MAK HILL Publications Research Journal of Medical Sciences

Research Article
doi: 10.36478/makrjms.2017.229.234

OPEN ACCESS

Key Words
Spinal anaesthesia, general anaesthesia, lower limb surgery, hemodynamic stability, postoperative pain

Corresponding Author
Dr. Syed Asmat Ali,
Department of General Surgery IQ City Medical College and Hospital Durgapur, India

Author Designation
[1-3]Assistant Professor

Received: 25th October 2017
Accepted: 16th November 2017
Published: 30th December 2017

Citation: Dr. Syed Asmat Ali, Dr. Harsha Vardhan and Dr. Vivek Pushp, 2017. A Comparative Study of Spinal Versus General Anaesthesia in Elective Lower Limb Surgeries: Intraoperative Hemodynamic Stability and Postoperative Pain Outcomes. Res. J. Med. Sci., 11: 229-234, doi: 10.36478/makrjms.2017.229.234

A Comparative Study of Spinal Versus General Anaesthesia in Elective Lower Limb Surgeries: Intraoperative Hemodynamic Stability and Postoperative Pain Outcomes

[1]Dr. Syed Asmat Ali, [2]Dr. Harsha Vardhan and [3]Dr. Vivek Pushp

[1,2]Department of General Surgery IQ City Medical College and Hospital Durgapur, India
[3]Department of Anesthesiology IQ City Medical College and Hospital Durgapur, India

Abstract
Optimal anaesthetic technique in elective lower limb surgeries remains debated. Spinal anaesthesia may offer enhanced intraoperative stability and postoperative recovery compared to general anaesthesia. To compare intraoperative hemodynamic stability, postoperative pain scores, analgesic requirements and complication rates between spinal and general anaesthesia in patients undergoing elective lower limb surgeries. This prospective observational study was conducted at IQ City Medical College and Hospital,Durgapur,in May 2016-April2017.A total of 200 adult patients(ASA I-II)were allocated to receive either spinal(n=100) or general anaesthesia(n=100). Intraoperative mean arterial pressure (MAP), heart rate (HR), pain scores (VAS at 2, 6, 12, 24 hours), total analgesic consumption and adverse events were recorded and compared using appropriate statistical tests. Spinal anaesthesia provided greater MAP stability, with fewer hypotensive episodes (18% vs. 32%) and lower vaso pressor use (12% vs. 24%). Postoperative VAS scores were significantly lower in the spinal group at all intervals. Time to first rescue analgesia was longer (5.8±1.7 vs. 3.2±1.2 hours) and cumulative morphine use was reduced (4.8±1.6 mg vs. 7.6±2.2 mg). Adverse events including nausea, vomiting and delayed mobilization were less common with spinal anaesthesia. Spinal anaesthesia is associated with superior intraoperative hemodynamic control, better postoperative analgesia and a more favourable early recovery profile in elective lower limb surgeries compared to general anaesthesia.

INTRODUCTION

The choice of anaesthetic technique plays a pivotal role in optimizing intraoperative hemodynamic control and postoperative recovery in lower limb surgeries. Both spinal and general anaesthesia are commonly employed for such procedures, with ongoing debate regarding their comparative effectiveness, safety and patient-centered outcomes. Spinal anaesthesia (SA) offers several physiologic advantages, particularly in orthopaedic and vascular surgeries of the lower limbs. It has been consistently associated with improved intraoperative hemodynamic stability, reduced intraoperative blood loss and fewer systemic complications compared to general anaesthesia (GA)[1,2]. In a large-scale trial, Finsterwald *et al.* demonstrated better control of blood pressure and lower rates of intraoperative vasopressor use in patients receiving SA compared to GA during spinal surgeries[1]. Hemodynamic outcomes are critical in elderly and high-risk patients, where spinal anaesthesia helps mitigate risks of cardiac stress associated with volatile agents and intubation[3]. Studies such as those by Ghanami *et al.* and De Rojas *et al.* have affirmed the superior cardiovascular stability provided by regional techniques during lower extremity vascular surgeries[4,5]. Moreover, Zou *et al.* recently highlighted lower intraoperative fluctuations and fewer ICU admissions in SA patients undergoing below-knee surgeries, adding to its perioperative safety profile[6]. Postoperative pain control is another key differentiation. Spinal anaesthesia inherently offers segmental analgesia that can extend into the early recovery phase, reducing reliance on systemic opioids and enhancing patient satisfaction. A retrospective analysis by Lux reported decreased pain scores and analgesic requirements for up to 24 hours post-surgery in patients receiving continuous SA[7]. Similar findings by Mung'ayi *et al.* and Nesek Adam *et al.* have supported spinal anaesthesia's role in minimizing postoperative pain and its associated complications[8,9]. Nonetheless, general anaesthesia may still be preferred in certain cases due to procedural familiarity, predictability of airway control and patient preferences. Comparative data, however, remain mixed across populations and surgery types. Hence, a direct evaluation of intraoperative and postoperative outcomes in patients undergoing elective lower limb surgeries under spinal versus general anaesthesia is clinically valuable.

Aims and Objectives:

Aims: To compare the intraoperative hemodynamic stability and postoperative pain outcomes between spinal anaesthesia and general anaesthesia in patients undergoing elective lower limb surgeries.

Primary Objective: To evaluate and compare the intraoperative hemodynamic parameters (mean arterial pressure, heart rate fluctuations and vasopressor requirements) between patients receiving spinal versus general anaesthesia.

Secondary Objectives:

- To assess postoperative pain scores at predefined intervals (2, 6, 12 and 24 hours) using the Visual Analog Scale (VAS) in both groups.
- To compare postoperative analgesic consumption (opioid and non-opioid) between the two anaesthesia modalities.
- To analyze incidence of immediate postoperative complications such as nausea, vomiting, urinary retention and delayed mobilization.

MATERIALS AND METHODS

Study Design and Setting: This was a prospective, comparative observational study conducted at IQ City Medical College and Hospital, Durgapur, from May 2016 to April 2017. The study compared the intraoperative hemodynamic stability and postoperative pain outcomes between spinal and general anaesthesia in adult patients undergoing elective lower limb surgeries. The protocol was reviewed and approved by the Institutional Ethics Committee and written informed consent was obtained from all participants prior to enrollment.

Sample Size Estimation: Based on previous studies reporting a clinically meaningful difference of 15mmHg in mean arterial pressure (MAP) between general and spinal anaesthesia groups with a standard deviation of approximately 25mmHg the required sample size was calculated using a two-tailed t-test (α=0.05, power= 80%). A minimum of 90 patients per group was required. Considering a 10% potential attrition rate, a total of 200 patients (100 per group) were enrolled.

Inclusion Criteria:

- Adults aged 18-65 years undergoing elective lower limb orthopaedic or vascular surgery (e.g., total knee arthroplasty, femoral plating, saphenous vein stripping).
- American Society of Anaesthesiologists (ASA) physical status I-II.
- Willingness to participate and provide informed consent.

Exclusion Criteria:

- Patients with contraindications to spinal anaesthesia (e.g., coagulopathy, spinal deformities, infection at the puncture site).
- Severe cardiovascular disease or unstable angina.

- Chronic opioid use or pre-existing chronic pain conditions.
- Allergy or hypersensitivity to study drugs.
- Conversion from spinal to general anaesthesia intra operatively.
- Intraoperative complications unrelated to anaesthesia (e.g., surgical bleeding requiring transfusion).

Anaesthetic Protocol: Patients were allocated into two groups based on attending anaesthesiologist preference and clinical feasibility:

- **Group SA (Spinal Anaesthesia):** Patients received 2.5-3.0mL of 0.5% hyperbaric bupivacaine intrathecally at L3-L4 or L4-L5 in the sitting position.
- **Group GA (General Anaesthesia):** Patients were induced with intravenous propofol (2 mg/kg), fentanyl (2 mcg/kg) and rocuronium (0.6 mg/kg) followed by endotracheal intubation and maintenance with isoflurane in a 50:50 oxygen-nitrous oxide mixture.

Standard intraoperative monitoring was applied, including ECG, non-invasive blood pressure and pulse oximetry. Hemodynamic parameters were recorded at baseline and every 5 minutes intra operatively. Postoperative pain was assessed using the Visual Analog Scale (VAS) at 2, 6, 12 and 24 hours. Rescue analgesia was standardized (IV paracetamol and morphine as required).

Outcome Measures:

- **Primary Outcome:** Intraoperative hemodynamic stability (fluctuations in MAP, HR, vasopressor use).
- **Secondary Outcomes:** Postoperative pain scores, total analgesic consumption and adverse events (e.g., nausea, vomiting, urinary retention).

Statistical Analysis: Data were analyzed using SPSS Version 25. Continuous variables were expressed as mean±SD and compared using the Student's t-test. Categorical variables were analyzed using the Chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

RESULTS AND DISCUSSIONS

Demographic and Baseline Characteristics: A total of 200 patients were enrolled, with 100 receiving spinal anesthesia and 100 undergoing general anesthesia. The groups were comparable in terms of demographic and clinical baseline characteristics. The mean age was 45.6±10.2 years in the spinal group and 46.8±11.1 years in the general anesthesia group. Male patients constituted 54.0% and 56.0% in the spinal and general groups, respectively. BMI values were evenly distributed across groups (23.1±3.4 vs. 23.8±3.7 kg/m²). Most patients were classified as ASA II in both groups. Preoperative hemodynamic parameters, including mean arterial pressure and heart rate, were statistically similar between groups. These balanced baseline characteristics provide a robust foundation for comparative analysis.

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Spinal Anesthesia Group	General Anesthesia Group
Age (years, mean±SD)	45.6±10.2	46.8±11.1
Male, n (%)	54 (54.0%)	56 (56.0%)
BMI (kg/m², mean±SD)	23.1 ± 3.4	23.8 ± 3.7
ASA I, n (%)	36 (36.0%)	32 (32.0%)
ASA II, n (%)	64 (64.0%)	68 (68.0%)
Duration of Surgery (min, mean±SD)	92.4±18.3	95.7±20.1
Preoperative MAP (mmHg, mean±SD)	91.3±7.2	90.7±6.9
Preoperative HR (bpm, mean±SD)	76.5±8.6	78.1±7.9

Intraoperative Hemodynamic Parameters: The intraoperative hemodynamic parameters differed significantly between the two anesthetic groups. Patients under spinal anesthesia demonstrated relatively stable mean arterial pressure (MAP) throughout the procedure, with only mild declines observed over the first 60 minutes (from 91.3±7.2 mmHg at baseline to 79.6±7.2mmHg at 60 minutes). In contrast, patients in the general anesthesia group experienced a steeper drop in MAP, particularly within the first 30 minutes, with values decreasing from 90.7±6.9mmHg at baseline to 73.1±7.8mmHg at 60 minutes. The incidence of intraoperative hypotension was higher in the general anesthesia group (32%) compared to the spinal group (18%). Similarly, vasopressor use was more frequent in the general group (24% vs. 12%). Heart rate trends also differed, with the general anesthesia group showing a progressive increase post-induction, while the spinal group exhibited a gradual decline. These findings suggest superior hemodynamic stability in patients receiving spinal anesthesia.

Table 2: Intraoperative Hemodynamic Parameters

Parameter	Spinal Anesthesia Group	General Anesthesia Group
Baseline MAP (mmHg)	91.3±7.2	90.7±6.9
MAP at 15 min	84.5±6.8	78.4±8.2
MAP at 30 min	82.1±7.5	76.3±8.6
MAP at 45 min	80.3±7.0	74.5±8.1
MAP at 60 min	79.6±7.2	73.1±7.8
Baseline HR (bpm)	76.5±8.6	78.1±7.9
HR at 15 min	72.1±7.9	84.2±8.4
HR at 30 min	70.8±8.2	85.6±7.9
HR at 45 min	68.3±7.5	86.1±8.2
HR at 60 min	67.0±7.4	85.7±7.6
Hypotension episodes, n (%)	18 (18.0%)	32 (32.0%)
Vasopressor use, n (%)	12 (12.0%)	24 (24.0%)

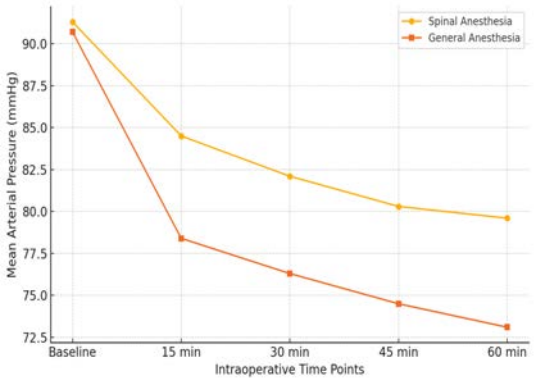

Fig. 1: Intraoperative Mean Arterial Pressure Trends in Spinal vs. General Anaesthesia Groups

This line graph illustrates mean arterial pressure (MAP) at 5 key intraoperative time points in both anaesthetic groups. Patients in the spinal anaesthesia group demonstrated more stable MAP values over time, whereas general anaesthesia was associated with a sharper decline, particularly within the first 30 minutes.

Postoperative Pain Outcomes: Pain scores assessed via the Visual Analog Scale (VAS) were consistently lower in the spinal anesthesia group across all time intervals. At 2 hours postoperatively, the mean VAS score in the spinal group was 2.4±1.0 compared to 3.8±1.1 in the general anesthesia group. This difference persisted through 6, 12 and 24 hours post-surgery, with the spinal group maintaining statistically lower scores. Moreover, the average time to first rescue analgesia was significantly longer in the spinal group (5.8±1.7 hours) versus the general anesthesia group (3.2±1.2 hours), highlighting the superior analgesic efficacy of spinal anesthesia in the immediate postoperative period.

Table 3: Postoperative VAS Scores and Time to First Rescue Analgesia

Time Point	Spinal Anesthesia Group	General Anesthesia Group
2 hours	2.4±1.0	3.8±1.1
6 hours	3.2±1.1	4.4±1.2
12 hours	3.9±1.3	4.9±1.5
24 hours	3.5±1.2	4.3±1.3
Time to First Rescue Analgesia (hrs)	5.8±1.7	3.2±1.2

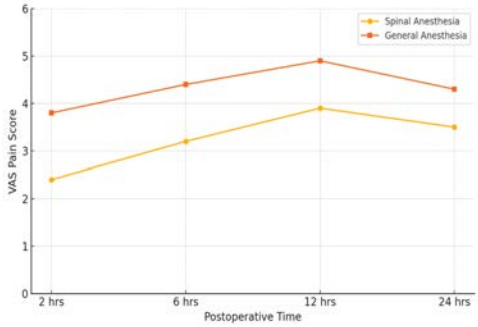

Fig. 2: Postoperative Pain Trends Measured by VAS Scores

This line graph depicts mean VAS pain scores at 2, 6, 12 and 24 hours postoperatively. Patients who received spinal anaesthesia consistently reported lower pain levels across all time points compared to those who underwent general anaesthesia, indicating prolonged analgesic benefit.

Analgesic Requirements: Postoperative analgesic consumption differed significantly between the two groups. Patients in the spinal anesthesia group required less opioid and non-opioid analgesia during the first 24 hours post-surgery. The mean total morphine requirement was 4.8±1.6 mg in the spinal group, compared to 7.6±2.2mg in the general anesthesia group. Similarly, paracetamol consumption was lower in the spinal group (2100±500 mg) versus the general group (2700±600mg). The average number of rescue analgesic doses administered was also significantly fewer in the spinal group (1.2±0.7) than in the general group (2.3±0.9), underscoring the prolonged analgesic benefits of spinal anesthesia.

Table 4: Total Analgesic Consumption with in 24 Hours Postoperatively

Analgesic Parameter	Spinal Anesthesia Group	General Anesthesia Group
Total Morphine (mg, mean±SD)	4.8±1.6	7.6±2.2
Total Paracetamol (mg, mean±SD)	2100±500	2700±600
Number of Rescue Doses (mean±SD)	1.2±0.7	2.3±0.9

Postoperative Adverse Events: The incidence of adverse events varied notably between the two groups. Patients in the general anesthesia group experienced higher rates of nausea (14%) and vomiting (10%) compared to those in the spinal anesthesia group (6% and 4%, respectively). Conversely, urinary retention was more common among spinal anesthesia recipients (8% vs. 2%). Respiratory depression occurred only in the general anesthesia group (3%). Additionally, delayed mobilization and prolonged PACU stays were significantly more frequent in the general group (12% and 9%, respectively) than in the spinal group (5% and 4%). These findings support the better early recovery profile associated with spinal anesthesia.

Table 5: Incidence of Postoperative Adverse Events

Adverse Event	Spinal Anesthesia Group	General Anesthesia Group
Nausea, n (%)	6 (6.0%)	14 (14.0%)
Vomiting, n (%)	4 (4.0%)	10 (10.0%)
Urinary Retention, n (%)	8 (8.0%)	2 (2.0%)
Respiratory Depression, n (%)	0 (0.0%)	3 (3.0%)
Delayed Mobilization (>12 hrs), n (%)	5 (5.0%)	12 (12.0%)
Prolonged PACU Stay (>2 hrs), n (%)	4 (4.0%)	9 (9.0%)

This prospective study compared spinal and general anaesthesia in elective lower limb surgeries, focusing on intraoperative hemodynamic, postoperative pain, analgesic requirements and early complications. Our findings strongly favour spinal anaesthesia for enhanced intraoperative stability and postoperative recovery. Intraoperative monitoring revealed significantly greater mean arterial pressure (MAP)

stability in the spinal group. While both groups started with similar baseline MAP, the general anaesthesia cohort demonstrated a more pronounced decline by the 30-minute mark, necessitating increased vasopressor use. These findings align with Finsterwald *et al.,* who reported greater hemodynamic stability and fewer vasopressor interventions in high-risk spinal patients compared to general anaesthesia recipients[1]. Heart rate (HR) trends similarly supported spinal anaesthesia, showing a gradual decline versus the sympathetic stimulation and elevated HR seen with general anaesthesia. Tekye and Alipour also found reduced intraoperative HR fluctuations and improved early recovery in patients receiving unilateral spinal anaesthesia[10]. Postoperative pain scores were consistently lower in the spinal anaesthesia group at all measured intervals. The analgesic effect of neuraxial blockade appears to extend well into the recovery period, delaying the need for rescue analgesia. These findings corroborate those of Nesek Adam *et al.,* who observed superior pain control and lower opioid consumption following spinal anaesthesia in vascular procedures[11]. Total analgesic use within 24 hours was also significantly lower among spinal recipients in our cohort. Morphine and paracetamol requirements, as well as the number of rescue doses, were markedly reduced-confirming enhanced opioid-sparing effects. Ciudad *et al.* reported similar outcomes in their comparative study of spinal-epidural and general anaesthesia for lower limb microvascular reconstruction, noting reduced postoperative morphine consumption in the spinal group[9]. Regarding complications, spinal anaesthesia was associated with fewer instances of nausea, vomiting, and prolonged PACU stay. Although urinary retention was slightly higher in this group, respiratory depression and delayed mobilization were more frequent among general anaesthesia patients. These trends mirror the results reported by McLain *et al.,* who found higher postoperative complication rates and longer recovery durations under general anaesthesia[12]. Overall, our findings reinforce the growing body of literature suggesting spinal anaesthesia as the preferred modality in elective lower limb procedures, especially where intraoperative hemodynamic stability and enhanced postoperative recovery are prioritized. De Rojas *et al.* and Sadrolsadat *et al.* similarly concluded that spinal anaesthesia offers a more favourable perioperative profile in lumbar and lower limb surgeries[13,5].

Limitations: This study was conducted at a single centre, which may limit generalizability to other clinical settings. Although random allocation was not performed, efforts were made to balance baseline characteristics. Blinding was not feasible due to the nature of anaesthetic techniques, introducing potential observer bias. Finally, postoperative outcomes were assessed only for the first 24 hours, limiting long-term insight.

CONCLUSION

Spinal anaesthesia demonstrated superior intraoperative hemodynamic stability, reduced postoperative pain scores, lower analgesic requirements and fewer early complications compared to general anaesthesia in elective lower limb surgeries. These findings support the preferential use of spinal anaesthesia in appropriate surgical candidates to enhance recovery and minimize perioperative risks.

REFERENCES

1. Finsterwald M., M. Muster, M. Farshad, A. Saporito, M. Brada and J.A. Aguirre., 2018. Spinal versus general anesthesia for lumbar spine surgery in high risk patients: Perioperative hemodynamic stability, complications and costs. J. Clin. Anesthesia, Vol. 46: 10.1016/j.jclinane.2018.01.004.
2. Roberts D.J., S.K. Nagpal, D. Kubelik, T. Brandys and H.T. Stelfox *et al.,* 2020. Association between neuraxial anaesthesia or general anaesthesia for lower limb revascularisation surgery in adults and clinical outcomes: Population based comparative effectiveness study. BMJ, Vol. 0. 10.1136/bmj.m4104.
3. Knaggs A., P. Mason, K. Macleod and K. Delis., 2004. Effects of epidural-and-general anesthesia combined versus general anesthesia alone on the venous hemodynamic of the lower limb. Thrombosis Haemostasis, Vol. 92: 10.1160/TH04-04-0233.
4. Ghanami R.J., J. Hurie, J.S. Andrews, R.N. Harrington and M.A. Corriere *et al.,* 2013. Anesthesia-Based Evaluation of Outcomes of Lower-Extremity Vascular Bypass Procedures. Ann. Vasc. Surg., Vol. 27: 10.1016/j.avsg.2012.04.006.
5. Rojas J.O.D., P. Syre and W.C. Welch., 2014. Regional anesthesia versus general anesthesia for surgery on the lumbar spine: A review of the modern literature. Clin. Neurol. Neurosurg., Vol. 119: 10.1016/j.clineuro.2014.01.016.
6. Zou L., Q. Wei S. Pan F. Xiao and Y. Jiang., 2024. Comparison of the Effects of Combined Femoral and Sciatic Nerves Block versus General Anesthesia on Hemodynamic Stability and Postoperative Complication. Drug, Healthcare and Patient Safety., 16: 225-234.
7. Lux E.A., 2012. Continuous spinal anesthesia for lower limb surgery: A retrospective analysis of 1212 cases. Local Regional Anesthesia, Vol. 5: 10.2147/LRA.S35535.

8. Mung'ayi V., K. Mbaya, T. Sharif and D. Kamya., 2015. A randomized controlled trial comparing hemodynamic stability in elderly patients undergoing spinal anaesthesia at L5, S1 versus spinal anaesthesia at L3, 4. Afr. Health Sci., Vol. 15: 10.4314/ahs.v15i2.210.
9. Nesek A.V., Z. Rasic and D. Schwarz., 2012. The effect of spinal versus general anesthesia on postoperative pain and analgesic requirements in patients undergoing peripheral vascular surgery. Acta Clin Croat., 5: 215-221.
10. Tekye S.M.M. and M. Alipour., 2014. Comparison of the effects and complications of unilateral spinal anesthesia versus standard spinal anesthesia in lower-limb orthopedic surgery. Braz. J. Anesthesiol., Vol. 64: 10.1016/j.bjane.2013.06. 014.
11. Ciudad P., J.M. Escandón, O.J. Manrique, H. Escobar, B.P. Mago and A.A. Malca., 2023. Efficacy of Combined Spinal-Epidural Anesthesia for Lower Extremity Microvascular Reconstruction. J. Surg. Res., Vol. 291: 10.1016/j.jss.2023.07.026.
12. McLain R.F., G.R. Bell, I. Kalfas, J.E. Tetzlaff and H.J. Yoon., 2004. Complications Associated With Lumbar Laminectomy: A Comparison of Spinal Versus General Anesthesia. Spine. Spine, Vol. 29: 10.1097/01.brs.0000144834.43115.38.
13. Sadrolsadat S.H., A.R. Mahdavi, R.S. Moharari, M.R. Khajavi, P. Khashayar, A. Najafi and A. Amirjamshidi., 2009. A prospective randomized trial comparing the technique of spinal and general anesthesia for lumbar disk surgery: A study of 100 cases. Surg. Neurol., Vol. 71: 10.1016/j.surneu.2008.08.003.