Heliyon 10 (2024) e34620

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Comparison of the effects of single injection and continuous infusion popliteal nerve block on pain and hemodynamics in diabetic foot surgery; prospective randomized clinical trial

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ARTICLE INFO

Keywords:
Popliteal nerve block
Diabetic foot
Pain
Single injection
Continuous infusion

ABSTRACT

Objectives: In patients undergoing surgery due to diabetic foot complications from uncontrolled diabetes may lead to neuraxial or general anesthesia-related issues. Regional anesthesia techniques can be preferred to prevent these complications. This study aimed to compare the hemodynamic effects and outcomes in terms of pain of continuous infusion and single injection methods of popliteal nerve block in patients undergoing surgery due to diabetic foot.
Materials and methods: Sixty-three patients in ASA II-IV risk group scheduled for diabetic foot surgery were randomized into two groups for popliteal nerve block as the anesthesia method. Group 1 (n:32), 30 mL of local anesthetic was administered around the popliteal nerve under ultrasound guidance and nerve stimulator. Group 2 (n:31) had a catheter placed beyond the needle tip by 4–5 cm. An elastomeric pump was prepared for the infusion of 2 mL/h of 0.25 % bupivacaine through the catheter. Hemodynamic parameters before and after the block, onset, block duration times, postoperative pain scores, time to analgesic requirement, patient satisfaction, and discharge time were recorded.
Results: Pain scores were higher in Group 1 after 12 h postoperatively and in Group 2 after 60 h postoperatively ($p = 0.006$, $p < 0.01$, respectively). The time to the first analgesic requirement was not statistically different between Group 1 (mean 804.64 ± 1020.8 min) and Group 2 (mean 2012.78 ± 1424 min) ($p = 0.072$). There was no significant difference in systolic, diastolic, mean arterial blood pressure, and heart rate between groups before and after successful blockade ($p > 0.05$).
Conclusions: Continuous infusion method of popliteal nerve block provides a longer pain-free period. Both methods showed similar hemodynamic data and low pain scores. Although continuous infusion method provides better analgesia, its procedural cost, technical difficulties, and adverse effects on patient comfort should also be considered.

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https://doi.org/10.1016/j.heliyon.2024.e34620
Received 11 June 2024; Received in revised form 8 July 2024; Accepted 12 July 2024
Available online 14 July 2024

1. Introduction

The purpose of peripheral nerve blocks is to disrupt nerve conduction distally at a nerve terminal, thereby terminating the pain signal perceived by the cortex [1]. Popliteal sciatic nerve block (PSNB) is a widely used anesthesia technique for foot and ankle surgery [2]. The block is performed just above the popliteal fossa at the bifurcation of the tibial and common peroneal nerves (CPN). When local anesthetic is administered to the sciatic nerve in the popliteal region, the anterior, lateral, and posterior lower leg, ankle, and foot are blocked [3]. While a single injection can provide limited postoperative pain control, extending the block and achieving better pain management can be achieved by administering continuous local anesthetic infusion. Peripheral nerve block is a good alternative, especially in surgical procedures associated with widespread organ system damage, such as Diabetes Mellitus (DM), to avoid potential complications of general and spinal anesthesia.

Diabetic foot ulcer is the most common cause of non-traumatic lower extremity amputation associated with diabetes [4]. Perioperative mortality in diabetic foot amputations can be as high as 5.8 % [5]. Well-planned postoperative pain control is important in increasing the rate of postoperative recovery and surgical success, and reducing the likelihood of developing chronic pain [6]. In patients undergoing lower extremity amputation for diabetic foot, achieving adequate anesthetic and analgesic effects while maintaining stable hemodynamics during surgery can be challenging due to long-standing diabetes, elderly age, and additional chronic illnesses [7]. Recently, peripheral nerve block performed under ultrasound guidance has become popular as it allows avoiding the negative effects of general anesthesia on cardiopulmonary functions [8]. Patients undergoing spinal anesthesia with peripheral nerve block experienced significantly deeper and longer-lasting hypotension compared to those receiving peripheral nerve block alone. Patients receiving peripheral nerve block, regardless of the presence of autonomic neuropathy, have been found to be both hemodynamically more stable and to have superior postoperative pain control. Therefore, peripheral nerve block is recommended as the preferred anesthesia method in diabetic patients [9].

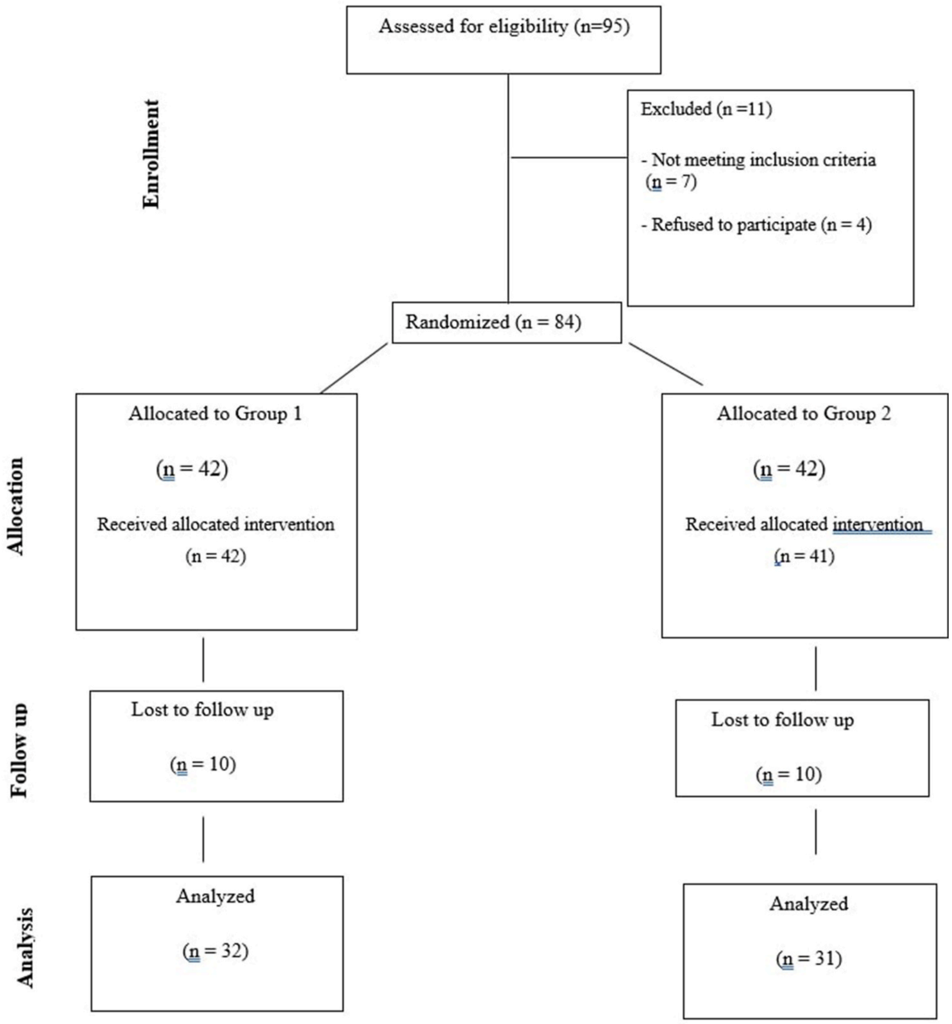

Fig. 1. Consort diagram schema.

The hypothesis of this study is that continuous infusion of popliteal nerve block in patients undergoing surgery due to diabetic foot will provide better pain management and more stable hemodynamics compared to single injection block.

2. Materials and methods

Following approval from the Hitit University Faculty of Medicine Clinical Research Ethics Committee (Date: August 28, 2019, No: 2019/62), a prospective randomized clinical study was conducted. Sixty-three patients who were scheduled for surgical intervention below the knee due to diabetic foot and provided written informed consent were included in the study. After admission to the pre-operative block room, patients who met the inclusion criteria and agreed to participate were randomly allocated into two groups using an internet-based software program (Research Randomizer, http://www.randomizer.org/): Group 1 (n = 32) received popliteal nerve block with a single injection method, and Group 2 (n = 31) received popliteal nerve block with continuous infusion method (Fig. 1). Sixty-three patients scheduled for surgery below the knee due to diabetic foot, who had given written informed consent, were included in the study.

The inclusion criteria were determined as follows: ASA physical classification II-IV, age 18 years and older, undergoing surgical operation due to diabetic foot, and patients who had read and accepted the voluntary consent form. Patients who had not given consent, those with a body mass index (BMI) above 40 kg/m2, pregnant patients, patients with neuromuscular diseases, known allergies to local anesthetics, coagulation disorders, infection at the site of block, psychiatric illness, and cognitive dysfunction were excluded from the study.

After patients were admitted to the operating room for the procedure, routine monitoring was performed, and 1–2 mg of midazolam was administered for sedation purposes. Popliteal nerve block was performed under ultrasound guidance (GE LogiqV2 portable ultrasound, L6-12-RS linear probe) in prone position with appropriate sterile conditions, using a 10 cm long, 22 G peripheral block needle (SonoPlex Stim cannula, Pajunk®, Geisingen, Germany) (Fig. 2). After identifying the popliteal nerve using ultrasonography and nerve stimulator, a total of 30 mL of local anesthetic, consisting of 10 mL of 2 % prilocaine and 20 mL of 0.5 % bupivacaine, was administered around the nerve. This was done in 5 mL increments with aspiration for negative pressure to exclude intravenous placement. When the continuous popliteal sciatic nerve block catheter was to be placed, 1–2 mL of local anesthetic was administered to the skin at the needle entry site. As with the single injection method, after confirming the correct position under ultrasound guidance and nerve stimulator, a total of 30 mL of local anesthetic, consisting of 10 mL of 2 % prilocaine and 20 mL of 0.5 % bupivacaine, was administered around the nerve in 5 mL increments with aspiration for negative pressure to exclude intravenous placement. The catheter was advanced 4–5 cm beyond the needle tip, and correct placement was confirmed by observing the hypoechoic distribution of 0.9 % saline within the sciatic nerve sheath. The catheter was then sutured and secured to the skin. (Fig. 3). After excluding intravascular placement of the catheter with negative aspiration, an elastomeric pump was prepared with 48 mL of 0.9 % NaCl and 48 mL of 0.5 % bupivacaine and was prepared to infuse at a rate of 2 mL/h.

If the block procedure was successful, patients were taken to the operating room. Routine monitoring (ECG, systolic blood pressure, diastolic blood pressure, mean arterial pressure) was performed, and the surgical procedure was initiated. Throughout the operation, patients were asked if they were experiencing any pain. If pain was reported, 0.5 mcg/kg of fentanyl was administered and recorded on the observation sheet. If a response to the fentanyl was observed, the procedure was continued. In cases of insufficient analgesia, general anesthesia was administered, and these cases were excluded from the study.

If VAS scores were 4 or higher after surgery, 1 g of intravenous paracetamol was administered, and the time to first analgesic

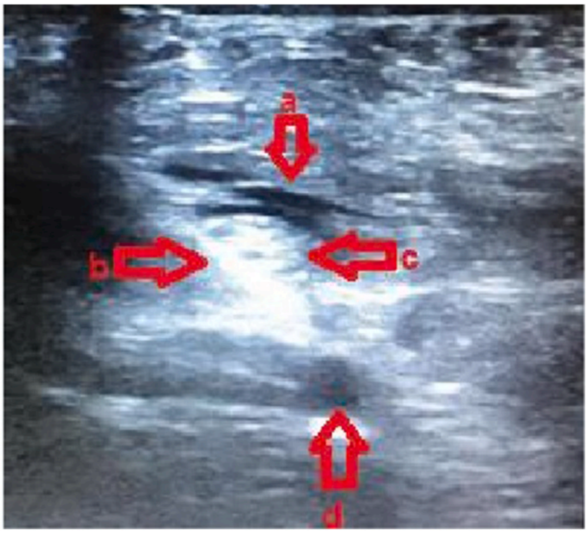

Fig. 2. USG image of local anesthetic spread around the TN and CPN with a single injection and the needle seen just below the nerve (a:local anesthetic spread around the nerve, b:peripheral block needle, c:popliteal nerve, d:popliteal artery).

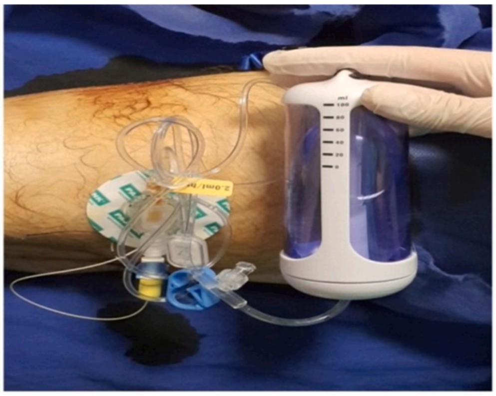

Fig. 3. Left picture suturing and fixing the catheter to the skin and right picture inserting the elastomeric pump.

requirement was recorded. In cases where there was no response to paracetamol, administration of 1 mg/kg tramadol was planned, and the time of administration postoperatively was documented.

Time to readiness for surgery was determined by evaluating motor and sensory block every 3 min after the block was performed. Hemodynamic monitoring parameters before and after the block, postoperative pain scores, monitoring of block durations, and need for additional analgesia were compared between groups. Additionally, the relationship between patients' neuropathy status and sensory and motor onset times, the effect of HbA1c levels on sensory onset time, motor onset time, and total block duration, and the relationship between hospital stay duration and patient satisfaction of the groups were examined.

2.1. Statistical analysis

In this study, statistical analyses were performed using the SPSS package program (Version 22.0, SPSS Inc., Chicago, IL, USA, Licensed by Hitit University). Descriptive statistics were presented as mean ± standard deviation for normally distributed continuous data, median (min-max) for non-normally distributed continuous and ordinal data, and number and percentage (%) for categorical data. The normality distribution was examined using the Shapiro-Wilk test. For the comparison of two independent sample means of continuous variables, the independent *t*-test was used for normally distributed data, and the Mann-Whitney *U* test was used for non-normally distributed data. For the comparison of two dependent groups of continuous variables, the paired *t*-test was used for normally distributed data. The Friedman test was used for the comparison of numerical variables among more than two dependent groups with non-normally distributed data. Bonferroni-corrected post-hoc tests were used to determine the source of differences following variance analysis. Relationships between categorical variables were investigated using the Chi-square test or Fisher's exact test depending on the data count in the cross-table cells. Relationships between categorical variables were investigated using the Chi-square test or Fisher's exact test for two independent groups and the McNemar test for two dependent groups. Relationships between numerical variables were examined using the Spearman correlation coefficient due to the non-normal distribution of the data. A significance level

Table 1
Compares the block characteristics between groups, including operation duration and time to first analgesic requirement.

	n	Mean	SD	Median	Min	Max	*p*
MOTOR BLOCK STARTING TIME (MIN)							
Group 1	32	19.22	14.38	16	2	50	0.705[a]
Group 2	31	18.13	13.49	12	3	45	
SENSORY BLOCK STARTING TIME (MIN)							
Group 1	32	11.75	13.45	6,5	0	47	0.934[a]
Group 2	31	12.26	12.04	10	0	40	
TOTAL BLOCK DURATION (MIN)							
Group 1	32	631.56	218.72	627,50	165	1000	0.621[b]
Group 2	31	733.26	435.83	660	110	2160	
OPERATION DURATION (MIN)							
Group 1	32	16.59	6.98	15	8	38	**0.003**[b]
Group 2	31	12.10	5.57	11	5	31	
TIME TO FIRST ANALGESIA REQUIREMENT (MIN)							
Group 1	32	804.64	1020.804	630	60	4200	**0.042**[b]
Group 2	31	2012.78	1424.050	2160	120	3600	
TOTAL	63	1277.39	1310.203	720	60	4200	

SD: Standard Deviation, Mean: Mean, Median: Median, Min: Lowest, Max: Highest.
[a] Student's *t*-test.
[b] Mann-Whitney.

of $p < 0.05$ was considered statistically significant.

3. Results

Patients undergoing popliteal nerve block with the single injection method (Group 1) and continuous infusion method (Group 2) were randomized into two groups.

Comparison of motor block onset, sensory block onset, total block durations, operation duration, and time to first analgesic requirement between the research groups are presented in Table 1. The time to the first analgesic requirement was statistically significantly shorter in Group 1, with a mean of 804.64 ± 1020.8 min, compared to Group 2, with a mean of 2012.78 ± 1424 min ($p < 0.05$).

Comparison of sensory onset time, motor onset time, and total block duration with the neuropathy status of patients between the research groups is presented in Table 2. The sensory onset time was earlier in patients with neuropathy compared to those without neuropathy ($p < 0.001$). There was no statistically significant difference in motor block onset time and total block duration based on neuropathy status ($p = 0.460$, $p = 0.723$, respectively).

There was no statistically significant difference between the patients' HbA1c levels and sensory onset time, motor onset time, and total block duration ($r = -0.059$, $p = 0.646$; $r = 0.013$, $p = 0.920$; $r = -0.010$, $p = 0.936$) (Table 3).

There was no statistically significant difference in hemodynamic data measured before and 45 min after the block procedure in the research groups ($p > 0.05$) (Table 4).

Evaluation of hospital stay and satisfaction of the research groups is presented in Table 5. There was no statistically significant difference in hospital stay and patient satisfaction.

VAS scores in Group 1 were higher until the 48th postoperative hour, while those in Group 2 were higher after the 48th hour ($p = 0.002$, $p = 0.012$, $p = 0.041$, $p = 0.016$, $p = 0.003$ for VAS values between groups at 12th, 24th, 36th, 48th hour, and 7th day, respectively) (Fig. 4).

There was a statistically significant difference in the mean arterial blood pressure values of patients on the 7th postoperative day between the research groups ($p = 0.001$) (Fig. 5). There was no statistically significant difference in mean arterial blood pressure values at other time points between the research groups.

4. Discussion

This study compares the effects of popliteal nerve block administered with a single injection and continuous infusion methods using an elastomeric pump on postoperative pain and hemodynamics in diabetic foot surgeries. In this prospective, randomized clinical study, which helps determine the necessity of prolonged infusion nerve blockade with the single injection popliteal block method in this patient group with numerous comorbidities, demographic data, ASA classification, and BMI were homogenized, thereby eradicating many factors that could affect postoperative hemodynamic parameters. Previous clinical studies have been conducted on anesthesia methods to be applied in diabetic foot surgeries, and these studies have demonstrated positive results of regional anesthesia methods in terms of hemodynamic stability, postoperative pain, hospital stay duration, and patient satisfaction. However, to the best of our knowledge, there is no literature regarding the superiority of continuous infusion or single injection method of peripheral nerve block over each other in terms of postoperative pain and hemodynamic effects in diabetic patients.

Diabetes mellitus (DM) is among the top 10 causes of death in adults and is estimated to have caused 4 million deaths worldwide in 2017. Cardiovascular diseases, including coronary artery disease, peripheral vascular disease, and cerebrovascular disease, are the primary causes of morbidity and mortality [10]. Many of the patients developing diabetic foot have uncontrolled glycemic status and long-standing diabetes, carrying the long-term complications of diabetes. In this study, it was observed that 88 % of the patients had at least one additional chronic disease diagnosed previously, and among these, coronary artery disease was the most common comorbidity accompanying DM [11]. Intraoperatively, particularly in patients with uncontrolled DM, more cardiovascular instability is observed, and sudden cardiac death may occur due to cardiac autonomic neuropathy, as the body cannot protect itself against the vasodilator effects of anesthesia.

Lai et al. conducted a study on 102 patients undergoing diabetic foot surgery, reporting a significantly higher incidence of hypotension in patients undergoing spinal anesthesia compared to those undergoing popliteal nerve block ($P = 0.001$). In the same study, while postoperative pain scores on the first day were significantly lower in the group undergoing popliteal nerve block ($P = 0.01$), the

Table 2
Comparison of sensory, motor onset and total block times with neuropathy status.

	Neuropathy	n	Mean	SD	Median	Min	Max	*p*
Sensory Onset	No	36	15.83	11.719	14.00	0	45	**<0.001**[a]
	Yes	27	6.89	12.286	2.00	0	47	
Motor Onset	No	36	16.83	11.944	13.50	2	45	0.460
	Yes	27	21.15	15.954	10.00	2	50	
Block Time	No	36	687.83	301.822	667.50	230	1440	0.723
	Yes	27	673.30	399.658	640.00	110	2160	

SD: Standard Deviation, Mean: Mean, Median: Median, Min: Lowest, Max: Highest.
[a] Mann-Whitney *U* Test.

Table 3
The relationship between HbA1c and sensory onset time, motor onset time and total block duration.

		Sensory Onset	Motor onset	Total Block Time
HbA1c	r	−0.059	0.013	−0.010
	p	0.646	0.920	0.936
	N	63	63	63

Spearman's rho correlation coefficient.

Table 4
Comparison of hemodynamic data before and after block.

	Group	Mean	SD	Median	Min	Max	*p*
Mean Arterial blood pressure before block (mmHg)	Group 1 (n:32)	111.75	14.71	111	90	144	Group 1: 0.650
	Group 2 (n:31)	110.84	15.16	113	83	140	Group 2: 0.107
End of block mean arterial blood pressure (mmHg)	Group 1 (n:32)	110.78	16.08	107	85	150	
	Group 2 (n:31)	108	17.30	112	65	145	
Pre-block systolic blood pressure (mmHg)	Group 1 (n:32)	161.72	25.639	159	118	209	Group 1: 0.387
	Group 2 (n:31)	161.9	24.415	165	118	214	Group 2: 0.280
End of block systolic blood pressure (mmHg)	Group 1 (n:32)	158.78	25.875	157	111	222	
	Group 2 (n:31)	158.48	27.588	166	89	206	
Diastolic blood pressure before block (mmHg)	Group 1 (n:32)	82.38	11.247	82	64	112	Group 1: 0.745
	Group 2 (n:31)	79.39	11.289	79	58	106	Group 2: 0.426
End-block diastolic blood pressure (mmHg)	Group 1 (n:32)	81.44	11.824	82	62	105	
	Group 2 (n:31)	77.1	11.22	79	51	97	
Heart rate before block	Group 1 (n:32)	86.72	13.83	85	59	115	Group 1: 0.561
	Group 2 (n:31)	87.58	10.53	85	72	112	Group 2: 0.422
Heart rate after block	Group 1 (n:32)	84.75	13.15	82,5	58	118	
	Group 2 (n:31)	85.48	9.94	84	68	108	

Paired *t*-test.
SD: Standard Deviation, Mean: Mean, Median: Median, Min: Lowest, Max: Highest.

Table 5
Comparison of the study groups in terms of length of hospital stay and patient satisfaction.

HOSPITAL STAY TIME (Days)							
GROUP	N	Mean	SD	Median	Min	Max	*p*
Group 1	32	53.44	37.23	53	5	171	0.690[a]
Gorup 2	31	52.81	41.65	48	7	222	
Total	63	53.13	39.15	50	5	222	
PATIENT SATISFACTION (%)							
GROUP	**N**	**Mean**	**SD**	**Median**	**Min**	**Max**	***p***
Group 1	32	78.75	26.60	90	0	100	0.727[a]
Group 2	31	78.87	21.66	80	30	100	
Total	63	78.80	24.10	90	0	100	

SD: Standard Deviation, Mean: Mean, Median: Median, Min: Lowest, Max: Highest.
[a] Mann-Whitney U.

duration of pain-free time was significantly longer in this group (P = 0.002) [9]. In this study, however, no significant change was observed in systolic, diastolic, mean blood pressures, and heart rate between the research groups before popliteal nerve block and 45 min after successful blockade (P > 0.05). No clinically significant negative effect of peripheral nerve block application on hemodynamics was observed during the follow-up period of the study in diabetic patients.

Studies have shown that peripheral nerve block application provides more stable hemodynamic results compared to general anesthesia and neuroaxial blocks. Kim et al. observed higher pain scores and lower blood pressures in diabetic foot patients undergoing popliteal nerve block compared to those undergoing general anesthesia with remifentanil. Based on these studies, it is suggested that peripheral nerve block application should be the preferred anesthetic method in diabetic foot patients due to inadequate pain management and hemodynamic instability caused by general anesthesia or neuroaxial blocks [12]. In this study examining the effects of popliteal nerve block with single injection and continuous infusion methods on pain and hemodynamics, systolic blood pressure was higher in Group 2 on the 5th, 6th, and 7th postoperative days compared to Group 1. Increased pain scores after catheter removal at 48 h in this group may have led to an increase in blood pressure. Although statistically significant, due to this change in blood pressure being less than 20 % compared to the previous values, it can be said that it did not affect hemodynamics in clinical practice. When mean arterial blood pressure values were evaluated, it was only higher in Group 2 on the 7th postoperative day. Again, the reason for this

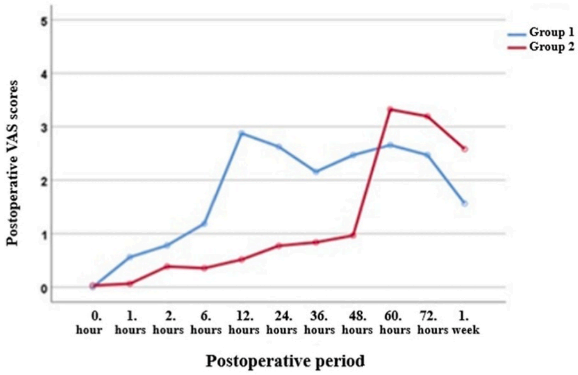

Fig. 4. Variation of postoperative VAS scores according to time.

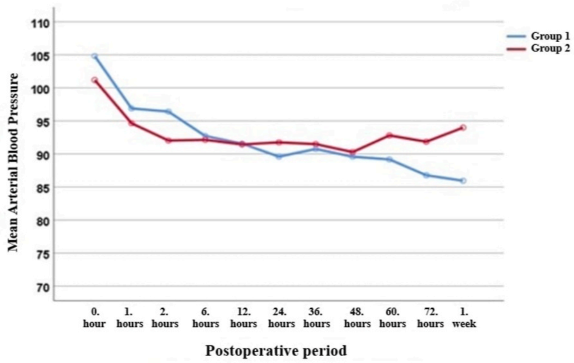

Fig. 5. Postoperative mean arterial blood pressure changes over time.

may be the increased pain scores and consequent rebound pain after catheter removal.

The phenomenon known as "rebound effect" has been reported to occur after peripheral nerve blocks performed with the single injection method. It has been described as a very severe pain that occurs after the recovery of sensitivity following the resolution of peripheral nerve block [13]. It is believed that patients feel the pain very severely when taken analgesics after the pain has started because the effect of the analgesics will not start before 30 min. Increasing the duration of nerve block has been reported not to increase rebound pain [14,15]. However, in this study, rebound pain was observed not in the group where popliteal nerve block was performed with the single injection method, but in the continuous infusion group after the catheter was removed at 48 h.

Contrary to the results of our study, Ding et al. concluded in a prospective, randomized, controlled study involving 44 patients undergoing ankle fracture surgery that continuous infusion with popliteal nerve block over a period of 72 h significantly reduced rebound pain and the need for oral opioid analgesia compared to single injection popliteal nerve block [14].

Similar to the study conducted by Elliott et al., in this study, low pain scores were observed in the research groups in the first 12 h postoperatively, and there was no statistically significant difference between the research groups in terms of pain. However, in Elliott et al.'s study, pain scores were significantly different between the groups receiving normal saline infusion through the perineural catheter for the next 72 h compared to the group receiving local anesthetic infusion [16]. In this study, similarly, pain scores were significantly higher in the single injection group at postoperative 12, 24, 36, 48 h, and on the 7th day. However, despite the statistically significant difference in VAS scores between the groups, it was found that the pain scores were surprisingly low. Throughout the follow-up period, the highest mean VAS score in both groups was found to be less than 4. In Elliott et al.'s study, the difference in pain scores was only between 1.5 and 2 points. The reason for this may be the administration of postoperative oral opioids [16]. Similarly, in this study, while pain scores ranged from an average of 0–2.88 in the single injection group, they ranged from an average of 0–3.32 in the group where the perineural catheter was placed for continuous infusion, and they were low as in Elliott et al.'s study.

In a prospective cohort study, it was reported that the median time until the first opioid request was more than 150 % longer in type 2 diabetic patients with diabetic peripheral neuropathy, with 50 % shorter onset times for sensory and motor blocks, and decreased pain scores at 24 h postoperatively [17]. Although the relationship between neuropathy and analgesia was not compared in this study, it was observed that the median time for sensory block initiation was 7 times shorter in patients with neuropathy than in those without neuropathy. The time required for motor block initiation was also 25 % shorter in neuropathic patients than in non-neuropathic ones, but no statistically significant difference was observed. In light of these results, it is seen that existing nerve damage due to diabetes shortens the block initiation time.

The duration of diabetes and hemoglobin A1c (HbA1c) levels (a measure of glycated hemoglobin as an indicator of average daily glucose levels) are the main determinants of diabetic neuropathy [18]. In a study investigating the relationship between glycated hemoglobin levels and sciatic nerve block performance in diabetic patients, it was found that application, onset, termination, and total block durations were significantly longer in the group with high HbA1c levels compared to the group with low levels [19]. In this study, the patients' HbA1c levels were found to be high as an indicator of poor glycemic control, and there was no statistically significant difference in HbA1c levels and diabetes duration between the groups. It was thought that patients were equally exposed to the risks and complications of diabetes. Despite the prolongation of the block duration, no statistically significant relationship was found between patients' HbA1c levels and sensory block initiation time, motor block initiation time, and total block duration. This could be explained by the fact that HbA1c levels were above 9 % on average in both groups, which is higher than normal.

Our study had some limitations. Firstly, when administering continuous local anesthesia infusion to patients, a fixed volume of local anesthetic was delivered. More objective findings could be obtained by using the patient-controlled analgesia method. Secondly, the fact that postoperative pain and analgesic requirements were monitored only for a specific period has limited our ability to gain insight into long-term outcomes. Thirdly, the presence of diabetic peripheral neuropathy may affect the efficacy of the block. Although data regarding neuropathy status were available in the study, specific analyses related to this condition are limited.

5. Conclusion

In this study comparing the single injection and continuous infusion methods in terms of hemodynamics and pain in diabetic foot surgeries, it was observed that pain scores were lower in the continuous infusion method compared to the single injection method. There was no clinically significant difference in the effects on hemodynamics. Although VAS scores were lower in the continuous infusion group until the 5th postoperative day, it was observed that they were higher in the single injection group after the discontinuation of local anesthetic infusion. Nevertheless, it can be said that the average pain scores were low in both groups. It was observed that the continuous infusion method required longer block duration and had a later need for analgesics. For these reasons, this method seems to be more advantageous. However, due to the low VAS scores and stable hemodynamics observed in diabetic foot surgeries, the single injection method can also be preferred in practice. The absence of clinically significant changes in hemodynamic parameters before and after the block procedure, as well as during the postoperative period, suggests that regional techniques may be safe in diabetic patient groups. Although patient satisfaction was statistically similar, during the follow-up period, it was observed that mobilization was difficult for patients in the group with perineural catheter insertion, and the catheter could easily come out if not well secured. Therefore, difficulties in procedures such as placement and securing of the perineural catheter, as well as the length of the procedure, may have negative effects on postoperative patient comfort in diabetic foot surgeries. The choice of which regional technique to use may vary depending on the clinician's preference and the patient's current condition based on the results of this study. However, it should be kept in mind that continuous infusion also prolongs pain-free duration and delays the need for analgesics.

Funding

The study had no funding source.

Ethical approval

This article approval from the Hitit University Faculty of Medicine Clinical Research Ethics Committee (Date: August 28, 2019, No: 2019/62).

Data availability statement

The data associated with the study has not been deposited into a publicly available repository. The complete data that support the findings of this study are available on request from the corresponding author.

CRediT authorship contribution statement

Sibel Önen Özdemir: Writing – review & editing, Validation, Investigation, Formal analysis, Data curation. **Yeliz Şahiner:** Writing – review & editing, Investigation, Formal analysis. **Selçuk Kayır:** Writing – review & editing, Validation, Supervision. **Güvenç Doğan:** Writing – review & editing, Validation, Supervision, Project administration, Conceptualization. **Arzu Akdağlı Ekici:** Writing – review & editing, Writing – original draft, Validation, Supervision, Project administration, Methodology, Conceptualization. **Gökçe Çiçek Dal:** Writing – review & editing, Validation, Supervision, Project administration. **Alperen Kısa:** Writing – review & editing, Writing – original draft, Methodology, Investigation.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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