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Perioperative Complications and Recovery Profile in Patients Receiving Regional Versus General Anesthesia for Lower Limb Surgeries: A Cross-Sectional Observational Study.

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ABSTRACT

Background:
Regional anesthesia is widely used for lower limb surgery, but comparative institutional data on perioperative complications and early recovery remain relevant.

Objectives:
To compare perioperative complications, postoperative pain, and early recovery outcomes between patients receiving regional anesthesia and general anesthesia for elective lower limb surgeries.

Methods:
This cross-sectional observational comparative study was conducted at Mamata Medical College and its associated teaching hospital, Khammam, Telangana, India, from March 2025 to August 2025. One hundred adults scheduled for elective lower limb surgery were enrolled by consecutive sampling; 50 received regional anesthesia, and 50 received general anesthesia according to anesthesiologist assessment and surgical requirements. Intraoperative complications, postoperative outcomes, 6-hour pain score, rescue analgesic use, oral intake, ambulation, and hospital stay were compared, with $p<0.05$ considered significant.

Results:
Baseline age, sex, ASA status, and surgical duration were comparable between groups. General anesthesia was associated with higher rates of hypotension (22.0% vs 10.0%, p=0.04), tachycardia (20.0% vs 8.0%, p=0.03), vasopressor requirement (24.0% vs 12.0%, p=0.048), and airway-related interventions (10.0% vs 0.0%, p=0.01). PONV was higher after general anesthesia (28.0% vs 8.0%, p=0.006). Regional anesthesia had lower 6-hour VAS scores (3.1±1.2 vs 5.4±1.5, p<0.001), lower rescue analgesic requirement (30.0% vs 64.0%, p<0.001), earlier ambulation (14.6±3.8 vs 18.9±4.5 hours, p<0.001), earlier oral intake (6.2±1.5 vs 8.7±2.1 hours, p<0.001), and shorter hospital stay (3.8±1.2 vs 4.6±1.5 days, p=0.02). Urinary retention was more frequent with regional anesthesia (16.0% vs 6.0%, p=0.09).

Conclusion:
Regional anesthesia was associated with better hemodynamic stability, lower early pain burden, reduced rescue analgesic use, and faster recovery after elective lower limb surgery, while general anesthesia showed higher PONV.

Recommendations:
Regional anesthesia should be considered where clinically feasible, with active bladder monitoring and standardized early recovery protocols.

Keywords: *regional anesthesia; general anesthesia; lower limb surgery; postoperative complications; recovery; pain.*
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INTRODUCTION

Lower limb orthopedic surgeries constitute a substantial proportion of elective operative workload and are frequently performed in adults with varying comorbidity profiles. The anesthetic technique influences intraoperative physiology, postoperative symptom burden, and speed of functional recovery. Regional anesthesia, particularly neuraxial blockade and peripheral nerve techniques, can attenuate the surgical stress response, reduce systemic anesthetic exposure, and provide site-specific analgesia. Comparative-effectiveness research in hip and knee arthroplasty has reported associations between neuraxial approaches and improved perioperative outcomes such as reduced complications and shorter length of stay when compared with general anesthesia [1]. Additional analyses have suggested that anesthetic technique can influence postoperative infectious outcomes and short-term morbidity following lower limb arthroplasty [2,3].

General anesthesia remains a common choice because it offers predictable operating conditions and is applicable across a wide range of procedures. However, it is also linked to hemodynamic variability during induction and maintenance, higher exposure to volatile agents and opioids, and a greater propensity for postoperative nausea and vomiting (PONV) in susceptible individuals. Large database studies in contemporary total knee arthroplasty, including outpatient pathways, have demonstrated differences in minor adverse events and recovery metrics between spinal and general anesthesia, reinforcing the relevance of technique selection within enhanced recovery frameworks [4]. Similar comparative analyses in revision arthroplasty have shown that spinal anesthesia is associated with improved perioperative profiles, including reduced complications and shorter hospital stay, even after adjustment for confounders [5,6]. In hip fracture surgery, randomized evidence has indicated comparable longer-term outcomes between spinal and general anesthesia, supporting the need to focus on procedure type, patient risk, and early postoperative recovery endpoints when choosing anesthetic technique [7].

PONV continues to be a clinically important outcome because it affects oral intake, mobilization, patient satisfaction, and unplanned resource utilization. A simplified risk score based on readily measured clinical predictors enables pragmatic risk stratification and prophylaxis planning [8], and consensus guidelines provide evidence-based recommendations for multimodal prevention and treatment strategies [9]. Pain intensity assessment using a visual analog scale (VAS) is widely accepted and has demonstrated high reliability in acute settings [10], with established thresholds for clinically meaningful change after surgery [11]. These tools allow standardized measurement of symptom trajectories that are directly relevant to recovery after lower limb procedures.

Despite growing evidence, local data from tertiary care centers in India addressing common elective lower limb surgeries are limited, particularly regarding perioperative complications and early functional recovery markers. Therefore, this study was designed to compare perioperative complications and recovery profiles among patients receiving regional anesthesia versus general anesthesia for elective lower limb surgeries at a teaching hospital. The objectives were to (1) quantify intraoperative complications, (2) evaluate postoperative complications and pain outcomes, and (3) compare early recovery parameters including ambulation, oral intake, and hospital stay between the two anesthetic techniques.

MATERIALS AND METHODS

Study design and setting

This cross-sectional observational comparative study [12] was conducted in the Department of Anaesthesiology, Mamata Medical College and its associated teaching hospital, Khammam, Telangana, India, over 6 months from March 2025 to August 2025. The associated teaching hospital provides outpatient, inpatient, operation theatre, emergency, intensive care, and multispecialty/superspecialty clinical services. The Department of Anaesthesiology provides perioperative services for elective and emergency surgical specialties, including lower limb orthopaedic and reconstructive procedures. This setting permitted standardized perioperative monitoring, postanesthesia recovery assessment, and ward-based follow-up during the early postoperative period.

Participants and sampling

Adult patients (≥18 years) scheduled for elective lower limb surgeries, including fracture fixation, arthroscopy, and elective reconstructive procedures, under either regional or general anesthesia were screened. Consecutive eligible patients were enrolled after written informed consent. Patients were excluded if they underwent emergency surgery, had contraindications to neuraxial anesthesia such as coagulopathy or local infection at the puncture site, refused the planned anesthesia technique, required combined anesthesia techniques, or had anticipated

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postoperative mechanical ventilation. The final cohort comprised 50 patients managed with regional anesthesia (RA group) and 50 patients managed with general anesthesia (GA group).

Study size

The study size of 100 participants was selected as a feasible consecutive sample based on the expected number of eligible elective lower limb surgery cases during the 6-month study period and the planned equal comparison of two anesthesia technique groups. A formal power calculation was not performed because the work was designed as an institutional observational comparison. Consecutive eligible participants were enrolled until 50 patients were included in each group, which was considered adequate for descriptive estimation and preliminary between-group comparison of common perioperative outcomes.

Bias

Potential selection bias was addressed by consecutive enrolment of eligible patients and by applying predefined inclusion and exclusion criteria before group classification. Measurement bias was minimized by using uniform intraoperative monitoring, prespecified definitions for complications, a structured data collection proforma, and fixed-time assessment of pain using the VAS at 6 hours. Observer and reporting bias were reduced by recording objective outcomes such as vasopressor use, rescue analgesic requirement, oral intake, ambulation time, and hospital stay from perioperative and ward records. Baseline comparability for age, sex, ASA physical status, and duration of surgery was assessed to identify major group imbalance; nevertheless, interpretation remained cautious because anesthesia technique was not randomized.

Anesthetic management

The choice of anesthetic technique was determined by the attending anesthesiologist based on surgical requirements and patient factors. Regional anesthesia primarily consisted of neuraxial blockade (spinal anesthesia with standard local anesthetic dosing) with supplemental oxygen and light sedation when required. General anesthesia involved intravenous induction, airway control with an endotracheal tube or supraglottic device as appropriate, maintenance with inhalational or total intravenous agents, and standard monitoring. In both groups, intraoperative monitoring included noninvasive blood pressure, electrocardiography, pulse oximetry, and end-tidal carbon dioxide for GA cases. Postanesthesia recovery assessment used discharge criteria based on established postanesthesia scoring principles [13].

Outcome measures and definitions

Baseline variables included age, sex, ASA physical status, and duration of surgery. Intraoperative complications recorded were hypotension (systolic blood pressure <90 mmHg or >20% fall from baseline), tachycardia (heart rate >100/min or >20% rise from baseline), vasopressor requirement, intraoperative nausea/vomiting, and airway-related interventions beyond routine ventilation. Postoperative outcomes included PONV within 24 hours (any nausea and/or emesis), shivering, and urinary retention requiring catheterization or documented inability to void. Pain intensity at 6 hours was assessed using a 0–10 VAS [10,11]. Additional analgesic requirement within the first 12 hours was recorded as the need for rescue analgesia beyond the scheduled regimen. Recovery endpoints were time to first oral intake, time to first ambulation, and length of hospital stay. Given the recognized association of neuraxial techniques with urinary retention in lower limb arthroplasty pathways, urinary retention was actively monitored using ward protocols [14].

Statistical analysis

Data were entered into a spreadsheet and analyzed using standard statistical software. Continuous variables were summarized as mean ± standard deviation and compared between groups using the independent-samples t-test when distributional assumptions were acceptable. Categorical variables were presented as frequency (percentage) and compared using the chi-square test or Fisher's exact test when expected cell frequencies were small. All analyses were two-sided, and a p-value <0.05 was considered statistically significant.

Ethical considerations

Before the commencement of the study, ethical clearance was obtained from the Institutional Ethics Committee of Mamata Medical College, Khammam, Telangana. Written informed consent was obtained from all participants after explaining the study objectives, procedures, expected benefits, and possible risks. Participant privacy was protected by anonymizing study records and restricting access to the study database. The study was conducted in accordance with accepted ethical standards for biomedical research involving human participants.

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RESULTS

During the study period, 112 patients scheduled for elective lower limb surgery were potentially eligible and examined for eligibility. Twelve patients were excluded due to emergency surgery (n=4), contraindication or refusal for the planned anesthesia technique (n=3), requirement for combined anesthesia (n=3), or anticipated postoperative mechanical ventilation (n=2). Thus, 100 patients were confirmed eligible, provided written informed consent, and were included in the study. All 100 participants completed perioperative follow-up and were analyzed; 50 received regional anesthesia, and 50 received general anesthesia (Figure 1).

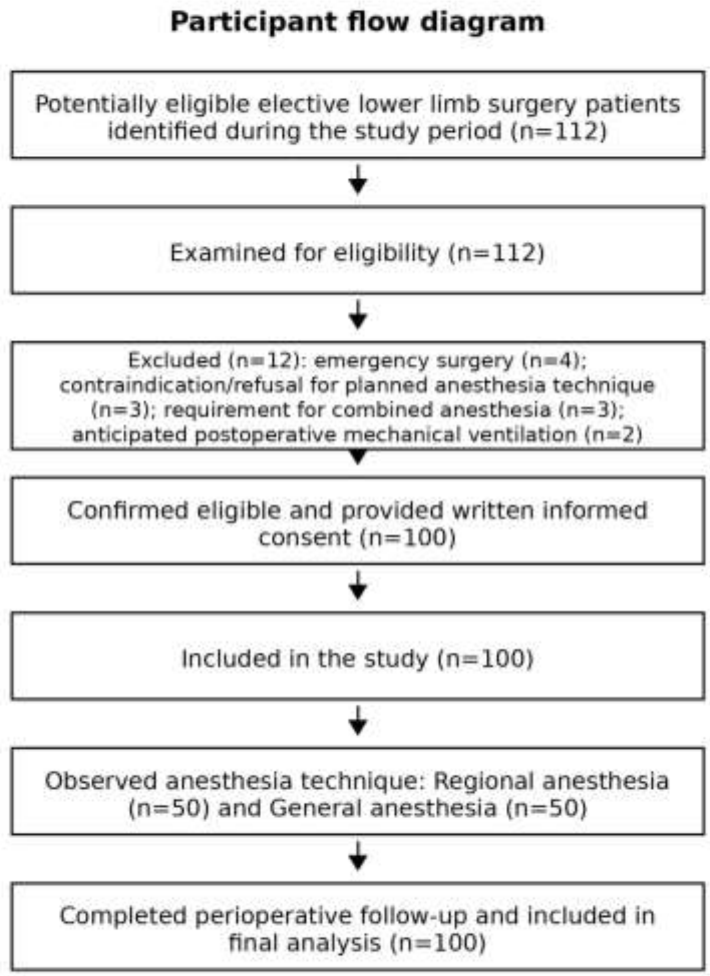

Figure 1. Participant flow diagram.

Baseline demographic and clinical characteristics were comparable between groups (Table 1). Mean age was similar between the RA and GA groups (46.8 ± 13.2 vs 45.5 ± 12.7 years, p=0.64). Male sex distribution (62.0% vs 58.0%, p=0.68), ASA physical status distribution (p=0.81), and mean duration of surgery (112.4 ± 28.6 vs 118.7 ± 31.4 minutes, p=0.29) also showed no statistically significant difference.

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Table 1. Baseline Demographic and Clinical Characteristics

Parameter	RA Group (n=50)	GA Group (n=50)	p-value
Age (years), mean ± SD	46.8 ± 13.2	45.5 ± 12.7	0.64
Male gender, n (%)	31 (62%)	29 (58%)	0.68
ASA I, n (%)	20 (40%)	18 (36%)	0.81
ASA II, n (%)	24 (48%)	25 (50%)	
ASA III, n (%)	6 (12%)	7 (14%)	
Duration of surgery (minutes), mean ± SD	112.4 ± 28.6	118.7 ± 31.4	0.29

Intraoperative complications are summarized in Table 2. General anesthesia showed higher hypotension (22.0% vs 10.0%, p=0.04), tachycardia (20.0% vs 8.0%, p=0.03), and vasopressor requirement (24.0% vs 12.0%, p=0.048) than regional anesthesia. Intraoperative nausea/vomiting was uncommon in both groups (6.0% vs 2.0%, p=0.30). Airway-related interventions beyond routine ventilation were documented only in the GA group (10.0% vs 0.0%, p=0.01).

Table 2. Intraoperative Complications

Parameter	RA Group (n=50)	GA Group (n=50)	p-value
Hypotension, n (%)	5 (10%)	11 (22%)	0.04
Tachycardia, n (%)	4 (8%)	10 (20%)	0.03
Vasopressor requirement, n (%)	6 (12%)	12 (24%)	0.048
Intraoperative nausea/vomiting, n (%)	1 (2%)	3 (6%)	0.30
Airway-related interventions, n (%)	0 (0%)	5 (10%)	0.01

Postoperative outcomes are presented in Table 3. PONV was significantly higher in the GA group than in the RA group (28.0% vs 8.0%, p=0.006). Regional anesthesia was associated with a lower 6-hour VAS pain score (3.1 ± 1.2 vs 5.4 ± 1.5, p<0.001) and a lower additional analgesic requirement within the first 12 hours (30.0% vs 64.0%, p<0.001). Shivering was comparable between groups (12.0% vs 18.0%, p=0.39). Urinary retention was numerically higher in the RA group (16.0% vs 6.0%, p=0.09), but the difference was not statistically significant.

Table 3. Postoperative Complications and Pain Profile

Parameter	RA Group (n=50)	GA Group (n=50)	p-value
PONV, n (%)	4 (8%)	14 (28%)	0.006
Shivering, n (%)	6 (12%)	9 (18%)	0.39
Urinary retention, n (%)	8 (16%)	3 (6%)	0.09
VAS score at 6 hours, mean ± SD	3.1 ± 1.2	5.4 ± 1.5	<0.001
Additional analgesic requirement (first 12 hours), n (%)	15 (30%)	32 (64%)	<0.001

Recovery parameters are shown in Table 4. The RA group achieved earlier first ambulation than the GA group (14.6 ± 3.8 vs 18.9 ± 4.5 hours, p<0.001) and earlier oral intake (6.2 ± 1.5 vs 8.7 ± 2.1 hours, p<0.001). Duration of hospital stay was also shorter in the RA group (3.8 ± 1.2 vs 4.6 ± 1.5 days, p=0.02). No mortality or major adverse cardiovascular events were documented in either group during the perioperative period.

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Table 4. Recovery Profile

Parameter	RA Group (n=50)	GA Group (n=50)	p-value
Time to first ambulation (hours), mean ± SD	14.6 ± 3.8	18.9 ± 4.5	<0.001
Time to oral intake (hours), mean ± SD	6.2 ± 1.5	8.7 ± 2.1	<0.001
Duration of hospital stay (days), mean ± SD	3.8 ± 1.2	4.6 ± 1.5	0.02

DISCUSSION

In this cross-sectional observational comparative study, regional anesthesia showed a more favorable perioperative profile than general anesthesia. General anesthesia had higher intraoperative hypotension (22.0% vs 10.0%, p=0.04), tachycardia (20.0% vs 8.0%, p=0.03), vasopressor requirement (24.0% vs 12.0%, p=0.048), and airway-related interventions (10.0% vs 0.0%, p=0.01). These findings align with comparative-effectiveness evidence in hip and knee arthroplasty showing advantages of neuraxial techniques in perioperative outcomes and resource utilization [1]. The lower hemodynamic event burden in the regional anesthesia group may reflect avoidance of induction-related sympathetic variation and reduced systemic anesthetic exposure.

Postoperative nausea and vomiting occurred more often after general anesthesia (28.0% vs 8.0%, p=0.006). This pattern is consistent with established risk models in which anesthetic technique and opioid exposure influence PONV likelihood [8], and with guideline recommendations favoring risk-stratified prophylaxis and opioid-sparing strategies [9]. In this study, the GA group also had higher 6-hour VAS scores (5.4 ± 1.5 vs 3.1 ± 1.2, p<0.001) and greater rescue analgesic requirement (64.0% vs 30.0%, p<0.001), which could have increased postoperative opioid exposure and contributed to PONV. The use of validated VAS methodology supports the clinical relevance of these pain differences [10,11].

Early ambulation and oral intake were achieved more rapidly in the regional anesthesia group. The time to first ambulation was shorter with regional anesthesia (14.6 ± 3.8 vs 18.9 ± 4.5 hours, p<0.001), and oral intake resumed earlier (6.2 ± 1.5 vs 8.7 ± 2.1 hours, p<0.001). Hospital stay was also shorter in the RA group (3.8 ± 1.2 vs 4.6 ± 1.5 days, p=0.02). Similar benefits have been reported in large propensity-matched analyses of outpatient and inpatient total knee arthroplasty, where spinal anesthesia was associated with fewer minor adverse events and favorable early recovery metrics [4]. Evidence from revision arthroplasty cohorts also supports improved postoperative trajectories with spinal anesthesia, including reduced complications and shorter hospitalization after adjustment for baseline risk [5,6]. Although this study focused on elective lower limb surgeries rather than arthroplasty alone, the direction of effect across recovery endpoints was concordant.

Urinary retention was numerically higher in the regional anesthesia group (16.0% vs 6.0%, p=0.09), although the difference did not reach statistical significance. This finding remains biologically plausible because neuraxial blockade can transiently affect bladder function and delay voiding. Prospective observational data from fast-track total joint arthroplasty pathways have identified spinal anesthesia as a risk factor for postoperative urinary retention and catheterization [14]. Therefore, postoperative bladder monitoring and clear catheterization thresholds remain important, especially among patients with pre-existing voiding risk factors. No major adverse cardiovascular events or mortality were recorded in either group, supporting the overall perioperative safety of both approaches within the observed elective surgical population.

Generalizability

The findings are most applicable to adult patients undergoing elective lower limb procedures in tertiary care teaching hospitals with standard monitoring, comparable surgical duration, and access to neuraxial anesthesia expertise. Settings with different case-mix, higher proportions of complex vascular procedures, or limited postoperative physiotherapy support could observe different recovery timelines. The comparative trends in PONV, early pain, and ambulation are expected to translate to similar institutions that follow structured analgesia, early mobilization, and postoperative bladder surveillance pathways.

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Conclusion

Regional anesthesia was associated with fewer intraoperative hemodynamic disturbances, lower early postoperative pain scores, reduced rescue analgesic consumption, and faster recovery milestones after elective lower limb surgeries. Patients receiving regional anesthesia ambulated earlier, tolerated oral intake sooner, and had a shorter hospital stay compared with those receiving general anesthesia. General anesthesia demonstrated higher rates of postoperative nausea and vomiting and a greater need for vasopressor support. Urinary retention occurred more often after regional anesthesia, highlighting the need for active postoperative bladder monitoring. Overall, technique selection should integrate patient risk, surgical requirements, and enhanced recovery goals, while prioritizing consistent symptom control and early mobilization. Standardized recovery protocols strengthened overall perioperative care.

Limitations

This single-center cross-sectional observational study used a nonrandomized allocation of anesthetic technique, permitting residual confounding from unmeasured clinical factors. The sample size limited subgroup analyses by procedure type and specific regional techniques. Postoperative outcomes were captured until discharge without extended follow-up for late complications. Analgesic and antiemetic administration followed routine practice rather than a fully standardized protocol, which may have influenced pain and PONV rates.

Recommendations

For elective lower limb surgeries, regional anesthesia should be prioritized when patient factors and surgical requirements permit, supported by staff competence in neuraxial techniques and block troubleshooting. Routine risk stratification for PONV should guide prophylaxis and rescue therapy, with emphasis on opioid-sparing multimodal analgesia. Postoperative pathways should include early mobilization targets, timely oral intake, and standardized discharge criteria. Because urinary retention was more frequent after regional anesthesia, bladder monitoring protocols and clear catheterization thresholds should be implemented. Future multicenter studies with randomized or robust adjusted designs should evaluate procedure-specific outcomes and longer-term functional recovery. Health-economic analyses can support resource planning.

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Abbreviations

ASA – American Society of Anesthesiologists
GA – General anesthesia
RA – Regional anesthesia
PONV – Postoperative nausea and vomiting
VAS – Visual analog scale
SD – Standard deviation
PACU – Postanesthesia care unit

Source of funding

The study had no funding.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

KAK-Concept and design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript. Statistical analysis and interpretation, revision of the manuscript. **CCHSS**- Design of the study, results interpretation, review of literature, and preparing the first draft of the manuscript, revision of the manuscript.**KKK-** Design of the study, results interpretation, review of literature, and preparing first draft of the manuscript, revision of the manuscript. Statistical analysis and interpretation, revision of the manuscript.**MRK-** Review of literature and preparing first draft of the manuscript. Statistical analysis and interpretation, revision of the manuscript

Data availability

Data is Available

Author biography

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Dr. Kumar has a strong academic interest in perioperative medicine, pain management, and critical care anaesthesiology. He regularly participates in clinical teaching and training of undergraduate medical students and junior residents, contributing to academic activities within the department. His research interests focus on improving anaesthetic techniques, enhancing postoperative analgesia, and optimizing perioperative patient outcomes through evidence-based clinical practice. He has been involved in clinical research and scholarly publications in the field of anaesthesiology.

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