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ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2026;15(2):754-60

The role of peripheral blocks in diabetic foot surgery: Is it comfort or a need?

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Received 03 October 2025; Accepted 02 March 2026
Available online 08 May 2026 with doi: 10.5455/medscience.2025.10.264

Abstract

Diabetic foot (DF) represents a serious complication of diabetes mellitus that often requires surgical intervention. The management of anesthesia can be particularly challenging due to the frequent presence of comorbidities and the associated risks of both general and spinal anesthesia. Ultrasound-guided peripheral nerve blocks (PNBs) offer a promising alternative, enhancing hemodynamic stability during the perioperative period and providing better postoperative pain relief. We performed a retrospective cross-sectional study involving 66 patients who underwent DF surgery with ultrasound-guided PNB at a tertiary care center. We analyzed data on demographics, type of anesthesia, opioid consumption, ICU admissions, mortality, and length of hospital stay. The average age of participants was 73.35 ± 12.80 years, with 77.3% beingmale. Regional anesthesia, specifically femoral-popliteal blocks, was employed in 36.4% of the cases. Patients who received PNB demonstrated a significantly reduced need for opioids postoperatively (p<0.001) and had lower rates of ICU admissions compared to those who received general anesthesia. Mortality rates were significantly linked to higher ASA scores (p=0.004), but did not correlate with the type of anesthesia used (p=0.175). Ultrasound-guided PNBs contribute to enhanced hemodynamic stability, lower opioid usage, and reduced ICU admissions for DF surgery, particularly in patients at high risk with elevated ASA scores. These results advocate for the integration of PNB as the standard anesthetic method to improve perioperative outcomes and minimize complications.

Keywords: Diabetic foot, peripheral nerve block, regional anesthesia, postoperative analgesia, hemodynamic stability, opioid reduction

Introduction

Diabetes mellitus is a chronic metabolic disorder characterized by persistent hyperglycemia due to defects in insulin secretion, insulin action, or both. Its global prevalence is rising rapidly, currently affecting around half a billion individuals worldwide, and is expected to increase further due to factors such as aging populations, urbanization, and life style changes [1]. Among the various complications associated with diabetes, diabetic foot (DF) is one of the most debilitating and costly clinical manifestations. DF includes a range of pathological conditions, such as infection, ulceration, and destruction of deep tissues in the foot, often occurring alongside neuropathy and peripheral arterial disease [2].

Epidemiological studies indicate that between 19% and 34% of individuals with diabetes will experience DF complications at somepoint in their lives, highlighting the substantial burden this condition places on health care systems globally [3].

The prevalence of diabetic foot ulcers (DFUs), a significant precursor to lower extremity amputation, is estimated to be around 6.3%. This condition is more commonly reported among male patients and those diagnosed with type 2 diabetes mellitus [4]. Surgical intervention is a critical aspect of managing complicated DF cases, particularly when conservative treatments are ineffective or when there is progression to severe infection or gangrene [5]. Surgical options vary from debridement of necrotic tissue to partial or complete amputation of the affected limb. It is important to note that non-traumatic lower extremity amputations are primarily attributed to DFUs, underscoring the urgent need for effective perioperative management strategies for this patient population [6].

CITATION
Karahan M, Ozdes OO, Kina S, et al. The role of peripheral blocks in diabetic foot surgery: Is it comfort or a need?. Med Science. 2026;15(2):754-60.

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DOI: 10.5455/medscience.2025.10.264

Patients undergoing surgery for DF often present with multiple comorbidities, including cardiovascular diseases such as ischemic heart disease and heart failure, as well as chronic kidney disease. These comorbid conditions, along with the polypharmacy commonly observed in this group,—especially the use of antiplatelet and anticoagulantagents,—pose significant challenges during the perioperative period. General and spinal anesthesia, while widely used, may carry increased risks in these patients due to potential hemodynamic instability, respiratory complications, and interactions with ongoing medications. Moreover, the management of postoperative pain is of paramount importance, not only to ensure patient comfort but also to prevent the development of chronic painyndromes, which are particularly prevalent following amputations [7].

In this context, peripheral nerve blocks (PNBs) guided by ultrasound have gained increasing attention as a viable anesthetic alternative. Ultrasound guidance allows for real-time, non-invasive visualization of nerve structures and their surrounding anatomy, enhancing the accuracy and safety of nerve block procedures. This technique facilitates precise local anesthetic delivery, reduces the risk of complications, and improves block success rates. Additionally, PNBs provide superior hemodynamic stability compared with general or spinal anesthesia, which is especially beneficial in critically ill or medically complex patients. The reproducibility and safety profile of ultrasound-guided PNBs make them an attractive option for anesthetic management in DF surgeries [8].

Recent literature has emphasized the benefits of ultrasound-guided femoralnerve, sciatic nerve, and popliteal blocks in lower extremity surgeries, show casing improved postoperative analgesia, reduced opioid consumption, and a lower incidence of systemic complications. Despite these encouraging findings, there is still a pressing need for further comparative studies that assess the efficacy and safety of PNBs in relation to traditional anesthetic techniques within the DF surgery population [9,10]. This study hypothesizes that ultrasound-guided PNBs are not only safer but also more effective than general anesthesia in this high-risk group. The primary aim is to compare postoperative hemodynamic stability, analgesic requirements, and prognostic outcomes between patients receiving PNBs and those undergoing general anesthesia, thereby providing valuable evidence to inform anesthetic practices in DF surgery.

Material and Methods

This study took place in the orthopedics and trauma clinic of a tertiary care hospital, utilizing a retrospective cross-sectional design. It was approved by the Kafkas University Faculty of Medicine Ethics Committee Ethics Committee (No: 2025/01/17, Date: 03 January 2025), and was conducted in accordance with the Declaration of Helsinki.

A total of 66 patients who underwent DF surgery were included in this study, withdata collected from January 2023 to December 2024. Patients were selected through a systematic review of electronic medical records and anesthesia charts. The inclusion criteria consisted of adult patients diagnosed with DF complications that necessitated surgical intervention, those who had complete medical and anesthesia documentation available, and those classified under American Society of Anesthesiologists (ASA) physical status categories II to IV.

Patients with incomplete medical records, those who underwent emergency procedures where a detailed anesthetic evaluation was not feasible, those who had lower extremity surgery within one month prior, and those requiring a second surgery within the first three days postoperatively were excluded from the study. The patient selection process is depicted in the following flow chart (Figure 1).

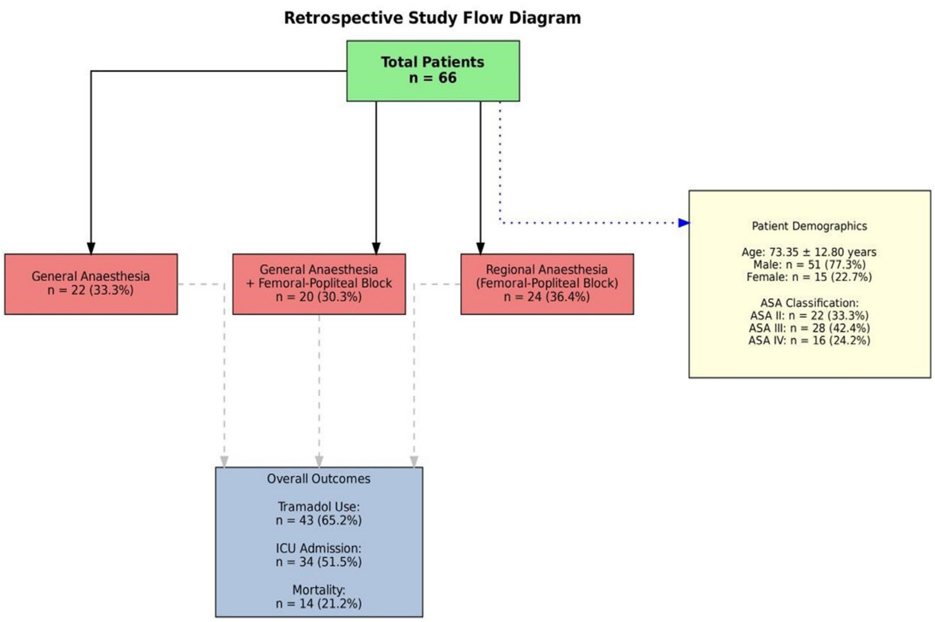

Figure 1. Flow chart illustrating the patient selection process and study design

DOI: 10.5455/medscience.2025.10.264

Demographic information (age, gender), ASA scores, anesthesia method used, opioid analgesic use in the first 24 hours after surgery, length of hospital stay, need for postoperative intensive care, and cases of postoperative in-hospital mortality were retrospectively recorded from patient files.

Statistical Analysis

Statistical analysis was performed using SPSS version 28.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics included counts (n) and percentages (%) for qualitative data. For quantitative data, means ± standard deviations were reported for data that adhered to a normal distribution, while medians and the 1st to 3rd quartiles were used for data that did not exhibit a normal distribution. The Shapiro-Wilk test was employed to assess the normality of the quantitative data. The Chi-square test was utilized for evaluating categorical variables. Differences between two independent groups were analyzed using the Student's t-test for normally distributed data and the Mann-Whitney U test for non-normally distributed data. The Kruskal-Wallis test was employed to compare non-normally distributed continuous variables across more than two groups. A p-value of less than 0.05 was deemed statistically significant. Sample size calculations indicated that, based on an expected block success rate of 90%, a margin of error of 5%, and a 95% confidence level, a minimum sample size of 62 patients was necessary.

Results

The average age of patients was determined to be 73.35 ± 12.80 years. Regarding gender distribution, a significant majority of the patients were male (77.3%). In the distribution of ASA scores, 42.4% (n=28) were classified as ASA 3, and 24.2% (n=16) as ASA 4. When examining the types of anesthesia administered, regional anesthesia Femoral-popliteal block (Fempop) was the most frequently used method, accounting for 36.4% (n=24) of the cases. Within the first 24 hours after surgery, tramadol was administered to 65.2% (n=43) of the patients. Approximately half of the patients, 51.5% (n=34), were admitted to postoperative intensive care, and 21.2% (n=14) experienced in-hospital mortality (Table 1).

Table 1. Patient demographics and postoperative outcomes

Variable	Number (n)	Percentage (%)
Age (mean ± SD)	73.35 ± 12.80	
Length of Hospital Stay (median, IQR)	9.00 (7.00–15.00)	
Gender		
Male	51	77.3
Female	15	22.7
ASA Score		
2	22	33.3
3	28	42.4
4	16	24.2
Anesthesia Type		
General Anesthesia	22	33.3
General Anesthesia + Femoral_Popliteal Block	20	30.3
Regional Anesthesia (Femoral_Popliteal Block)	24	36.4
Postoperative analgesia in first 24 Hours		
None	23	34.8
Tramadol	43	65.2
Postoperative intensive care		
No	32	48.5
Yes	34	51.5
Postoperative in-hospital mortality		
No	52	78.8
Yes	14	21.2

No statistically significant difference was observed in the average ages between patients who received tramadol (74.65 ± 13.12 years) and those who did not (70.91 ± 12.09 years) (p=0.262). In terms of gender distribution, the proportion of female patients in the tramadol group (32.6%) was notably higher compared to the group that did not receive tramadol (4.3%) (p=0.009). There was no significant difference in ASA scores between the two groups (p=0.622). The type of

DOI: 10.5455/medscience.2025.10.264

anesthesia administered had a statistically significant impact on tramadol usage (p<0.001). Specifically, all patients receiving general anesthesia also received tramadol, while only 51.2% of those who received tramadol underwent general anesthesia. Additionally, 73.9% of patients who received both general anesthesia and a Fempop did not receive tramadol, in contrast to 41.9% of patients who received regional anesthesia and were administered tramadol (Table 2).

Table 2. Comparison of patients with and withouttramadol in the first 24 hours after surgery

Variable	No Tramadol, n (%)	Tramadol n (%)	p-value
Age (mean ± SD)	70.91 ± 12.09	74.65 ± 13.12	0.262
Gender			
Male	22 (95.7)	29 (67.4)	0.009
Female	1 (4.3)	14 (32.6)	
ASA Score			
2	8 (34.8)	14 (32.6)	0.622
3	11 (47.8)	17 (39.5)	
4	4 (17.4)	12 (27.9)	
Anesthesia Type			
General Anesthesia	0 (0.0)	22 (51.2)	<0.001
General Anesthesia + FemPop	17 (73.9)	3 (7.0)	
Regional Anesthesia (FemPop)	6 (26.1)	18 (41.9)	

No statistically significant differences were observed in the average ages of patients admitted to the intensive care unit (ICU) (75.74 ± 10.91 years) compared to those who were not admitted (70.81 ± 14.29 years) (p=0.119). Additionally, no significant differences in gender distribution were detected between the two groups (p=0.873). There was also no statistically significant association found between ASA scores in the ICU-admitted and non-admitted groups (p=0.137). However, it is noteworthy that the proportion of patients with an ASA score of 4 was higher in the ICU-admitted group (32.4%) compared to the non-admitted group (15.6%). While no statistically significant relationship was identified between the type of anesthesia administered and ICU admission (p=0.180), the admission rate to the ICU was notably higher for patients who received general anesthesia combined with a Fempop (38.2%) compared to those who received regional anesthesia Fempop (26.5%) (Table 3).

Table 3. Comparison of patients with and without ICU admission

Variable	No ICU Admission, n (%)	ICU Admission, n (%)	p-Value
Age (mean ± SD)	70.81 ± 14.29	75.74 ± 10.91	0.119
Gender			
Male	25 (78.1)	26 (76.5)	0.873
Female	7 (21.9)	8 (23.5)	
ASA Score			
2	14 (43.8)	8 (23.5)	0.137
3	13 (40.6)	15 (44.1)	
4	5 (15.6)	11 (32.4)	
Anesthesia Type			
General Anesthesia	10 (31.3)	12 (35.3)	0.180
General Anesthesia + FemPop	7 (21.9)	13 (38.2)	
Regional Anesthesia (FemPop)	15 (46.9)	9 (26.5)	

No statistically significant difference was found in the average ages between surviving patients (73.75 ± 13.95 years) and those who died (71.86 ± 7.27 years) (p=0.627). Additionally, the gender distribution did not reveal significant differences between the groups (p=0.117). However, a statistically significant relationship was identified between ASA scores and postoperative mortality (p=0.004). Notably, none of the patients with an ASA score of 2 died, while 28.6% of patients with an ASA score of 3 and 37.5% of those with an ASA score of 4 did not survive. No statistically significant association was found regarding the type of anesthesia administered and postoperative mortality (p=0.175) (Table 4).

Table 4. Comparison of patients with and without postoperative mortality

Variable	No Death (n, %)	Death (n, %)	p-value
Age (mean ± SD)	73.75 ± 13.95	71.86 ± 7.27	0.627
Gender			
Male	38 (74.5)	13 (25.5)	0.117
Female	14 (93.3)	1 (6.7)	
ASA Score			
2	22 (100.0)	0 (0.0)	**0.004**
3	20 (71.4)	8 (28.6)	
4	10 (62.5)	6 (37.5)	
Anesthesia Type			
General Anesthesia	18 (81.8)	4 (18.2)	0.175
General Anesthesia + FemPop	13 (65.0)	7 (35.0)	
Regional Anesthesia (FemPop)	21 (87.5)	3 (12.5)	

Furthermore, there was no statistically significant difference in the median lengths of stay between age groups (10 and 9 days, respectively; p=0.894). Gender also did not have a significant impact on the length of stay (p=0.471). No statistically significant relationship was observed between ASA scores and length of hospital stay (p=0.142). Additionally, the type of anesthesia administered did not show a statistically significant difference in relation to the length of hospital stay (p=0.330) (Table 5).

Table 5. Length of hospital stay according to patient characteristics

Variable	Median (IQR)	p-value
Age		
<65	10 (7-15)	0.894
≥65	9 (7-14.5)	
Gender		
Male	9 (7-14)	0.471
Female	10 (7-21)	
ASA Score		
2	9.5 (7-14)	0.142
3	9 (6-12)	
4	11 (8.5-23.5)	
Anesthesia Type		
General Anesthesia	10.5 (5-15)	0.330
General Anesthesia + FemPop	9 (7-9.5)	
Regional Anesthesia (FemPop)	10.5 (7-19.5)	

Discussion

Diabetic foot is among the most severe complications of diabetes, profoundly diminishing quality of life, with an increasing proportion of cases necessitating surgical intervention [1,2]. As evidenced by our study, a significant number of patients undergoing surgery for DF are elderly and present with multiple comorbidities. In this patient population, effective anesthesia management is crucial due to the elevated perioperative risk [3,4].

Both general and spinal anesthesia can result in considerable hemodynamic fluctuations and systemic complications, especially in patients with cardiac and renal comorbidities [5,6]. In our study, patients who underwent general anesthesia displayed a significantly greater postoperative requirement for opioids (tramadol) and a higher demand for intensive care. This finding aligns with existing literature, which indicates that general anesthesia is linked to increased analgesic needs and a greater risk of complications during the postoperative period [8,9].

Peripheral nerve blocks, especially when performed under ultrasound guidance, offer a safe and effective alternative to anesthesia in DF surgery [10,11]. In our study, postoperative tramadol requirements and needs for intensive care were significantly lower in patients who received regional anesthesia.

This finding aligns with those reported by Lin et al. [7] and Ln et al. [12], suggesting that peripheral blocks improve hemodynamic stability and minimize postoperative complications.

Another noteworthy advantage of PNBs is their effectiveness in managing postoperative pain. In our study, the reduced requirement for opioids in patients receiving regional anesthesia also helps mitigate opioid-related side effects, such as nausea, vomiting, and respiratory depression [13,14]. Furthermore, effective pain management is crucial in preventing the development of chronic pain following amputation [15].

Our study also revealed that mortality rates were significantly higher in patients with elevated ASA scores. This finding reinforces the preference for regional anesthesia techniques in high-risk patients [16,17]. Additionally, robust evidence in the literature indicates that peripheral blocks are safer than general anesthesia for patients with high ASA scores and contribute to reduced mortality rates [18].

The success and complication rates of peripheral blocks are significantly enhanced when procedures are performed under ultrasound guidance [19]. In our study, no major complications related to the blocks were observed. However, the literature mentions that complications such as nerve damage, hematoma, and infection can occur, albeit infrequently [20,21]. Therefore, it is essential for these blocks to be performed by skilled practitioners with appropriate patient selection.

The phenomenon of "rebound pain" following peripheral blocks is another critical topic of discussion. Although our study did not report such an occurrence, some research suggests that severe pain may arise once the effects of the block wear off, necessitating additional an algesics [22]. Consequently, the adoption of multimodal analgesia strategies during the postoperative period is recommended [23]. In our study, no significant difference was found between the type of anesthesia and the duration of hospital stay concerning length of stay and recovery rate. However, the literature indicates that mobilization typically begins earlier in patients who receive peripheral blocks, potentially leading to a shorter hospital stay [24,25].

In clinical practice, national and international guidelines recommend regional anesthesia for high-risk patients undergoing DF surgery. Particularly for patients using antithrombotic medications, adherence to current guidelines is necessary to ensure the safe application of peripheral blocks [26]. In the future, the efficacy and safety of peripheral blocks can be further improved with new local anesthetic agents, long-acting block techniques, and catheter applications. In addition, a multidisciplinary team approach for preoperative assessment and personalized anesthesia planning will improve clinical outcomes [27].

In conclusion, PNBs are emerging not only as a comfort measure but also as a clinical necessity in DF surgery. To maintain hemodynamic stability and optimize postoperative analgesia, regional anesthesia is preferred, especially in high-risk patients [28]. Based on the findings of our study and the current literature, PNBs should become standard practice in DF surgery.

Study Limitations

Some limitations of this study include being a single-center study and having a retrospective cross-sectional design, which complicates the establishment of cause-and-effect relationships. Additionally, the relatively small sample size may restrict the generalizability of the findings. Variations in patients, anesthesia practices and patient management could affect the homogeneity of the results.

Conclusion

Our study demonstrates that ultrasound-guided PNBs provide superior hemodynamic stability compared with general anesthesia, reduce opioid consumption, and decrease rates of intensive care unit admission for DF surgery. Especially in high-risk patients with elevated ASA scores, regional anesthesia significantly reduces morbidity and mortality. When performed by experienced clinicians with appropriate patient selection, PNBs should be regarded as the standard anesthesia approach in DF surgery. The future integration of long-acting local anesthetics and multimodal analgesia protocols holds promise for further improvements in patient outcomes. Adherence to current guidelines and a multidisciplinary approach remain fundamental for optimizing safety and effectiveness.

Ethical Approval

Approved by the Kafkas University Faculty of Medicine Ethics Committee Ethics Committee (No: 2025/01/17, Date: 03 January 2025).

Patient Consent

Written informed consent was waived due to the retrospective study.

Conflict of Interest

The authors declare no conflict of interest.

Funding

The authors received no financial support for this study.

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DOI: 10.5455/medscience.2025.10.264

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