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Ultrasound Guided Peripheral Nerve Blocks for Emergency Below Knee Amputations - A Case Series

Aswini Lakshmi Narasimhan[1], Savitha Velayutham[2]

[1]Associate Professor, Department of Anesthesiology, ESIC Medical College and Hospital, Chennai, Tamil Nadu, India
[2]Senior Resident, Department of Anesthesiology, ESIC Medical College and Hospital, Chennai, Tamil Nadu, India

Corresponding Author: Dr. Aswini Lakshmi Narasimhan

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ABSTRACT

Background: Below-knee amputation (BKA) and distal lower limb wound debridement are frequently performed in patients with diabetes, peripheral vascular disease, and multiple systemic comorbidities. These patients often carry high perioperative risk, rendering general or neuraxial anesthesia challenging. Peripheral nerve blocks (PNBs) have emerged as a safe and effective alternative anesthetic approach.
Methods: This case series included patients undergoing BKA or lower limb wound debridement in whom ultrasound-guided lower limb PNBs were used as the primary anesthetic technique. The sciatic nerve block was combined with either femoral or saphenous nerve block. Intraoperative hemodynamics, adequacy of surgical anesthesia, need for supplemental analgesia, and postoperative pain scores were prospectively recorded.
Results: All patients achieved adequate surgical anesthesia with stable intraoperative hemodynamics. PNBs provided effective perioperative and postoperative analgesia, reducing opioid requirements and enhancing patient comfort. No major complications were observed. Ultrasound guidance facilitated precise nerve localization and improved block success. Limitations included the need for technical expertise and occasional requirement for supplemental analgesia.
Conclusion: Ultrasound-guided lower limb PNBs are a safe, effective, and reliable anesthetic technique for BKA and lower limb wound debridement, offering excellent intraoperative anesthesia and postoperative analgesia. Larger prospective studies are warranted to further evaluate their efficacy and long-term outcomes.
Keywords: Below-knee amputation, Peripheral nerve block, Sciatic nerve block, Femoral nerve block, Saphenous nerve block, Ultrasound guidance, Postoperative analgesia

INTRODUCTION

Procedures such as below-knee amputation and wound debridement are commonly performed in patients who have end-stage peripheral vascular disease, diabetes mellitus, and other systemic comorbid medical conditions. These patients often have a compromised cardiovascular or respiratory status, which makes the anesthetic management of these patients using a general or neuraxial anesthetic technique potentially problematic [1]. As an alternative anesthetic technique for the management of these patients, a peripheral nerve block anesthetic technique is proposed. The sciatic nerve block anesthetic technique,

in combination with the femoral nerve block anesthetic technique or the saphenous nerve block anesthetic technique, will be able to provide the required surgical anesthesia for the management of the patient who requires a below-knee amputation. The increasing popularity of the ultrasound technique for the guidance of nerve block anesthetic procedures has greatly enhanced the accuracy of nerve localization. This will be able to improve the visualization of the surrounding anatomical structures [2]. This case series will be able to demonstrate the efficacy of the ultrasound technique for the guidance of the lower limb nerve block anesthetic technique.

CASE SERIES

Case 1: A 60-year-old male, known case of type 2 diabetes mellitus for 20 years on insulin, with chronic smoking and alcohol use, presented with progressive left foot gangrene. He had a history of left 2nd toe ray amputation and 3rd and 4th toe ray amputations one week prior. On examination, gangrene of the left great toe with plantar slough was noted. The limb was cold with absent dorsalis pedis, anterior tibial, and posterior tibial pulses, suggestive of critical limb ischemia. DSA showed complete occlusion of mid and distal ATA and PTA at the ankle, not amenable to angioplasty. CT angiography revealed >50% stenosis of PTA and DPA with preserved proximal flow. Investigations revealed a hemoglobin of 8 g/dL, platelets of 70,000/mm³, INR of 2.0, (coagulopathy) serum creatinine of 2.2 mg/dL, ECG showed LVH with ST-T changes suggestive of ischemia, chest X-ray had bilateral lower zone infiltrates suggestive of infection. He was diagnosed as a case of left lower limb PAOD with critical limb ischemia and sepsis. In view of coagulopathy, active cardiac ischemia, pulmonary infection, and non-salvageable limb, patient was planned for left below-knee amputation under regional anesthesia, accepted under ASA IV (high risk). Under standard monitoring, ultrasound-guided femoral and sciatic nerve block was administered. Adequate sensory and motor block achieved. Intraoperative period was uneventful with stable hemodynamics, minimal blood loss, and no vasopressor requirement. Patient remained hemodynamically stable in the immediate postoperative period with adequate analgesia, no respiratory distress, and was shifted to ICU for close monitoring in view of high-risk status.

Case 2: A 56-year-old male, known case of type 2 diabetes mellitus for 15 years, coronary artery disease, and heart failure with reduced ejection fraction (EF 35%), presented with a right lower limb ulcer following a self-ruptured blister. He had a history of right great toe amputation 2 years prior. On examination, a 1 × 1 cm ulcer with discharge was present over the medial right ankle. The limb showed hair loss and trophic skin changes suggestive of chronic ischemia. Doppler revealed monophasic distal flow. CT angiography showed poor distal run-off. X-ray was suggestive of osteomyelitis. Blood Investigations revealed a hemoglobin of 8.5 g/dL, elevated white cell counts and a platelet count of 80,000/mm³ with an INR of 1.9 and Creatinine of 2.0 mg/dL. ECG showed left ventricular hypertrophy, sinus rhythm and chest x ray was normal. It was diagnosed as right lower limb peripheral arterial occlusive disease (PAOD) with infected non-healing ulcer and osteomyelitis. In view of coagulopathy, severe LV dysfunction, and non-salvageable limb, right below-knee amputation was planned under regional anesthesia. Patient accepted under ASA III (high risk). Under standard monitoring, ultrasound-guided sciatic and femoral nerve block was administered. Adequate block achieved. Intraoperative period was uneventful with stable hemodynamics, minimal blood loss, and no vasopressor requirement. Surgery lasted approximately 90 minutes. The patient remained hemodynamically stable, pain well controlled, no respiratory distress, and shifted to HDU for monitoring.

Case 3: A 50-year-old male, known case of type 2 diabetes mellitus and systemic hypertension, presented with a non-healing ulcer over the left leg following local infection after trivial trauma. Local examination revealed a raw ulcer measuring 15 × 3 cm over the lateral aspect and another ulcer measuring 7 × 5 cm over the medial aspect of the left leg. The ulcer beds showed slough with unhealthy granulation tissue and minimal serous discharge. Peripheral vascular examination showed feeble dorsalis pedis and anterior tibial pulsations, suggestive of distal arterial insufficiency. Arterial Doppler demonstrated reduced distal limb perfusion without significant proximal occlusion. Investigations showed a hemoglobin – 9.6 g/dL, elevated blood glucose levels. Total leukocyte count, platelets, renal function tests, electrolytes and coagulation profile were within normal limits. Wound culture showed mixed bacterial growth. He was diagnosed as non-healing infected ulcer with diabetic vasculopathy. In view of poor response to conservative management and non-salvageable limb, left below-knee amputation was planned. Patient was optimized and accepted under ASA III (high risk). Under standard monitoring, ultrasound-guided femoral and sciatic nerve block was administered. Adequate block achieved. Intraoperative period was uneventful with stable hemodynamics and minimal blood loss. Immediate postoperative period was stable with adequate analgesia. Patient was shifted to postoperative ward for monitoring. The postoperative course was uneventful, and stump showed satisfactory healing on follow-up.

Case 4: A 58-year-old male with long-standing type 2 diabetes mellitus for 15 years and systemic hypertension, with associated coronary artery disease on medical management and chronic kidney disease, presented with progressive pain and non-healing ulcers over the right foot for two months. He had a history of chronic smoking and alcohol use with blackish discoloration of toes and difficulty in ambulation. Local examination revealed dry gangrene of the right great and second toes with a slough-covered plantar ulcer measuring 8 × 4 cm. The limb was cold with absent dorsalis pedis and posterior tibial pulses, suggestive of critical limb ischemia. Arterial Doppler showed diffuse atherosclerotic disease with markedly reduced distal arterial flow. Investigations showed a hemoglobin – 9.8 g/d, mild leukocytosis, serum creatinine of 1.9 mg/dL, Platelets, electrolytes, coagulation profile were within acceptable limits. Blood glucose was poorly controlled. ECG showed LVH with ischemic ST–T changes. Chest X-ray had features of chronic bronchitis This was diagnosed as right lower limb peripheral arterial occlusive disease with diabetic foot gangrene. In view of non-salvageable limb and multiple comorbidities, right below-knee amputation was planned. Patient was optimized and accepted under ASA III (high risk). Under standard monitoring, ultrasound-guided femoral and sciatic nerve block was administered. Adequate block achieved. Intraoperative period was uneventful with stable hemodynamics and minimal blood loss. Immediate postoperative period was stable with adequate analgesia and no respiratory distress. Patient was shifted to postoperative ward for monitoring. Postoperative recovery was uneventful, and stump showed satisfactory healing on follow-up.

Case 5: A 63-year-old male with long-standing type 2 diabetes mellitus (18 years), chronic kidney disease (Stage III), and carcinoma esophagus on palliative therapy, presented with progressive pain and non-healing ulcer over the right foot for one month. He had associated weight loss, poor oral intake, and generalized weakness. There was a history of chronic smoking and alcohol use. Local examination revealed gangrene of the right great and second toes with a slough-covered plantar ulcer measuring 8 × 4 cm. The limb was cold with absent dorsalis pedis and posterior tibial pulsations, suggestive of critical limb ischemia. Arterial Doppler

showed diffuse peripheral arterial disease with markedly reduced distal arterial flow. Investigations revealed a hemoglobin – 8.5 g/dL , mild leukocytosis , platelet count of 90,000/mm³ , creatinine of 2.3 mg/dL , blood urea of 72 mg/dL , blood glucose – poorly controlled , ECG showed LVH with nonspecific ST-T changes ,Chest X-ray had mild bilateral basal infiltrates .Diagnosed as right lower limb peripheral arterial occlusive disease with diabetic foot gangrene in a patient with chronic kidney disease and carcinoma esophagus. In view of non-salvageable limb, poor nutritional status, and multiple comorbidities, right below-knee amputation was planned. Patient was optimized and accepted under ASA III (high risk). Under standard monitoring, ultrasound-guided femoral and sciatic nerve block was administered. Adequate block achieved. Intraoperative period was uneventful with stable hemodynamics and minimal blood loss. Immediate postoperative period was stable with adequate analgesia. Patient was shifted to HDU for close monitoring in view of CKD and malignancy. Postoperative recovery was uneventful, and stump showed satisfactory healing on follow-up.

Table 1: Age, clinical history, and investigation details

S. No	Age/Sex	Diagnosis	Key Clinical Features	Investigations	Comorbidities	ASA	Outcome
1	60/M	Left PAOD with gangrene and sepsis	Progressive foot gangrene, prior toe amputations, absent distal pulses	Hb 8 g/dL, Platelets 70,000, INR 2.0, Creatinine 2.2	DM, smoking, alcohol use	IV	Stable, shifted to ICU
2	56/M	Right PAOD with infected ulcer	Non-healing ankle ulcer, trophic changes	Hb 8.5 g/dL, Platelets 80,000, INR 1.9, Creatinine 2.0	DM, CAD, Low EF	III	Stable, shifted to HDU
3	50/M	Left diabetic vasculopathy	Large non-healing ulcers, feeble pulses	Hb 9.6 g/dL, elevated glucose	DM, HTN	III	Uneventful recovery
4	58/M	Right PAOD with gangrene	Toe gangrene, plantar ulcer	Hb 9.8 g/dL, Creatinine 1.9	DM, HTN, CAD, CKD	III	Uneventful recovery
5	63/M	Right PAOD with gangrene	Gangrene with poor nutrition	Hb 8.5 g/dL, Platelets 90,000, Creatinine 2.3	DM, CKD, Ca esophagus	III	Stable, shifted to HDU

Hb: Hemoglobin, PAOD: Peripheral arterial occlusive disease, DM: Diabetes mellitus, HTN: Hypertension, CAD: Coronary artery disease, HFrEF: Heart failure with reduced ejection fraction, CKD: Chronic kidney disease, Ca: Carcinoma, INR: International normalized ratio, ECG: Electrocardiogram, CXR: Chest X-ray, HDU: High dependency unit, ICU: Intensive care unit, ASA: American Society of Anesthesiologists physical status classification

Table 2: ASA status, procedure done, intraoperative, and post-operative course

S. No	Age/Sex	ASA Status	Procedure Done	Intraoperative Course	Post-operative Course
1	60/M	IV	Left below-knee amputation under femoral + sciatic block	Hemodynamically stable, minimal blood loss, no vasopressors	Stable, adequate analgesia, shifted to ICU for monitoring
2	56/M	III	Right below-knee amputation under femoral + sciatic block	Stable vitals, minimal blood loss, surgery ~90 min	Stable, pain well controlled, shifted to HDU
3	50/M	III	Left below-knee amputation under femoral + sciatic block	Uneventful, stable hemodynamics, minimal blood loss	Stable, shifted to ward, satisfactory recovery

4	58/M	III	Right below-knee amputation under femoral + sciatic block	Stable intraoperative course, minimal blood loss	Stable, adequate analgesia, uneventful recovery
5	63/M	III	Right below-knee amputation under femoral + sciatic block	Uneventful, stable hemodynamics, minimal blood loss	Stable, shifted to HDU, satisfactory recovery
ASA: American Society of Anesthesiologists, HDU: High dependency unit, ICU: Intensive care unit					

DISCUSSION

Below-knee amputation (BKA) is one of the most commonly performed major lower limb amputations and is most frequently indicated for complications of diabetes mellitus, peripheral arterial disease, severe infection, and trauma. The global incidence of major lower limb amputation is estimated to range between 5-30 per 100,000 population annually, with diabetic foot complications accounting for a large proportion of cases [3]. Whenever feasible, BKA is preferred over above-knee amputation because preservation of the knee joint improves postoperative mobility, rehabilitation potential, and functional outcomes. Patients undergoing BKA or distal lower limb wound debridement often present with multiple comorbidities such as diabetes, cardiovascular disease, renal impairment, and sepsis, which significantly increase perioperative anesthetic risk [4]. The sensory innervation of the leg below the knee is primarily derived from the sciatic nerve and the saphenous branch of the femoral nerve. The sciatic nerve divides into the tibial and common peroneal nerves, supplying the posterior, lateral, and plantar aspects of the leg and foot, while the saphenous nerve provides sensory supply to the medial aspect of the leg down to the ankle. Therefore, adequate anesthesia for procedures such as BKA and lower limb wound debridement generally requires a combination of sciatic nerve block with femoral or saphenous nerve block to achieve complete dermatomal coverage of the operative field. These anatomical considerations form the basis for the use of lower limb peripheral nerve blocks as an effective anesthetic technique for distal leg surgeries [5].

All blocks were performed under strict aseptic precautions with standard ASA monitoring and intravenous access. Ultrasound-guided femoral and sciatic nerve blocks were administered. The femoral nerve was identified in the inguinal region lateral to the femoral artery using a high-frequency linear probe, and local anesthetic was deposited around the nerve. The sciatic nerve was identified using the popliteal approach, and local anesthetic was injected circumferentially under ultrasound guidance. Adequate sensory and motor blockade was confirmed prior to surgical incision.

A uniform local anesthetic regimen was followed for all patients using a combination of 0.5% bupivacaine and 2% lignocaine with adrenaline, with total dose calculated based on patient weight and within recommended maximum safe limits. The total volume was divided between femoral and sciatic nerve blocks to achieve adequate dermatomal coverage. Dexamethasone (4–8 mg) was used as an adjuvant in all patients to prolong duration of analgesia and improve block quality. Careful aspiration and incremental injection technique were followed to avoid intravascular injection and local anesthetic systemic toxicity [6].

Peripheral nerve blocks have increasingly been used as an alternative anesthetic technique for surgeries involving the distal lower limb, particularly in patients undergoing below-knee amputation or wound debridement who frequently present with multiple systemic comorbidities. Compared with general anesthesia, peripheral nerve blocks provide targeted anesthesia without airway manipulation and with minimal systemic drug exposure, thereby potentially reducing perioperative respiratory and cardiovascular complications [7]. Patients presenting for BKA often have limited cardiovascular reserve due to long-standing diabetes mellitus, peripheral

vascular disease, and ischemic heart disease, making them more
susceptible to hemodynamic fluctuations during anesthesia. In contrast to neuraxial anesthesia, which may produce sympathetic blockade and significant hypotension peripheral nerve blocks generally maintain better hemodynamic stability while still providing adequate surgical anesthesia [8]. An additional advantage of peripheral nerve blockade is the provision of effective perioperative and postoperative analgesia, which can significantly decrease opioid requirements and related adverse effects. Furthermore, previous studies have suggested that effective perioperative regional analgesia may reduce the incidence and severity of chronic
post-amputation pain and phantom limb pain, highlighting the potential long-term benefits of this technique in patients undergoing limb amputation [9].

In the present case series, lower limb peripheral nerve blocks were utilized as the main anesthetic technique for patients undergoing below-knee amputation and lower limb wound debridement, which proved to provide adequate intraoperative anesthesia with stable hemodynamic parameters. Peripheral nerve blocks provide anaesthesia by specifically targeting the nerves that provide innervation to the surgical site, thus avoiding any systemic physiological responses. These blocks are not only useful for surgical purposes, but they are also known to provide postoperative analgesia, which may reduce postoperative opioid requirements and improve postoperative comfort. Various studies have shown that nerve blocks involving sciatic nerve blocks with femoral or saphenous nerve blocks provide reliable anesthesia and satisfactory analgesia for surgical procedures involving the lower limb. In addition, with the increasing use of ultrasound guidance in nerve blocks, higher accuracy of nerve localization and spread of local anesthetic agents are being observed, thus increasing the success rates of nerve blocks and improving their safety [10].

Even though the results of this case series emphasize the efficacy of using lower limb peripheral nerve blocks for the surgical procedures of below knee amputation and wound debridement, there are a few disadvantages to be taken into consideration. Peripheral nerve block procedures demand the required technical skills, knowledge of the regional anatomy, and the availability of the required equipment, such as the use of an ultrasound machine, to attain the desired results [11]. Moreover, inadequate block coverage might be experienced in a few instances if the anesthetic coverage of the concerned nerve supply is not adequately anesthetized, which might necessitate the administration of supplementary analgesia or the change of anesthetic technique. The results of this study are also subject to the limitation of the small sample size of the patients included in the study. The results of this study emphasize the efficacy of using peripheral nerve block anesthetic technique for the required surgical procedures, which is a completely safe method for the patients undergoing the required surgical procedures [12]. Future prospective studies involving larger patient groups will also help to further elucidate the role of peripheral nerve blocks as a primary method of anesthesia in below-knee amputations and similar surgeries, and their overall impact on postoperative outcomes and chronic pain control.

CONCLUSION

This case series indicates that a combination of lower limb peripheral nerve blocks, including sciatic nerve block with femoral or saphenous nerve block, can provide effective anesthesia for below-knee amputation and distal lower limb wound debridement. The technique was found to provide adequate surgical conditions, hemodynamic stability, and satisfactory analgesia in patients with substantial comorbid conditions. Peripheral nerve blocks can potentially provide an effective alternative to general or neuraxial anesthesia in high-risk patients undergoing distal lower limb surgical procedures. Further investigations with a larger sample

size of patients are needed to confirm these results and assess their applicability.

Declaration by Authors

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