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RESEARCH ARTICLE
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PERINEURAL CATHETERIZATION VIA POPLITEAL SCIATIC NERVE BLOCK: A SAFER ALTERNATIVE TO GENERAL ANAESTHESIA IN PATIENTS WITH RAISED INTRACRANIAL PRESSURE UNDERGOING ORTHOPAEDIC FOOT SURGERIES– A CASE SERIES

Dr Durai Henry[1*], Dr Nikhil Gite[2], Dr Sushma Muthineni[3], Dr Anam Baig[4], Dr Pravin Sapkal[5]

[1*](Junior Resident at GMC Akola) +91 9655040838, +91 6282708128 henry.daniel075@gmail.com
[2](Assistant Professor GMC Akola)
[3](Junior Resident at GMC Akola)
[4](Junior Resident at GMC Akola)
[5](Associate Professor GMC Akola)

Abstract

Background: Patients with a history of raised intracranial pressure (ICP) present significant anesthetic challenges during lower limb surgeries. General anesthesia risks cerebral hemodynamic instability, while neuraxial blocks are relatively contraindicated. In such scenarios, peripheral nerve blocks may offer a safer alternative.

Objective: To describe a case series of eight patients with recent head injuries and crush injuries to the foot, who underwent orthopedic surgery using ultrasound-guided perineural catheterization of the sciatic nerve via the popliteal approach.

Methods: This prospective observational case series was conducted at a tertiary trauma center. Eight patients with trimalleolar or complex foot fractures, all with a background of subarachnoid hemorrhage or extradural hematoma, underwent orthopedic fixation under continuous sciatic nerve block and intermittent femoral nerve block. Intraoperative hemodynamic stability, pain scores, and postoperative outcomes were evaluated.

Results: All eight patients tolerated the procedure well, with stable intraoperative vitals and no need for conversion to general anesthesia. Postoperative pain was effectively managed with continuous perineural infusion, with all patients reporting low VAS scores (<3). No complications related to catheterization or neurological deterioration were observed.

Conclusion: This case series demonstrates that ultrasound-guided perineural catheterization of the sciatic nerve is a viable and safe alternative to general or neuraxial anesthesia in high-risk patients with a history of raised ICP. It offers stable anesthesia, excellent analgesia, and minimal systemic impact in complex orthopedic foot surgeries.

KEYWORDS: Perineural catheterization, Sciatic nerve block, Raised intracranial pressure (ICP).

Introduction

Managing patients with traumatic brain injury (TBI) undergoing non-neurosurgical procedures presents a unique anesthetic challenge. Raised intracranial pressure (ICP), if not managed cautiously, may lead to devastating neurological consequences. General anesthesia (GA), though routinely used,

may cause fluctuations in ICP, hemodynamic instability, and airway manipulation, all of which can worsen cerebral perfusion or increase intracranial hypertension [1,2]. Neuraxial techniques, while effective for lower limb surgeries, are relatively contraindicated in raised ICP due to the risk of brain herniation [3,4].

Peripheral nerve blocks (PNBs), particularly with the use of ultrasound guidance and perineural catheters, allow for precise nerve localization, reduced systemic anesthetic load, and excellent pain control without compromising cerebral dynamics [5-7]. The popliteal approach to sciatic nerve block is a well-established technique for surgeries distal to the knee, especially effective in foot and ankle procedures [8-10].

This case series highlights our experience in managing eight patients with post-traumatic raised ICP and concurrent foot injuries using ultrasound-guided perineural catheterization of the sciatic nerve, offering a safer alternative to GA.

OBJECTIVES AND AIMS

1. To avoid general anesthesia in patients with raised ICP undergoing foot surgeries.
2. To assess the safety of sciatic nerve perineural catheterization via the popliteal approach.
3. To evaluate intraoperative hemodynamic stability and postoperative analgesia.
4. To explore regional anesthesia as an alternative when spinal is contraindicated.

PRIMARY OUTCOME:

• Effectiveness of regional anesthesia in avoiding general anesthesia in patients with recent raised ICP.

SECONDARY OUTCOMES:

• Hemodynamic stability during surgery.
• Quality of postoperative analgesia (VAS scores).
• Incidence of complications related to the block or catheter.
• Total intraoperative and 24-hour postoperative opioid consumption.

PATIENT DEMOGRAPHICS & CLINICAL SUMMARY

Patie nt	Age	Sex	Head Injury	ICP Management	Orthopaedic Diagnosis	Neurosur gical Clearance	Surgical Procedure	Pain Score (VAS)	Hemodyn amic Stability	Post-Op Analgesia
1	*70*	*F*	*EDH*	*Mannitol*	*Tri malleolar #*	*Yes*	*ORIF + Flap*	*2/10*	*Stable*	*Continuous LA*
2	*45*	*M*	*SAH*	*Head Elevation*	*Foot Crush (Achillis tendon fracture)*	*Yes*	*Debridement + SSG*	*1/10*	*Stable*	*Continuous LA*
3	*60*	*M*	*SAH*	*Osmotic Agents*	*Bimalleolar #*	*Yes*	*ORIF*	*3/10*	*Stable*	*LA + Paracetamo l*
4	*58*	*F*	*EDH*	*Mannitol*	*Tri malleolar #*	*Yes*	*ORIF + VAC*	*2/10*	*Stable*	*Continuous LA*
5	*67*	*M*	*SAH + EDH*	*ICP Monitor*	*Foot Fracture (Calcaneum #)*	*Yes*	*ORIF + Grafting*	*2/10*	*Stable*	*Continuous LA*
6	*51*	*M*	*EDH*	*Conservative*	*Bimalleolar #*	*Yes*	*ORIF*	*2/10*	*Stable*	*LA infusion*
7	*72*	*F*	*SAH*	*Head-up Tilt*	*Tri malleolar #*	*Yes*	*ORIF*	*1/10*	*Stable*	*Continuous LA*
8	*65*	*M*	*SAH*	*Mannitol*	*Foot Crush (metatarsals #)*	*Yes*	*Debridement + VAC*	*2/10*	*Stable*	*LA + NSAIDs*

METHODOLOGY

Study Design:

This is a prospective, observational case series conducted to evaluate the efficacy and safety of ultrasound-guided perineural catheterization of the sciatic nerve via the popliteal approach, as an alternative to general anesthesia in patients with raised intracranial pressure (ICP) undergoing orthopedic foot surgeries.

Study Setting:

The study was conducted in the Department of Anesthesiology and Intensive Care at a tertiary care trauma center in Maharashtra, India, which receives a high volume of road traffic accident (RTA) cases with polytrauma including neurotrauma and orthopedic injuries.

Study Duration:

January 2025 – March 2025 (3 months).

Study Population

Inclusion Criteria:

- Patients aged between 18–80 years.
- Road traffic accident (RTA) victims with severe crush injury involving the foot and ankle.
- Patients posted for orthopedic foot surgery such as open reduction and internal fixation (ORIF) or debridement with plastic surgical intervention.
- History of raised ICP (due to subarachnoid hemorrhage, extradural hematoma, etc.) with neurosurgical clearance after stabilization.
- ASA physical status II or III.
- Ability to obtain informed consent or proxy consent.

Exclusion Criteria:

- Active local infection or cellulitis at the planned site of block.
- Coagulopathy or anticoagulant therapy that could not be safely discontinued.
- Allergy to local anesthetic drugs.
- Neurological deficits in the lower limb affecting sciatic or femoral nerve territories.
- Refusal of consent.
- Hemodynamic instability or shock at the time of planned surgery.

Data Collection and Parameters Monitored

All included patients underwent detailed pre-anesthetic evaluation. Demographic data (age, gender, comorbidities), injury profile, neuroimaging reports, neurosurgical interventions, GCS trends, and orthopedic diagnosis were recorded.

During the procedure and postoperatively, the following parameters were monitored and recorded:

- Heart rate, blood pressure, respiratory rate, oxygen saturation.
- Sedation score (if any sedation used).
- Pain scores using Visual Analogue Scale (VAS) at 0, 2, 6, 12, and 24 hours postoperatively.
- Duration of surgery and intraoperative hemodynamic stability.
- Total dose and type of local anesthetic used.
- Postoperative opioid requirement.
- Any adverse events: LA toxicity, catheter dislodgement, block failure, neurological deficits.

Technique of Block Administration

- All procedures were performed in the operating room by anesthesiologists experienced in ultrasound-guided regional anesthesia.
- A high-frequency linear ultrasound probe was used to identify the sciatic nerve in the popliteal fossa at the level of bifurcation.
- Following aseptic preparation and skin infiltration with lignocaine, an 18G Tuohy needle was introduced using an in-plane approach under real-time ultrasound guidance.
- A perineural catheter was inserted and advanced 3–5 cm beyond the needle tip into the vicinity of the sciatic nerve sheath.
- After confirming placement with hydrodissection and negative aspiration, a test dose of 2 ml of 2% lignocaine with adrenaline was administered.
- This was followed by a bolus of 10–15 ml of a local anesthetic mixture containing 0.5% bupivacaine, 2% lignocaine with adrenaline.
- A separate intermittent femoral nerve block was administered to cover the saphenous and medial leg territories.
- The catheter was secured, and patients were monitored throughout the surgery and postoperatively.

Fig1: Placement of catheter

Fig 2: Fixing the catheter (Tunnelling)

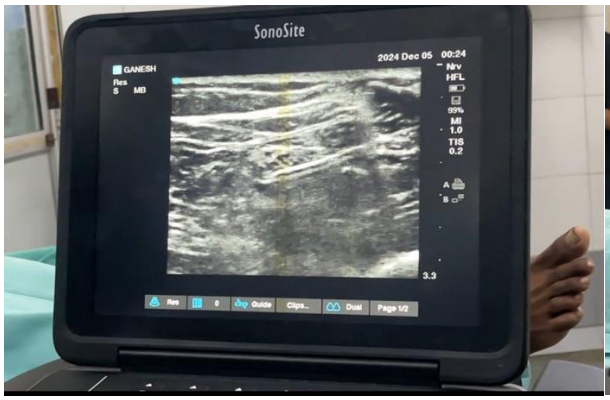
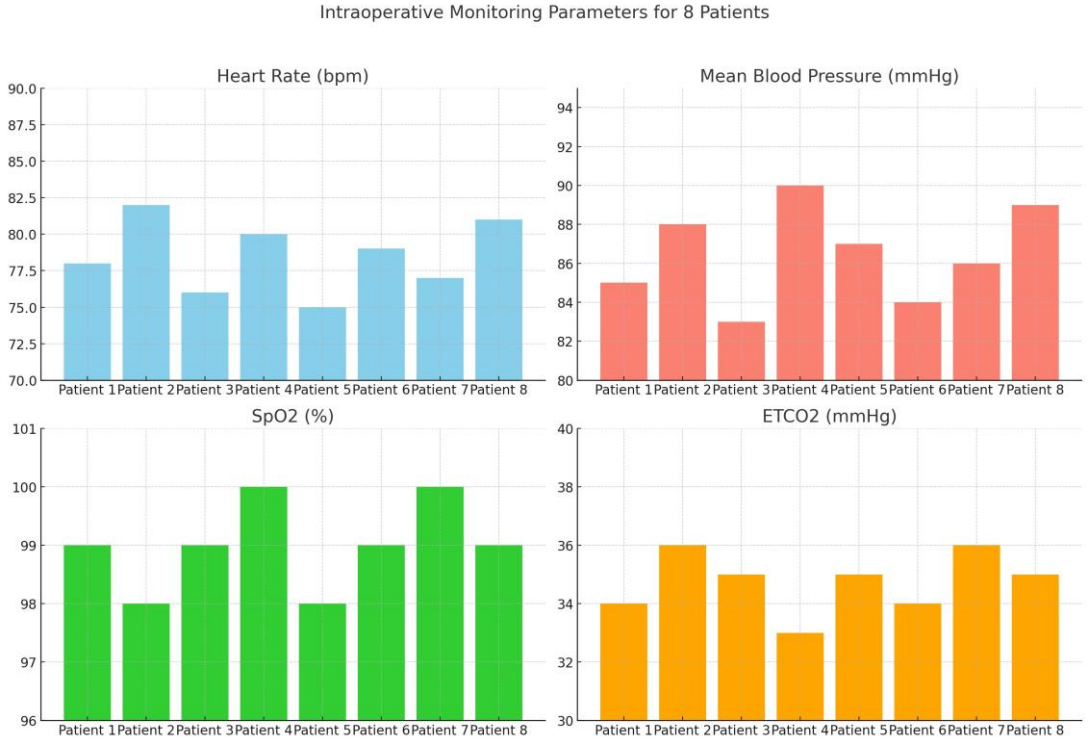
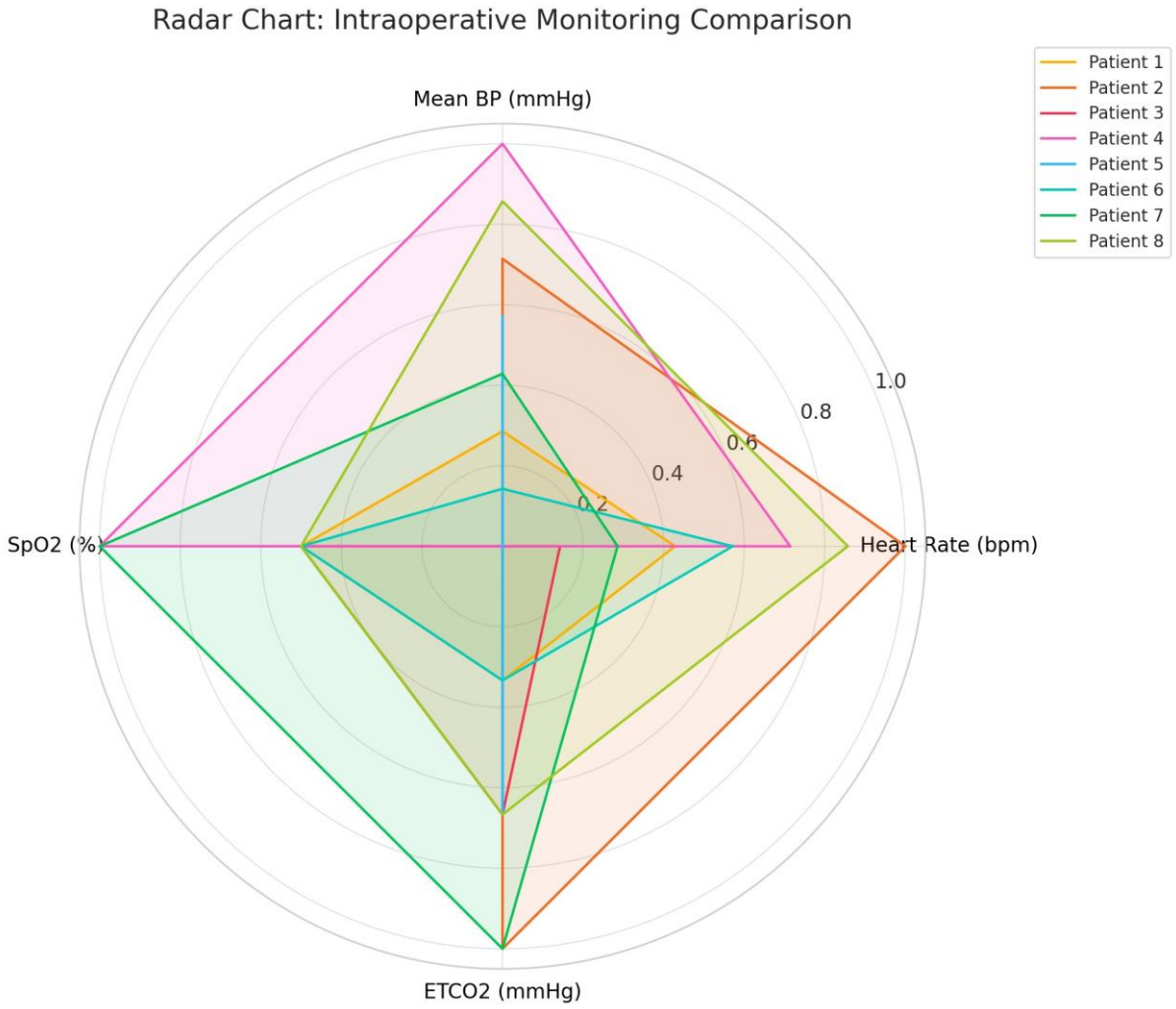


Fig 3: Touhy's needle inside the Sciatic sheath

Fig 4: Hydro dissected sciatic sheath

INTRA OPERATIVE VITALS:





Here is a graphical representation and radar chart of the intraoperative monitoring parameters for all 8 patients:

- **Heart Rate** remained between 75–82 bpm, indicating stable hemodynamics.
- **Mean Blood Pressure** was maintained between 83–90 mmHg, supporting cerebral perfusion.
- **SpO_2** levels stayed at or above 98%, reflecting adequate oxygenation.
- **$ETCO_2$** levels were within 33–36 mmHg, suggesting optimal ventilation and minimal CO_2 retention.

All values fall within clinically acceptable ranges, supporting the **hemodynamic and respiratory stability** achieved using perineural catheterization instead of general anesthesia.

DISCUSSION

The decision to avoid general anesthesia in patients with recent or resolving raised ICP is grounded in sound neurophysiological reasoning. GA agents can lead to cerebral vasodilation, CO_2 retention, and fluctuations in mean arterial pressure — all of which impact cerebral perfusion pressure (CPP) and ICP [1,2]. Additionally, positive pressure ventilation during GA can reduce venous return and elevate ICP, which may be detrimental in recently stabilized head injury patients [3].

Neuraxial techniques, though efficient in lower limb surgeries, carry a theoretical risk of transtentorial herniation in patients with elevated ICP, especially when CSF pressure is displaced during dural puncture or neuraxial drug administration [4,11]. Hence, they are relatively contraindicated.

Peripheral nerve blocks (PNBs) offer a compelling alternative. With ultrasound-guided techniques, precise deposition of local anesthetic around the nerve sheath reduces drug requirement and minimizes the systemic effects [5,6]. Continuous perineural catheterization further enhances this by allowing titration of anesthesia over time, maintaining steady sensory blockade and avoiding peaks and troughs of analgesia [7,12,13].

In the context of orthopedic foot surgeries, the sciatic nerve (via popliteal approach) provides comprehensive analgesia for distal limb procedures. This technique is safe, motor-sparing (if well-localized), and avoids the need for airway instrumentation or sedation [9,10,14].

Studies have also demonstrated that PNBs are associated with lower postoperative opioid consumption, reduced hospital stay, and better patient satisfaction [12,15]. Our case series supports these findings, with all patients maintaining hemodynamic stability, low VAS pain scores, and early postoperative recovery.

peripheral nerve blocks (PNBs)—especially when administered via ultrasound-guided techniques—offer high precision and minimal invasiveness, critical in polytrauma patients where systemic stability is paramount. Real-time sonographic visualization reduces the likelihood of vascular puncture, nerve trauma, or inadvertent intraneural injection, improving the safety profile even in complex trauma scenarios [16,17].

Perineural catheterization, as used in this case series, provides sustained regional anesthesia without the hemodynamic depressant effects associated with either general or neuraxial techniques. In patients recovering from intracranial injuries—where tight control over cerebral perfusion pressure (CPP) is essential—such regional techniques minimize fluctuations in mean arterial pressure (MAP) and intracranial pressure (ICP), maintaining cerebral autoregulation [18,19].

From a practical standpoint, the sciatic nerve in the popliteal fossa is easily accessible, particularly when limb injuries are distal to the knee. The bifurcation into the tibial and common peroneal nerves at this level allows effective blockade for foot and ankle surgeries [8,14]. By combining this with an intermittent femoral nerve block, we achieved complete coverage of the surgical site without relying on spinal or general anesthesia.

Our patient cohort, all of whom had a history of intracranial pathology (SAH, EDH) and underwent neurosurgical stabilization, tolerated the procedure well, with no reported neurological worsening postoperatively. Importantly, VAS scores remained below 3 in all patients, with no intraoperative

conversion to general anesthesia required. Hemodynamic parameters remained within 20% of baseline throughout the perioperative period.

Several studies echo our findings. Ilfeld et al. and Rawal et al. reported that continuous PNBs reduce opioid requirements, PONV, and time to ambulation while enhancing patient satisfaction [7,12]. In neurotrauma patients, where sedation and opioids are best minimized due to their effects on neurological monitoring, PNBs become particularly advantageous [20].

Finally, this technique's success in our series also emphasizes its logistical simplicity and reproducibility. With trained personnel and portable ultrasound, catheter placement can be achieved in the OR or even in high-dependency units, making it suitable for resource-limited or high-risk surgical settings [21,22].

CONCLUSION:

In patients recovering from head injuries, every decision in the operating room carries heightened gravity. When traditional options like general or neuraxial anesthesia carry potential harm, we are called to think beyond routine. Ultrasound-guided perineural catheterization of the sciatic nerve at the popliteal level emerges not just as an alternative—but as a lifeline.

In our series, it offered stable, effective, and compassionate anesthesia, ensuring surgical success without compromising neurological safety. With each patient, we witnessed not only surgical healing but also preserved neurological integrity—a testament to the power of precision, vigilance, and innovation in anesthesia care.

This technique deserves strong consideration in high-risk neurotrauma settings, where it may bridge the gap between surgical necessity and patient safety.

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