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Retrospective review of single-shot and continuous popliteal block efficacy for elective foot and ankle surgery

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Abstract

Background: Postoperative pain after foot and ankle surgery is commonly managed using popliteal nerve blocks. Continuous popliteal blocks are utilized due to prolonged analgesia, but catheters increase complications that can hinder rehabilitation. The purpose of our study was to compare postoperative pain and patient satisfaction between patients who received continuous and single-shot popliteal blocks in our health system.

Methods: Data was collected for all patients who received continuous or single-shot popliteal blocks at a single academic medical center. Patients were divided based on type of block and further stratified by surgical procedure (ORIF vs. arthroscopic ankle) for sub-analysis. Collected data included demographics, surgical procedure, postoperative day 1 (POD1) pain levels, postoperative day 7 (POD7) patient satisfaction levels, and use of an additional saphenous nerve block. Patient satisfaction and pain levels were collected via phone call using a 5-item Likert Response Scale and 0-10 Numeric Pain Rating. POD1 pain scores and POD7 patient satisfaction levels were compared between block types using Student's t-test and Mann-Whitney *U* test respectively. These scores were also sub-analyzed based on surgery type using the same tests.

Results: There was no significant difference between continuous or single-shot techniques in postoperative pain (1.85 vs 2.19; $p = 0.3371$) or patient satisfaction (4.943 vs. 4.8; $p = 0.2331$). Surgery type had no effect on patient-reported pain or satisfaction.

Conclusion: POD1 pain and POD7 patient satisfaction are comparable in continuous and single-shot popliteal blocks; therefore, given the increased risk of continuous blocks, providers should consider using single-shot for analgesia after foot and ankle surgery.

Keywords: Popliteal block, patient satisfaction, postoperative pain, single-shot popliteal block, continuous popliteal block, foot-and-ankle surgery

Introduction

Foot and ankle surgery is increasingly performed in outpatient settings ^[1]. Insufficient pain management is a common problem in outpatient surgery, and postoperative pain leads to decreased patient satisfaction, development of chronic pain, prolonged PACU stays, and increased cost of care ^[7, 9, 12]. Pain from foot and ankle surgery is also associated with increased postoperative opioid consumption and side effects including nausea, vomiting, sedation, constipation, and persistent opioid use ^[7].

Popliteal blocks are commonly performed for foot and ankle postoperative pain ^[3]. Continuous popliteal blocks provide analgesia for up to 48 hours after surgery and have often been cited as superior analgesic techniques compared to single-shot ^[7, 9, 11, 12]. Conversely, continuous blocks take longer to perform and have an increased risk of nerve injury ^[3, 4]. Muscular weakness and sensory deficits associated with the interruption of peripheral nerve function may delay postoperative recovery ^[9]. For these reasons, we set out to determine whether patient satisfaction and postoperative pain scores could be used to differentiate the types of analgesic techniques. We hypothesize that postoperative pain scores, patient satisfaction survey, and interview results would be superior for patients undergoing foot and ankle surgery with continuous popliteal blocks compared to those with single-shot popliteal blocks within our medical system.

Materials and Methods

Retrospective data was collected for all patients who underwent either open reduction and internal fixation (ORIF) of the ankle or arthroscopic ankle surgery who received a continuous or single-shot popliteal block at a single academic medical center between October 2018 and May 2023. Patients were excluded if they did not receive an ORIF or arthroscopic ankle surgery, report postoperative day 1 pain scores (POD1), or complete the 7-day postoperative (POD7) satisfaction survey. All surgeries were performed by fellowship-trained orthopedic surgeons and all blocks performed by board certified anesthesiologists.

1775 patients were initially identified as having a popliteal block. The patient population was further divided by ORIF and arthroscopic ankle surgery. 1260 patients with procedures that did not fit into these categories were excluded (Ex. Achilles tendon repair, bunionectomy, ankle arthrodesis). An additional 160 patients were excluded due to incomplete follow-up and postoperative pain score data. The final patient population included 355 patients, with 280 receiving continuous and 75 receiving single-shot popliteal blocks.

Patients were divided into the continuous or single-shot block groups and were further classified by procedure type (ORIF vs. arthroscopic ankle surgery) for sub-analysis. Data collected for this study include demographics, surgical procedure type, postoperative day 1 (POD1) pain levels, postoperative day 7 (POD7) patient satisfaction levels, and use of an additional saphenous block. Patient satisfaction levels were collected via phone call by a regional anesthesia nursing coordinator using a 5-item Likert Response Scale ("How satisfied are you with your nerve block on a scale of 1-5?" with 1 being very dissatisfied and 5 being very satisfied). Similarly, pain levels were recorded via phone call using a 0-10 Numeric Pain Rating Scale. All study data was entered into REDCap (Research Electronic Data Capture, Nashville, TN) by a regional anesthesia nursing coordinator [5, 6].

Each patient had a popliteal block placed by an anesthesiologist with regional subspecialty training using the lateral approach above the knee with ultrasound guidance and nerve stimulation. The type of popliteal block was determined by the surgeon at the time of case posting. The initial block for continuous and single-shot popliteal blocks was performed with a bolus of 20 to 30 mL of 0.5% ropivacaine with 8-10 mg of dexamethasone administered in divided doses around the sciatic nerve. For patients receiving a continuous popliteal block, a 20-gauge catheter was inserted under ultrasound guidance throughout a 17-gauge Tuohy needle. Catheter tip placement was confirmed visually and with a test-dose of 3-5cc lidocaine with epinephrine. A pump with 0.25% bupivacaine (On-Q; Avanos, Alpharetta, GA, USA) was connected to the catheter by the anesthesiologist and set to a rate typically between 8 and 10 mL/h. Single-shot saphenous blocks were placed in the supine position with divided doses of 0.5% ropivacaine with 1-2 mg dexamethasone for a total of 10 cc. Successful block placement was confirmed for all patients by the anesthesiologist after emergence from general anesthesia in the PACU.

POD1 pain scores were analyzed using Student's t-test. Comparison of POD7 patient satisfaction levels between the continuous and single-shot groups were conducted using the

Mann-Whitney *U* test. Sub-analysis for types of foot and ankle surgical procedures were similarly analyzed. For all analyses, a p-value of <0.05 was considered statistically significant.

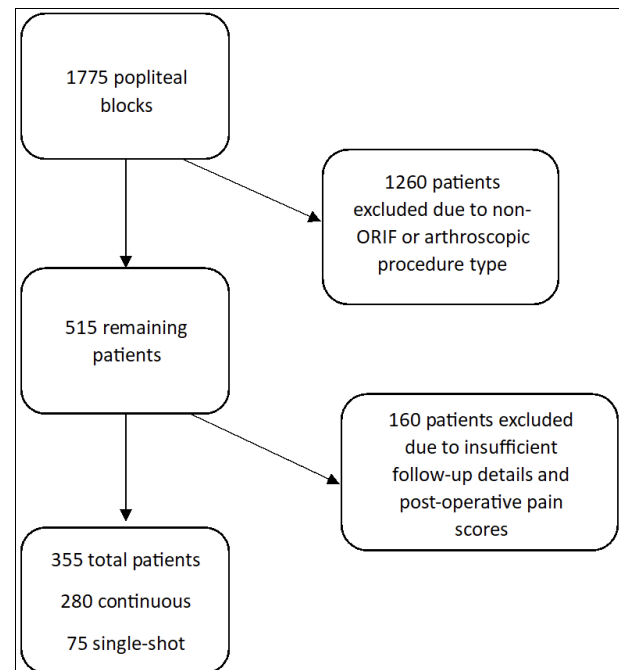


Fig 1: Flowchart depicting process for patient inclusion in the study

Results

A total of 355 patients met the eligibility criteria and were included in the study, with 280 receiving continuous and 75 receiving single-shot blocks. In the continuous group, 65 (23.2%) patients underwent arthroscopic surgery and 215 (76.8%) ORIF. In the single-shot group, 30 patients (40%) underwent arthroscopic surgery and 45 (60%) were treated with ORIF. There was no difference in patient age, gender, race, or ethnicity between the groups (Figure 1).

POD1 pain scores averaged 1.85 for continuous blocks and 2.19 for single-shot popliteal blocks ($p=0.34$, 95% CI [-1.05, 0.36]). The average POD7 patient satisfaction score was 4.94 for the continuous group and 4.80 for the single-shot group ($U = 10868$, $p = 0.23$). In the single-shot group, 69 (92%) patients reported being "Very Satisfied," 3 (4%) were "Somewhat Satisfied," and 3 (4%) were "Very Dissatisfied" with their nerve blocks. For the continuous patients, 267 (95.4%) patients reported being "Very Satisfied," 10 (3.6%) were "Somewhat Satisfied," and 3 (1.1%) were "Neither satisfied nor dissatisfied."

Comparison of POD1 pain scores and POD7 patient satisfaction scores between continuous and single-shot patients was sub-analyzed based on surgical type: ORIF or arthroscopic ankle surgery. For patients who underwent ORIF, POD1 pain scores averaged 1.90 for continuous blocks and 1.80 for single-shot blocks ($p=0.83$). Patients who had arthroscopic surgery had average POD1 scores of 1.60 in the continuous group and 2.70 in the single-shot group ($p=0.07$). The average POD7 patient satisfaction scores were 4.94 for continuous and 4.87 for single-shot groups who received ORIF surgery ($p=0.56$). The POD7 patient satisfaction scores for patients who went through arthroscopic ankle surgery averaged to 4.94 for continuous and 4.70 for single-shot groups ($p=0.30$).

Table 1: Patient Demographics

Variable	Single-shot Group (n =75) Mean (±SD) or Frequency (%)	Continuous Group (n = 280) Mean (±SD) or Frequency (%)	P-Value
Age	45.8 (±18.2)	46.2 (±17.7)	0.87
Gender	Male = 23 (30.7%)	Male = 112 (40.0%)	0.14
	Female = 52 (69.3%)	Female = 168 (60.0%)	
Race	White = 56 (74.7%)	White = 217 (77.5%)	0.60
	Black = 13 (17.3%)	Black = 49 (17.5%)	
	Other/Unknown = 6 (8.0%)	Other/Unknown = 14 (5.0%)	
Ethnicity	Non-Hispanic/Latino = 71 (94.7%)	Non-Hispanic/Latino = 262 (93.6%)	0.91
	Hispanic/Latino = 3 (4.0%)	Hispanic/Latino = 15 (5.4%)	
	Unknown = 1 (1.3%)	Unknown = 3 (1.1%)	

Table 2: Comparison of POD1 Scores between Single-Shot and Continuous Groups based on surgical type

Variable	Single-shot Group (n =75)	Continuous Group (n = 280)	P-Value
POD1 Scores	2.19	1.85	0.34
Patient Satisfaction	4.80	4.94	0.23

Table 3: Comparison of POD1 Scores between Single-Shot and Continuous Groups with Surgical Type Sub-analysis

Variable	Single-shot Group (n = 75)	Continuous Group (n = 280)	P-Value
ORIF	1.80	1.90	0.83
Arthroscopic ankle surgery	2.70	1.60	0.07

Table 4: P-value Comparison for Patient Satisfaction scores between Single-Shot and Continuous Groups based on Surgical Type.

Variable	Single-shot Group (n = 75)	Continuous Group (n = 280)	P-Value
ORIF	4.87	4.94	0.56
Arthroscopic Ankle Surgery	4.70	4.94	0.30

Discussion

Popliteal blocks are commonly used to manage moderate to severe postoperative pain in ambulatory foot and ankle surgery [3, 7]. Continuous popliteal blocks are cited as a superior method compared to single-shot popliteal blocks [7, 9, 11, 12]. However, continuous blocks take longer to perform and can cause complications including muscle weakness, sensory deficits, and infections [3, 9]. Considering these factors, this study compares POD1 pain and POD7 patient satisfaction scores between patients who receive single-shot and continuous blocks in our health system.

Postoperative pain scores are an important metric to measure efficacy of regional anesthesia. Single-shot popliteal blocks last between 15-22 hours, which may not be enough for postoperative pain that can persist up to 7 days [8, 12]. Additionally, single-shot blocks are associated with rebound pain, which is a quantifiable increase in pain once a peripheral nerve block wears off [4]. Rebound pain after single-shot blocks usually occurs 12-24 hours after surgery, making POD1 pain scores the highest and an important metric of comparison [2, 11]. Because of these effects from single-shot blocks, continuous blocks are commonly recommended in literature as they provide analgesia for up to 48 hours and lessen rebound pain [2, 9].

Previous literature has found lower pain scores after foot and ankle surgery using continuous popliteal blocks. But there was variability in the duration of this analgesic benefit. White reported significantly lower pain scores from continuous block use on postoperative days 0 and 1 [11]. Although not statistically significant, pain scores from continuous blocks were consistently lower than single-shot popliteal blocks until POD7 [5]. Several studies have reported similar findings with lower opioid consumption and consistently lower postoperative pain scores from continuous block use [2, 7, 12]. However, Ding *et al.* only

found significantly lower pain scores until 12 hours post-surgery while Ilfeld *et al.* and Zaric *et al.* recorded statistically improved pain scores between POD0 and POD2 [2, 9, 12]. Elliot *et al.* also found statistically better pain scores between POD0 to POD3, but this study did not fully endorse using continuous popliteal blocks because both types had low pain scores [3].

Although some literature found lower POD1 pain scores using continuous blocks, our study found no difference in POD1 scores between patients who received continuous and single-shot popliteal blocks. This could be explained by a difference in bolus composition. Our study was the only one that added dexamethasone to ropivacaine. Dexamethasone can delay onset of postoperative pain by up to 9 hours when combined with ropivacaine in single-shot popliteal blocks [10]. As a result, both types of blocks might have still been in effect when measuring POD1 scores in our study. Rebound pain (12-24 h after surgery) is commonly referred to as being worse in single-shot popliteal blocks. Existing studies fail to standardize the timing of POD1 assessment in hours and may inconsistently capture this phenomenon when reporting POD1 scores [2]. Additional studies could evaluate the effect of dexamethasone on postoperative pain scores between continuous and single-shot popliteal blocks beyond POD1.

Another important parameter in clinical research is patient satisfaction as it may more completely describe a patient's experience. Continuous popliteal blocks are associated with higher patient satisfaction due to prolonged analgesia, reduced opioid use and therefore fewer side effects, faster recovery, and lower hospital costs [2, 3, 7, 9, 11, 12]. Conversely, lower patient satisfaction from peripheral nerve blocks has been specifically correlated with presence of rebound pain, procedural discomfort (Surprisingly absent in catheter data), and pain experienced in the PACU [4].

Previous literature had more variable findings when comparing patient satisfaction scores between continuous or single-shot popliteal blocks. White *et al.* reported a significantly higher percentage of patients who were completely satisfied with pain management from continuous blocks compared to single-shot popliteal blocks after 24 hours [11]. Similar findings with higher average satisfaction scores in patients who received continuous blocks on POD2 also exist [7]. However, Zaric *et al.* shows that both types of blocks yielded high patient satisfaction scores and there was no significant difference between them [12]. Our study found no significant difference in patient satisfaction between continuous and single-shot popliteal blocks on POD7. Given the disconnect between POD1 pain and patient satisfaction scores in literature, patient satisfaction is likely determined by more than just pain.

Differences in patient satisfaction from continuous and single-shot popliteal blocks can be explained by variability in when the measurement was taken. White *et al.* and Ilfeld *et al.* recorded patient satisfaction scores on POD1 and POD2 respectively when average postoperative pain scores are high [7, 11]. Additionally, the single-shot block is expected to stop working after POD1 while the continuous popliteal block is still in effect [9]. Differences in pain in patients who received continuous and single-shot popliteal blocks are most pronounced and could lead to greater differences in patient satisfaction. Conversely, our study recorded patient satisfaction scores on POD7 which could reflect similar levels of postoperative pain experienced by patients in both groups during this time, whereas possible complications with continuous blocks could be recognized as unresolving. White *et al.* found that average pain scores are the same for both groups on POD7 [11]. It is possible that White *et al.* and Ilfeld *et al.* showed greater initial patient satisfaction from continuous blocks while our study presented no difference in longer-term patient satisfaction. More investigation is needed to determine the optimal time to measure patient satisfaction after block placement and possibly a tool to differentiate the components of satisfaction.

Our study's main strength is the generalizability of the findings. Previous literature had narrowed their scope to include patients with the same type of surgery, contain different surgeries with similar expected postoperative pain, or ensure that there was no significant difference in surgery type between groups [3, 7, 11, 12]. In contrast, our study included patients who underwent different types of foot and ankle surgery that elicit variable levels of postoperative pain. We stratified patients who received continuous and single-shot popliteal blocks based on the type of surgery received: ORIF or arthroscopic. The lack of difference in reported outcomes ensures that the variability of surgical pain by surgery type did not influence postoperative pain scores or patient satisfaction. Other factors that further broaden the applicability of our results are the large sample size of 355 patients and the administration of the popliteal blocks by different anesthesiologists with procedures performed by different surgeons, which better reflects real-world clinical care.

Conversely, our study has limitations due to its retrospective design and lack of an *a priori* power calculation. Retrospective studies are more prone to bias with patients either responding very favorably or unfavorably [1]. Most patients in our study reported low POD1 pain scores and

high patient satisfaction scores. However, our results match some of the findings of previous randomized control trials. Elliot *et al.* stated that there were low postoperative pain scores for patients who received continuous and single-shot popliteal blocks [3]. Zaric *et al.* reported that most of their patients were "very satisfied" with both continuous and single-shot popliteal blocks with no statistical significance [12]. Another possible limitation is lack of data on opioid consumption to qualify postoperative pain scores. Data regarding opioid consumption from verbal phone assessments was inconsistently available and could not be analyzed. However, previous studies that measured both postoperative pain and opioid consumption show that both variables parallel each other.

Conclusion

Our study has found that there is no significant difference in POD1 pain or POD7 patient satisfaction scores with the use of single-shot or continuous popliteal blocks. These results are sustained even when taking surgical type (ORIF or arthroscopic ankle surgery) into account, as they cause different levels of postoperative pain. In light of these scores being comparable between continuous and single-shot popliteal blocks with the risk profile of catheters, we recommend single-shot popliteal blocks for postoperative analgesic control in foot and ankle surgery. A prospective study is needed to confirm our study's findings, as this conclusion does not coincide with the current preference for continuous popliteal blocks from existing literature.

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Conflict of Interest: Nil.

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