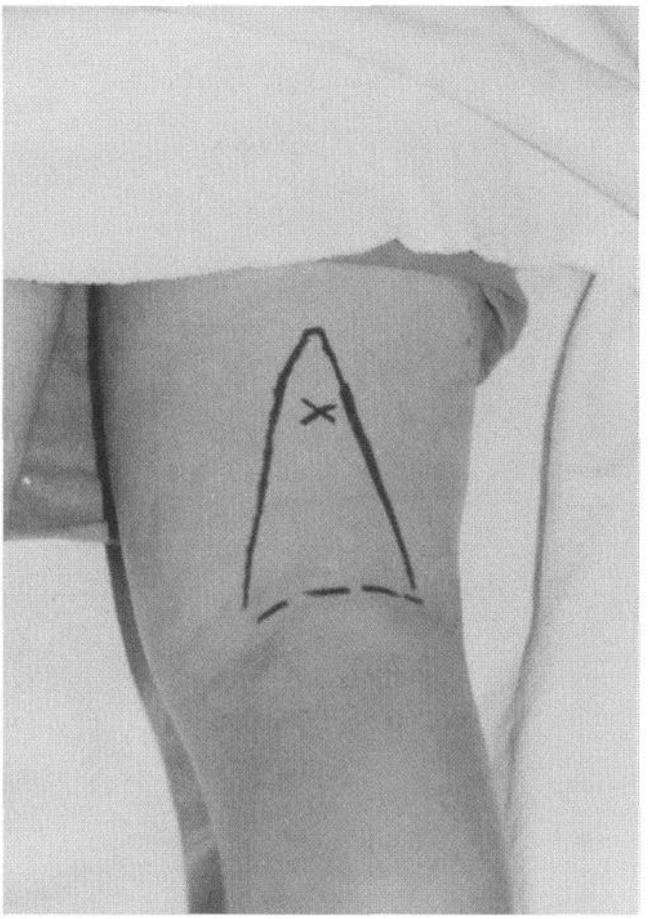

Figure 1. Landmarks to perform continuous popliteal sciatic nerve block: between the muscular borders of the popliteal fossa (biceps femoris, semitendinosus, and semimembranosus muscles), on the midline, at least 10 cm above the popliteal skin crease.

20-gauge, 30-cm catheter was threaded over the wire using the Seldinger technique (Figure 2). After an aspiration test, 30 mL of 1% mepivacaine with epinephrine 1/200,000 was injected and followed by a continuous infusion of 0.125% bupivacaine with sufentanil 0.1 μg/mL and clonidine 1 μg/mL at 7 mL/h for 48 h. When the use of a tourniquet was planned, an inguinal paravascular femoral nerve block was performed using the technique and landmarks of Winnie et al. (11). The femoral nerve was localized by nerve stimulation and blocked with 10 mL of local anesthetic solution. Our technique was considered easy if one or two attempts were required to locate the sciatic nerve in the popliteal fossa, difficult if three or four attempts were required, and very difficult if more than four attempts were required.

Postoperative pain score (PPS) (0 = no pain; 1 = moderate pain only when moving; 2 = moderate pain at rest, severe pain when moving; 3 = constant severe pain) was recorded by the nurses at 4, 8, 12, 24, 36, and 48 h. Postoperative analgesia was standardized. If PPS was ≥1, 1 g propacetamol (PRO) (Pro-dafalgan®; Upsamedica s.a, Brussels, Belgium) was administered IV and was followed, if PPS remained unchanged after 30 min, by 10–20 mg IM piritramide (DIPI), a synthetic opioid (Dipidolor®; Janssen Pharmaceutica, Beerse, Belgium). Time between induction of anesthesia and first request of analgesic, highest PPS (mean of the highest PPS), mean PPS (mean of all PPS), supplemental analgesia, and side effects were noted. The patients were reviewed by the surgeon at 1 wk and 1 mo after the procedure. They were asked about any potential adverse effect or complication.

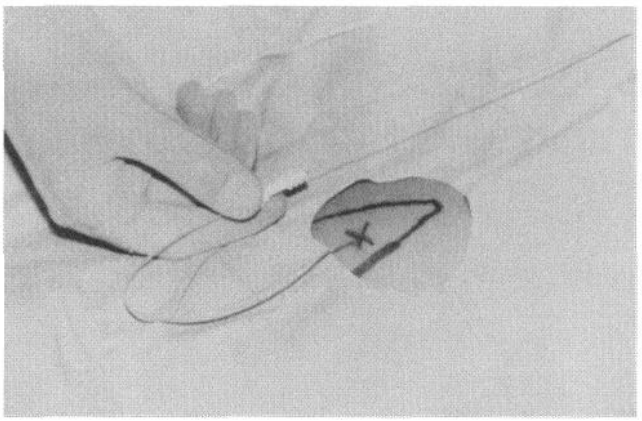

Figure 2. A 20-gauge catheter was threaded over the wire using the Seldinger technique. Special caution was taken to position the catheter at the same depth as the needle and thus in close proximity to the sciatic nerve.

To assess its analgesic efficacy, CPSB (Group A) was compared with data obtained from a retrospective review of 60 patients who underwent foot surgery (same procedures by the same surgeons as in Group A) under standardized general anesthesia (induction with sufentanil 0.3 μg/kg and thiopentone 3–5 mg/kg, and maintenance with 1%–1.5% isoflurane in 60% N_2O/40% O_2). Postoperative analgesia was provided as above (IV propacetamol and/or IM DIPI) in 15 of these patients (Group B) or by IV PCA with morphine (dose, 1.5 mg; lockout, 7 min) in the others (Group C). In our institution, the postoperative follow-up of all orthopedic patients includes PPS, supplemental analgesia, and side effects. These variables are noted by the nurses every 4 h, during the first 48 h postoperatively. Thus, the same variables as in the present study could be recorded in Groups B and C. Data from the three groups were compared with analysis of variance and least-significant difference test when appropriate. Side effects were analyzed with χ^2 test. Results are expressed as mean ± SEM. A P value < 0.05 was considered significant.

Results

The three groups were comparable in terms of age, weight, height, sex ratio, and type and length of surgery (86 ± 3, 96 ± 4, and 90 ± 3 min, respectively, in

Table 1. Studied Variables and Side Effects in Each Group

	Group A (n = 60)	Group B (n = 15)	Group C (n = 45)	P value
Time analg (h)	38.2 ± 2.1*	1.3 ± 1.2	0.7 ± 0.1	<0.005
Highest PPS	0.8 ± 0.1*	2.1 ± 0.2	1.6 ± 0.1	<0.005
Mean PPS	0.3 ± 0.1*	1.1 ± 0.1	0.8 ± 0.1†	<0.005
PRO (mg)	683 ± 160†	1818 ± 226	1067 ± 192	=0.015
DIPI (mg)	1.2 ± 0.5†	33.5 ± 7.9	0†	<0.005
IV PCA (mg of morphine)			57.3 ± 4.6	
Nausea/vomiting (%)	5	7	49‡	<0.005
Urinary retention (%)	0	0	18‡	<0.005
Sedation (%)	0	0	11‡	0.002
Technical problems (%)	25*	0	0	<0.005

Time analg = time between induction of anesthesia and first request of analgesic; PPS = postoperative pain score; PRO = propacetamol; DIPI = piritramide; IV PCA = intravenous patient-controlled analgesia.
* Statistically significant when compared with Groups B and C.
† Statistically significant when compared with Group B.
‡ Statistically significant when compared with Groups A and B.

Groups A, B, and C). CPSB was easy to perform in 55 (92%), difficult in three (5%), and very difficult in two obese patients (3%) in whom it was difficult to find the sciatic nerve. The sciatic nerve was localized at a depth of 4–6 cm. A tourniquet was used in all patients. During the surgical procedure, four patients (one for severe back pain and three for foot pain) (6.7%) required unplanned general anesthesia and five patients (one for tourniquet pain and four for foot pain) (8.3%) received IV sedation with 5–10 μg sufentanil. All these patients were included in the postoperative follow-up. Time between induction of anesthesia and first request of analgesic, highest PPS (mean of the highest PPS), mean PPS (mean of all PPS), supplemental analgesia (PRO and DIPI) and side effects are presented in Table 1. When compared with Groups B and C, highest and mean PPS were statistically significantly lower in Group A. In this group, the mean dose of PRO was reduced by 62% and 36% when compared with Groups B and C, respectively. When compared with Group B, the mean dose of DIPI was reduced by 96% in Group A. Nineteen patients (32%) required supplemental analgesia in Group A compared with 15 patients (100%) in Group B and 22 patients (49%) in Group C. Only five patients (8%) required postoperative opioid in Group A compared with 14 patients (91%) in Group B (50% of them required large doses [≥30 mg DIPI] of IM opioids) and 45 patients (100%) in Group C. When compared with Groups A and B, nausea and/or vomiting were significantly more frequent in Group C. Urinary retention and sedation were noted only in Group C. Postoperative technical problems (broken or kinked catheter) were noted in 15 patients (25%) in Group A. In six of these patients (10%), CPSB had to be prematurely stopped. No immediate (hematoma, paresthesia, IV injection) or delayed (infection, long-term paresthesia) complications were noted in Group A.

Discussion

Foot surgery often induces severe and prolonged postoperative pain (1). Preble and Sinatra (2) stated that, after ankle surgery, patients experience intense pain (visual analog scale, 6.3 ± 1.9; range 4–10) and require large doses of morphine (3.4 ± 1.6 mg/h). Traditional IM opioids on an "as needed" basis often lead to undermedication and ineffective postoperative analgesia (3–5). This was confirmed in our study. Patients in Group B (IM therapy) had high postoperative pain scores and experienced several episodes of severe pain. They required large doses of opioids and were poorly satisfied with their postoperative analgesia.

IV PCA with opioids provides better pain control and more rapid return to normal activity than IM therapy (5–7). However, analgesic efficacy and patient satisfaction with PCA vary with the incidence of side effects produced by the administered drug (8). Moreover, there is a lack of data to demonstrate PCA opioid treatment provides sufficiently low pain scores during mobilization (12). In our study, IV PCA with morphine provided lower postoperative pain scores than IM therapy. However, about 50% of patients required supplemental IV PRO for insufficient analgesia, mainly during mobilization. Moreover, the high incidence of side effects (nausea and vomiting, urinary retention, and sedation) noted in this group reduced patient satisfaction. We therefore conclude from this study that, after foot surgery, IV PCA with morphine provides better pain relief (at rest) than IM therapy but its analgesic efficacy and patient satisfaction are reduced by side effects.

Continuous epidural analgesia would be an alternative technique to treat pain after foot surgery. However, the fifth lumbar and first sacral segments are particularly resistant to blockade and are frequently missed. After injection of 20 mL 2% lidocaine into a lumbar epidural catheter (L2-3 or L3-4) with patients in a horizontal supine position, Ponhold et al. (9)

reported 13% adequate anesthesia for foot surgery. When using the hammock position (supine 30° trunk elevation with 30° leg elevation), they increased their success rate to 53%. As stated by Bromage (12), not only is analgesia slow to appear in these segments but also the quality of analgesia is unreliable when it does develop. Thus, continuous epidural analgesia may not be a reliable method to relieve pain after foot surgery.

Our study describes an original technique of continuous popliteal sciatic nerve block. It is an easy to perform, safe, and efficient method to provide postoperative analgesia after foot surgery. Its high success rate may be related to a high and median popliteal approach, the use of a discriminating mode of nerve stimulation (10), the systematic search for optimal needle position, and special caution taken to position the catheter at the same depth as the introducing needle. Because the popliteal fossa is filled with fat, diffusion of injected local anesthetic around the nerves may be impaired. Positioning the catheter tip near the sciatic nerve before injection is thus essential for enhancing the chances of successful block. We use a peripheral nerve stimulator to enhance discrimination of the distance between needle and nerve (10). A high popliteal approach allows the main sciatic trunk to be reached before its division and enhances the rate of complete sciatic nerve block. A midline puncture is also less painful because muscle trauma is avoided.

The high incidence of postoperative technical problems (25%) noted in this study was, in most circumstances, related to the material used. Indeed, as the sciatic nerve was localized at a depth of 4–6 cm, the 30-cm catheter was too long and, thus predisposed to kinking and/or breaking. At the end of this study, we reduced the length of the catheter to 15 cm. Fewer postoperative technical problems (<10%) were noted but only 10 patients were studied. This observation must be confirmed by a larger study.

Added to the local anesthetic solution, sufentanil reduced onset time of the block (13) and clonidine prolonged duration of both anesthesia and analgesia (14) after single-shot brachial plexus blockade. Their inclusion in our continuous infusion is based on unpublished data that supports enhanced onset and prolonged duration of continuous peripheral nerve blockade. This observation must be confirmed by a large randomized study.

In conclusion, continuous popliteal sciatic nerve block is an easy to perform, safe, and more efficient technique than parenteral opioids to treat postoperative pain after foot surgery. In our institution, it has become the standard technique of postoperative analgesia after foot surgery.

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