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Original Research Article

ENHANCED RECOVERY AFTER SURGERY (ERAS) PROTOCOLS IN TOTAL KNEE AND HIP ARTHROPLASTY: ROLE OF ANESTHESIA

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ABSTRACT

Background: Enhanced Recovery After Surgery (ERAS) protocols have significantly improved perioperative outcomes in total knee arthroplasty (TKA) and total hip arthroplasty (THA). Anesthetic management plays a crucial role in reducing postoperative pain, facilitating early mobilization, and minimizing complications in elderly patients.

Materials and Methods: This prospective observational study was conducted at Government Dindigul Medical College Hospital from February 2025 to February 2026. A total of 100 patients aged ≥60 years undergoing elective TKA or THA were included. Patients were managed under standardized ERAS protocols. Demographic variables, anesthetic techniques, postoperative pain scores, opioid consumption, mobilization time, complications, and duration of hospital stay were evaluated.

Results: Spinal anesthesia was the most commonly utilized anesthetic technique and was administered in 48 patients. Patients receiving regional anesthesia demonstrated significantly lower postoperative pain scores compared to those receiving general anesthesia. Mean VAS score at 6 hours was 3.2 ± 1.1 in the spinal anesthesia group versus 5.1 ± 1.4 in the general anesthesia group ($p < 0.001$). Earlier mobilization was observed in patients receiving spinal anesthesia (14.2 ± 3.8 hours) compared to general anesthesia (22.6 ± 5.4 hours). Hospital stay was shorter among patients receiving spinal anesthesia (4.6 ± 1.2 days) compared to general anesthesia (7.2 ± 1.8 days). Postoperative nausea and vomiting, delirium, and ICU admissions were more frequently observed among patients receiving general anesthesia.

Conclusion: ERAS-guided regional anesthesia techniques were associated with superior perioperative recovery, reduced opioid requirement, earlier ambulation, fewer postoperative complications, and shorter hospitalization in elderly arthroplasty patients.

Keywords: Enhanced Recovery After Surgery, Total Knee Arthroplasty, Total Hip Arthroplasty, Regional Anesthesia, Elderly Patients, Multimodal Analgesia.

INTRODUCTION

Total knee arthroplasty (TKA) and total hip arthroplasty (THA) are among the most successful orthopedic procedures performed for advanced degenerative joint disease, particularly in the elderly population. With increasing life expectancy and rising prevalence of osteoarthritis, the number of arthroplasty procedures has shown a substantial global increase over the last two decades.[1] Although these procedures provide significant improvement in pain relief, mobility, and quality of life, perioperative recovery in older adults remains challenging because of multiple comorbidities, reduced physiological reserve, and higher susceptibility to postoperative complications.[2]

Traditionally, perioperative management in arthroplasty involved prolonged fasting, liberal

opioid administration, delayed mobilization, and extended hospital stay. Such conventional approaches were often associated with increased postoperative pain, nausea and vomiting, delayed rehabilitation, thromboembolic events, and prolonged functional recovery.[3] In recent years, the concept of Enhanced Recovery After Surgery (ERAS) has emerged as an evidence-based multidisciplinary perioperative care pathway aimed at minimizing surgical stress, preserving physiological function, and accelerating postoperative recovery.[4]

ERAS protocols were initially developed for colorectal surgery but have now gained widespread acceptance in orthopedic procedures, particularly total knee and hip arthroplasty. These protocols incorporate several coordinated interventions including preoperative counseling, optimization of nutrition, reduced fasting duration, multimodal analgesia, minimally invasive surgical techniques, early oral feeding, and rapid postoperative mobilization.[5] Among these components, anesthetic management plays a central role in determining perioperative outcomes.

The choice of anesthesia significantly influences postoperative pain control, opioid consumption, hemodynamic stability, mobilization, and duration of hospitalization. Regional anesthesia techniques such as spinal anesthesia and peripheral nerve blocks are increasingly preferred in arthroplasty because they provide superior analgesia with fewer systemic adverse effects compared to general anesthesia.[6] In addition, multimodal analgesic strategies that reduce opioid dependence have become an important part of ERAS pathways, especially in elderly patients who are more vulnerable to opioid-related complications such as respiratory depression, delirium, urinary retention, and postoperative cognitive dysfunction.

Early mobilization is another key principle of ERAS protocols, as delayed ambulation has been associated with increased risk of venous thromboembolism, muscle wasting, pulmonary complications, and prolonged hospital stay. Effective perioperative anesthesia facilitates rapid recovery of motor function and enables early physiotherapy participation following surgery.[3] Several studies have demonstrated that ERAS-guided anesthetic approaches contribute to reduced pain scores, shorter inpatient stay, decreased postoperative morbidity, and improved patient satisfaction following TKA and THA.[7]

Despite increasing evidence supporting ERAS in arthroplasty, there remains limited prospective observational data from Indian tertiary care government hospitals, particularly among elderly patients undergoing joint replacement surgeries. Differences in patient demographics, healthcare infrastructure, perioperative practices, and resource availability necessitate institution-specific evaluation of ERAS implementation. Therefore, the present study was undertaken at Government Dindigul Medical College Hospital to assess the role of anesthesia within ERAS protocols in elderly patients undergoing total knee and hip arthroplasty and to evaluate its impact on postoperative recovery outcomes.

MATERIALS AND METHODS

Study Design and Setting: This prospective observational study was conducted in the Departments of Anesthesiology and Orthopedics at Government Dindigul Medical College Hospital, Tamil Nadu, India. The study was carried out over a period of one year from February 2025 to February 2026. The objective of the study was to evaluate the influence of anesthesia-related Enhanced Recovery after Surgery (ERAS) practices on perioperative recovery outcomes among elderly patients undergoing total knee arthroplasty (TKA) and total hip arthroplasty (THA).

Prospective observational methodology was chosen as it allows systematic evaluation of perioperative practices and real-world postoperative outcomes without altering standard institutional protocols.[8]

Study Population: The study included patients aged 60 years and above who were scheduled for elective primary total knee arthroplasty or total hip arthroplasty under standardized perioperative ERAS pathways. A total of 100 patients were enrolled consecutively during the study period.

Inclusion Criteria

- Age ≥60 years
- Patients undergoing elective primary TKA or THA
- American Society of Anesthesiologists (ASA) physical status I–III
- Patients willing to participate and provide written informed consent

Exclusion Criteria

- Revision arthroplasty procedures
- Emergency orthopedic surgeries
- Patients with severe cognitive dysfunction or psychiatric illness
- Patients with contraindications to neuraxial anesthesia
- Patients unwilling to participate in the study

Preoperative Assessment: All patients underwent detailed pre-anesthetic evaluation one day prior to surgery. Demographic characteristics including age, sex, body mass index (BMI), comorbid illnesses, ASA grading, and baseline laboratory investigations were recorded. Particular attention was given to cardiovascular, respiratory, renal, and metabolic disorders, which are common among elderly arthroplasty patients and may influence perioperative recovery.[9]

As part of ERAS implementation, patients received structured preoperative counseling regarding the surgical procedure, anesthetic plan, postoperative pain management, mobilization schedule, and rehabilitation goals. Prolonged fasting was avoided

according to institutional ERAS guidelines. Clear fluids were permitted up to two hours before surgery, while solid food restriction was maintained for six hours preoperatively.

Intraoperative Management

The anesthetic technique was selected based on patient profile, surgical requirements, anesthesiologist preference, and patient consent. The anesthetic modalities observed in the present study included:

- Spinal anesthesia
- Combined spinal epidural anesthesia
- General anesthesia
- Peripheral nerve blocks as adjuncts for postoperative analgesia

Standard intraoperative monitoring included electrocardiography, noninvasive blood pressure, pulse oximetry, respiratory rate, and temperature monitoring. Intravenous fluid therapy was administered using goal-directed principles to avoid both hypovolemia and fluid overload, which are known contributors to delayed postoperative recovery.[10]

Multimodal analgesia formed a key component of perioperative ERAS management. Non-opioid analgesics including paracetamol and nonsteroidal anti-inflammatory drugs were administered whenever not contraindicated. Opioid administration was minimized to reduce opioid-related adverse events such as sedation, postoperative nausea and vomiting, respiratory depression, urinary retention, and delirium.

Maintenance of normothermia was ensured throughout surgery using warming devices and warmed intravenous fluids. Surgical duration and intraoperative hemodynamic events were documented.

Postoperative ERAS Protocol: Postoperatively, all patients were transferred to the recovery area and subsequently to the orthopedic ward after stabilization. Early oral intake was initiated as tolerated. Postoperative pain assessment was performed using the Visual Analog Scale (VAS) at 6, 12, 24, and 48 hours after surgery.

Early mobilization was encouraged under supervision of physiotherapists. Time to first ambulation was recorded in hours from completion of surgery. Postoperative opioid consumption during the first 48 hours was documented and converted into morphine equivalent doses for analysis.

Patients were monitored for postoperative complications including:

- Postoperative nausea and vomiting
- Hypotension
- Delirium
- Urinary retention
- Respiratory complications
- Requirement of ICU admission
- Readmission within 30 days

Length of hospital stay was calculated from the day of surgery until discharge.

Outcome Measures

Primary Outcome Measures

- Postoperative pain scores
- Time to first mobilization
- Length of hospital stay

Secondary Outcome Measures

- Total postoperative opioid consumption
- Incidence of postoperative complications
- ICU admission
- Patient satisfaction with recovery

Ethical Consideration: Ethical clearance for the study was obtained from the Institutional Ethics Committee of Government Dindigul Medical College Hospital prior to commencement of the study. Written informed consent was obtained from all study participants.[11]

Statistical Analysis: All collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 25. Continuous variables were expressed as mean ± standard deviation, while categorical variables were represented as frequencies.

Comparisons between anesthetic groups were performed using independent sample t-test or one-way analysis of variance (ANOVA) for continuous variables and Chi-square test for categorical variables. A p-value of less than 0.05 was considered statistically significant.[12]

RESULTS

Demographic Characteristics: A total of 100 elderly patients undergoing elective total knee arthroplasty (TKA) and total hip arthroplasty (THA) were included in the present study. The majority of patients belonged to the age group of 60–69 years, followed by 70–79 years and ≥80 years. The mean age of the study population was 68.4 ± 6.2 years. Female patients outnumbered male patients in the study population.

Most patients were categorized under ASA physical status II, followed by ASA III and ASA I. Hypertension and diabetes mellitus were the most frequently observed comorbid conditions among the study participants [Table 1]. The age-wise distribution of study participants is represented in [Figure 1].

Surgical and Anesthetic Characteristics: Among the enrolled patients, 63 patients underwent total knee arthroplasty, whereas 37 patients underwent total hip arthroplasty. Spinal anesthesia was the most commonly utilized anesthetic technique and was administered in 48 patients, followed by combined spinal epidural anesthesia in 28 patients and general anesthesia in 24 patients.

Peripheral nerve blocks were administered in 61 patients as part of multimodal analgesic management under ERAS protocols. The mean duration of surgery was 118.6 ± 22.4 minutes for TKA and 132.8 ± 25.7 minutes for THA procedures [Table 2]. The distribution of anesthetic techniques

among the study population is illustrated in [Figure 2].

Postoperative Pain and Recovery Outcomes: Postoperative pain assessment revealed significantly lower Visual Analog Scale (VAS) scores among patients managed with regional anesthesia techniques compared to general anesthesia. At 6 hours postoperatively, the mean VAS score in the spinal anesthesia group was 3.2 ± 1.1, whereas patients receiving general anesthesia demonstrated a mean score of 5.1 ± 1.4.

Patients receiving regional anesthesia demonstrated earlier postoperative mobilization. The mean time to first ambulation was 14.2 ± 3.8 hours in the spinal anesthesia group compared to 22.6 ± 5.4 hours in the general anesthesia group.

Furthermore, postoperative opioid consumption was markedly lower among patients receiving spinal anesthesia and peripheral nerve blocks as part of ERAS-based multimodal analgesia. Detailed postoperative recovery outcomes are summarized in [Table 3].

Comparison of postoperative pain scores at different postoperative intervals is shown in [Figure 3], while comparison of time to first mobilization according to anesthetic technique is presented in [Figure 4].

Length of Hospital Stay: Length of hospital stay was significantly reduced among patients managed with regional anesthesia techniques. Patients who received spinal anesthesia had a mean hospital stay of 4.6 ± 1.2 days, while those managed under general anesthesia required a mean hospitalization of 7.2 ± 1.8 days.

The comparison of hospital stay between anesthetic groups is depicted in [Figure 5].

Postoperative Complications: Postoperative complications were more frequently observed among patients who received general anesthesia. Postoperative nausea and vomiting occurred in 7 patients in the general anesthesia group compared to 5 patients in the spinal anesthesia group.

Similarly, postoperative delirium and ICU admissions were more common among patients receiving general anesthesia. However, the incidence of urinary retention and intraoperative hypotension did not demonstrate statistically significant variation between anesthetic groups. The postoperative complication profile among study participants is summarized in [Table 4].

Overall Recovery Outcome: Overall perioperative recovery was superior in patients managed with ERAS-guided regional anesthesia techniques. Reduced postoperative pain, earlier ambulation, lower opioid consumption, shorter hospital stay, and decreased incidence of postoperative complications collectively contributed to improved recovery and patient satisfaction in elderly patients undergoing total knee and hip arthroplasty.

Table 1: Demographic and Clinical Characteristics of the Study Population.

Variable	Frequency
Age Group	
60–69 years	52
70–79 years	36
≥80 years	12
Gender	
Male	42
Female	58
ASA Status	
ASA I	16
ASA II	54
ASA III	30
Comorbidities	
Hypertension	59
Diabetes Mellitus	46
Coronary Artery Disease	17
Chronic Kidney Disease	6

Table 2: Surgical and Anesthetic Characteristics

Variable	Frequency
Type of Surgery	
Total Knee Arthroplasty	63
Total Hip Arthroplasty	37
Anesthetic Technique	
Spinal Anesthesia	48
Combined Spinal Epidural	28
General Anesthesia	24
Peripheral Nerve Block Used	61
Mean Duration of Surgery (minutes)	124.3 ± 24.8

Table 3: Postoperative Recovery Outcomes According to Anesthetic Technique

Outcome Variable	Spinal Anesthesia (n=48)	Combined Spinal Epidural (n=28)	General Anesthesia (n=24)	p-value
VAS at 6 hrs	3.2 ± 1.1	3.5 ± 1.3	5.1 ± 1.4	<0.001
VAS at 24 hrs	2.8 ± 0.9	3.0 ± 1.0	4.2 ± 1.2	<0.001

Time to Mobilization (hrs)	14.2 ± 3.8	16.5 ± 4.1	22.6 ± 5.4	<0.001
Opioid Consumption (mg)	18.4 ± 5.2	21.1 ± 6.4	34.6 ± 7.8	<0.001
Hospital Stay (days)	4.6 ± 1.2	5.1 ± 1.4	7.2 ± 1.8	<0.001
Patient Satisfaction Score	8.8 ± 0.9	8.2 ± 1.1	6.9 ± 1.3	0.003

Table 4: Postoperative Complications According to Anesthetic Technique.

Complication	Spinal Anesthesia	General Anesthesia	p-value
Nausea/Vomiting	5	7	0.021
Delirium	2	4	0.048
Hypotension	6	3	1.000
Urinary Retention	4	3	0.512
Respiratory Complications	2	4	0.048
ICU Admission	1	3	0.041
Readmission within 30 Days	1	2	0.183

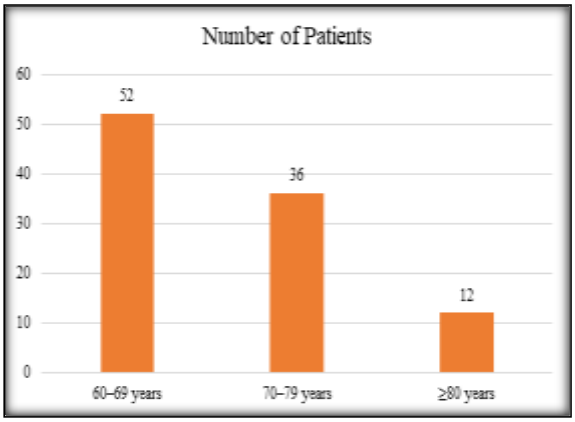

Figure 1: Age-wise Distribution of Study Participants

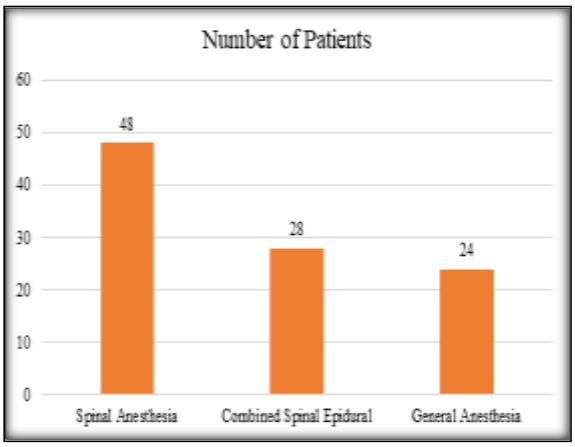

Figure 2: Distribution of Anesthetic Techniques among Study Participants

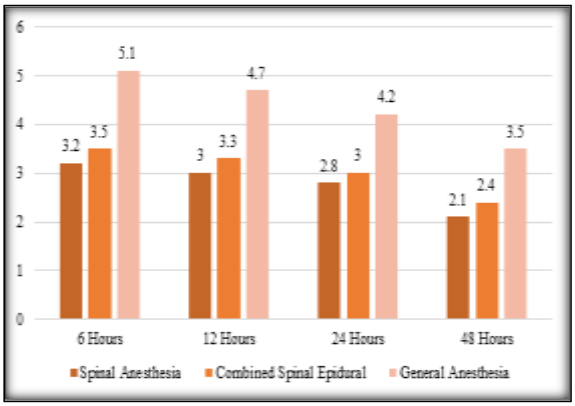

Figure 3: Comparison of Postoperative Visual Analog Scale (VAS) Pain Scores between Anesthetic Groups

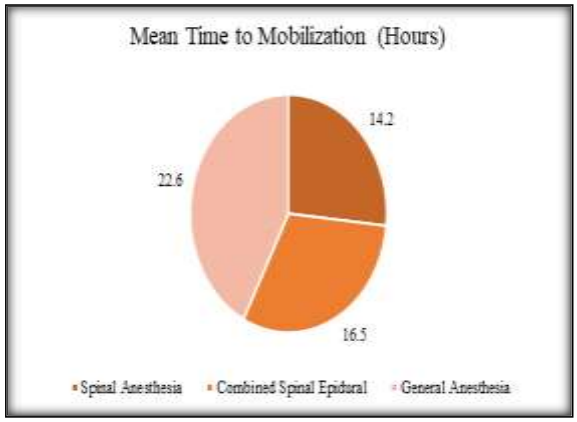

Figure 4: Comparison of Mean Time to First Mobilization According to Anesthetic Technique

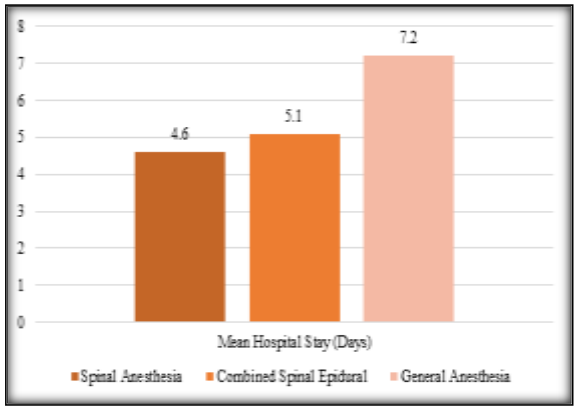

Figure 5: Comparison of Mean Duration of Hospital Stay between Anesthetic Groups

DISCUSSION

Enhanced Recovery after Surgery (ERAS) protocols have increasingly transformed perioperative care in orthopedic surgery by emphasizing multimodal, evidence-based strategies aimed at reducing surgical stress and promoting rapid functional recovery. The present prospective observational study evaluated the role of anesthesia within ERAS pathways among elderly patients undergoing total knee and hip arthroplasty. The findings of this study demonstrated that regional anesthesia-based ERAS management was associated with superior postoperative recovery, reduced pain scores, earlier mobilization, lower opioid consumption, fewer

postoperative complications, and shorter hospital stay.

The elderly population presents unique perioperative challenges because of reduced physiological reserve, multiple coexisting medical illnesses, and increased susceptibility to postoperative morbidity. In the present study, most patients belonged to the 60–69 years age group, with hypertension and diabetes mellitus representing the most common associated comorbidities. These observations are consistent with previous arthroplasty studies that identified degenerative joint disease and metabolic disorders as predominant conditions among elderly orthopedic patients.[13]

Regional anesthesia techniques, particularly spinal anesthesia combined with peripheral nerve blocks, were utilized in the majority of patients in the present study. Patients receiving regional anesthesia demonstrated significantly lower postoperative pain scores compared to those undergoing general anesthesia. Effective postoperative analgesia remains one of the most important goals of ERAS pathways because uncontrolled pain delays mobilization, increases opioid requirement, prolongs hospitalization, and negatively affects functional recovery. Similar findings were reported by Soffin and YaDeau, who emphasized that neuraxial anesthesia and multimodal analgesia significantly improve perioperative pain management in total joint arthroplasty.[14]

One of the most notable findings of the present study was the significantly earlier postoperative mobilization observed among patients managed with regional anesthesia. Early ambulation is a cornerstone of ERAS protocols as it reduces the incidence of thromboembolic complications, pulmonary dysfunction, muscle deconditioning, and prolonged dependency. Patients receiving spinal anesthesia in the current study achieved earlier ambulation compared to those managed under general anesthesia. These findings correlate with the observations of Kehlet and Wilmore, who reported that optimized perioperative anesthesia facilitates accelerated rehabilitation and functional recovery following major surgery.[15]

Postoperative opioid consumption was markedly lower among patients managed with ERAS-guided regional anesthesia techniques. Opioid minimization has become increasingly important in modern perioperative practice, especially among elderly patients who are highly vulnerable to opioid-related adverse effects including respiratory depression, sedation, postoperative delirium, nausea, vomiting, and urinary retention. The reduced opioid requirement observed in the present study likely contributed to the lower incidence of postoperative nausea and vomiting and postoperative delirium among patients receiving regional anesthesia.

Another significant observation in the present study was the reduction in length of hospital stay among patients managed with spinal anesthesia and multimodal analgesic strategies. Reduced hospitalization not only improves patient satisfaction and functional recovery but also decreases healthcare expenditure and hospital resource utilization. Similar outcomes have been demonstrated in contemporary ERAS literature, where implementation of standardized perioperative recovery pathways resulted in shorter inpatient stay without compromising patient safety.[16]

Postoperative complications were comparatively higher in patients receiving general anesthesia. The incidence of postoperative nausea and vomiting and delirium was significantly increased in this group. Elderly patients are particularly susceptible to postoperative cognitive dysfunction due to age-related neurophysiological changes and systemic exposure to anesthetic agents. The lower complication profile observed in patients receiving regional anesthesia further supports the growing preference for neuraxial techniques in arthroplasty procedures under ERAS protocols.[17]

The present study has several strengths. Its prospective observational design enabled systematic collection of perioperative data in a real-world clinical setting. Furthermore, the study specifically focused on elderly patients, a population in whom optimization of perioperative recovery is especially important. Evaluation of multiple recovery parameters including pain scores, opioid consumption, mobilization, complications, and hospital stay provided a comprehensive assessment of ERAS-based anesthetic outcomes.

However, certain limitations should also be acknowledged. Being a single-center observational study, the findings may not be generalizable to all healthcare settings. Variations in surgical technique, postoperative rehabilitation, and institutional ERAS adherence may have influenced perioperative outcomes. Additionally, long-term functional outcomes and quality-of-life measures were not assessed in the present study.

Overall, the findings of this study reinforce the critical role of anesthesia in successful ERAS implementation for total knee and hip arthroplasty. Regional anesthesia combined with multimodal analgesia appears to provide substantial perioperative advantages in elderly patients by improving recovery quality while minimizing postoperative morbidity.

CONCLUSION

The present prospective observational study demonstrated that anesthesia plays a pivotal role in the successful implementation of Enhanced Recovery After Surgery (ERAS) protocols among elderly patients undergoing total knee and total hip arthroplasty. Regional anesthesia techniques, particularly spinal anesthesia combined with multimodal analgesia and peripheral nerve blocks, were associated with superior perioperative outcomes when compared to general anesthesia.

Patients managed under ERAS-guided regional anesthesia protocols experienced significantly lower postoperative pain scores, reduced opioid consumption, earlier mobilization, shorter duration of hospital stay, and fewer postoperative complications such as nausea, vomiting, delirium, and ICU admission. These findings highlight the importance of optimizing anesthetic strategies to enhance postoperative recovery and functional rehabilitation in elderly orthopedic patients.

The study further emphasizes that integration of evidence-based perioperative anesthetic practices within ERAS pathways can improve overall patient recovery while reducing postoperative morbidity and healthcare burden. Early mobilization and opioid-sparing analgesic approaches appear to be particularly beneficial in the geriatric population, where postoperative complications can significantly affect long-term outcomes and quality of life.

Although the present study was conducted in a single tertiary care government institution, the findings strongly support the routine incorporation of ERAS-based anesthetic management in total joint arthroplasty programs. Future multicentric studies with larger sample sizes and long-term follow-up are warranted to further validate these observations and establish standardized perioperative ERAS protocols tailored for elderly arthroplasty patients in resource-limited healthcare settings.

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