

## Original Research Article

# UNILATERAL SPINAL ANAESTHESIA VERSUS ULTRASOUND-GUIDED SCIATIC-FEMORAL NERVE BLOCK IN BELOW-KNEE SURGERY

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### ABSTRACT

**Background:** Below-knee surgeries require effective regional anaesthesia that ensures rapid onset, hemodynamic stability, and prolonged postoperative analgesia. While unilateral spinal anaesthesia (USA) offers rapid block onset, ultrasound-guided sciatic-femoral nerve block (PNB) may provide superior analgesia with improved cardiovascular stability. This study compared the safety and efficacy of these two techniques in patients undergoing below-knee surgery.

**Material and Methods:** In this prospective randomized comparative study, 94 patients (ASA I-II) scheduled for elective below-knee surgeries were allocated into two groups (n=47 each). Group USA received unilateral spinal anaesthesia with hyperbaric bupivacaine, while Group PNB received ultrasound-guided femoral and sciatic nerve blocks. Primary outcomes included onset of block, duration of analgesia, and intraoperative hemodynamic stability. Secondary outcomes included motor block duration, time to ambulation, opioid consumption, block success rate, and perioperative complications. Statistical significance was set at  $p < 0.05$ .

**Results:** USA demonstrated significantly faster onset of sensory ( $4.6 \pm 1.2$  min vs  $9.8 \pm 2.3$  min;  $p < 0.001$ ) and motor block ( $6.2 \pm 1.5$  min vs  $12.4 \pm 2.8$  min;  $p < 0.001$ ) with earlier surgical readiness. However, PNB provided significantly prolonged analgesia ( $468 \pm 82$  min vs  $214 \pm 41$  min;  $p < 0.001$ ) and lower 24-hour tramadol consumption ( $64 \pm 26$  mg vs  $122 \pm 38$  mg;  $p < 0.001$ ). Hypotension was significantly higher in the USA group (25.5% vs 6.4%;  $p = 0.012$ ). Block success rates were comparable (>95%) in both groups.

**Conclusion:** Unilateral spinal anaesthesia ensures rapid onset and early ambulation, whereas ultrasound-guided sciatic-femoral nerve block provides superior hemodynamic stability and prolonged postoperative analgesia. Technique selection should be individualized based on patient profile and surgical priorities.

**Keywords:** Unilateral spinal anaesthesia; Sciatic nerve block; Femoral nerve block; Below-knee surgery; Hemodynamic stability.

## INTRODUCTION

Below-knee surgeries are commonly performed for orthopedic trauma, vascular procedures, and reconstructive interventions.<sup>[1]</sup> Effective anaesthesia for these procedures requires adequate intraoperative analgesia, muscle relaxation, hemodynamic stability, and prolonged postoperative pain control.<sup>[2]</sup> Regional anaesthesia is widely preferred over general

anaesthesia in lower limb surgeries due to reduced airway manipulation, lower incidence of postoperative nausea and vomiting, decreased thromboembolic events, and superior postoperative analgesia.<sup>[2]</sup>

Spinal anaesthesia remains a commonly used technique; however, conventional bilateral spinal anaesthesia is associated with significant sympathetic blockade, leading to hypotension in approximately

15–33% of patients.<sup>[3]</sup> Unilateral spinal anaesthesia (USA) was introduced to limit block spread to the operative limb by using lower doses of hyperbaric local anaesthetic and lateral positioning.<sup>[4]</sup> This technique has been shown to reduce the incidence of hypotension (reported as low as 5–10%), minimize unnecessary contralateral motor block, and allow faster recovery compared to conventional spinal anaesthesia.<sup>[5]</sup>

Peripheral nerve blocks (PNBs) have gained popularity with the advent of ultrasound guidance.<sup>[6]</sup> The combination of femoral and sciatic nerve blocks provides comprehensive anaesthesia for below-knee surgeries by targeting the major sensory and motor innervation of the lower limb.<sup>[7]</sup> Ultrasound guidance improves block success rates to over 90–95% and reduces complications such as vascular puncture and nerve injury.<sup>[8]</sup> Additionally, PNBs offer superior postoperative analgesia with reduced opioid consumption and minimal sympathetic blockade, thereby ensuring greater hemodynamic stability.<sup>[9]</sup>

However, PNBs may require longer performance time and technical expertise, whereas unilateral spinal anaesthesia offers faster onset but carries a risk of bilateral spread and hemodynamic fluctuations.<sup>[10]</sup> Comparative evidence between these two techniques in below-knee surgeries remains limited and inconsistent.<sup>[11]</sup>

Therefore, this study aimed to compare the safety and efficacy of unilateral spinal anaesthesia and ultrasound-guided femoral–sciatic nerve block in below-knee surgeries.

## MATERIALS AND METHODS

### Study Design and Setting

This prospective, randomized comparative study was conducted in the Department of Anaesthesiology in association of Department of Orthopaedics at a tertiary care teaching hospital after obtaining approval from the Institutional Ethics Committee. The study was carried out over a period of 12 months. Written informed consent was obtained from all participants prior to enrolment. The study adhered to the principles of the Declaration of Helsinki.

### Study Population

Adult patients aged 18–65 years of either sex, belonging to American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective below-knee surgeries under regional anaesthesia were included. Below-knee surgeries comprised orthopedic procedures such as tibial fixation, ankle fracture repair, foot surgeries, and soft tissue procedures distal to the knee joint. Patients with contraindications to spinal or peripheral nerve block (coagulopathy, infection at injection site, severe spinal deformity), known allergy to local anaesthetics, pre-existing neuropathy, severe cardiovascular disease, BMI >35 kg/m<sup>2</sup>, pregnancy, or refusal to participate were excluded.

Sample Size and Randomization

The sample size was calculated based on data from a recent Indian prospective study comparing ultrasound-guided combined sciatic–femoral nerve block and spinal anaesthesia for below-knee surgeries, which reported a pooled standard deviation of approximately 45.3 minutes for time to first analgesic requirement. Assuming a clinically significant difference of 26 minutes between groups (effect size  $\approx 0.58$ ), with a two-sided  $\alpha$  of 0.05 and 80% power, the required sample size was determined accordingly [12]. Using the standard formula for two independent means, this yielded a required sample size of 47 patients per group (total  $n = 94$ ). Therefore, a total of 94 patients were enrolled and randomly assigned in a 1:1 ratio to the two groups. Randomization was performed using computer-generated random numbers placed in sequentially numbered, sealed opaque envelopes; the envelope was opened immediately prior to block performance by an anaesthesiologist not involved in postoperative assessment.

### Preoperative Preparation

All patients underwent pre-anaesthetic evaluation one day prior to surgery. Standard fasting guidelines were followed. On arrival in the operating room, intravenous access was secured with an 18G cannula and patients were preloaded with Ringer's lactate 10 ml/kg over 15–20 minutes. Standard monitoring including non-invasive blood pressure (NIBP), electrocardiography (ECG), and pulse oximetry (SpO<sub>2</sub>) was instituted and baseline parameters were recorded.

### Anaesthetic Technique

In Group USA, patients were placed in the lateral decubitus position with the operative limb dependent. After aseptic preparation, a 25G Quincke spinal needle was inserted at the L3–L4 interspace via a midline approach. After confirmation of free flow of cerebrospinal fluid, 1.5–2 ml of 0.5% hyperbaric bupivacaine (7.5–10 mg) was administered slowly over 10–15 seconds. The lateral position was maintained for 10–15 minutes to achieve unilateral block before turning the patient supine.

In Group PNB, ultrasound-guided femoral and sciatic nerve blocks were performed using a high-frequency linear probe (for femoral nerve) and a low-frequency curvilinear probe (for sciatic nerve, popliteal approach). After skin antisepsis and local infiltration, a 22G insulated nerve block needle was advanced under real-time ultrasound visualization. For the femoral nerve block, 15–20 ml of 0.5% bupivacaine was deposited around the nerve sheath. For the sciatic nerve block (popliteal approach), 20–25 ml of 0.5% bupivacaine was injected after negative aspiration. Adequate spread around the nerve was confirmed sonographically.

### Intraoperative Monitoring and Assessment

Sensory block was assessed using pinprick method in dermatomal distribution every 2 minutes for the first 15 minutes and then every 5 minutes until surgical anaesthesia was achieved. Motor block in Group USA was assessed using the Modified Bromage

Scale, while in Group PNB, motor blockade of femoral and sciatic distributions was assessed clinically. Time to onset of sensory block, time to achieve complete motor block, and time to readiness for surgery were recorded.

Hemodynamic parameters (heart rate, systolic and diastolic blood pressure, mean arterial pressure, and SpO<sub>2</sub>) were recorded at baseline, every 5 minutes for the first 30 minutes, and every 10 minutes thereafter until completion of surgery. Hypotension (defined as >20% fall from baseline or systolic BP <90 mmHg) was treated with intravenous fluids and incremental doses of mephentermine 6 mg. Bradycardia (HR <50 bpm) was treated with atropine 0.6 mg intravenously.

#### Postoperative Assessment

Duration of sensory block, duration of motor block, and duration of analgesia (time from block administration to first request for rescue analgesic or Visual Analogue Scale  $\geq 4$ ) were recorded. Postoperative pain was assessed using a 10-point Visual Analogue Scale (VAS). Rescue analgesia was provided with intravenous paracetamol 1 g and, if required, tramadol 1 mg/kg. Incidence of complications such as hypotension, bradycardia, nausea, vomiting, urinary retention, local anaesthetic toxicity, and nerve-related complications were documented.

#### Outcome Measures

The primary outcome measures were onset time of sensory block, duration of analgesia, and

intraoperative hemodynamic stability. Secondary outcomes included duration of motor block, time to ambulation, total analgesic consumption within 24 hours, block success rate, and incidence of complications.

#### Statistical Analysis

Data were entered into Microsoft Excel and analysed using SPSS version 25.0. Continuous variables were expressed as mean  $\pm$  standard deviation and compared using independent Student's t-test. Categorical variables were expressed as frequency and percentage and analysed using Chi-square test as appropriate. A p-value <0.05 was considered statistically significant.

## RESULTS

The two groups were comparable with respect to demographic and baseline clinical characteristics. The mean age was 44.8  $\pm$  11.6 years in the USA group and 43.9  $\pm$  12.2 years in the PNB group (p = 0.71). Male predominance was observed in both groups (66.0% vs 61.7%, p = 0.67). Mean BMI was similar between groups (24.9  $\pm$  3.1 vs 25.3  $\pm$  3.4 kg/m<sup>2</sup>, p = 0.54). The majority of patients belonged to ASA physical status I (59.6% vs 63.8%, p = 0.68). Mean duration of surgery did not differ significantly (86.4  $\pm$  18.9 vs 89.1  $\pm$  20.3 minutes, p = 0.49), confirming baseline comparability. [Table 1]

**Table 1: Baseline Demographic and Clinical Characteristics of Study Participants**

Variable	Group USA (n=47)	Group PNB (n=47)	p-value
	Frequency (%) / mean $\pm$ SD		
Age (years)	44.8 $\pm$ 11.6	43.9 $\pm$ 12.2	0.71
Gender			
Female	16 (44.0%)	18 (38.3%)	0.67
Male	31 (66.0%)	29 (61.7%)	
BMI (kg/m <sup>2</sup> )	24.9 $\pm$ 3.1	25.3 $\pm$ 3.4	0.54
ASA classification			
ASA I	28 (59.6%)	30 (63.8%)	0.68
ASA II	19 (40.4%)	17 (36.2%)	
Duration of surgery (min)	86.4 $\pm$ 18.9	89.1 $\pm$ 20.3	0.49

ASA – American Society of Anesthesiologists; BMI – Body Mass Index; USA – Unilateral Spinal Anaesthesia; PNB – Ultrasound-guided Sciatic–Femoral Nerve Block.

Unilateral spinal anaesthesia demonstrated significantly faster onset of sensory block (4.6  $\pm$  1.2 min vs 9.8  $\pm$  2.3 min, p < 0.001) and motor block (6.2  $\pm$  1.5 min vs 12.4  $\pm$  2.8 min, p < 0.001) compared to PNB. Time to readiness for surgery was also

significantly shorter in the USA group (7.4  $\pm$  1.8 min vs 14.1  $\pm$  3.1 min, p < 0.001). However, the PNB group showed significantly prolonged duration of motor block (236  $\pm$  48 min vs 158  $\pm$  32 min, p < 0.001) and duration of analgesia (468  $\pm$  82 min vs 214  $\pm$  41 min, p < 0.001). Block success rates were comparable between groups (95.7% vs 97.9%, p = 0.56). [Table 2]

**Table 2: Comparison of Block Characteristics Between Groups**

Parameter	Group USA (n=47)	Group PNB (n=47)	p-value
	Frequency (%) / mean $\pm$ SD		
Onset of sensory block (min)	4.6 $\pm$ 1.2	9.8 $\pm$ 2.3	<0.001
Onset of motor block (min)	6.2 $\pm$ 1.5	12.4 $\pm$ 2.8	<0.001
Time to readiness for surgery (min)	7.4 $\pm$ 1.8	14.1 $\pm$ 3.1	<0.001
Duration of motor block (min)	158 $\pm$ 32	236 $\pm$ 48	<0.001
Duration of analgesia (min)	214 $\pm$ 41	468 $\pm$ 82	<0.001
Block success rate	45 (95.7%)	46 (97.9%)	0.56

Baseline MAP was comparable between groups ( $92.3 \pm 8.1$  mmHg vs  $91.7 \pm 7.9$  mmHg,  $p = 0.74$ ). However, the lowest MAP recorded intraoperatively was significantly lower in the USA group ( $74.6 \pm 9.4$  mmHg vs  $86.2 \pm 7.3$  mmHg,  $p < 0.001$ ). The incidence of hypotension (>20% fall from baseline)

was significantly higher in the USA group (25.5% vs 6.4%,  $p = 0.012$ ). Mean intraoperative heart rate was comparable ( $p = 0.37$ ). Although bradycardia occurred more frequently in the USA group (10.6% vs 2.1%), the difference was not statistically significant ( $p = 0.09$ ). [Table 3]

**Table 3: Intraoperative Hemodynamic Parameters Between Groups**

Parameter	Group USA (n=47)	Group PNB (n=47)	p-value
	Frequency (%) / mean $\pm$ SD		
Baseline MAP (mmHg)	$92.3 \pm 8.1$	$91.7 \pm 7.9$	0.74
Lowest MAP recorded (mmHg)	$74.6 \pm 9.4$	$86.2 \pm 7.3$	<0.001
Mean HR intraoperative (bpm)	$76.8 \pm 9.2$	$78.5 \pm 8.7$	0.37
Hypotension (>20% fall)	12 (25.5%)	3 (6.4%)	0.012
Bradycardia	5 (10.6%)	1 (2.1%)	0.09

MAP – Mean Arterial Pressure; HR – Heart Rate.

Postoperative pain scores were significantly lower in the PNB group at both 2 hours ( $0.9 \pm 0.6$  vs  $1.8 \pm 0.9$ ,  $p < 0.001$ ) and 6 hours ( $1.7 \pm 0.8$  vs  $3.4 \pm 1.1$ ,  $p < 0.001$ ). Time to first rescue analgesia was significantly prolonged in the PNB group ( $468 \pm 82$  min vs  $214 \pm 41$  min,  $p < 0.001$ ). Consequently, total

24-hour tramadol consumption was significantly lower in the PNB group ( $64 \pm 26$  mg vs  $122 \pm 38$  mg,  $p < 0.001$ ). However, time to ambulation was shorter in the USA group ( $5.2 \pm 1.1$  hours vs  $7.8 \pm 1.4$  hours,  $p < 0.001$ ). [Table 4]

**Table 4: Postoperative Analgesia and Recovery Profile Between Groups**

Parameter	Group USA (n=47)	Group PNB (n=47)	p-value
	mean $\pm$ SD		
VAS at 2 hrs	$1.8 \pm 0.9$	$0.9 \pm 0.6$	<0.001
VAS at 6 hrs	$3.4 \pm 1.1$	$1.7 \pm 0.8$	<0.001
Time to first rescue analgesia (min)	$214 \pm 41$	$468 \pm 82$	<0.001
Total tramadol consumption (mg/24h)	$122 \pm 38$	$64 \pm 26$	<0.001
Time to ambulation (hrs)	$5.2 \pm 1.1$	$7.8 \pm 1.4$	<0.001

VAS – Visual Analogue Scale.

The incidence of hypotension was significantly higher in the USA group (25.5% vs 6.4%,  $p = 0.012$ ). Nausea and vomiting (12.8% vs 4.3%,  $p = 0.14$ ) and urinary retention (10.6% vs 2.1%,  $p = 0.09$ ) were more frequent in the USA group but did not reach

statistical significance. Block failure requiring supplementation was comparable (4.3% vs 2.1%,  $p = 0.56$ ). No cases of local anaesthetic systemic toxicity or persistent neurological deficit were observed in either group. [Table 5]

**Table 5: Comparison of Perioperative Complications Between Groups**

Complication	Group USA (n=47)	Group PNB (n=47)	p-value
	Frequency (%)		
Hypotension	12 (25.5%)	3 (6.4%)	0.012
Nausea/Vomiting	6 (12.8%)	2 (4.3%)	0.14
Urinary retention	5 (10.6%)	1 (2.1%)	0.09
Block failure requiring supplementation	2 (4.3%)	1 (2.1%)	0.56
Local anaesthetic toxicity	0 (0.0%)	0 (0.0%)	—
Persistent neurological deficit	0 (0.0%)	0 (0.0%)	—

## DISCUSSION

This prospective randomized comparative study evaluated the safety and efficacy of unilateral spinal anaesthesia (USA) and ultrasound-guided sciatic–femoral nerve block (PNB) for below-knee surgeries. The rapid onset observed with USA (sensory onset  $4.6 \pm 1.2$  min vs  $9.8 \pm 2.3$  min;  $p < 0.001$ ) is attributable to the intrathecal administration of hyperbaric bupivacaine, which directly bathes the nerve roots in cerebrospinal fluid, facilitating rapid diffusion and sodium channel blockade.<sup>[13]</sup> Similar findings have been reported in Indian comparative studies by Bhardwaj et al., Sinha et al., and Siddiqui et al., evaluating neuraxial versus peripheral nerve techniques for lower limb surgeries, which

demonstrated shorter readiness time with spinal anaesthesia compared to combined sciatic–femoral block.<sup>[14,15,16]</sup> The shorter time to readiness for surgery in the USA group ( $7.4 \pm 1.8$  min vs  $14.1 \pm 3.1$  min;  $p < 0.001$ ) supports its utility in high-turnover operating rooms where rapid anaesthetic onset is desirable.

In contrast, the significantly prolonged duration of analgesia in the PNB group ( $468 \pm 82$  min vs  $214 \pm 41$  min;  $p < 0.001$ ) reflects the pharmacodynamic advantages of perineural local anaesthetic deposition.<sup>[17]</sup> Peripheral nerve blocks produce sustained neural blockade because the drug is deposited within fascial compartments surrounding the nerve, resulting in slower systemic absorption and prolonged action.<sup>[17]</sup> This translated clinically into

significantly lower 24-hour tramadol consumption in the PNB group ( $64 \pm 26$  mg vs  $122 \pm 38$  mg;  $p < 0.001$ ). These findings are consistent with reviews by Yang et al., and Niyonkuru et al., demonstrating superior postoperative analgesia with ultrasound-guided peripheral nerve blocks, which reduce central sensitization and opioid-related adverse effects.<sup>[18,19]</sup> Similar reductions in postoperative opioid requirement have been documented in Indian studies by Wani et al., Adhyapak et al., and Kumar et al., comparing sciatic–femoral blocks with neuraxial techniques.<sup>[20,21,22]</sup>

Hemodynamic stability was a major differentiating factor between the two techniques. The incidence of hypotension was significantly higher in the USA group (25.5% vs 6.4%;  $p = 0.012$ ), and the lowest intraoperative mean arterial pressure was significantly reduced in this group ( $74.6 \pm 9.4$  mmHg vs  $86.2 \pm 7.3$  mmHg;  $p < 0.001$ ). This is physiologically explained by sympathetic blockade following neuraxial anaesthesia, which leads to peripheral vasodilation, venous pooling, and decreased systemic vascular resistance.<sup>[23]</sup> Although unilateral spinal anaesthesia aims to limit sympathetic spread, partial bilateral sympathetic involvement can still occur, especially with patient repositioning. In contrast, peripheral nerve blocks spare central sympathetic pathways, preserving cardiovascular stability. This advantage is particularly relevant in elderly patients and those with limited cardiovascular reserve.<sup>[24]</sup> Comparable trends have been observed in recent regional anaesthesia studies by Das et al., and Natrajan et al., in Indian tertiary care settings, reinforcing the cardiovascular safety profile of ultrasound-guided peripheral blocks.<sup>[25,26]</sup>

Despite the delayed onset, block success rates were comparable (95.7% in USA vs 97.9% in PNB;  $p = 0.56$ ), highlighting the technical reliability of both approaches when performed under standardized conditions. The high success rate in the PNB group reflects the growing accuracy of ultrasound guidance, which allows direct visualization of nerve structures and real-time monitoring of local anaesthetic spread, thereby reducing block failure and complications as reported in studies by Ibrahim et al., and Akkaya et al.<sup>[27,28]</sup> Importantly, no cases of local anaesthetic systemic toxicity or persistent neurological deficit were observed, underscoring the safety of both techniques in experienced hands.

The longer duration of motor block in the PNB group ( $236 \pm 48$  min vs  $158 \pm 32$  min;  $p < 0.001$ ) resulted in delayed ambulation ( $7.8 \pm 1.4$  h vs  $5.2 \pm 1.1$  h;  $p < 0.001$ ). While prolonged motor blockade may delay early mobilization, it also ensures sustained analgesia during the immediate postoperative inflammatory phase, when nociceptive input is maximal. Therefore, the choice between techniques should be individualized based on surgical requirements, expected postoperative pain intensity, and patient comorbidities.<sup>[29,30]</sup>

**Limitations:** This study was conducted at a single tertiary care centre with a relatively moderate sample size, which may limit generalizability. Blinding of the performing anaesthesiologist was not feasible due to the nature of the interventions, introducing potential performance bias. Long-term neurological outcomes were not assessed beyond the immediate postoperative period. Additionally, cost-effectiveness analysis and patient satisfaction scores were not formally evaluated, which could have provided further insight into the broader clinical applicability of both techniques.

## CONCLUSION

In conclusion, unilateral spinal anaesthesia and ultrasound-guided sciatic–femoral nerve block are both safe and effective techniques for below-knee surgeries. Unilateral spinal anaesthesia provides faster onset and earlier surgical readiness, making it suitable for time-sensitive procedures. In contrast, ultrasound-guided peripheral nerve block offers superior hemodynamic stability, prolonged postoperative analgesia, and reduced opioid consumption. The choice of technique should be individualized based on patient comorbidities, surgical duration, and postoperative analgesic requirements. These findings support the role of ultrasound-guided peripheral nerve blocks as an effective opioid-sparing alternative in contemporary regional anaesthesia practice.

## REFERENCES

1. Vaishya R, Lal H. Three common orthopaedic surgical procedures of the lower limb. *J Clin Orthop Trauma*. 2018;9(2):101-2.
2. Kamel I, Ahmed MF, Sethi A. Regional anesthesia for orthopedic procedures: What orthopedic surgeons need to know. *World J Orthop*. 2022;13(1):11-35.
3. Gong C, Ye X, Liao Y, Ye P, Zheng T, Zheng X. Hypotension after unilateral versus bilateral spinal anaesthesia: A Systematic review with meta-analysis. *Eur J Anaesthesiol*. 2025;42(3):203-23.
4. Atef H, El-Kasaby A, Omera M, Badr M. Optimal dose of hyperbaric bupivacaine 0.5% for unilateral spinal anesthesia during diagnostic knee arthroscopy. *Local Reg Anesth*. 2010;3:85-91.
5. Lin C, Xian WL, Xu J, Zhao T, Wu ZQ, Wang FJ. ED50 and ED95 of hypobaric ropivacaine during unilateral spinal anesthesia in older patients undergoing hip replacement surgery. *Front Med (Lausanne)*. 2025;12:1571574.
6. Dabbagh A, Madadi F, Ebrahimi M, et al. Experimental implementation of the peripheral nerve block clinical registry: an observational study. *Front Med (Lausanne)*. 2025;12:1486300.
7. Bansal L, Attri JP, Verma P. Lower limb surgeries under combined femoral and sciatic nerve block. *Anesth Essays Res*. 2016;10(3):432-6.
8. Lewis SR, Price A, Walker KJ, McGrattan K, Smith AF. Ultrasound guidance for upper and lower limb blocks. *Cochrane Database Syst Rev*. 2015;2015(9):CD006459.
9. Jiménez Contreras RJ, Castillo Garcia LT, Quintero García MA, Figueroa Caballero MF. Association Between Peripheral Nerve Blocks and Reduced Opioid Rescue Use in the PACU After Knee Surgery: A Retrospective Study From a Mexican Tertiary Center. *Cureus*. 2025;17(7):e89055.

10. Lee M, Lee C, Lim J, Kim H, Choi YS, Kang H. Comparison of a Peripheral Nerve Block versus Spinal Anesthesia in Foot or Ankle Surgery: A Systematic Review and Meta-Analysis with a Trial Sequential Analysis. *J Pers Med.* 2023;13(7):1096.
11. Sebekos K, Guiab K, Stamelos G, et al. Comparison of Outcomes in Below-Knee Amputation Between Vascular, General, and Orthopedic Surgeons. *J Surg Res.* 2023;290:247-56.
12. Pattajoshi B, Panigrahi S, Mohanty P, Mohanty RK, Panigrahi SK. A Prospective Comparative Study Between Ultrasound-Guided Combined Sciatic-Femoral Nerve Block Versus Spinal Anesthesia for the Patients Undergoing Elective Below-Knee Surgeries. *Cureus.* 2022;14(6):e26137.
13. Davarci I, Tuzcu K, Karcioğlu M, et al. Comparison between ultrasound-guided sciatic-femoral nerve block and unilateral spinal anaesthesia for outpatient knee arthroscopy. *J Int Med Res.* 2013;41(5):1639-47.
14. Bhardwaj A, Ravi PR, Mishra SK, Damodar P. Comparison of unilateral spinal anaesthesia with ultrasound-guided combined sciatic and femoral nerve block in elective arthroscopic knee surgeries. *Med J Armed Forces India.* 2023;79(4):392-8.
15. Sinha A, Arora D, Singh S, Das T, Biswas M. Evaluating Analgesic Efficacy of Single Femoral Nerve Block versus Combined Femoral-Sciatic Nerve Block Post Total Knee Arthroplasty. *Anesth Essays Res.* 2020;14(2):326-30.
16. Siddiqui R, Bansal S, Puri A, Sinha M. A Comparative Study of Ultrasound-Guided Continuous Adductor Canal Block With Ultrasound-Guided Continuous Femoral Nerve Block in Unilateral Total Knee Arthroplasty for Limb Mobilization and Analgesic Efficacy. *Cureus.* 2022;14(3):e22904.
17. Vadhanan P, Tripathy DK, Adinarayanan S. Physiological and pharmacologic aspects of peripheral nerve blocks. *J Anaesthesiol Clin Pharmacol.* 2015;31(3):384-93.
18. Yang Y, Xu Y, Tang H, Hu Y, Bai F. The efficacy and safety of peripheral nerve blocks for postoperative analgesia following total hip arthroplasty: a network meta-analysis. *BMC Anesthesiol.* 2025;25(1):522.
19. Niyonkuru E, Iqbal MA, Zeng R, Zhang X, Ma P. Nerve Blocks for Post-Surgical Pain Management: A Narrative Review of Current Research. *J Pain Res.* 2024;17:3217-39.
20. Wani SA, Nahida Q, Wani SA, Kakroo S, Farooq S. Combined femoral and sciatic nerve blocks for lower limb surgeries. *Indian J Clin Anaesth.* 2021;8(1):74-8.
21. Adhyapak N, Mane R, Patil M, et al. 172 Ultrasound guided combined sciatic plus femoral nerve block in high risk patients posted for lower limb surgeries. *Regional Anesthesia Pain Medicine.* 2021;70:A90-1.
22. Kumar A, Kumar A, Mandal C. Comparative Study between Combined Sciatic-Femoral Nerve Block and Subarachnoid Block in Lower Limbs Surgeries. *Int J Pharmaceutical Clinical Research.* 2024;16(2);1445-53.
23. Bajwa SJ, Kulshrestha A, Jindal R. Co-loading or pre-loading for prevention of hypotension after spinal anaesthesia! a therapeutic dilemma. *Anesth Essays Res.* 2013;7(2):155-9.
24. Canakci E, Unal D, Guzel Y. The Effect of Unilateral Spinal Anaesthesia and Psoas Compartment with Sciatic Block on the Postoperative Pain Management in Total Knee Arthroplasty Surgery. *Pain Res Manag.* 2017;2017:4127424.
25. Das KK, Kalita P, Patir M, Deori AK. A comparative study of clinical effects of sciatic-femoral nerve block versus spinal anaesthesia in geriatric patients in lower limb orthopaedic surgeries. *ParipeX - Indian J Research.* 2021;10(7):12-4.
26. Natrajan P, Bhat RR, Remadevi R, Joseph IR, Vijayalakshmi S, Paulose TD. Comparative Study to Evaluate the Effect of Ultrasound-Guided Pericapsular Nerve Group Block Versus Fascia Iliaca Compartment Block on the Postoperative Analgesic Effect in Patients Undergoing Surgeries for Hip Fracture under Spinal Anesthesia. *Anesth Essays Res.* 2021;15(3):285-9.
27. Ibrahim WA, Ashraf MM, Abdel-Maksoud RRA, Sultan WE. Ultrasound-guided femoro-sciatic nerve block with and without using nerve locator for below-knee surgeries. *Res Opinion Anesthesia Intensive Care.* 2020;7(1):1-7.
28. Akkaya A, Tekelioglu UY, Demirhan A, et al. Ultrasound-guided femoral and sciatic nerve blocks combined with sedoanalgesia versus spinal anesthesia in total knee arthroplasty. *Korean J Anesthesiol.* 2014;67(2):90-5.
29. Lee M, Lee C, Lim J, Kim H, Choi YS, Kang H. Comparison of a Peripheral Nerve Block versus Spinal Anesthesia in Foot or Ankle Surgery: A Systematic Review and Meta-Analysis with a Trial Sequential Analysis. *J Pers Med.* 2023;13(7):1096.
30. Patel SK, Parikh R, Gupta H, et al. Effects of Ultrasound-Guided Lower Extremity Nerve Blocks for Below-Knee Procedures in the Emergency Department of a Tertiary Care Hospital, Central Gujarat. *Cureus.* 2023;15(7):e41450.