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Ankle Block vs Single-Shot Popliteal Fossa Block as Primary Anesthesia for Forefoot Operative Procedures: Prospective, Randomized Comparison

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Abstract

Background: Postoperative pain is often difficult to control with oral medications, requiring large doses of opioid analgesia. Regional anesthesia may be used for primary anesthesia, reducing the need for general anesthetic and postoperative pain medication requirements in the immediate postoperative period. The purpose of this study was to compare the analgesic effects of an ankle block (AB) to a single-shot popliteal fossa block (PFB) for patients undergoing orthopedic forefoot procedures.

Methods: All patients having elective outpatient orthopedic forefoot procedures were invited to participate in the study. Patients were prospectively randomized to receive either an ultrasound-guided AB or PFB by a board-certified anesthesiologist prior to their procedure. Intraoperative conversion to general anesthesia and postanesthesia care unit (PACU) opioid requirements were recorded. Postoperative pain was assessed using the visual analog scale (VAS) at regular time intervals until 8 AM on postoperative day (POD) 2. Patients rated the effectiveness of the block on a 1 to 5 scale, with 5 being very effective. A total of 167 patients participated in the study with 88 patients (53%) receiving an AB and 79 (47%) receiving a single-shot PFB.

Results: There was no significant difference in the rate of conversion to general anesthesia between the 2 groups (13.6% [12/88] AB vs 12.7% [10/79] PFB). PACU morphine requirements and doses were significantly reduced in the PFB group ($P = .004$) when compared to the AB group. The VAS was also significantly lower for the PFB patients at 10 PM on POD 0 (4.6 vs 1.6, $P < .001$), 8 AM on POD 1 (5.9 vs 4.2, $P = .003$), and 12 PM on POD 1 (5.4 vs 4.1, $P = .01$). Overall complication rates were similar between the groups (AB 9% vs PFB 10.1%, $P = .51$) and there were no significant differences in residual sensory paresthesias (AB 2.3% [2/88] vs PFB 5.1% [4/79], $P = .29$), motor loss (0% vs 0%), or block site pain and/or erythema (AB 6.9% [6/88] vs PFB 5.1% [4/79], $P = .44$). The analgesic effect of the PFB lasted significantly longer when compared to the ankle block (AB 14.5 hours vs PFB 20.9 hours, $P < .001$). There was no significant difference in patient-perceived effectiveness of the block between the 2 groups, with both blocks being highly effective (AB 4.79/5 vs PFB 4.82/5, $P = .68$).

Conclusion: Regional anesthesia was a safe and reliable adjunct to perioperative pain management and highly effective in patients undergoing elective orthopedic forefoot procedures. However, patients who received a PFB had significantly better pain management and decreased opioid requirements in the immediate perioperative period than patients who received an ankle block.

Level of Evidence: Level I, prospective randomized study.

Keywords: ankle block, popliteal fossa block, forefoot disorders, outcome studies, regional anesthesia

Introduction

Postoperative pain following forefoot surgery is often difficult to control with oral medication.[7,9] High doses of opioid analgesia are frequently required, and often cause nausea, vomiting, and/or a delay in discharge from the hospital. Regional anesthesia has been used as primary anesthesia and as an adjunct to postoperative pain control

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following forefoot surgery.[3,7,10,12] Options for regional anesthesia include single-shot popliteal fossa block (PFB), continuous PFB with use of a catheter, and ankle block (AB). Regional anesthesia has been shown to reduce postoperative pain, narcotic use, antiemetic use, and hospital stay when compared to opiates alone.[2,11] Transient weakness and an insensate lower extremity are expected following PFB, and these effects theoretically may lead to an increased risk of accidental injury in the early postoperative period. Complications after PFB have also been reported in the literature.[1] A prospective cohort study of 147 foot and ankle operative patients who received continuous PFB with use of a catheter demonstrated a prevalence of neurologic symptoms as high as 41% at 2 weeks, which decreased to 24% at 34 weeks.[5] AB is an attractive alternative to PFB for primary anesthesia for forefoot procedures that may reduce potential risks associated with a more proximal nerve block.[8]

To date, there have been no prospective studies that adequately compare single-shot popliteal fossa block to ankle block for patients undergoing outpatient orthopedic forefoot procedures. The decision to employ one block over another is often made based on surgeon or anesthesiologist preference. At our institution, popliteal fossa blocks are frequently used for forefoot procedures due to concern that an ankle block will be less effective and result in conversion to general anesthesia, which delays the case, increases costs, and prolongs the immediate postoperative recovery period. However, the difference between PFB and AB has not been evaluated in a randomized, prospective manner.

The purpose of this study was to compare single shot PFB to AB as the primary anesthesia for patients undergoing orthopedic forefoot procedures. The primary outcome variable was the percentage of patients that converted to general anesthesia following either a single shot PFB or AB. We hypothesized that patients with a single shot PFB would have lower conversion to general anesthesia, less opioid pain medication requirements, better pain control, but higher neuropathic complications in the immediate postoperative period.

Methods

Study Characteristics

Institutional review board approval was obtained prior to initiation of this study. The study was internally funded. The study was performed prospectively with randomization of patients into each of the treatment groups. Inclusion criterion for the study population was any patient undergoing elective, unilateral, forefoot surgery, including both soft tissue and osseous procedures. Exclusion criteria were history of diabetes mellitus, history of peripheral neuropathy, active infection, use of an On-Q pain pump, bilateral procedures, known allergy to local anesthetics, procedures proximal to Chopart joint, and patient noncompliance. Two hundred two patients were enrolled in the study from May 21, 2009, to August 10, 2014, but only 167 patients completed the primary outcome variable. Thirty-five patients were withdrawn from the study: 10 patients never scheduled surgery, 8 patients requested general anesthesia after enrollment, 7 patients underwent bilateral surgery after enrollment, 4 patients were scheduled at a different facility, 4 patients received incorrect randomization, and 2 patients received an On-Q pain pump. Of the 167 patients who participated in the study, 88 patients (53%) received an AB and 79 (47%) a single-shot PFB.

An ankle tourniquet was used routinely for all forefoot procedures performed in the study. All blocks were performed 30 to 45 minutes before the procedure start time. Patients who underwent ankle block were allowed to heel-weight-bear immediately after the procedure. Patients who received a popliteal block were made nonweightbearing until their block wore off and motor function recovered because of the risk of fall. All patients were given a postoperative shoe.

The primary outcome variable was conversion to general anesthesia from peripheral nerve block alone, which was determined by the anesthesia staff based on the adequacy of anesthesia from the administered block. Secondary outcome measures included the visual analog scale (VAS), patient-perceived block effectiveness from 1 (not effective) to 5 (very effective), length of postanesthesia care unit (PACU) stay, and narcotic use in morphine equivalents. All patients were examined for skin, motor, and sensory complications from their block by an attending orthopedic foot and ankle surgeon at their first postoperative visit 10 to 14 days after surgery.

Randomization

Patients were randomized to undergo single-shot PFB vs AB on the morning of their surgery using a sealed envelope. A random number generator was used to determine a 1:1 randomization schedule. All blocks were administered prior to transportation into the operative suite.

Ankle Block Technique

Ankle blocks were performed by injecting a total of 50 mL of 0.25% bupivacaine in equal amounts (10 mL) around the 5 major nerves supplying the foot—the posterior branch of the tibial nerve, the saphenous nerve, the deep peroneal nerve, the superficial peroneal nerve, and the sural nerve. Ultrasound was used to identify the posterior branch of the tibial nerve only because of its variable course and relation to the artery.

Popliteal Fossa Block Technique

Single-shot popliteal fossa nerve blocks were administered using ultrasound guidance. The sciatic nerve was first identified in the proximal popliteal fossa between the biceps femoris and the semimembranosus/semitendinosus (SM/ST) muscles. Under direct ultrasound visualization, an 18-gauge, thin-walled needle was advanced into the space between the biceps femoris and SM/ST muscles, approximately 1.0 cm medial to the sciatic nerve. An injection of 20 mL of 0.25% preservative-free bupivacaine with 1:200 000 epinephrine was administered and observed in real time to ensure adequate distribution around the nerve. A separate injection of the saphenous nerve was administered when indicated by the operative approach.

Statistics

A power analysis was performed based on the primary dichotomous outcome variable of intraoperative conversion to general anesthesia. A review of anesthesia data from all operative cases performed during the 6 months prior to study initiation indicated an 8% conversion to general anesthesia after AB alone, compared to a 0.5% conversion after PFB alone. Based on a 1-tailed, 0.05 significance level, 80% power, Fisher exact test of conversion to general anesthesia with the above proportions, an estimated 101 cases per group were needed. No patient loss to follow-up was expected because the data for the primary outcome variable was collected the day of surgery.

Standard descriptive statistics were calculated, including means, percentages, standard deviation, and 95% confidence intervals. Dichotomous variables were analyzed using a Fisher exact chi-square test. Continuous variables were analyzed using a Wilcoxon test. All statistical tests were performed at an a priori significance level of 0.05.

Results

There were no significant differences in patient age, demographic data, or type of surgeries performed between the 2 groups. There was no significant difference in the rate of conversion to general anesthesia between the 2 groups (13.6% [12/88] AB vs 12.7% [10/79] PFB). The most common reason for conversion to general anesthesia in both groups was movement during surgery without pain. PACU morphine requirements and doses were significantly reduced in the PFB group ($P = .004$) (Table 1). The VAS was also significantly lower for the PFB patients at 10 PM on POD 0 (4.6 vs 1.6, $P < .001$), 8 AM on POD 1 (5.9 vs 4.2, $P = .003$), and 12 PM on POD 1 (5.4 vs 4.1, $P = .01$). All other time points through 8 AM POD 2 favored PFB, but were not statistically significant. Overall complication rates were similar between the groups (AB 9% [8/88] vs PFB 10.1% [8/79], $P = .51$) and there were no significant differences in residual sensory paresthesias (AB 2.3% [2/88] vs PFB 5.1% [4/79], $P = .29$), motor loss (0% vs 0%, $P = 1.0$), or block site pain or erythema (AB 6.9% [6/88] vs PFB 5.1% [4/79], $P = .44$). The analgesic effect of the PFB lasted significantly longer when compared to the ankle block (AB 14.5 hours vs PFB 20.9 hours, $P < .001$). There was no significant difference in patient-perceived effectiveness of the block between the 2 groups, with both blocks being highly effective (AB 4.79/5 vs PFB 4.82/5, $P = .68$).

Table 1. Comparison of Outcomes Between Ankle Block and Popliteal Block.

	Ankle Block	Popliteal Block	*P* Value
Morphine equivalents[a]			
PACU drug 1	2.6	1.5	.06
PACU drug 2	0.6	0.7	.64
PACU total	3.3	2.2	.09
Day of surgery	31.6	18.3	<.01
Postoperative day 1	56.4	46.4	.34
Visual analog scale (0-10)[a]			
10:00 PM day of surgery	4.6	1.6	<.01
8:00 AM postoperative day 1	5.9	4.2	<.01
12:00 PM postoperative day 1	5.4	4.1	.01
4:00 PM postoperative day 1	5.1	4.4	.14
10:00 PM postoperative day 1	5.2	4.3	.06
8:00 AM postoperative day 2	4.7	4.2	.31
Length of block time (h)[a]	14.5	20.9	<.01
Block effectiveness* (0-5)	4.8	4.8	.68

[a]Data are presented as mean and Wilcoxon test used to determine significance.

Discussion

Limited data exist comparing single-shot PFB to AB for forefoot surgery. This study was performed to compare single-shot PFB to AB as the primary anesthetic for patients undergoing orthopedic forefoot procedures. With regard to our hypothesis, we found no significant difference in conversion to general anesthesia between PFB and AB, but the PFB group had significantly lower opiate pain medication requirement in PACU, lower VAS scores, and longer analgesic effect from the block.

PFBs have been shown to reduce opiate requirement and pain scores in the immediate postoperative period after foot and ankle surgery.[4,6] Little evidence exists regarding the efficacy of AB for forefoot surgery. A prospective, randomized, controlled trial comparing general anesthetic alone to AB only found a significant difference in time to perceived pain in favor of the AB group, but no difference in the

number of opiate tablets consumed, patient satisfaction, or pain scores on POD 0-2.[3] Similarly, we found AB was inferior with regard to postoperative analgesic parameters, though this study did not make a comparison to general anesthetic alone.

The results of this study showed no significant difference in the complication rate between AB and PFB. The short-term neurologic complication rate for PFB at the first postoperative follow up visit was not negligible at 5.1%, but it should be emphasized that this was not the long-term or unresolved complication rate. In a retrospective case series of 915 patients that received a single-shot PFB and 99 patients that received a continuous PFB infusion, 5% of patients had neurologic complications at 1 week postoperatively and 0.7% had unresolved symptoms at their final follow-up.[1]

Strengths of this study were the prospective enrollment and analysis, and randomization of treatment groups. The major limitation was that the number of patients who completed the study was slightly below the number needed to attain adequate power for the primary outcome of conversion to general anesthesia due to exclusion of patients for various factors described in the methods. Therefore, though a significant difference was not found between PFB and AB, one may still exist for the rate of conversion to general anesthesia. Nonetheless, a significant difference was demonstrated for the majority of secondary outcomes, in favor of PFB.

In conclusion, regional anesthesia is a safe and reliable adjunct to perioperative pain management with high patient-perceived effectiveness for elective orthopedic forefoot procedures. This was the first study to compare PFB to AB in a prospective, randomized manner for forefoot surgery. Though we found no significant difference in the rate of conversion to general anesthesia, single shot PFB was superior to AB with regard to postoperative analgesia parameters. Patients that received a PFB had significantly better pain scores, a longer analgesic effect, and decreased opioid requirements in the immediate postoperative period when compared to patients who received an ankle block. The results of this study provide guidance to surgeons and anesthesiologists when choosing between PFB and AB for perioperative pain control.

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Declaration of Conflicting Interests

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