

Comparison of popliteal anesthesia and spinal anesthesia in patients with the diabetic foot: Our clinical series

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Abstract

Aim: Surgery is of great importance in the treatment of diabetic foot. We aimed to compare unilateral spinal anesthesia and ultrasound-guided popliteal block procedures in patients diagnosed with a diabetic foot ulcer.

Materials and Methods: In this study, we included 54 patients diagnosed with diabetic foot ulcers in our hospital between September 2010 and December 2012. The patients were randomly divided into two groups of 27 patients each: Group I (Spinal group) and Group II (Popliteal group). Spinal anesthesia was performed in Group I, whereas ultrasound-guided popliteal block was performed in Group II. During and after the anesthesia, the total isotonic fluid given, average patient and surgeon satisfaction score, and length of hospital stay were evaluated.

Results: In Group I, the average length of hospital stay was 6.07 ± 1.2 days, the total isotonic fluid given was 1832.2 ± 280.7 ml, and the average patient and surgeon satisfaction score was 2.44 ± 0.5 .

In Group II, the average length of hospital stay was 6.5 ± 1.04 days, the total isotonic fluid given was 731.11 ± 130.2 ml, and the average patient and surgeon satisfaction score were 3. In addition, in Group I, 9 patients had bradycardia and 12 patients had hypotension and nausea. The findings of the study indicate a statistically significant difference in terms of the total isotonic fluid given and average patient and surgeon satisfaction scores ($p < 0.05$). However, no statistically significant difference was observed in terms of hospital stay ($p > 0.05$).

Conclusion: In conclusion, we believe that ultrasound-guided popliteal block provides more reliable and efficient analgesia than spinal anesthesia in patients with diabetic foot ulcers.

Keywords: Diabetic foot ulcers; diabetes mellitus; spinal anesthesia; ultrasound-guided popliteal block

INTRODUCTION

The global prevalence of diabetic foot is 6.4% (1). Approximately 15%–20% of patients with diabetes are at risk of developing diabetic foot throughout their lives (2,3). Furthermore, approximately 20%–33% of costs associated with diabetes mellitus (DM) are used for treatments of diabetic foot (3,4). Wounds that were initially insignificant due to polyneuropathy may be serious enough to require amputation at a later stage (5).

It has been acknowledged that regional anesthesia is more advantageous than general anesthesia in diabetic foot surgery because patients with diabetes are generally in the elderly population and often accompanied by systemic diseases that cause organ dysfunction, such as peripheral artery disease and cardiovascular diseases (6,7).

Regional anesthesia is preferred in plastic surgery in diabetic foot surgery due to the aforementioned causes

and less postoperative complications. Nonetheless, spinal anesthesia is the frequently applied method (8); however, its effectiveness is controversial. Ozturk et al. stated that the effectiveness of spinal anesthesia decreases in patients with diabetes compared to the normal population (9).

Depending on the wound location, there is no common consensus regarding the applied method of anesthesia, although regional anesthesia is more often used than spinal anesthesia. Hossaray et al. compared spinal anesthesia with lateral approach popliteal anesthesia in patients with diabetic foot in terms of block times and patient satisfaction (10). However, the length of hospital stay, amount of fluid delivered, and surgeon's satisfaction were not considered.

We aimed to compare the effect of spinal anesthesia and popliteal block procedures in terms of length of hospital

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stay, patient and surgeon satisfaction, and the total isotonic fluid given in patients hospitalized with a diabetic foot ulcer in our hospital.

MATERIALS and METHODS

This is a retrospective study conducted between September 2010 and December 2012. The data were collected retrospectively. This study was approved by Istanbul Aydin University local ethics committee (2021-011) and this study was conducted in accordance with the Declaration of Helsinki. Written informed consent was obtained from all patients before the surgery. Patients with additional diseases other than DM were excluded from the study. The American Society of Anesthesiologists physical status of the patients was III-IV.

In this study, we included 54 patients diagnosed with diabetic foot ulcers. The patients were divided into two groups of 27 patients each: Group I (Spinal group) and Group II (Popliteal group). Spinal anesthesia was performed in Group I, whereas ultrasound-guided popliteal block was performed in Group II.

The preoperative and perioperative pulse and blood pressure of the patients were evaluated. Furthermore, intraoperative glucose–insulin–potassium solution was used for blood glucose regulation in the patients. The patients' preoperative blood glucose levels were less than 185 mg/dl.

In Group I, we observed the patients' pulse, oxygen saturation, and blood pressure using electrocardiography (ECG) and performed invasive blood pressure and pulse oximeter monitoring. In the preoperative period, we established vascular access with a 20 G cannula from the antecubital area and administered a 0.9% isotonic solution (10 ml/kg/hour) for hydration over 30 minutes. For premedication, 2 mg dormicum (Roche, Switzerland) was administered. When the patients were stabilized in the lateral decubitus position, we carried out skin disinfection using an antiseptic solution and a 25 G Spinocan needle to penetrate the subarachnoid spaces at L3–L4 or L4–L5. After we observed free cerebrospinal fluid flow, we injected the patients with 7.5 mg hyperbaric bupivacaine (Vem, Turkey) with 25 mcg fentanyl (Janssen, Belgium) in a total volume of 2 ml. The patients remained in this position for 15 minutes after the injection, followed by unilateral spinal anesthesia. Patients with sensorial block-level T12–L2 were ready for the surgery. Perioperatively, we maintained >95% SaO₂ by providing patients with 4 l/min O₂ using the mask.

On the contrary, in Group II, we performed invasive blood pressure and pulse oximeter monitoring before the ultrasound-guided popliteal block (SonoSite MicroMaxx ultrasound) (Figure 1). For maintenance fluid therapy, we established vascular access with a 20 G cannula from the antecubital area and infused 0.9% isotonic solution. For premedication, 2 mg dormicum (Roche, Switzerland) was administered. With patients in the prone position, after popliteal skin disinfection using an antiseptic solution, we injected 5 ml 1% lidocaine (Emc, United Kingdom) as

a local anesthetic. During the block application, we used a 6–13 MHz frequency linear ultrasound probe and an 18 G 50 mm needle for all patients (Figure 2). We directed the needle to the nerve in the plane and injected a mixture of 10 ml 0.5% levobupivacaine (AstraZeneca, Turkey) and 5 ml 2% lidocaine (Emc, United Kingdom) around the nerve after confirmation using a neurostimulator (although paresthesia or motor response is preferred, it is not necessary, but without these findings block efficiency diminishes)(Figure 3). We then pushed forward a 3–4-cm catheter along the nerve and injected 2–3 ml of local anesthetic. We verified the catheter's position using ultrasound and obtained catheter immobilization. After 15 minutes, anesthesia was achieved, and we assessed the sensorial block (pinprick and heat-cold test) and motor block (modified Bromage Scale) scores in both groups (Table 1) (11).



Figure 1. Ultrasound Device

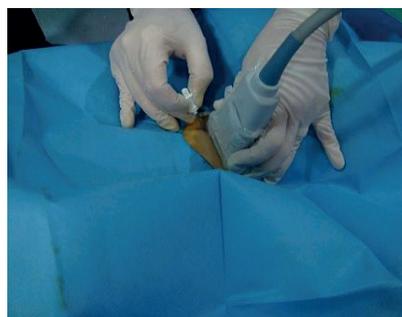


Figure 2. 6–13 MHz frequency linear ultrasound probe and an 18 G 50 mm needle

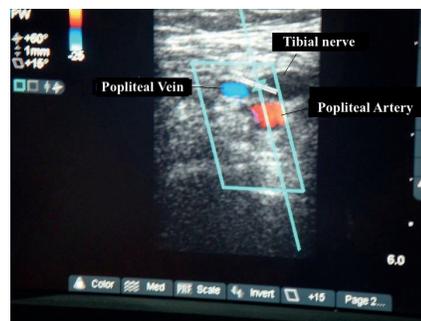


Figure 3. Image of popliteal area in ultrasound

Table 1. Modified bromage scale

| Grade | Criteria | Degree of Block |
|-------|--|--------------------|
| I | Free Movement of legs and feet | None |
| II | Just able to flex knees with free movement of feet | Partial 33% |
| III | Unable to flex knees, but with free movement of feet | Partial 66% |
| IV | Unable to move legs or feet | Complete paralysis |

Surgical procedures were then performed for each patient. In addition, the popliteal catheters were used for postoperative analgesia applications. For all patients, pulse and blood pressure were evaluated preoperatively and perioperatively.

Postoperatively, to assess the quality of analgesia, as well as the patient's and surgeon's satisfaction, the four-point scale was used (Table 2) (12). The total amount of fluid delivered to the patients in both groups and the average length of their hospital stays were calculated.

Table 2. The four-point scale

| Satisfaction | Score |
|--------------|-------|
| Poor | 0 |
| Fair | 1 |
| Good | 2 |
| Excellent | 3 |

For statistical analysis, we employed SPSS (IBM SPSS Statistics for Mac, Version 21.0, IBM Corp., USA) to perform the data analysis. The distributions of variables and normality were checked using the Kolmogorov–Smirnov test. Mean ± standard deviation (SD), median, and interquartile range values were used for descriptive statistics. To analyze the ordinal parameters, the Mann–Whitney U test was employed. For the parametric variables, one-sample and paired samples t-tests were used for the analysis. A p-value <0.05 was considered to reach statistical significance.

RESULTS

The findings of our study suggested that in Group I (20 [76%] male; 7[24] female), the average age and SD were 55.1(69-39) ± 7.1, respectively, and the average length of hospital stays and the SD was 6.07 (9-4) ± 1.2, respectively. Furthermore, in this group, the fluid was administered both pre and perioperatively. The total mean isotonic fluid was given, and the SD was 1832.2 (2300–1300) ± 280.7 ml, respectively. The average patient's and surgeon's satisfaction scores and SD were 2.44 ± 0.5, respectively (Table 3). Nine patients had bradycardia and 12 patients had hypotension and nausea (Table 4). For patients with hypotension, 500 cc Hydroxyethyl starch (Voluven®,

Fresenius Kabi, Turkey) and 10 mg Ephedrine (Sandoz, Turkey) was administered and 15 mg Ephedrine was administered for patients maintenance isotonic solutions. For patients with bradycardia, 0.5 mg Atropine Sulfate (AtroPen®, Meridian, USA) was given intravenously.

In Group II (19 [70.3%] male; 8[29.7%] female), the average age and SD were 55.9 (72-38) ± 6.8, respectively. The average length of hospital stays and the SD was 6.5 (9-5) ± 1.04, respectively. In this group, the fluid was only given preoperatively. The total mean isotonic fluid was given, and the SD was 731.11(1000-500) ± 130.2 ml, respectively. The average patients' and surgeon's satisfaction scores were 3, respectively (Table 3). There were no complications observed in this group.

There was a statistically significant difference in terms of the total fluid given (Figure 4) and the average patient's and surgeon's satisfaction scores (p < 0.05). However, there was no statistically significant difference in terms of hospital stay (p > 0.05).

Table 3. Results of parameters

| Mean ±Sd | Group I (Spinal) N=27 | Group II (Popliteal) N=27 | p value |
|---|-----------------------|---------------------------|---------|
| Hospital Stay(Day) | 6.07 ±1.2 | 6.5 ±1.04 | 0.09 |
| Total Given Fluid(cc) | 1832.2±280.7 | 731.11±130.2 | <0.01* |
| Patient's and Surgeon's satisfaction scores | 2.44 ±0.5 | 3 | 0.04* |

***: There was a statistically significant difference between the two groups**

Table 4. Table of complications

| Side Effect | Group I (Spinal) N:27 | Group II (Popliteal) N:27 |
|-------------|-----------------------|---------------------------|
| Bradycardia | 9(33%) | - |
| Hypotension | 12(44%) | - |
| Nausea | 12(44%) | - |

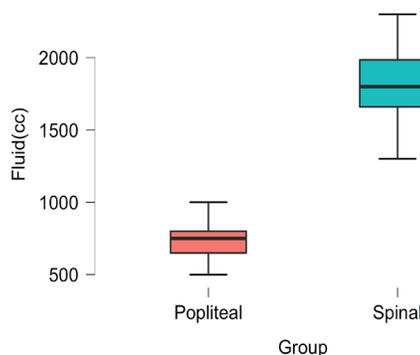


Figure 4. The Graphic of total given fluid

DISCUSSION

The main goal in patients with diabetes is to prevent undesirable consequences, such as hypoglycemia, hyperglycemia, protein breakdown, electrolyte imbalance, ketoacidosis, glycosuria, and osmotic diuresis by maintaining the blood sugar level between 80 and 200 mg (13). In addition, with events such as infection, sepsis, liver disease, obesity, alcohol use, stress, pain, and cardiovascular surgery in the perioperative and postoperative period, it should be considered that using drugs such as corticosteroids, thyroid drugs, oral contraceptives, thiazide diuretics also increases the need for insulin.

Surgical treatment for diabetic patients is crucial to improve the patients' quality of life (14). General anesthesia is not preferred due to concomitant diseases and systemic effects of diabetes. Edema and infection around the wound may not allow anesthesia at the midtarsal or ankle level. Fortunately, due to the suitability of the anatomy of the lower limb, different levels of neuron blockade such as hip knee epidural/spinal are possible (15). Spinal anesthesia is a technique commonly used in lower extremity surgeries (6), and it is advantageous compared to general anesthesia. It reduces intraoperative blood loss and postoperative thromboembolic incidence; morbidity in high-risk patients also provides continued analgesia in the postoperative period. In this technique, changes can be seen, especially in the cardiovascular system. During the sympathetic block, arterial vasodilation, peripheral reflex vasoconstriction, bradycardia, and hypotension may occur. Different regional anesthetics have been used in diabetic foot since the complications of spinal anesthesia, and the effect on patients with diabetes has reportedly decreased (9,16).

Popliteal anesthesia is one of these applications. In peripheral nerve block applications, ultrasound (USG) is increasingly used in recent years because the spread of nerves, surrounding tissues, needle, and the injected local anesthetic could be seen. This significantly reduced the complication rate.

Block techniques have been applied with USG. It has been found that it decreases visual analog scale values, reduces opioid consumption, has no negative effects on nausea and sedation, does not affect hemodynamics, suppresses stress hormones, and achieves higher block success. Blocks made with USG are preferred because they are faster and easier to apply and less damage to vascular structures, reducing the amount of local anesthetic used.

Acute hemodynamic changes that may occur with spinal blocks with popliteal block were also avoided. Nerves (tibial and peroneal) blocked in the popliteal fossa are the extensions of the sciatic nerve. The main use of a popliteal block is foot and ankle surgery. Since sensory blockade of the medial lower leg and ankle is provided with the saphenous nerve block, adding this block to most patients who undergo popliteal block provides more convenience in the use of tourniquets and medical ankle surgery.

There are studies in the literature comparing popliteal anesthesia and spinal anesthesia in diabetic and non-diabetic patients. The studies compared popliteal and spinal anesthesia in hallux valgus surgery, and Jeon et al. showed that the duration of anesthesia was higher in popliteal anesthesia (17). Hossaray et al. compared spinal anesthesia and popliteal anesthesia, but did not evaluate in terms of hospital stay, amount of fluid delivered, and patient / surgeon satisfaction (10).

In our study, we compared the effects of popliteal and spinal anesthesia in diabetic patients hospitalized in our clinic in terms of hospital stay, amount of fluid delivered, and patient/surgeon satisfaction. Hyperbaric bupivacaine and fentanyl doses in the spinal anesthesia group were made in accordance with the study of Talwar et al. (18). They stated that the combination of fentanyl with bupivacaine is a motor and sensorial appropriate combination in the lower limb anesthesia. In patients with popliteal block, the method was performed in accordance with the medications and doses used by Kim et al. (16). There was a significant difference between the two groups in terms of total fluids given. Giving little fluid is an important advantage in popliteal anesthesia. Fluid loading may cause adverse effects, especially in patients with heart failure or end-organ failure (19). Patient and surgeon satisfaction was found to be significantly higher in the group undergoing popliteal anesthesia where wound healing fastens (19).

The length of hospital stay is associated with the condition of the patient after the operation. If the operation develops at the desired level with no complication, the patients are discharged as soon as possible. There is a positive correlation between hospital stay and cost (20). Although the length of hospital stay in patients receiving spinal anesthesia is less than that of the popliteal group, this difference is not significant. Thus, it was observed that popliteal anesthesia was more useful in diabetic foot surgery than spinal anesthesia. In addition, bradycardia and hypotension are important disadvantages in spinal anesthesia.

LIMITATIONS

There are some limitations to our study. The number of samples can be increased. Other than popliteal methods of anesthesia or different drug doses can be compared. The number of parameters compared could be increased.

CONCLUSION

In conclusion, popliteal anesthesia has shown to be more advantageous compared to spinal anesthesia in the treatment of diabetic foot surgery. We believe that our study will shed light on future studies in this field.

Competing Interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical Approval: This study was approved by Istanbul Aydin University local ethics committee (2021-011) and this study was conducted in accordance with the Declaration of Helsinki.

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