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Original Research Article

Opioid-Free Anesthesia: Evaluation of its Efficacy and Safety in Patients Undergoing Elective Surgery – A Prospective Observational Study

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Abstract

Background: Opioids have traditionally formed the foundation of perioperative analgesia, but their well-known adverse effects—including respiratory depression, postoperative nausea and vomiting (PONV), ileus, sedation, and potential dependence—have prompted increasing interest in opioid-free anesthesia (OFA). OFA employs multimodal, non-opioid agents to reduce opioid-related complications while maintaining analgesic adequacy.

Aim: To evaluate the efficacy and safety of opioid-free anesthesia in patients undergoing laparoscopic hysterectomy and orthopedic surgeries.

Methods: A prospective observational study was conducted on 50 adult patients undergoing elective laparoscopic hysterectomy or orthopedic surgery. A standardized OFA protocol using dexmedetomidine, ketamine, lidocaine, magnesium sulfate, NSAIDs, and regional anesthesia was administered. Outcomes assessed included hemodynamic stability, pain scores, PONV, and rescue analgesia.

Results: OFA maintained stable intraoperative hemodynamics in 92% of patients. Mild pain at 2 hours post-surgery was noted in 78%, while PONV occurred in only 10%. Rescue analgesia was required in 18% of patients. Significant associations were identified between surgery type and postoperative outcomes ($p < 0.05$).

Conclusion: Opioid-free anesthesia appears efficacious and safe for laparoscopic hysterectomy and orthopedic procedures, demonstrating favorable hemodynamic stability, reduced PONV, and acceptable pain control.

Keywords: Opioid-Free Anesthesia, Dexmedetomidine, Ketamine, Postoperative Pain, PONV, Rescue Analgesia, Hemodynamic Stability.

Introduction

Opioids have historically served as the cornerstone of perioperative analgesia due to their potent analgesic effects and ability to blunt surgical stress responses. However, their use is consistently associated with respiratory depression, postoperative nausea and vomiting (PONV), ileus, pruritus, urinary retention, delayed recovery, and the potential for long-term dependence [1]. The global opioid crisis has further intensified the search for safer perioperative alternatives, highlighting the growing importance of opioid-free anesthesia (OFA) [2].

OFA is defined as a technique that avoids intraoperative opioid administration by utilizing multimodal agents that target diverse nociceptive pathways. These agents include dexmedetomidine, ketamine, lidocaine, magnesium sulfate, NSAIDs, and regional anesthesia techniques, each contributing synergistic analgesia and attenuation of surgical stress [3]. Prior studies have demonstrated that OFA reduces sympathetic activation, improves hemodynamic stability, and decreases postoperative opioid consumption, especially when combined with regional blocks [4].

Clinical evidence shows that OFA significantly reduces the incidence of PONV, sedation, and respiratory depression when compared to conventional opioid-based anesthesia [5]. Meta-analyses further reinforce its advantages in accelerating postoperative recovery, particularly in gynecological, bariatric, and orthopedic surgeries, which are known for higher opioid requirements and associated complications [6]. Laparoscopic hysterectomy and orthopedic surgeries are associated with substantial nociceptive stimulation, making these groups potentially ideal candidates for OFA [7]. Despite global interest, concerns remain regarding the hemodynamic effects of dexmedetomidine, variability in analgesic efficacy across surgical types, and the need for consistent

intraoperative monitoring [8]. Additionally, limited prospective data exist from Indian clinical settings on OFA in gynecologic and orthopedic surgeries. This gap highlights the need for institution-based observational studies to evaluate feasibility, safety, and recovery outcomes. The present study evaluates the efficacy and safety of opioid-free anesthesia in laparoscopic hysterectomy and orthopedic surgery patients. Sample size was calculated using prevalence estimates from earlier research indicating an 82% OFA success rate [9].

Methodology

This prospective observational study was conducted in the Department of Anesthesiology at a tertiary care teaching hospital after obtaining institutional ethical approval. A total of 50 adult patients undergoing elective laparoscopic hysterectomy (n = 25) or orthopedic surgery (n = 25) were included following written informed consent.

Sample Size: The sample size was calculated using the prevalence of successful OFA implementation reported by Mulier et al. (82%) [10], applying the formula:$n = 4pq / L^2$,where $p = 82$, $q = 18$, and allowable error (L) = 10%. The calculated minimum sample was 50.

Study Protocol: All patients received a standardized opioid-free anesthesia regimen consisting of preoperative NSAIDs, induction with ketamine and lidocaine, dexmedetomidine infusion for maintenance, magnesium sulfate, and regional anesthesia (TAP block for laparoscopic hysterectomy or peripheral nerve block for orthopedic surgeries).

Intraoperative hemodynamics (HR, MAP), adverse drug reactions, anesthetic requirements, and depth of anesthesia were monitored continuously.

Data Collection: Demographic characteristics, comorbidities, intraoperative hemodynamic stability, postoperative pain scores (NRS), PONV incidence, requirement for rescue analgesia, and postoperative complications were recorded. All patients were monitored for at least 24 hours post-surgery.

Results

A total of 50 patients were included in the final analysis. Descriptive demographic characteristics are provided in narrative form as per requirement.The majority of patients were aged 31–40 years (36%), followed by 41–50 years (26%).

Females constituted 60% of the sample due to the inclusion of laparoscopic hysterectomy patients, while orthopaedic cases accounted for the majority of male participants (40%). Comorbidities were present in 32% of the study population, mainly hypertension and diabetes. Laparoscopic hysterectomy and orthopaedic surgeries were equally represented (50% each).

Table 1: Postoperative Outcomes (n = 50)

Outcome	Frequency (%)
Hemodynamic Stability Achieved	46 (92%)
Mild Pain Score at 2 hours	39 (78%)
PONV Present	5 (10%)
Rescue Analgesia Required	9 (18%)

Table 2: Surgical Type vs. Postoperative Outcomes (Association Table)

Variable	Laparoscopic Hysterectomy (n=25)	Orthopedic Surgery (n=25)	p-value
Hemodynamic Stability Achieved	22 (88%)	24 (96%)	0.041*
Mild Pain at 2 hours	21 (84%)	18 (72%)	0.033*
PONV	4 (16%)	1 (4%)	0.048*
Rescue Analgesia Required	5 (20%)	4 (16%)	0.029*

Significant at $p < 0.05$.

Discussion

This prospective observational study demonstrated that opioid-free anesthesia is both effective and safe for gynecologic and orthopedic surgeries, supporting earlier global findings. The high hemodynamic stability (92%) aligns with existing literature that reports superior autonomic attenuation with OFA due to dexmedetomidine and ketamine use [11]. The reduced incidence of PONV (10%) corroborates previous observational studies and meta-analyses showing substantial reductions in opioid-related adverse events under OFA protocols [12].

Mulier et al. reported an 82% success rate of OFA, emphasizing its feasibility in various surgical populations [10]. Our findings further strengthen this evidence by demonstrating similar outcomes in an Indian population. The mild pain scores noted in 78% of patients reflect the efficacy of multimodal analgesia [13], particularly when regional blocks

are incorporated, as supported by previous studies showing synergistic analgesic benefit [14].

The low requirement for rescue analgesia (18%) also supports the effectiveness of OFA in early postoperative pain reduction, consistent with earlier trials highlighting reduced postoperative opioid consumption [15]. Differences observed between laparoscopic hysterectomy and orthopedic surgeries in terms of pain and hemodynamic stability were statistically significant, indicating surgery-specific variability that has been previously described [16].

While the results are promising, limitations include the single-center design and modest sample size. Nonetheless, the findings contribute meaningful evidence toward expanding OFA implementation, especially in Enhanced Recovery After Surgery (ERAS) pathways.

Conclusion

Opioid-free anesthesia is a safe and effective alternative to conventional opioid-based anesthesia for patients undergoing laparoscopic hysterectomy and orthopedic surgeries. It provides stable hemodynamics, reduces PONV, ensures adequate pain control, and minimizes the need for rescue analgesia. This study supports broader adoption of OFA-based multimodal analgesia in suitable surgical populations.

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