Journal of Health and Aging
Published online at https://tcsuckhoelaohoa.vn

Cases report

PERIPHERAL NERVE BLOCK ANESTHESIA FOR LIMB AMPUTATION IN PATIENTS WITH HEARTH FAILURE AND REDUCED EJECTION FRACTION

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ABSTRACT: Heart failure with reduced ejection fraction (EF) presents significant anesthetic risks during limb amputation, especially in patients with multiple comorbidities. This report describes two cases of male patients with Heart failure with reduced ejection fraction (HFrEF) with EF measured at 27% and 45% respectively, who underwent emergency limb amputation under ultrasound-guided peripheral nerve block (PNB). The first patient, with stage V chronic kidney disease (CKD), received a supraclavicular brachial plexus block using 20 mL of 0.35% ropivacaine. Sensory onset occurred at 5 minutes, motor onset at 25 minutes, and analgesia lasted 13 hours. The second patient received adductor canal and popliteal sciatic nerve blocks using 35 mL ropivacaine and IV dexamethasone. Sensory onset was 20 minutes, motor onset 25 minutes, and analgesia lasted 21 hours. Both patients remained awake and hemodynamically stable throughout surgery, with no complications. These cases highlight the safety and efficacy of PNB in high-risk cardiovascular patients. Adjusted dosing strategies, especially in renal impairment, allowed prolonged analgesia without toxicity. Compared to general or spinal anesthesia, PNB avoids airway manipulation and minimizes hemodynamic fluctuations.

Keywords: supraclavicular brachial plexus nerve block, adductor canal block, popliteal sciatic block, heart failure, limb amputation

Received: 20/09/2025 Accepted: 20/10/2025 Published: 27/02/2026

1. OVERVIEW

The selection and implementation of anesthesia in patients with heart failure with reduced ejection fraction remains challenging for anesthesiologists due to perioperative cardiovascular complications. We report 2 cases of peripheral nerve block for emergency limb amputation surgery in patients with heart failure with reduced EF of 27-45%.

Heart failure is a complex cardiovascular disorder characterized by impaired cardiac function, which profoundly compromises patients' tolerance to surgical interventions, such as those with a reduced ejection fraction (EF < 45%). The selection and management of anesthesia in patients with reduced EF heart failure remains highly challenging for anesthesiologists due to the substantial risk of perioperative cardiovascular complications. Compared to patients with coronary artery disease, those with heart failure exhibit a threefold increase in 30-day mortality (from 2.9% to 9.3%) and a 67% increase in 90-day mortalies [1].

A growing body of evidence indicates that peripheral nerve block anesthesia for upper extremity surgery confers significant advantages over general anesthesia with opioid administration. This approach has been shown to provide superior postoperative analgesia, reduce opioid consumption and the incidence of opioid-related adverse effects, while simultaneously eliminating the need for invasive airway manipulation [2-10]. When performed by experienced practitioners and under ultrasound guidance, this technique can achieve successful anesthesia in the majority of cases (94.2–100%), it allows for a reduction in local anesthetic volume, shortens onset time, and minimizes complication rates (0.4–1.7%), [3-5, 11, 12] even in patients receiving anticoagulant or antiplatelet therapy [10-13].

In addition, peripheral nerve block anesthesia for lower extremity surgery provides effective anesthesia with prolonged analgesic effects [7, 11, 14] while reducing pulmonary and hemodynamic complications, lowering mortality rates, decreasing the need for postoperative intensive care, and ultimately shortening both average hospital stay and hospitalization costs [8].

Therefore, ultrasound-guided peripheral nerve block represents an ideal anesthetic option for extremity surgeries, particularly in high-risk patients with hemodynamic instability such as those with heart failure [10, 12].

2. CASES PRESENTATION

2.1. The first case

A 63-year-old male (160 cm, 54 kg) was admitted with pain in the right third finger and first two toes, accompanied by dyspnea. His medical history included hypertension, dyslipidemia, coronary artery disease with prior Percutaneous Coronary Intervention (PCI) and three Drug-Eluting Stent (DES) placements, heart failure with reduced ejection fraction (EF 24%), poorly controlled type II diabetes mellitus, and stage V chronic kidney disease on maintenance hemodialysis.

Laboratory results showed elevated serum creatinine (345 μmol/L), reduced estimated glomerular filtration rate (eGFR) (16.67 mL/min), and high proBNP (>9000 pg/mL). Imaging revealed splenomegaly, bilateral chronic renal changes, and a large right pleural effusion. Echocardiography demonstrated severely impaired left ventricular systolic function (EF 27%), atrial and ventricular dilatation, global hypokinesia, severe tricuspid regurgitation, and elevated pulmonary artery systolic pressure (PAPs) at 40 mmHg). Tricuspid Annular Plane Systolic Excursion (TAPSE) was reduced (14 mm), indicating right ventricular dysfunction.

Vascular ultrasound of the right upper extremity showed distal radial and ulnar artery narrowing (1.8–2 mm) with mild atherosclerosis, and complete cephalic vein occlusion due to chronic thrombosis.

Following multidisciplinary consultation, the patient underwent semi-urgent right mid-forearm amputation under ultrasound-guided supraclavicular brachial plexus block using 20 mL of 0.35% ropivacaine. Sensory block onset was 5 minutes, motor block 25 minutes. The 74-minute procedure was well tolerated, with 13 hours of postoperative analgesia and stable hemodynamics throughout.

After 3 days of medical management in the Department of Nephrology–Dialysis with a diagnosis: Acute decompensated

chronic heart failure / Coronary artery disease status post 3 stent placements – Dry gangrene of the right third finger and the first and second toes of the right foot – Hypertension – Dyslipidemia – Poorly controlled type II diabetes mellitus – Stage V chronic kidney disease; we conducted a multidisciplinary consultation involving vascular–thoracic surgery, orthopedic surgery, and anesthesiology, and a consensus was reached to proceed with semi-urgent surgery for right mid-forearm amputation due to progressive infectious necrosis involving the entire right hand for this patient.

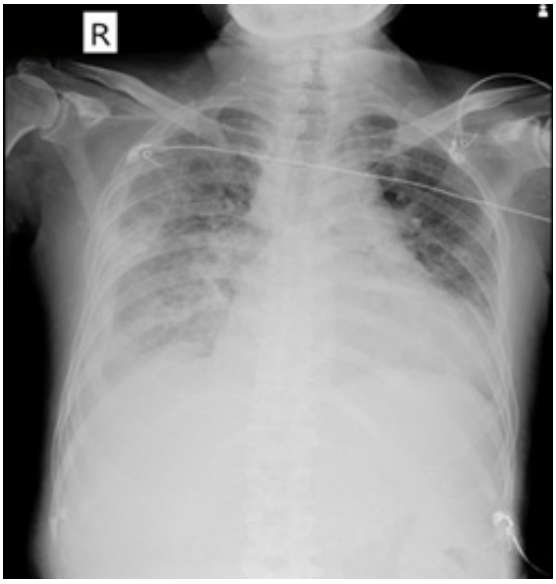

Figure 1. Chest X-ray (posteroanterior view)

Due to severe pain, the patient could not maintain an optimal position for axillary brachial plexus block. Therefore, we elected to perform an ultrasound-guided supraclavicular brachial plexus block using 20 mL of 0.35% ropivacaine (prepared by mixing 10 mL of 0.2% ropivacaine with 10 mL of 0.5% ropivacaine). The onset of sensory blockade was 5 minutes, while motor blockade occurred at 25 minutes. The surgical procedure lasted 1 hour and 14 minutes, during which the patient remained awake and hemodynamically stable. The duration of sensory analgesia was 13 hours.

The patient remained hospitalized for 12 days for wound management of dry gangrene in the first and second toes of the right foot and was discharged once his clinical condition had improved.

2.2. The second case

A 59-year-old male patient, height 165 cm and weight 60 kg, was admitted with a 14-day history of a right foot ulcer accompanied by severe leg pain. His past medical history included hypertension, dyslipidemia, heart failure with reduced ejection fraction (EF 40%), and poorly controlled type II diabetes mellitus.

Laboratory testing revealed proBNP > 9000. Vascular ultrasound of the lower extremities demonstrated > 70% stenosis of the left anterior tibial and dorsalis pedis arteries, as well as near-occlusion of the right anterior tibial and dorsalis pedis arteries.

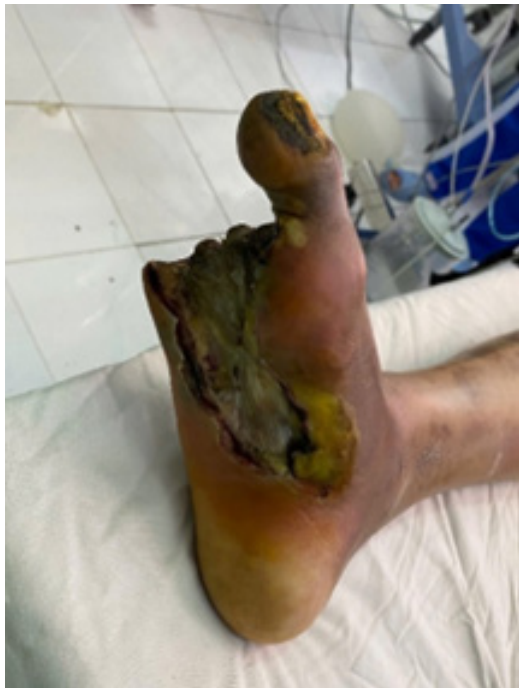

Figure 2. Extensive right foot ulcer

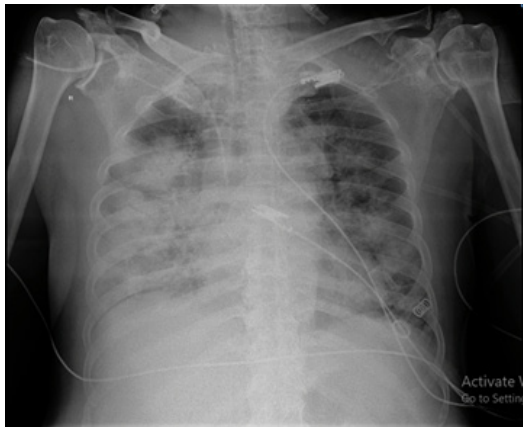

Figure 3. Chest X-ray (posteroanterior view)

After 10 days of medical management in the Department of Cardiothoracic Surgery with a diagnosis: Infected right foot ulcer / Heart failure with EF 45% – Lower extremity arterial stenosis – Type II diabetes mellitus, We conducted a multidisciplinary consultation involving infectious diseases, endocrinology, clinical pharmacy, and orthopedic surgery, and a decision was made to proceed with emergency surgery for right mid-leg amputation due to extensive necrotizing infection of the right foot, with concern for septicemia.

Preoperative transthoracic echocardiography demonstrated reduced left ventricular systolic function with an EF of 45% (Simpson method), mild-to-moderate mitral regurgitation (grade 1.5-2/4), mild tricuspid regurgitation (grade 1.5/4), reduced apical wall motion involving most left ventricular segments and TAPSE is approximately 18 mmHg, and pulmonary artery systolic pressure (PAPs) estimated at 40 mmHg.

The patient underwent ultrasound-guided adductor canal block with 15 mL of 0.2% ropivacaine, followed by ultrasound-guided popliteal sciatic nerve block in the left lateral decubitus position (performed after the patient was able to tolerate the supine position due to pain relief from the adductor canal block) using 20 mL of 0.5% ropivacaine. Intravenous dexamethasone 6,6 mg was administered after the blocks. The onset of sensory blockade was 20 minutes. The surgical procedure lasted 2 hours, during which the patient remained awake and hemodynamically stable. The duration of sensory analgesia was 21 hours.

The patient remained hospitalized for respiratory management of pneumonia and pleural effusion, infection control, and glycemic regulation, and was discharged once his condition had improved.

3. DISCUSSION

These two cases demonstrate that ultrasoundguided PNB can provide reliable surgical anesthesia and prolonged postoperative analgesia for limb amputation in patients with HFrEF and multiple comorbidities. Advantages observed here include maintenance of consciousness, avoidance of airway instrumentation, minimal intraoperative hemodynamic fluctuation, and effective analgesia extending into the first postoperative day. These benefits align with prior reports that regional anesthesia reduces pulmonary and cardiovascular complications, postoperative intensive care needs, and length of stay for highrisk amputee populations [6-9].

Dose adjustment of local anesthetic was guided by renal impairment and patient risk. In case 1 (CKD stage V, creatinine clearance ≈15 mL/min), total ropivacaine dose was reduced (>25% reduction compared with routine dosing) to mitigate potential systemic accumulation; despite the reduction, sensory duration remained clinically adequate (≈13 h), consistent with reports that reduced clearance and tissue factors may prolong block duration in renal dysfunction [8, 15]. In case 2, combination of adductor canal and popliteal sciatic blocks with adjunctive IV dexamethasone produced prolonged analgesia (~21 h), comparable to published series using combined femoral/ sciatic approaches for lower limb amputation [7, 11].

Ultrasound guidance maximizes block precision, permits reduced volumes, accelerates onset, and lowers complication rates [3-5, 12, 14]. For highrisk cardiovascular patients, PNB avoids the myocardial depressant effects of many general anesthetics and the profound sympathectomy of neuraxial blockade, reducing perioperative hemodynamic instability [1, 6]. Nonetheless, PNB requires expertise, appropriate monitoring, and contingency planning for conversion to general anesthesia or sedation if needed.

Limitations: this report includes only two cases; findings are not generalizable without larger studies. Perioperative outcomes were favorable, but longterm functional and survival outcomes were not assessed. Reporting bias and center expertise may influence reproducibility.

4. CONCLUSION

From our two clinical cases, it can be demonstrated that peripheral nerve block under ultrasound guidance can be effectively performed to provide anesthesia for limb amputation in patients with heart failure and reduced ejection fraction. This approach offers several advantages, including maintaining patient alertness throughout the surgery, minimal

hemodynamic impact, avoidance of invasive airway manipulation, and safety in patients receiving anticoagulant therapy.

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