CHAPTER **24**

# INDICATIONS FOR USE OF CONTINUOUS POPLITEAL CATHETER INFUSION FOR MANAGEMENT OF PROTRACTED POSTOPERATIVE PAIN

*Matrona Giakoumis, DPM*

## INTRODUCTION

Major foot and ankle surgery often produces substantial and prolonged postoperative pain that results in a significant amount of opioid usage. The popliteal sciatic nerve block is a recognized way of providing analgesia and anesthesia to the lower extremity. The continuous popliteal nerve blockade is an advanced form of regional anesthesia that builds on this simple idea. The concept of continuous peripheral nerve blockade (CPNB) dates back to the 1940s (1) and has evolved significantly from the experimental study involving a needle inserted through a cork and taped to a patient's chest. It is a well-validated technique, supported by numerous randomized controlled trials and has proven to be advantageous in a number of ways. Various studies have reported a decrease in postoperative pain, urinary retention, sleep disturbance, need for opioid analgesics and their subsequent side effects, time until and actual discharge, and ultimately improved patient satisfaction and quality of recovery (2-7).

## CURRENT APPLICATIONS

The indications for CPNB vary and include limb salvage (8), digit transfer and replantation (9), intractable hiccups (10), and induction of vasodilation after a vascular accident (11). However, the only validated lower extremity application involves the perioperative period (12-17) and subsequently the continuous popliteal nerve block. Studies have shown the CPNB to be efficacious in hundreds of adult and pediatric patients (18-20). Two other patient populations of interest involve the elderly and chronic pain patients who have had moderate to major foot and ankle surgery. Caution, however, is advised in patients with renal and/or hepatic insufficiency.

## ANATOMICAL PERSPECTIVE AND DISTRIBUTION OF ANESTHESIA

The sciatic nerve, the largest nerve in the body is composed of branches from L4 to S3 and is formed by both the ventral and dorsal divisions of the ventral primary rami of the sacral plexus (21). It innervates all the muscles distal to the knee as well as posterior thigh and the overlying skin distal to the knee (22), except for an area of skin on the anteromedial leg that is supplied by the saphenous nerve. The sciatic nerve, which consists of two separate nerve trunks, is enveloped in a common epineural sheath just before it branches into the common peroneal nerve laterally and tibial nerve medially at the apex of the popliteal fossa. The popliteal fossa is the diamond-shaped depression posterior to the knee joint. It is bound by the medial and lateral heads of the gastrocnemius muscle and plantaris muscle inferiorly, the semitendinosus and semimembranosus tendons superomedially and the biceps femoris superolaterally (21, 23).

## TECHNICAL PEARLS

The classic approach to the popliteal block described in the literature is the posterior approach. The lateral approach (14), however, is clinically equivalent in efficacy to the classic posterior approach and allows the surgeon to perform the technique without having to change the patient's position. The technique that will be described here uses the lateral approach.

From this approach, the nerve lays superficial to the popliteal artery and vein. On occasion, after insertion of the stimulating needle, a local twitch of the biceps femoris muscle or semitendinosus and semimembranosus muscle is observed. If this occurs, the needle should be redirected slightly medial or lateral, respectively. Stimulation of the tibial and peroneal nerves will evoke the following motor

responses: plantarflexion (tibial nerve), eversion (superficial/deep peroneal nerves), dorsiflexion (deep peroneal nerve), and inversion (tibial and deep peroneal nerve). Studies have shown that inversion of the foot yields the best sensory and motor blockade while dorsiflexion of the foot is considered second best (24, 25).

## MATERIALS

The following materials are needed: sterile towels, sterile gloves, surgical marking pen, skin prep (e.g., Duraprep [3M]), 4"x 4" gauze pack, surface electrode, peripheral nerve stimulator, 30 ml syringe with local anesthetic, 0.25% Bupivacaine, skin adhesive (e.g., mastisol [Ferndale IP, Inc.]), transparent dressing (e.g., Tegaderm [eM]) and CONTIPLEX Tuohy Continuous Nerve Block Set (e.g., Braun Melsungen AG, Melsungen, Germany) that consists of an 18 gauge x 4 inch (100 mm) insulated tuohy needle, a 20 gauge (100 cm) polyamide nylon catheter with closed tip, a catheter connector, and a threading assist guide.

## CONTINUOUS POPLITEAL NERVE BLOCK TECHNIQUE

1. With the patient in the supine position, slightly flex the leg at the knee joint by elevating it on a pillow while maintaining the long axis of the foot 90 degrees to the operating table.
2. Palpate the upper border of the patella and drop a line from the superior pole to the groove just anterior to the biceps femoris, which can be palpated. Mark the spot with a marking pen.
3. Prep the skin.
4. Attach the electrode to the surrounding skin and connect to the peripheral nerve stimulator (Figure 1).
5. Connect a 10-cm Tuohy-style tip needle to the nerve stimulator (initial setting of 1.5 mA) and insert needle horizontal to the skin to contact the femur (Figure 2).
6. Once contact is made, withdraw the needle to the skin and redirect in a cephalad and 30-45 degree posterior direction (Figure 3).
7. Advance the needle slowly while looking for inversion or dorsiflexion of the foot. Tip: Occasionally, a very small (e.g. 1 mm) movement of the needle results in a quick change of motor response from e.g., plantarflexion to dorsiflexion. This indicates an intimate needle-nerve relationship at the level before the divergence of the sciatic nerve.
8. Once appropriate twitches are obtained, continue manipulating the needle until the desired response is seen or felt at a current of 0.5 mA. Stimulation at 0.5 mA may not be possible in certain population groups. Tip: A clear specific motor response at stimulating currents up to 1.0 mA in patients with long standing diabetes mellitus, peripheral neuropathy and severe PVD is acceptable (26).
9. Aspirate for blood; if clear, inject 20mL of the local anesthetic.
10. Insert the indwelling catheter through the needle up to the 5 cm mark and withdraw the needle back to skin level while simultaneously advancing the catheter to prevent inadvertent removal. Check for inadvertent intravascular placement (Figure 4).
11. Apply Mastisol to the surrounding skin, coil the remaining catheter and secure to the skin with Tegaderm (Figure 5).

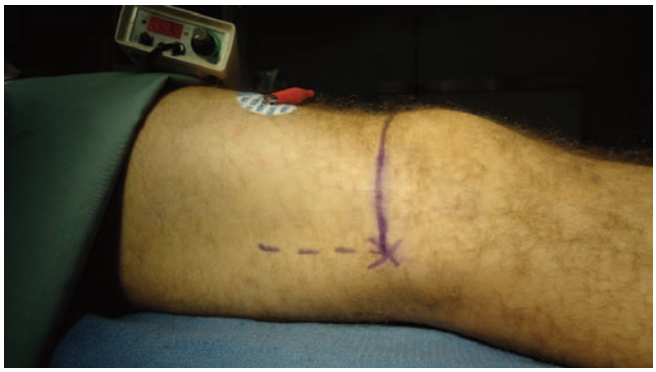

Figure 1. The landmarks: line drawn from the superior pole of the patella in an anterior-to-posterior direction along the lateral thigh ending in the groove between the vastus lateralis and the biceps femoris tendon.

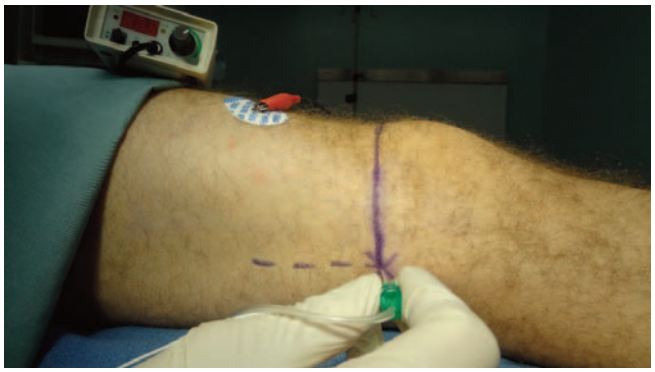

Figure 2. Initial penetration of skin with needle horizontal to skin.

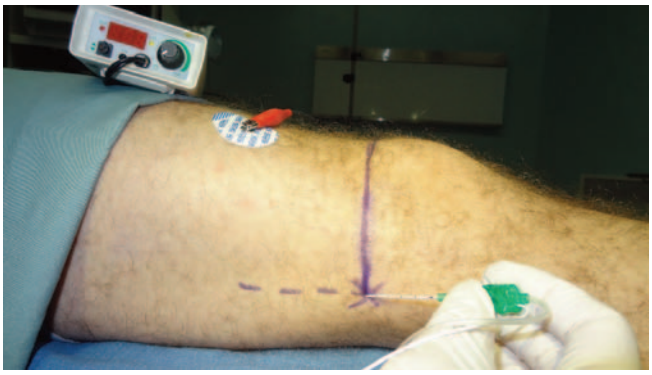

Figure 3. Redirecting of the needle slightly cephalad and 30-45 degrees posteriorly.

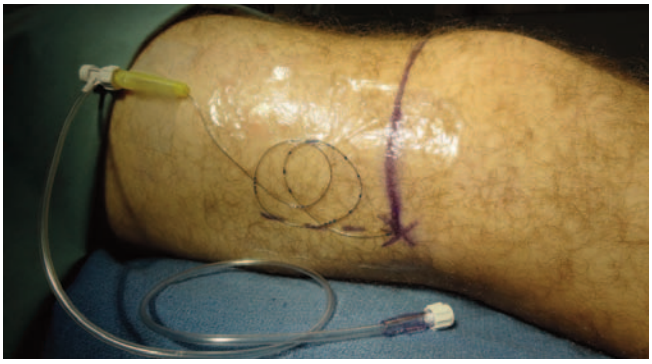

Figure 5. Securing of the continuous popliteal nerve block catheter.

## MANAGEMENT OF CONTINUOUS POPLITEAL CATHETER INFUSION

The primary analgesic infused during CPNB is a local anesthetic with a long duration of action and a favorable sensory:motor block ratio such as bupivacaine. After the initial bolus of local anesthetic, the continuous infusion of a dilute local anesthetic concentration, e.g. 0.125% Bupivacaine is initiated. The infusion is maintained at 10 ml/hr. The literature is conflicting on whether a stronger concentration or volume of the anesthetic should be used. Adjuncts such as clonidine and opioids have been added to CPNB (27-29). For our chronic pain patients, we have used a continuous popliteal infusion of Marcaine 0.125%-Fentanyl/2mcg/ml-100 ml/hour at 4ml/hour.

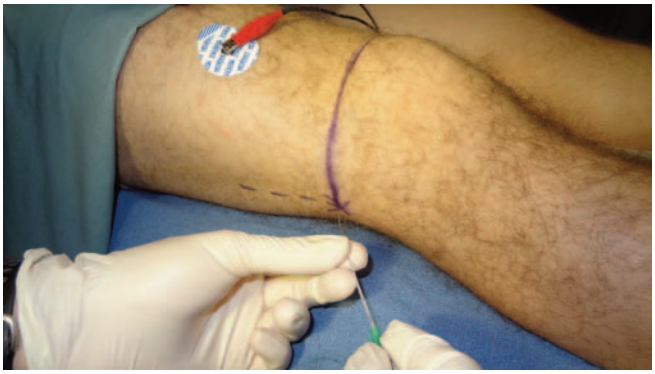

Figure 4. Withdrawal of the needle with continuous advancement of catheter to prevent accidental withdrawal.

## COMPLICATIONS AND HOW TO AVOID THEM

Complications such as infection, hematoma, vascular puncture, nerve injury, and pressure necrosis of the heel are rare but have been reported in the literature. Infections can be avoided by using sterile technique and by minimizing the number of passes of the needle through the skin. Hematoma formation can by avoided by using a "localization needle" technique. The Tuohy needle tends to be of a wider diameter and if the nerve is not localized with the first two to three needle passes, a smaller gauge needle should be used until successful localization. The vascular sheath lies medial and deep to the sciatic nerve and vascular puncture can further be prevented by avoiding deep insertion of the needle. If subsequent attempts need to be made due to the inability to obtain a motor response with the initial stimulation, the needle should be directed more lateral to avoid inadvertent vascular penetration and more cephalad, since it is more likely that the sciatic nerve has not divided in that direction. By deferring from maintaining a twitch at a current less that 0.5 mA, nerve injury can be avoided. Lastly, pressure necrosis can be averted by instructing the patient on the care of an insensate limb.

## CONCLUSION

Effective pain management after surgery is an ongoing concern for the surgeon due to the direct and significant influence on the patient's recovery process and satisfaction with the postoperative care. Adequate pain control is often complicated in chronic pain, geriatric, and pediatric populations. Local anesthetic infusion, alone, or in combination with other medications in the hospital and ambulatory setting is an ideal tool for the management of protracted postoperative pain and should be considered after major podiatric surgery.

## REFERENCES


1. Ansorbo FP. Method of continuous brachial plexus block. Am J Surg 1946;71:716-22.
2. Singelyn FJ, Aye F, Gouverneur JM. Continuous popliteal sciatic nerve block: An original technique to provide postoperative analgesia after foot surgery. Anesth Analg 1997;84:383-6.
3. Capdevila X, Barthelet Y, Biboulet P, et al. Effects of perioperative analgesic technique on the surgical outcome and duration of rehabilitation after major knee surgery. Anesthesiology 1999;91:8-15.
4. Di Benedetto P, Casati A, Bertini L, et al. Postoperative analgesia with continuous sciatic nerve block after foot surgery: A prospective, randomized comparison between the popliteal and subgluteal approaches. Anesth Analg 2002;94:996-1000.
5. Chelly JE, Greger J, Casati A, et al. Continuous lateral sciatic blocks for acute postoperative pain management after major ankle and foot surgery. Foot Ankle Int 2002;23:749-52.
6. White PF, Issioui T, Skrivanek GD, et al. The use of a continuous popliteal sciatic nerve block after surgery involving the foot and ankle: Does it improve quality of recovery? Anesth Analg 2003;97:1303-9.
7. Klein SM, Greengrass RA, Gleason DH, et al. Major ambulatory surgery with continuous regional anesthesia and a disposable infusion pump. Anesthesiology 1999;91:1473-8.
8. Loland VJ, Ilfeld BM, Abrams RA et al. Ultrasound-guided perinerual catheter and local anesthetic infusion in the perioperative management of pediatric limb salvage: A case report. Paediatr Anaesth 2009;19:905-7.
9. Berger A, Tizian C, Zenz M. Continuous plexus block for improved circulation in microvascular surgery. Ann Plast Surg 1958;14:16-9.
10. Sarnoff SJ, Sarnoff LC. Prolonged peripheral nerve block by means of indwelling plastic catheter: treatment of hiccup. Anesthesiology 1951;12:270-5.
11. Manriquez RG, Pallares V. Continuous brachial plexus block for prolonged sympathectomy and control of pain. Anesth Analg 1978;57:128-30.
12. Richman JM, Liu SS, Courpas G, et al. Does continuous peripheral nerve block provide superior pain control to opioids? A meta-analysis. Anesth Analg 2006;102:248-57.
13. Ilfeld BM. Continuous Peripheral Nerve Blocks: A Review of the Published Evidence. Anesth Analg 2011;113:904-25.
14. Collum CR, Courtney PG. Sciatic Nerve Blockade by a Lateral Approach to the Popliteal Fossa. Anaesth Intensive Care 1993;21:A236-7.
15. Zaric D, Boysen K, Christiansen J, et al. Continuous popliteal sciatic nerve block for outpa tient foot surgery–a randomized, controlled trial. Acta Anaesthesiol Scand 2004;48:337-41.
16. Ilfeld BM, Morey TE, Wang RD, et al. Continuous popliteal sciatic nerve block for post- operative pain control at home: A randomized, double-blinded, placebo-controlled study. Anesthesiology 2002;97:959–65.
17. Elliot R, Pearce C, Seifert C, et al. Continuous infusion versus single bolus popliteal block following major ankle and hindfoot surgery: A prospective, randomized trial. Foot Ankle Int 2010;31:1043-7.
18. Ludot H, Berger J, Pichenot V et al. Continuous peripheral nerve block for post-operative pain control at home: A prospective feasibility study in children. Reg Anesth Pain Med 2008;33:52-6.
19. Ilfeld BM, Smith DW, Enneking FK. Continuous regional analgesia following ambulatory pediatric orthopedic surgery. Am J Orthop 2004;33:405-8.
20. Ganesh A, Rose JB, Wells L, et al. Continuous peripheral nerve blockade for inpatient and outpatient postoperative analgesia in children. Anesth Analg 2007;105:1234-42.
21. Draves Debra J. Popliteal Fossa and the Leg. In: Anatomy of the Lower Extremity. Baltimore (MD): Williams & Wilkins; 1986. p. 241-270.
22. Carron H, Giorgio A, Kepes E. Nerve block. Aches Pains 1983;4:41-6.
23. Cavaliere RG, Pappas E. Anesthesia. In: McGlamry ED, Banks AS, Downey MS, editors. Comprehensive Textbook of Foot Surgery, 3nd ed. Baltimore (MD): Williams & Wilkins; 2001. p. 193-4.
24. Benzon HT, Kim C, Benzon HP, et al. Correlation between evoked motor response of the sciatic nerve and sensory blockade. Anesthesiology 1997;87:547-2.
25. Borgeat A, Blumenthal S, Lambert M, et al. The feasibility and complications of the continuous popliteal nerve block: A 1001-case survey. Anesth Analg 2006;103:229-33.
26. Continuous Popliteal Nerve Block: Lateral Approach. (2009) NYSORA. URL: http://www.nysora.com/peripheral_nerve_blocks/nerve_stimulator_techniques/3072continuous_popliteal_nerve_block_lateral_approach.html.
27. Singelyn FJ, Vanderelst PE, Gouverneur JM. Extended femerol nerve sheath block after total hip arthroplasty: continuous versus patient-controlled techniques. Anesth Analg 2011;92:455-9.
28. Pere P. The effect of continuous interscalene brachial plexus block with 0.125% bupivacaine lus fentanyl on diaphragmatic motility and ventilatory function. Reg Anesth 1993;18:93-7.
29. YaDeau JT, LaSala VR, Paroli L. Clonidine and Analgesic Duration After Popliteal Fossa Nerve Blockade: Randomized, double-blind, placebo-controlled study. Anesth Analg 2008;106:1916-20.