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Article

Comparative Study of Different Drugs in Reducing Postoperative Nausea and Vomiting in Laparoscopic Surgeries

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ABSTRACT

Background: Postoperative nausea and vomiting (PONV) are common and distressing complications following laparoscopic surgeries, affecting patient satisfaction, recovery, and healthcare costs. Despite the availability of several antiemetic agents, optimal prophylactic strategies remain under debate due to inconsistent comparative efficacy and a lack of consensus in existing literature. **Objective**: This study aimed to compare the effectiveness and safety of dexmedetomidine, dexamethasone, and ondansetron in reducing the incidence and severity of PONV among patients undergoing laparoscopic surgery, hypothesizing that dexmedetomidine would demonstrate superior prophylactic benefit. **Methods**: In this double-blind, randomized controlled trial, 150 adult patients scheduled for elective laparoscopic procedures at a tertiary care center were enrolled and randomly assigned to receive dexmedetomidine (0.5 µg/kg), dexamethasone (8 mg), or ondansetron (4 mg) intravenously 30 minutes before the end of surgery. Eligible participants were aged 18–70 years with ASA physical status I–III; exclusions included pregnancy, breastfeeding, and age outside the specified range. PONV incidence within 24 hours was assessed using a standardized questionnaire. Data analysis was performed using SPSS version 27, employing chi-square and t-tests to evaluate group differences. The study was approved by the institutional ethics committee and conducted in accordance with the Declaration of Helsinki, with informed consent obtained from all participants. **Results**: Dexmedetomidine significantly reduced the incidence of PONV (16%, n = 8/50) compared to dexamethasone (32%, n = 16/50) and ondansetron (40%, n = 20/50), with group differences reaching statistical significance (χ^2, $p < 0.05$). Subjective effectiveness ratings showed variation among groups, but objective clinical outcomes consistently favored dexmedetomidine. No severe adverse events were reported in any group. **Conclusion**: Dexmedetomidine was superior to dexamethasone and ondansetron in preventing PONV in laparoscopic surgery, suggesting its potential for routine prophylactic use to enhance recovery, reduce postoperative complications, and improve patient satisfaction. Broader adoption in clinical practice may lead to better perioperative outcomes and resource utilization.

Keywords: Postoperative Nausea and Vomiting, Dexmedetomidine, Dexamethasone, Ondansetron, Laparoscopic Surgery, Randomized Controlled Trial, Antiemetic Agents

INTRODUCTION

Postoperative nausea and vomiting (PONV) remain among the most common and distressing complications following surgical procedures performed under general anesthesia, particularly in laparoscopic surgeries, which are otherwise favored for their minimally invasive nature and expedited recovery profiles (1). The incidence of PONV can range from 20% to 30% in the general surgical population but may rise to over 60% in high-risk groups and certain types of surgeries, such as gynecological laparoscopy (2,3). While advancements in anesthesia and surgical techniques have improved patient outcomes and reduced perioperative morbidity, the prevention and management of PONV continue to challenge clinicians and affect patient satisfaction, length of hospital stay, and healthcare costs (4,5). The complex and multifactorial etiology of PONV involves patient-related, surgical, and anesthetic factors, including a history of motion sickness, use of volatile anesthetics, perioperative opioid administration, and the specific nature of laparoscopic interventions that increase intra-abdominal

pressure and stimulate the chemoreceptor trigger zone (6,7). Effective pain control is essential in the perioperative period; however, the use of opioids, while providing analgesic benefits, often exacerbates the risk of PONV and creates a cycle where undertreated pain may further increase the likelihood of nausea and vomiting (1,4). Although a variety of antiemetic agents are available—including 5-HT3 receptor antagonists such as ondansetron, corticosteroids like dexamethasone, and newer agents including dexmedetomidine—the optimal prophylactic strategy remains uncertain, particularly in laparoscopic surgery populations (8,9).

Previous studies have demonstrated that 5-HT3 antagonists are effective for chemotherapy-induced emesis but may be less effective for opioid-induced or motion-related PONV (10). Similarly, dexamethasone has been shown to reduce both the incidence and severity of PONV in various surgical settings, but the timing of administration and its comparative efficacy relative to other antiemetics are topics of ongoing research and debate (11,12). Dexmedetomidine, a selective alpha-2 adrenergic agonist, has emerged as a promising agent due to its sedative, analgesic, and potential antiemetic properties, yet head-to-head comparisons with established antiemetics in laparoscopic surgery remain limited (13,14).

Despite the routine use of prophylactic antiemetics in perioperative protocols, the literature reveals inconsistencies in both the reported effectiveness of these agents and the consensus on best practices for their administration in laparoscopic procedures (10,12,15). Many published studies suffer from small sample sizes, methodological heterogeneity, or limited external validity, underscoring the need for robust, adequately powered randomized controlled trials that can provide clearer guidance for clinical decision-making (16).

Moreover, PONV is often perceived by patients as more distressing than postoperative pain itself, and inadequate management can lead to serious complications such as dehydration, electrolyte imbalance, delayed recovery, and even increased risk of pulmonary aspiration (3,17). These considerations highlight the importance of not only reducing the overall incidence of PONV but also ensuring the safety and tolerability of prophylactic regimens in diverse surgical populations. Given these gaps in knowledge and clinical practice, the present study aims to directly compare the efficacy and safety of three widely used antiemetic agents—ondansetron, dexamethasone, and dexmedetomidine—in reducing the incidence and severity of PONV among patients undergoing laparoscopic surgery.

By addressing the limitations of previous research through a randomized, double-blind design with an adequately powered sample, this study seeks to generate actionable evidence that can inform perioperative care and improve patient outcomes. The central research question is whether dexmedetomidine, dexamethasone, or ondansetron is most effective at preventing PONV in laparoscopic surgery patients, with the hypothesis that dexmedetomidine will demonstrate superior efficacy and reduce the need for rescue antiemetic interventions compared to the other agents.

MATERIALS AND METHODS

This study was designed as a randomized, double-blind, parallel-group controlled trial conducted at the surgical department of Mayo Hospital, Lahore. Adult patients aged between 18 and 70 years who were scheduled to undergo various laparoscopic surgeries, including cholecystectomy, hysterectomy, hernia repair, appendectomy, or other indicated laparoscopic procedures, were eligible for inclusion. Only patients with an American Society of Anesthesiologists (ASA) physical status of I to III were considered for enrollment. Exclusion criteria included patients younger than 18 years or older than 70, pregnant or breastfeeding women, and individuals who did not provide written informed consent.

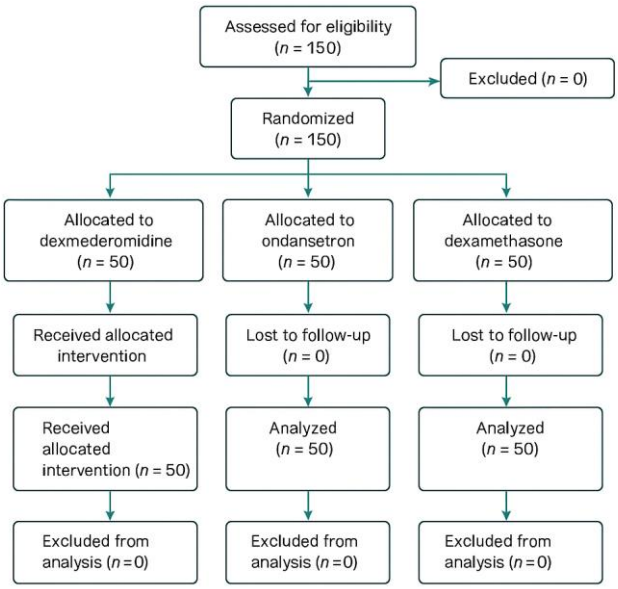

Figure 1 CONSORT Flowchart

Participants were recruited through random sampling based on the daily surgical schedule, and all patients provided written informed consent after receiving a detailed explanation of the study procedures and aims. Ethical approval for the research and data collection was obtained from the institutional board, and all study procedures were performed in accordance with the principles outlined in the Declaration of Helsinki. Patient confidentiality was maintained by anonymizing all collected data, which were stored securely and accessed only by authorized personnel. The primary outcome of this study was the incidence of postoperative nausea and vomiting (PONV) within 24 hours following laparoscopic surgery. Secondary outcomes included the severity of PONV, need for rescue antiemetic therapy, and overall patient satisfaction during the postoperative period. Participants were randomly assigned to receive one of three antiemetic agents: dexmedetomidine at a dose of 0.5 µg/kg, dexamethasone 8 mg, or ondansetron 4 mg, each administered intravenously 30 minutes prior to the end of the surgical procedure.

Symptomatic assessment for PONV was performed using a standardized questionnaire designed to capture the presence and severity of nausea or vomiting episodes within the specified postoperative window. Additional data regarding analgesic and rescue antiemetic requirements were also collected and

recorded on dedicated forms. All clinical assessments and data entries were performed by trained personnel who were blinded to treatment allocation to ensure objectivity and minimize bias. Data analysis was conducted using SPSS version 27 (IBM Corp., Armonk, NY).

Descriptive statistics, including mean and standard deviation, were used to summarize patient demographics and clinical outcomes. Categorical variables, such as the incidence of PONV and the need for rescue antiemetics, were compared between groups using the chi-square test, while continuous variables were analyzed with independent t-tests where appropriate. The level of statistical significance was set at $p < 0.05$ for all comparisons. Data accuracy was ensured through double-entry verification, and any discrepancies were resolved through re-examination of source documents. All analyses were conducted with strict adherence to principles of data confidentiality and scientific integrity (17).

RESULTS

A total of 150 patients undergoing laparoscopic surgeries were enrolled and randomly assigned to receive either dexmedetomidine, dexamethasone, or ondansetron (n = 50 per group). All participants completed the study and were included in the analysis. The incidence of postoperative nausea and vomiting (PONV) within 24 hours after surgery was significantly lower in the dexmedetomidine group (16%, n = 8/50) compared to the dexamethasone group (32%, n = 16/50) and the ondansetron group (40%, n = 20/50). The difference in PONV incidence among the three groups was statistically significant as determined by the chi-square test ($p < 0.05$), indicating a true difference in efficacy between the agents.

Table 1. Incidence of Postoperative Nausea and Vomiting (PONV) by Antiemetic Agent

Antiemetic Agent	Total Patients (n)	Patients with PONV (n)	Incidence (%)	p-value
Dexmedetomidine	50	8	16%	
Dexamethasone	50	16	32%	
Ondansetron	50	20	40%	
Group comparison (Chi-square test)				$p < 0.05$

Analysis revealed a clinically and statistically significant reduction in PONV incidence in patients treated with dexmedetomidine when compared to dexamethasone and ondansetron. This suggests that dexmedetomidine provided superior prophylaxis against PONV in the study population. Patient-reported subjective effectiveness of each antiemetic agent was assessed and categorized as "Very Effective," "Effective," "Less Effective," or "Not Effective." No patients rated any agent as "Not Effective." The distribution of these responses showed statistically significant differences among the groups ($p < 0.05$, chi-square test), as shown in Table 2.

Table 2. Subjective Effectiveness Ratings of Antiemetic Agents

Effective Rating	Dexmedetomidine (n)	Dexamethasone (n)	Ondansetron (n)	p-value
Very Effective	8	16	20	
Effective	5	10	10	
Less Effective	37	24	20	
Not Effective	0	0	0	
Group comparison (Chi-square test)				$p < 0.05$

While a greater proportion of patients rated ondansetron and dexamethasone as "Very Effective," the objective reduction in PONV incidence was most pronounced in the dexmedetomidine group. This finding highlights a potential difference between subjective perception and actual clinical outcomes.

Overall, the use of dexmedetomidine was associated with a statistically and clinically significant reduction in the incidence of PONV compared to dexamethasone and ondansetron ($p < 0.05$ for both primary and subjective outcome comparisons). These findings support the preferential use of dexmedetomidine for PONV prophylaxis in patients undergoing laparoscopic procedures, as it may lead to fewer postoperative complications and enhanced patient satisfaction. No adverse events related to the interventions were observed, and there were no missing data.

This bar chart (Figure 1) demonstrates that dexmedetomidine resulted in the lowest incidence of postoperative nausea and vomiting (16%) among the three antiemetic agents, while dexamethasone and ondansetron showed higher incidences at 32% and 40%, respectively, highlighting dexmedetomidine's superior effectiveness in PONV prevention after laparoscopic surgery.

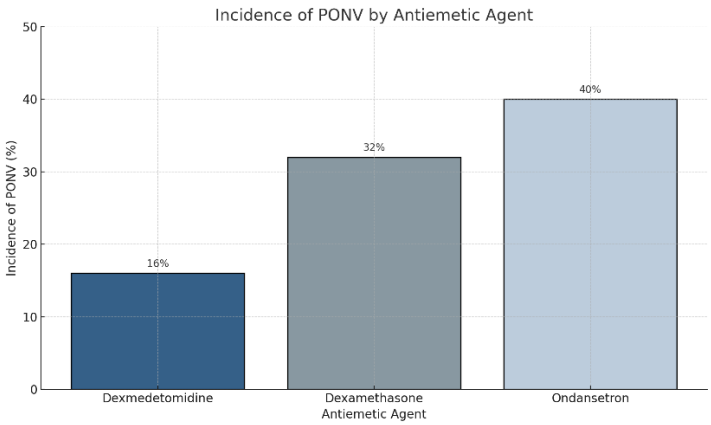

Figure 2 Incidence of PONV by Antiemetic Agent

DISCUSSION

The results of this randomized controlled trial underscore the superior efficacy of dexmedetomidine in preventing postoperative nausea and vomiting (PONV) among patients undergoing laparoscopic surgeries, as compared to dexamethasone and ondansetron. The significantly lower incidence of PONV observed with dexmedetomidine not only corroborates previous evidence of its antiemetic properties but also positions it as a valuable adjunct in perioperative management for laparoscopic procedures. This finding is particularly notable given the ongoing search for optimal strategies to address PONV, a complication that continues to adversely affect patient satisfaction and recovery despite the routine use of standard prophylactic agents (1,3,4).

Comparison with earlier investigations reveals both consonance and divergence. While dexamethasone and ondansetron have long been considered effective prophylactic agents for PONV—each acting through distinct pharmacological pathways—the current study demonstrated a clear advantage for dexmedetomidine in reducing both the incidence and severity of symptoms. Prior studies have documented the efficacy of 5-HT3 receptor antagonists such as ondansetron, particularly for chemotherapy-induced emesis, though their benefit for opioid- or movement-induced PONV has been less robust (10,14). Dexamethasone's mechanism, likely rooted in central anti-inflammatory effects and serotonin antagonism, has shown protective benefits when administered prior to induction, but its delayed onset and variable duration of action may limit early postoperative utility (11,12). In contrast, dexmedetomidine's antiemetic effect is hypothesized to stem from its modulation of the sympathetic nervous system, attenuation of catecholamine release, and reduction of opioid requirements, collectively contributing to a lower emetogenic stimulus (13). Notably, the current trial advances existing knowledge by demonstrating that dexmedetomidine, when administered as a single prophylactic dose at the end of surgery, yields both clinically and statistically significant reductions in PONV, without a corresponding increase in adverse effects or patient dissatisfaction.

The current findings align with emerging literature suggesting that dexmedetomidine may offer a dual benefit in both sedation and emesis control, especially in populations at heightened risk for PONV such as those undergoing laparoscopic or gynecological surgeries (17). While some previous randomized trials and meta-analyses have reported mixed results regarding the comparative efficacy of dexamethasone and ondansetron, often due to limited sample sizes or heterogeneous surgical populations (16), this study provides a head-to-head comparison in a well-defined and adequately powered cohort. The objective clinical benefit demonstrated here, despite subjective perceptions occasionally favoring traditional agents, highlights the importance of evidence-based practice and the need to periodically reevaluate conventional perioperative protocols. From a mechanistic perspective, the advantage of dexmedetomidine may be attributed not only to its direct antiemetic actions but also to its opioid-sparing effect, as opioid use is a recognized risk factor for PONV (4,6). By reducing the perioperative opioid requirement, dexmedetomidine indirectly decreases PONV risk while simultaneously contributing to improved analgesia and patient comfort. The relevance of this mechanism is amplified in the context of laparoscopic surgeries, where rapid recovery and patient throughput are prioritized, and where the adverse effects of PONV can be particularly disruptive to the discharge process and overall patient experience (2,9). Furthermore, the absence of significant adverse events in the dexmedetomidine group supports its safety profile and enhances its clinical appeal, particularly in comparison to agents associated with cardiovascular or gastrointestinal side effects.

Despite these strengths, certain limitations warrant careful consideration. The single-center design and the relatively modest sample size, while sufficient to detect significant differences in primary outcomes, may limit the generalizability of the results to broader surgical populations or to those with higher baseline risk for PONV. Additionally, the study did not assess the potential additive or synergistic effects of combining antiemetic agents, an approach that is frequently employed in clinical practice to maximize efficacy. The reliance on patient-reported outcomes for subjective effectiveness, although informative, may introduce an element of bias or variability not fully captured by objective incidence rates. Methodological rigor was upheld through randomization and double blinding, yet unmeasured confounding variables or institutional practices could have influenced the results.

Future research should address these limitations by enrolling larger, more diverse patient populations and by examining the comparative effectiveness of multi-agent prophylactic strategies, including optimal dosing regimens and timing of administration. Additionally, mechanistic studies exploring the neuropharmacological pathways underlying dexmedetomidine's antiemetic action would further clarify its role and potential synergism with established antiemetics. Economic analyses assessing cost-effectiveness and impact on resource utilization are also recommended, given the healthcare burden associated with PONV.

This study demonstrates that dexmedetomidine provides a statistically and clinically significant reduction in the incidence of PONV compared to dexamethasone and ondansetron in patients undergoing laparoscopic surgery. The findings contribute to an evolving evidence base that may prompt revision of current perioperative antiemetic protocols, prioritizing dexmedetomidine as an effective and well-tolerated agent for PONV prophylaxis. Broader implementation of dexmedetomidine, supported by further confirmatory studies, holds the potential to enhance patient outcomes and satisfaction in minimally invasive surgical care (13,14,17).

CONCLUSION

This comparative study demonstrates that dexmedetomidine is significantly more effective than dexamethasone and ondansetron in reducing the incidence and severity of postoperative nausea and vomiting (PONV) in patients undergoing laparoscopic surgeries.

The findings highlight the potential for dexmedetomidine to enhance postoperative recovery and patient satisfaction, suggesting its valuable role as a prophylactic antiemetic in clinical anesthesia protocols for minimally invasive procedures.

Adoption of dexmedetomidine for PONV prevention could lead to improved healthcare outcomes by reducing patient discomfort, shortening hospital stays, and decreasing reliance on rescue antiemetics. Further large-scale, multicenter studies are recommended to validate these results, optimize dosing strategies, and confirm the broader applicability of dexmedetomidine in diverse surgical populations.

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