

Comparable Postoperative Pain Levels Using 2 Different Nerve Blocks in the Operative Treatment of Displaced Intra-articular Calcaneal Fractures

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Abstract

Background: The aim of this study was to compare the postoperative pain levels in patients undergoing osteosynthesis of the calcaneus with either a popliteal nerve block or an ankle block.

Methods: A retrospective analysis of all consecutive patients undergoing operative fixation of a calcaneal fracture via a sinus tarsi approach between August 2012 and April 2017 in a single foot/ankle specialized center was performed. Single-shot popliteal blocks were placed using ultrasound guidance by an anesthesiologist while ankle blocks were placed by a foot/ankle specialized surgeon. Pain levels were measured through the numerical rating scale (NRS). In total, 83 patients were included in this study; 33 received a popliteal block, and 50 received an ankle block. No statistically significant differences were present in baseline characteristics between the 2 groups.

Results: Comparable postoperative pain levels were observed in both groups. There was no statistically significant difference in amount of morphine used between the 2 groups.

Conclusion: No differences were found in postoperative pain levels between patients receiving a single-shot popliteal block and patients who received a single-shot ankle block following calcaneal fracture surgery.

Level of Evidence: III, comparative series.

Keywords: calcaneal, fracture, pain, analgesia, ankle block, popliteal block

The operative treatment of calcaneal fractures can result in significant postoperative pain.² This is reflected in a recent study regarding orthopedic trauma surgery, in which over 20% of the patient-initiated telephone calls after discharge concerned postoperative pain.⁹ Multiple options are available in managing postoperative pain after foot and ankle surgery. A nerve block is part of a multimodal approach in the treatment of pain. As the affected area is innervated by the sciatic nerve, a nerve block can be performed at different levels: upper sciatic, popliteal region block, ankle block, or simply local infiltration of the wound. Popliteal or ankle blocks are used most frequently in foot and ankle surgery.

Disadvantages of a popliteal nerve block are the duration of the procedure and the additional costs associated with placement and follow-up.^{5,6,11} Therefore, if an ankle block provides comparable analgesia, a reduction in resource use and costs may be achieved. However, to this date, we were unable to find any studies comparing a peripheral (popliteal) nerve block with an ankle block in calcaneal fracture surgery.

Thus, the primary aim of the study was to compare the postoperative pain levels in patients undergoing osteosynthesis of the calcaneus via sinus tarsi approach (STA) using a popliteal block or an ankle block. A secondary aim was to compare duration of hospital stay between the above groups.

Methods

All consecutive adult patients between August 2012 and April 2017 who were operated upon due to an isolated calcaneal fracture via a sinus tarsi approach (STA) at a single academic level 1 trauma center were retrospectively analyzed.

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Table 1. General Descriptives.^a

Characteristic	Ankle Block (n = 50)	Popliteal Block (n = 33)	P Value
Sex			.31 ^b
Male	36 (72)	27 (82)	
Female	14 (28)	6 (18)	
Age, mean (SD), y	48.1 (13.5)	41.9 (15.0)	.06 ^c
ASA score			.51 ^b
ASA 1	33 (66)	25 (76)	
ASA 2	16 (32)	8 (24)	
ASA 3	1 (1)	0 (0)	
Side			.08 ^b
Left	19 (38)	19 (58)	
Right	31 (62)	14 (42)	
Sanders classification			.37 ^b
Type 2	38 (76)	26 (79)	
Type 3	9 (18)	3 (9)	
Type 4	3 (6)	4 (12)	
Smoking habits			.12 ^b
Smoking	16 (32)	16 (50)	
Not smoking	34 (68)	16 (50)	
Missing			
Tourniquet use			.70 ^b
Yes	36 (74)	25 (76)	
No	14 (26)	8 (24)	
Type of anesthesia			.99 ^d
General anesthesia	49 (98)	32 (97)	
Spinal anesthesia	1 (2)	1 (3)	

Abbreviation: ASA, American Society of Anesthesiologists.

^aValues are presented as number (%) unless otherwise indicated.

^b χ^2 test.

^cIndependent samples t test.

^dFisher exact test.

Exclusion criteria were bilateral fractures, use of a block other than popliteal or ankle block, patients sustaining multiple injuries, continuous nerve blocks, and missing postoperative pain data at more than 2 sample points. We retrospectively reviewed electronic patient hospital charts. The following characteristics were obtained: sex, age at time of procedure, American Society of Anesthesiologists (ASA) score, fracture side, Sanders classification, (non)smoker, and use of tourniquet. The following characteristics were collected regarding postoperative pain management: location of the block (ie, popliteal or ankle), block placed by surgeon or anesthesiologist, and type of postoperative analgesia (ie, patient-controlled analgesia [PCA] or oral [oxycodone]). Furthermore, the cumulative amount of morphine used by patients during admission was recorded (starting on the day following surgery). For our analysis of the cumulative amount of morphine used, we calculated the equipotent dose of morphine for all opioids used by using a formula described by others.²¹ The popliteal nerve block was placed by the anesthesiologist preoperatively using ultrasound guidance, at the popliteal fossa. An ankle block was performed

intraoperatively by the surgeon in the event that a popliteal nerve block was not placed by the anesthesiologist.

Patient and treatment characteristics are displayed in Table 1. A total of 150 patients were eligible. Sixty-seven patients were excluded due to bilateral fracture (n = 5), block different from standard (n = 9), multiple-injury patients (n = 3), continuous block instead of single shot (n = 28), and missing numeric rating scale (NRS) scores on more than 2 time points (n = 22). A total of 83 patients were included for analysis. Of these patients, 33 received a popliteal block by the anesthesiologist, and 50 received an ankle block by the trauma surgeon. Intergroup differences were absent regarding sex, age, ASA, Sanders classification, and smoking habits (Table 1). In total, 8% of the postoperative pain scores were missing at the various time points; these were handled through multiple imputation. There were no significant differences in the preoperative pain scores; mean NRS preoperative popliteal block vs ankle block was 1.4 vs 1.5 ($P = .64$).

The primary outcome parameter was postoperative pain, which was measured using the NRS. The NRS is a verbally

Table 2. Postoperative Pain Scores.

Characteristic	Ankle Block (n = 50), Mean (SEM)	Popliteal Block (n = 33), Mean (SEM)	P Value
NRS T0	1.5 (0.2)	1.4 (0.3)	.64 ^a
NRS T1	2.3 (0.2)	2.4 (0.5)	.82 ^a
NRS T2	2.4 (0.3)	1.5 (0.3)	.09 ^a
NRS T3	3.1 (0.3)	2.6 (0.4)	.34 ^a
NRS T4	2.3 (0.2)	2.2 (0.3)	.76 ^a

Abbreviations: NRS, numeric rating scale; SEM, standard error of the mean; T0, preoperative; T1, at return to ward; T2, evening following surgery; T3, morning following surgery; T4, afternoon following surgery.

^aIndependent samples *t* test.

administered pain rating scale in which a patient can rate his or her pain ranging from 0 (no pain) to 10 (maximum pain).¹⁰ The NRS was scored routinely preoperatively (T0), postoperatively at the operative ward after transfer from the postoperative care (T1), in the evening of the operation day (T2), in the morning on the day following surgery (T3), and in the afternoon on the day following surgery (T4). The assessment of pain was done by the nurse on call and registered in the electronic patient chart.

Popliteal blocks were placed using a bolus of local anesthetic (levobupivacaine 0.25% or 0.5%, 10-20 mL). Standard medication for the ankle block was 10 to 20 cc bupivacaine 0.5%. The ankle block was placed by a surgeon specialized in foot and ankle surgery. The block was placed after positioning of the patient in a supine or lateral decubitus position. Patients had already received general or spinal anesthesia. The block was placed using anatomical landmarks nearby the sural, tibial, saphenous, superficial peroneal, and deep peroneal nerve as described by Schurman¹⁹ and Dhukaram and Kumar.³ Ultrasound guidance was not used for placing the ankle block.

Standard postoperative pain medication for all patients included Paracetamol (acetaminophen) 4 g/d in 4 doses and Metamizole (dipyrone) 4/d in 4 doses. In addition, all patients received PCA with morphine 1 mg/mL or slow-release Oxycodone (oxycontin) 10 mg twice daily and standard Oxycodone (oxynorm) 5 mg up to 6 doses daily depending on the postoperative NRS.

The PCA was routinely discontinued on the morning following surgery when usage was below 10 mg/4 hours and only restarted in case of inadequate analgesia. All patients were discharged with oral paracetamol (acetaminophen), non-steroidal anti-inflammatory drugs (NSAIDs), and oxycodone for 1 week. Based upon a hospital-wide protocol, patients were discharged only when their NRS score was below 4.

Statistics

Statistical analysis was performed with SPSS v. 24.0 (SPSS, Inc, an IBM Company, Chicago, IL). Categorical data are presented as frequencies and percentages. Continuous data are presented as means and standard deviations or standard

error of the mean (SEM) (in case of use of imputed data) or medians and interquartile ranges (IQRs) where appropriate. Missing data were handled through imputation. To avoid bias, multiple imputation through predictive mean matching and using sex and age as a predictor with 10 imputed data sets was performed for the missing data. Data were subsequently pooled using Rubin's rule.¹⁸ Differences in baseline characteristics, postoperative pain, and hospital stay were analyzed with the χ^2 , independent *t* test, or Mann-Whitney *U* test where appropriate. Significance levels were derived from 2-tailed tests and were set at $P < .05$.

Results

Postoperative NRS scores did not differ significantly between the popliteal and ankle block on any of the time points (Table 2). Twelve percent of patients with a popliteal block received an additional PCA postoperatively; in the ankle block group, this was 38% ($P = .01$). In 2 patients with a popliteal block, analgesia was insufficient and a new single-shot popliteal block was placed postoperatively. No patients in the ankle block group required a reblock; this difference was not statistically significant (6% vs 0%, $P = .16$). For 87% (72 of 83) of the patients, data on the cumulative amount of morphine used were available. The cumulative amount of morphine used during admission did not statistically differ between the 2 groups, with a median (IQR) of 13 (13-17) mg (range, 0-40) vs 13 (3-26) mg (range, 0-94), $P = .69$ (popliteal vs ankle block, respectively).

Smoking did not significantly influence postoperative pain scores. The duration of surgery trended shorter in the ankle block group, but this difference was not statistically significant. There were no intergroup differences in the frequency of wound complications. Median (IQR) hospital stay in days after surgery for the popliteal block vs ankle block was 1.0 (1-1.5) vs 1.5 (1-3), $P = .01$ (Table 3).

Discussion

The aim of the current study was to investigate the differences in postoperative pain between 2 types of postoperative

Table 3. Operation Characteristics and Outcomes.

Characteristic	Ankle Block (n = 50)	Popliteal Block (n = 33)	P Value
Operation duration, mean (SD), min	84 (26)	91 (28)	.26 ^a
Wound dehiscence, No. (%)	1 (2)	1 (3)	.99 ^b
Wound infection, No. (%)	2 (4)	3 (9)	.38 ^b
Length of hospital stay, median (IQR), d	1.5 (1-3)	1 (1-1.5)	.01 ^c

Abbreviation: IQR, interquartile range.

^aIndependent samples t test.

^bFisher exact test.

^cMann-Whitney U test.

pain management. We observed no significant differences in postoperative pain score between patients with a popliteal block or an ankle block. The popliteal and ankle block had a similar direct analgesic effect, as shown by the NRS on T1 (first pain score measured at the ward). The analgesic effect seemed to last a little longer in the popliteal group, as reflected by the NRS on T2. However, this difference was not statistically significant. It has been shown that a peripheral block may last a little longer compared with a regional block.¹⁵ The clinical relevance of this difference, however, is not clear, as a reduction in NRS of 1.3 to 3 points or 33% is needed to be clinically relevant.^{7,12,17} As the aforementioned difference in NRS between the 2 methods was absent at all time points, we considered it clinically irrelevant. Another important point is that the cumulative amount of morphine used between the 2 groups did not statistically significantly differ between the 2 groups. In our study, the ankle block apparently provided adequate analgesia without increasing the use of intravenous or oral morphine. This finding is especially important in light of the abuse of opioids observed in the United States in the past decade.¹

In a randomized study by Miguez et al,¹⁵ a single-shot popliteal block was compared with a single-shot ankle block. They found that both methods provided adequate analgesia in patients undergoing elective forefoot procedures. Monsó et al¹⁶ found the same in a group of 3050 patients undergoing minor foot surgery. This comes at an expense as the use of a popliteal block has been shown to actually result in a higher incidence of rebound pain after it wears off.⁸

Most patients were discharged after 1 day (median, 1; IQR, 1-2), and maximum length of stay was 13 days. A small statistically significant difference in hospital stay was observed between the 2 groups. However, as this was only half a day, the clinical relevance is unclear. Furthermore, prolonged hospital stay was never because of insufficient pain management but because of logistical reasons, questioning the attribution of the ankle block to the prolonged hospital stay.

Several studies have compared a single-shot nerve block with a continuous popliteal nerve block (CPNB) in foot and

ankle surgery.^{2,4-6,11,14,20} Only Elliot et al⁵ found a significantly lower postoperative pain score in patients with a CPNB. All other authors, however, reported prolonged total procedure time due to the placement of a CPNB compared with a single-shot block. These results question the added value of continuous blocks over single-shot blocks. Furthermore, these blocks require extra resources as extra equipment is needed and patients are sometimes even discharged with a continuous block in situ, possibly necessitating extra home care. Therefore, continuous blocks may be reserved for more severe cases in which persistent pain is expected and additional analgesia may be warranted.

This study has several limitations. First, our study is retrospective, which may introduce selection bias. However, we have included all consecutive patients to reduce this problem. Second, the data of the pain scores were not complete, with approximately 8% of the NRS scores missing. We have overcome this problem by using multiple imputation for the missing pain scores, which has been shown to be a reliable method in case of missing data.¹³ Interestingly, PCA was applied more often in patients with an ankle block. We believe this was mainly as a precaution as patients had not received a block by the anesthesiologist. As a result of this, in almost all cases, the PCA could be discontinued on the morning following surgery, which is also reflected by the fact that the cumulative amount of morphine used did not statistically significantly differ between the 2 groups.

A strength of this study is that it is the first to use the ankle block as an alternative to more elaborate analgesia techniques in the operative treatment of displaced intra-articular calcaneal fractures. We have shown that the 2 regimens of postoperative analgesia resulted in similar pain levels. A reduction in hospital costs may be achieved when using ankle blocks in calcaneal fracture surgery. This may also be true in other foot ankle trauma procedures as the additional investment of equipment and personnel to perform a nerve block did not lead to better analgesia. The actual time needed to perform a block outside the operation room is an investment of time and use of scarce resources. We therefore question the need for nerve blocks for these specific procedures as a routine.

Conclusion

We found no differences in postoperative pain levels between patients receiving a popliteal block and those who received an ankle block following calcaneal fracture surgery. This may suggest that ankle blocks deliver adequate analgesia in routine cases. In daily practice, this can lead to a more efficient use of resources and personnel. The results of the present study may serve as a basis for a prospective study on this subject to provide more definitive answers.

Declaration of Conflicting Interests

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References

- Chen KY, Chen L, Mao J. Buprenorphine-naloxone therapy in pain management. *Anesthesiology*. 2014;120(5):1262-1274.
- Cooper J, Benirschke S, Sangeorzan B, Bernards C, Edwards W. Sciatic nerve blockade improves early postoperative analgesia after open repair of calcaneus fractures. *J Orthop Trauma*. 2004;18(4):197-201.
- Dhukaram V, Kumar CS. Nerve blocks in foot and ankle surgery. *Foot Ankle Surg*. 2004;10(1):1-3.
- Ding DY, Manoli A, Galos DK, Jain S, Tejwani NC. Continuous popliteal sciatic nerve block versus single injection nerve block for ankle fracture surgery: a prospective randomized comparative trial. *J Orthop Trauma*. 2015;29(9):393-398.
- Elliot R, Pearce CJ, Seifert C, Calder JD. Continuous infusion versus single bolus popliteal block following major ankle and hindfoot surgery: a prospective, randomized trial. *Foot Ankle Int*. 2010;31(12):1043-1047.
- Falyar CR. Ultrasound-guided ankle blocks: a review of current practices. *AANA J*. 2015;83(5):357-364.
- Farrar JT, Berlin JA, Strom BL. Clinically important changes in acute pain outcome measures: a validation study. *J Pain Symptom Manag*. 2003;25(5):406-411.
- Goldstein RY, Montero N, Jain SK, Egol KA, Tejwani NC. Efficacy of popliteal block in postoperative pain control after ankle fracture fixation. *J Orthop Trauma*. 2012;26(10):557-561.
- Hadeed MM, Kandil A, Patel V, Morrison A, Novicoff WM, Yarburo S. Factors associated with patient-initiated telephone calls after orthopaedic trauma surgery. *J Orthop Trauma*. 2017;31(3):e96-e100.
- Hawker G, Mian S, Kendzerska T, French M. Measures of adult pain. *Arthritis Care Res*. 2011;63(11):240-252.
- Hunt KJ, Higgins TF, Carlston CV, Swenson JR, McEachern JE, Beals TC. Continuous peripheral nerve blockade as postoperative analgesia for open treatment of calcaneal fractures. *J Orthop Trauma*. 2010;24(3):148-155.
- Lee JS, Hobden E, Stiell IG, Wells GA. Clinically important change in the visual analog scale after adequate pain control. *Acad Emerg Med*. 2003;10(10):1128-1130.
- Li P, Stuart EA, Allison DB. Multiple imputation: a flexible tool for handling missing data. *JAMA*. 2015;314(18):1966-1967.
- McLeod DH, Wong DHW, Vaghadia H, Claridge RJ, Merrick PM. Lateral popliteal sciatic nerve block compared with ankle block for analgesia following foot surgery. *Can J Anaesth*. 1995;42(9):765-769.
- Migues A, Slullitel G, Vescovo A, Droblas F, Carrasco M, Turenne HP. Peripheral foot blockade versus popliteal fossa nerve block: a prospective randomized trial in 51 patients. *J Foot Ankle Surg*. 2005;44(5):354-357.
- Monsó A, Santalieuja J, Barbal F, Fitó F, Riudeubás J, Viladot R. Regional anaesthesia in foot surgery: peripheral blockade of the foot versus popliteal sciatic nerve block. *Foot Ankle Surg*. 2000;6(2):95-98.
- Ridderikhof ML, Lirk P, Schep NW, et al. The PanAM study: a multi-center, double-blinded, randomized, non-inferiority study of paracetamol versus non-steroidal anti-inflammatory drugs in treating acute musculoskeletal trauma. *BMC Emerg Med*. 2013;13:19.
- Rubin DB. *Multiple Imputation for Nonresponse in Surveys*. New York, NY: John Wiley; 1987.
- Schurman DJ. Ankle-block anesthesia for foot surgery. *Anesthesiology*. 1976;44(4):348-352.
- Singelyn FJ. Single-injection applications for foot and ankle surgery. *Best Pract Res Clin Anaesthesiol*. 2002;16(2):247-254.
- Vissers KCP, Besse K, Hans G, Devulder J, Morlion B. Opioid rotation in the management of chronic pain: where is the evidence? *Pain Pract*. 2010;10(2):85-93.