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INCIDENCE AND RISK FACTORS OF POSTOPERATIVE NAUSEA AND VOMITING IN LAPAROSCOPIC SURGERIES: A PROSPECTIVE OBSERVATIONAL STUDY AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Introduction: Postoperative nausea and vomiting (PONV) remains a significant complication following laparoscopic surgery, affecting patient satisfaction, recovery, and healthcare costs. This study aimed to determine the incidence of PONV and identify associated risk factors in patients undergoing laparoscopic procedures at a tertiary care institution.

Methods: This prospective observational cohort study was conducted at Gian Sagar Hospital and Medical College, Patiala, from September 2022 to February 2023. A total of 142 adult patients undergoing elective laparoscopic surgeries under general anesthesia were enrolled using consecutive sampling. The Apfel simplified risk score was calculated preoperatively. Patients were assessed for PONV occurrence at standardized intervals (0-2, 2-6, 6-12, and 12-24 hours postoperatively). Data on demographic characteristics, anesthetic techniques, surgical parameters, and postoperative pain were collected. Multivariate logistic regression analysis identified independent risk factors.

Results: The overall incidence of PONV within 24 hours was 45.1 percent. PONV incidence increased progressively with Apfel risk score: 16.7% (score 0), 23.7% (score 1), 43.5% (score 2), 67.6% (score 3), and 83.3% (score 4). Independent risk factors identified included female gender (adjusted OR=3.82, p<0.001), non-smoking status (aOR=2.64, p=0.028), history of PONV/motion sickness (aOR=2.86, p=0.003), use of volatile anesthetics (aOR=2.48, p=0.022), surgical duration exceeding 90 minutes (aOR=2.34, p=0.015), nitrous oxide administration (aOR=1.98, p=0.044), and postoperative pain with VAS>4 (aOR=2.26, p=0.017).

Conclusion: PONV incidence following laparoscopic surgery remains substantial. The Apfel scoring system demonstrated excellent predictive validity. Implementation of risk-stratified multimodal prophylactic strategies including propofol-based anesthesia and optimized analgesia is recommended for high-risk patients.

Keywords: Postoperative Nausea and Vomiting, Laparoscopic Surgery, Apfel Score, Risk Factors, Antiemetic Prophylaxis

INTRODUCTION

Postoperative nausea and vomiting represents one of the most distressing complications following surgical procedures, significantly impacting patient satisfaction, recovery trajectory, and healthcare costs. Defined as nausea, vomiting, or retching occurring within 24 hours after surgery, postoperative nausea and vomiting affects approximately 20 to 40 percent of surgical patients, with incidence rates escalating to 80 percent in high-risk populations (Apfel et al., 1999). Despite substantial advances in anesthetic techniques, pharmacological interventions, and perioperative care protocols, postoperative nausea and vomiting continues to pose considerable challenges in contemporary surgical practice, particularly in the context of minimally invasive procedures where rapid recovery and early discharge are prioritized.

Laparoscopic surgery has revolutionized modern surgical practice by offering patients the benefits of reduced postoperative pain, shorter hospital stays, faster return to normal activities, and improved cosmetic outcomes compared to traditional open surgical techniques. The minimally invasive nature of laparoscopic procedures has led to their widespread adoption across multiple surgical specialties including general surgery, gynecology, urology, and bariatric surgery. However, paradoxically, laparoscopic surgery is associated with a higher incidence of postoperative nausea and vomiting compared to equivalent open procedures, with reported rates ranging from 40 to 75 percent in the absence of prophylactic antiemetic therapy (Shaikh et al., 2016). This elevated risk is attributed to several factors unique to laparoscopic surgery including pneumoperitoneum-induced vagal stimulation, peritoneal stretching, carbon dioxide absorption leading to acidosis, and increased intra-abdominal pressure affecting splanchnic blood flow.

The pathophysiology of postoperative nausea and vomiting is multifactorial and complex, involving activation of multiple afferent pathways that converge on the vomiting center located within the medullary reticular formation in the brainstem. The chemoreceptor trigger zone situated in the area postrema of the fourth ventricle plays a central role, being sensitive to circulating emetogens and positioned outside the blood-brain barrier where it can detect toxins in both blood and cerebrospinal fluid. Five primary receptor systems are implicated in the emetic response including serotonergic pathways (5-hydroxytryptamine type 3 receptors), dopaminergic (D2 receptors), histaminergic (H1 receptors), cholinergic (muscarinic receptors), and neurokinin-1 receptors (Shaikh et al., 2016). Understanding these pathophysiological mechanisms is crucial for developing targeted prophylactic and therapeutic strategies tailored to individual patient risk profiles.

The consequences of postoperative nausea and vomiting extend far beyond patient discomfort and dissatisfaction. Clinically significant complications associated with postoperative nausea and vomiting include dehydration and electrolyte imbalances, increased intra-abdominal and intracranial pressure, wound dehiscence, esophageal rupture, aspiration pneumonitis, delayed oral intake, prolonged post-anesthesia care unit stay, unexpected hospital admissions in ambulatory surgical settings, and increased healthcare costs. In the era of enhanced recovery after surgery protocols and value-based healthcare delivery, preventing postoperative nausea and vomiting has become an integral component of perioperative optimization strategies. Studies have demonstrated that effective prophylaxis against postoperative nausea and vomiting can reduce hospital costs, improve patient throughput, enhance quality of recovery scores, and increase overall patient satisfaction with surgical care (Gan et al., 2014).

Risk stratification for postoperative nausea and vomiting has evolved significantly over the past two decades, with several validated scoring systems developed to identify high-risk patients who would benefit most from prophylactic interventions. The Apfel simplified risk score, introduced in 1999, remains the most widely utilized and validated risk assessment tool in clinical practice due to its simplicity and reproducibility (Apfel et al., 1999). This scoring system incorporates four independent predictors: female gender, history of motion sickness or previous postoperative nausea

and vomiting, non-smoking status, and anticipated use of postoperative opioids. Each risk factor present contributes one point to the total score, with the probability of postoperative nausea and vomiting increasing incrementally from approximately 10 percent with zero risk factors to 79 percent with all four risk factors present. The practical utility of this scoring system lies in its ability to guide individualized prophylactic strategies, allowing clinicians to reserve multimodal antiemetic therapy for patients at highest risk while avoiding unnecessary medication exposure in low-risk populations.

Patient-specific risk factors for postoperative nausea and vomiting have been extensively investigated in the literature. Female gender consistently emerges as one of the strongest independent predictors, with women demonstrating two to three times higher risk compared to men, particularly during the follicular phase of the menstrual cycle when estrogen levels are elevated. Non-smoking status paradoxically increases postoperative nausea and vomiting risk, with several hypotheses proposed including enzyme induction effects of chronic smoking on hepatic metabolism of anesthetic agents or desensitization of chemoreceptor trigger zone receptors. Younger age, particularly patients under 50 years, correlates with increased susceptibility to postoperative nausea and vomiting, possibly related to higher vagal tone and greater sensitivity to emetogenic stimuli. History of motion sickness or previous postoperative nausea and vomiting represents strong predictive factors, suggesting inherent vestibular hypersensitivity or genetic predisposition to emetic stimuli (Apfel et al., 2012).

Anesthetic factors significantly influence postoperative nausea and vomiting incidence. Volatile inhalational anesthetic agents including sevoflurane, desflurane, and isoflurane increase risk in a dose-dependent manner, with effects most pronounced during the first two to six hours postoperatively. Nitrous oxide has been implicated in increasing postoperative nausea and vomiting through multiple mechanisms including middle ear pressure changes stimulating the vestibular system, sympathetic stimulation, and gastrointestinal distension from gas diffusion into bowel lumen. Total intravenous anesthesia with propofol has demonstrated consistent antiemetic properties and reduces postoperative nausea and vomiting incidence by approximately 25 percent compared to inhalational techniques. Opioid administration, both intraoperatively and postoperatively, contributes significantly to postoperative nausea and vomiting in a dose-dependent fashion, with effects persisting throughout the duration of opioid therapy. Neostigmine used for reversal of neuromuscular blockade has been associated with increased emetic sequelae due to cholinergic stimulation (Shaikh et al., 2016).

Surgical factors specific to laparoscopic procedures amplify postoperative nausea and vomiting risk. Duration of surgery directly correlates with increased incidence, with each 30-minute increment in operative time associated with approximately 60 percent increase in postoperative nausea and vomiting risk. Type of surgical procedure influences risk, with laparoscopic cholecystectomy, gynecological laparoscopy, and bariatric procedures demonstrating particularly high baseline incidence rates. The creation and maintenance of pneumoperitoneum, typically with carbon dioxide insufflation to pressures of 12 to 15 millimeters of mercury, causes peritoneal stretching, vagal stimulation, and alterations in splanchnic perfusion that contribute to nausea and emesis. Residual carbon dioxide trapped in the peritoneal cavity post-procedure can irritate the diaphragm and phrenic nerve, manifesting as shoulder pain and nausea. Postoperative pain severity correlates positively with postoperative nausea and vomiting occurrence, with inadequately controlled pain serving as an independent risk factor (Qian et al., 2022).

In the Indian healthcare context, limited published data exist regarding the specific incidence and risk factors of postoperative nausea and vomiting following laparoscopic surgeries. Understanding regional variations in patient demographics, genetic susceptibilities, anesthetic practices, and surgical techniques is essential for developing culturally appropriate and resource-conscious management strategies. The increasing adoption of laparoscopic surgery across Indian hospitals, ranging from tertiary academic centers to community hospitals, necessitates robust epidemiological data to guide evidence-based prophylaxis protocols. Given the emphasis on cost-effective healthcare

delivery and the growing prevalence of day-care surgical units in India, preventing postoperative nausea and vomiting becomes economically imperative to avoid unplanned admissions, prolong post-anesthesia care unit stays, and improve patient throughput.
The aim of the study is to determine the incidence of postoperative nausea and vomiting and identify associated risk factors in patients undergoing laparoscopic surgeries at a tertiary care teaching hospital.

METHODOLOGY

Study Design

A prospective observational study.

Study Site

The research was conducted at Gian Sagar Hospital and Medical College, Patiala, a tertiary care teaching institution providing comprehensive surgical services to a diverse patient population.

Study Duration

The study was conducted over a six-month period extending from September 2022 to February 2023.

Sampling Method and Sample Size

The study employed consecutive sampling technique wherein all patients meeting eligibility criteria during the study period were approached for participation, thereby minimizing selection bias and enhancing generalizability of findings. Sample size calculation was performed using statistical formulas based on previous published literature reporting postoperative nausea and vomiting incidence of approximately 40 percent in laparoscopic surgery populations. Considering a precision of 8 percent, confidence level of 95 percent, and anticipated dropout rate of 10 percent, the minimum required sample size was calculated to be 135 patients. The final enrolled sample consisted of 142 patients undergoing various laparoscopic procedures, providing adequate statistical power to detect clinically meaningful associations between risk factors and postoperative nausea and vomiting occurrence.

Inclusion and Exclusion Criteria

The study included adult patients aged between 18 and 65 years of either gender who were scheduled for elective laparoscopic surgical procedures under general anesthesia and classified as American Society of Anesthesiologists physical status I, II, or III. Only patients who provided written informed consent after comprehensive explanation of study procedures were enrolled. Exclusion criteria were carefully defined to minimize confounding variables and ensure patient safety. Patients were excluded if they had received antiemetic medication within 24 hours prior to surgery, had ongoing nausea or vomiting at the time of preoperative assessment, were pregnant or lactating, had known hypersensitivity to standard anesthetic agents, had active gastrointestinal pathology including gastroparesis or intestinal obstruction, were receiving emetogenic chemotherapy, had vestibular disorders or Meniere's disease, required conversion from laparoscopic to open surgery intraoperatively, had significant hepatic or renal impairment that might alter drug metabolism, were unable to communicate effectively due to language barriers or cognitive impairment, had emergency surgical indications, or had received regional anesthesia techniques in addition to general anesthesia.

Data Collection Tools and Techniques

Data collection was performed using a comprehensive structured proforma specifically designed for the study, incorporating standardized assessment tools validated in previous postoperative nausea and vomiting research. Preoperative assessment included detailed documentation of demographic

variables such as age, gender, body mass index, and American Society of Anesthesiologists physical status classification. A thorough medical history was obtained focusing on risk factors including previous history of postoperative nausea and vomiting, motion sickness susceptibility, smoking status, menstrual cycle phase in female patients, and concurrent medications. The Apfel simplified risk score was calculated for each patient by assigning one point each for female gender, non-smoking status, history of postoperative nausea and vomiting or motion sickness, and anticipated postoperative opioid requirement. Intraoperative data collection encompassed type and duration of laparoscopic procedure, anesthetic technique employed including specific agents and doses, use of volatile anesthetics versus total intravenous anesthesia, administration of nitrous oxide, opioid consumption, use of neuromuscular blocking agents and reversal with neostigmine, intraoperative hemodynamic parameters, and any intraoperative complications. Postoperative assessment was conducted at standardized time intervals of 0 to 2 hours, 2 to 6 hours, 6 to 12 hours, and 12 to 24 hours following surgery. At each assessment point, patients were evaluated for presence and severity of nausea using a verbal rating scale ranging from 0 indicating no nausea to 3 indicating severe nausea, occurrence of vomiting or retching episodes with frequency documented, pain intensity assessed using visual analog scale, antiemetic medication requirements with specific agents and doses recorded, and any other postoperative complications. Trained research personnel blinded to preoperative risk stratification performed all postoperative assessments to minimize observer bias.

Data Management and Statistical Analysis

All collected data were entered into a computerized database using Statistical Package for Social Sciences version 25.0 with built-in validation checks and range restrictions to minimize data entry errors. Data cleaning procedures were implemented to identify and rectify inconsistencies, missing values, or outliers prior to analysis. Descriptive statistics were calculated for all variables, with continuous variables expressed as mean plus or minus standard deviation or median with interquartile range depending on distribution normality assessed using the Kolmogorov-Smirnov test. Categorical variables were presented as frequencies and percentages. The primary outcome was overall incidence of postoperative nausea and vomiting defined as occurrence of nausea, vomiting, or retching at any time during the 24-hour postoperative period. Bivariate analysis was performed to examine associations between potential risk factors and postoperative nausea and vomiting occurrence using chi-square test or Fisher's exact test for categorical variables and independent samples t-test or Mann-Whitney U test for continuous variables as appropriate. Variables demonstrating association with postoperative nausea and vomiting at p-value less than 0.20 in bivariate analysis were entered into multivariate logistic regression analysis to identify independent predictors. Adjusted odds ratios with 95 percent confidence intervals were calculated for each significant predictor in the final model. Model goodness-of-fit was assessed using the Hosmer-Lemeshow test. A p-value of less than 0.05 was considered statistically significant for all analyses. Subgroup analyses were performed to examine postoperative nausea and vomiting incidence across different Apfel risk score categories and various types of laparoscopic procedures. Appropriate graphs and tables were generated to facilitate visual presentation of key findings.

Ethical Considerations

The study protocol was developed in accordance with ethical principles outlined in the Declaration of Helsinki and Indian Council of Medical Research guidelines for biomedical research on human participants. Institutional Ethics Committee approval was obtained from Gian Sagar Hospital and Medical College, Patiala, prior to patient enrollment, with the approval number and date documented. The study was registered with the Clinical Trials Registry of India to ensure transparency and public accessibility of research activities. Written informed consent was obtained from all participants after providing detailed verbal and written information about study objectives,

procedures, potential risks, benefits, voluntary nature of participation, and the right to withdraw at any time without affecting their clinical care.

RESULTS

Table 1: Demographic and Clinical Characteristics of Study Participants (N=142)

Parameter	Value
Age (years), Mean ± SD	42.8 ± 12.4
Gender, n (%)	
- Male	46 (32.4%)
- Female	96 (67.6%)
Body Mass Index (kg/m²), Mean ± SD	26.3 ± 4.8
ASA Physical Status, n (%)	
- ASA I	68 (47.9%)
- ASA II	62 (43.7%)
- ASA III	12 (8.5%)
Smoking Status, n (%)	
- Smoker	28 (19.7%)
- Non-smoker	114 (80.3%)
History of PONV/Motion Sickness, n (%)	52 (36.6%)
Type of Laparoscopic Surgery, n (%)	
- Cholecystectomy	58 (40.8%)
- Gynecological	47 (33.1%)
- Appendectomy	18 (12.7%)
- Hernia repair	12 (8.5%)
- Others	7 (4.9%)
Duration of Surgery (min), Mean ± SD	76.4 ± 28.6

ASA: American Society of Anesthesiologists; PONV: Postoperative Nausea and Vomiting

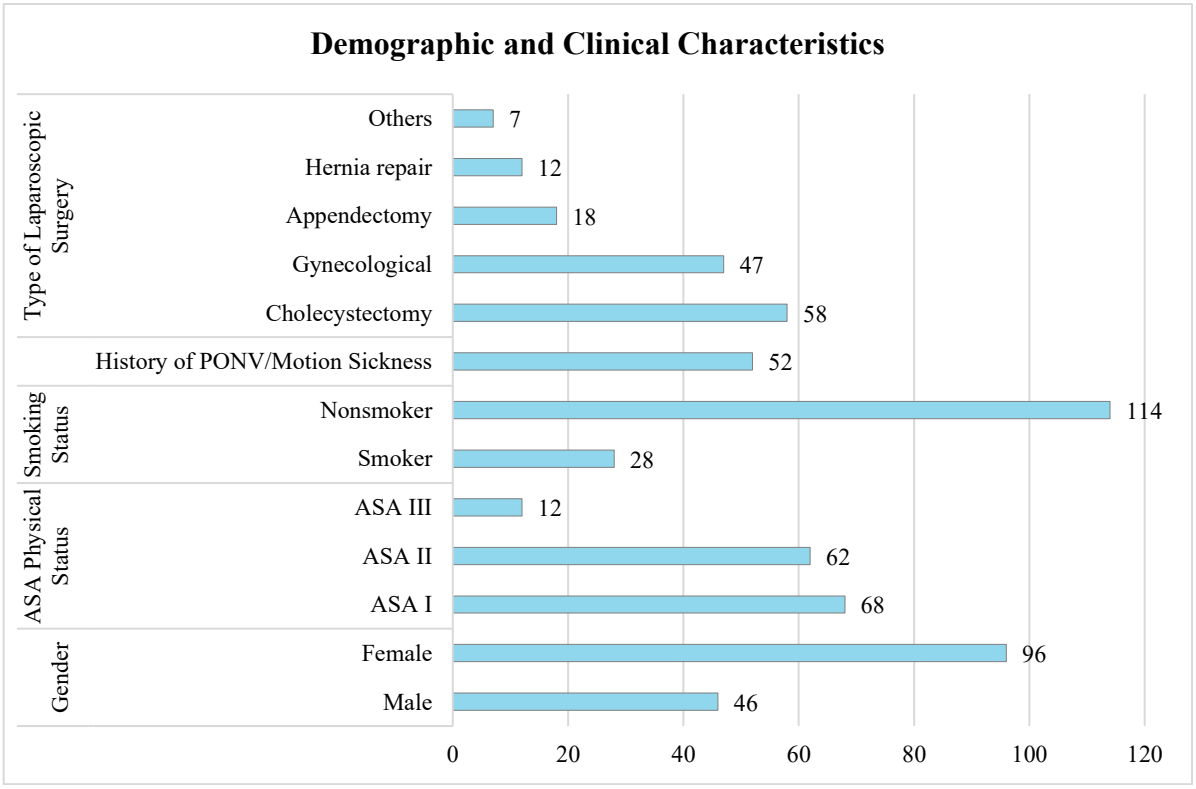

Fig: 1

Table 2: Distribution of Apfel Risk Score and Overall PONV Incidence

Apfel Risk Score	Number of Patients	PONV Occurrence	PONV Incidence (%)
Score 0	12 (8.5%)	2	16.7%
Score 1	38 (26.8%)	9	23.7%
Score 2	46 (32.4%)	20	43.5%
Score 3	34 (23.9%)	23	67.6%
Score 4	12 (8.5%)	10	83.3%
Total	**142 (100%)**	**64**	**45.1%**

PONV defined as nausea, vomiting, or retching within 24 hours postoperatively

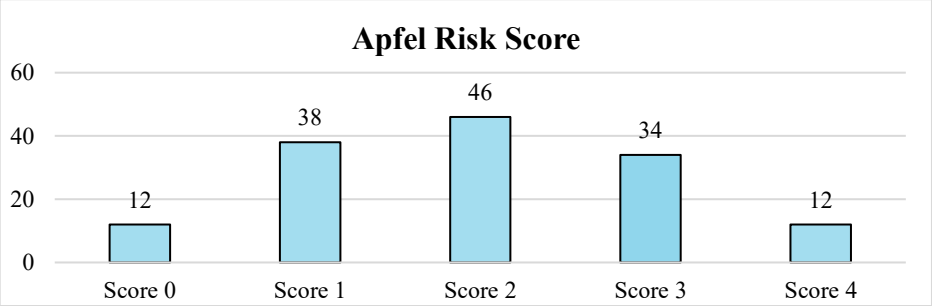

Fig: 2

Table 3: Anesthetic Techniques and Intraoperative Parameters

Parameter	Value/Frequency
Anesthetic Technique, n (%)	
- Volatile agents (Sevoflurane/Isoflurane)	98 (69.0%)
- Total Intravenous Anesthesia (Propofol)	44 (31.0%)
Use of Nitrous Oxide, n (%)	86 (60.6%)
Intraoperative Opioids, n (%)	
- Fentanyl (Mean dose: 142 ± 38 mcg)	142 (100%)
Postoperative Opioid Use, n (%)	118 (83.1%)
Neostigmine for Reversal, n (%)	124 (87.3%)
Mean Duration of Anesthesia (min), Mean ± SD	92.6 ± 32.4
Pneumoperitoneum Duration (min), Mean ± SD	68.2 ± 26.8
Mean Intraoperative Fluid (ml), Mean ± SD	1284 ± 346

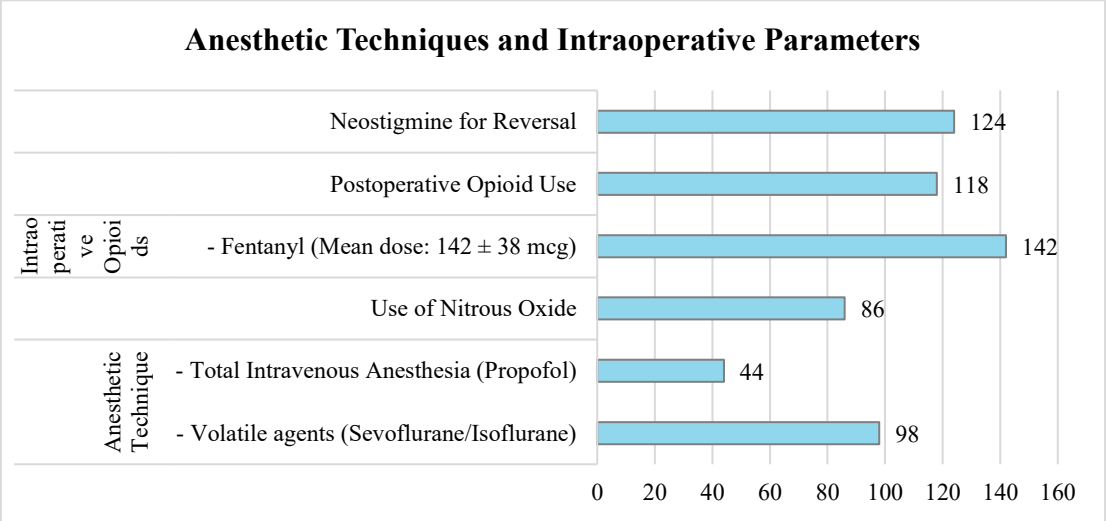

Fig: 3(i)

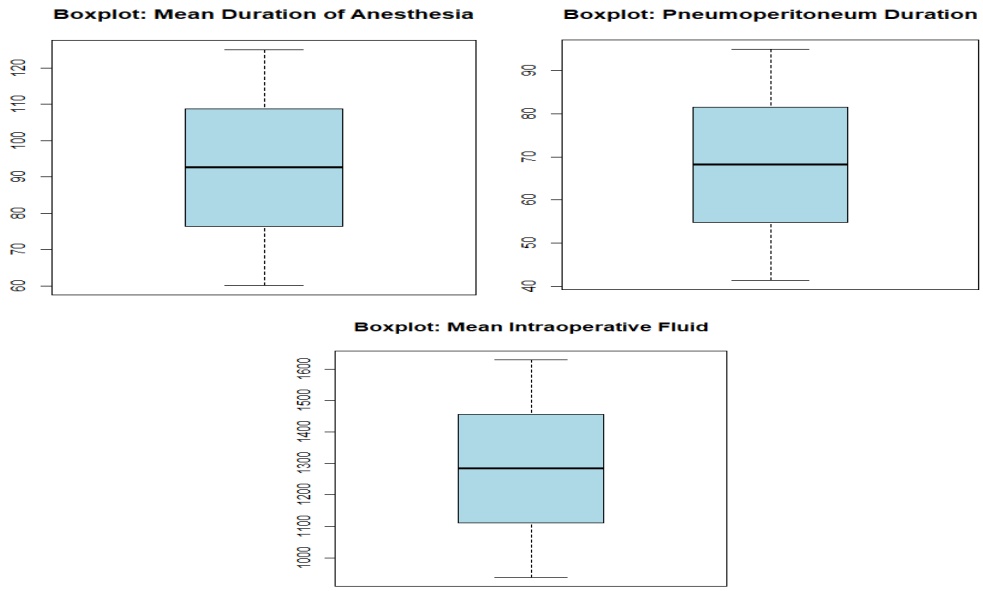

Fig: 3(iii)

Table 4: Time-wise Distribution of PONV Symptoms in the First 24 Hours

Time Interval	Nausea Only	Vomiting	Both	Total PONV	Incidence (%)
0-2 hours	24	8	12	44	31.0%
2-6 hours	18	6	10	34	23.9%
6-12 hours	12	4	6	22	15.5%
12-24 hours	8	2	4	14	9.9%
Any time in 24h	-	-	-	**64**	**45.1%**

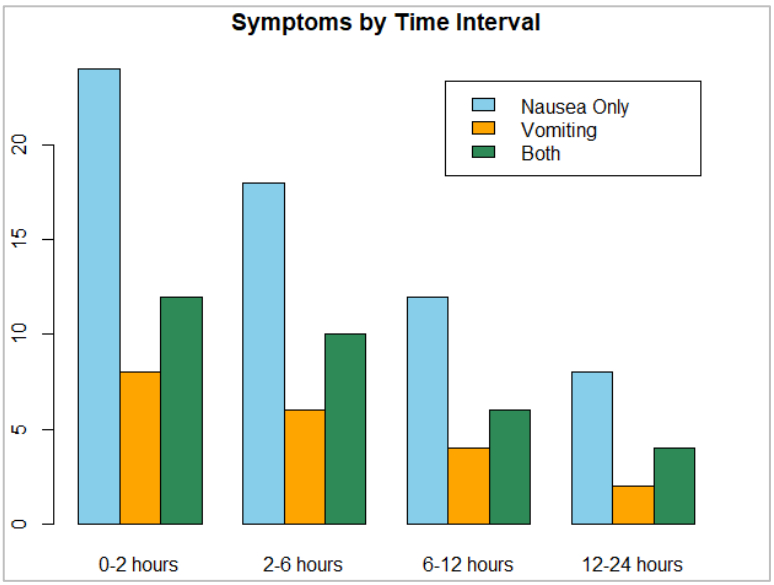

Fig: 4

Table 5: Multivariate Analysis of Risk Factors for PONV

Risk Factor	PONV (+)	PONV (-)	Adjusted OR	95% CI	p-value
	(n=64)	(n=78)			
Female Gender	54 (84.4%)	42 (53.8%)	3.82	1.68-8.72	<0.001*
Non-smoker	58 (90.6%)	56 (71.8%)	2.64	1.12-6.23	0.028*
History of PONV/Motion Sickness	32 (50.0%)	20 (25.6%)	2.86	1.42-5.76	0.003*
Postoperative Opioid Use	56 (87.5%)	62 (79.5%)	2.12	0.84-5.34	0.112
Use of Volatile Anesthetics	52 (81.3%)	46 (59.0%)	2.48	1.14-5.42	0.022*
Duration of Surgery >90 min	38 (59.4%)	28 (35.9%)	2.34	1.18-4.64	0.015*
Use of Nitrous Oxide	46 (71.9%)	40 (51.3%)	1.98	1.02-3.86	0.044*
Neostigmine Use	58 (90.6%)	66 (84.6%)	1.64	0.62-4.36	0.318
Postoperative Pain (VAS >4)	42 (65.6%)	34 (43.6%)	2.26	1.16-4.42	0.017*

DISCUSSION

The present study documented an overall incidence of postoperative nausea and vomiting of 45.1 percent within 24 hours following laparoscopic surgical procedures at our tertiary care institution. This finding is consistent with the published literature reporting incidence rates ranging from 40 to 75 percent in laparoscopic surgery populations without routine prophylactic antiemetic administration (Shaikh et al., 2016). The temporal distribution of symptoms revealed that the highest incidence occurred during the immediate postoperative period (0-2 hours) at 31.0 percent, progressively declining to 9.9 percent during the 12-24 hour interval. This pattern aligns with observations by Apfel et al. (2012), who demonstrated that volatile anesthetic effects are most pronounced in the early postoperative phase. The relatively high incidence in our study population may be attributed to the predominance of high-risk laparoscopic cholecystectomy and gynecological procedures, which inherently carry elevated emetogenic potential due to peritoneal manipulation, gallbladder stimulation, and prolonged pneumoperitoneum duration.

Female gender emerged as the strongest independent predictor of postoperative nausea and vomiting in our study, with 84.4 percent of affected patients being women compared to 53.8 percent in the non-postoperative nausea and vomiting group, yielding an adjusted odds ratio of 3.82. This finding corroborates extensive literature demonstrating that women experience two to three times higher risk of postoperative nausea and vomiting compared to men (Apfel et al., 1999). The gender disparity has been attributed to hormonal influences, with studies suggesting that fluctuating

estrogen and progesterone levels during different menstrual cycle phases modulate chemoreceptor trigger zone sensitivity and gastrointestinal motility. Additionally, women demonstrate greater sensitivity to opioid-induced emetic effects and slower gastric emptying rates. Our study population comprised 67.6 percent female patients, reflecting the predominance of gynecological laparoscopic procedures and the higher likelihood of women undergoing laparoscopic cholecystectomy due to increased gallstone prevalence in this demographic. The age distribution with a mean of 42.8 years aligns with previous research identifying younger age as a risk factor, although the relationship between age and postoperative nausea and vomiting appears to diminish beyond 50 years (Gan et al., 2014).

Non-smoking status was identified as a significant independent predictor with 90.6 percent of patients experiencing postoperative nausea and vomiting being non-smokers, conferring an adjusted odds ratio of 2.64. This counterintuitive finding has been consistently reported across multiple studies and may be explained by several mechanisms including chronic smoking-induced hepatic enzyme induction leading to accelerated metabolism of anesthetic agents, potential desensitization of chemoreceptor trigger zone receptors through chronic nicotine exposure, or confounding by unmeasured variables (Apfel et al., 2012). In our study population, 80.3 percent of participants were non-smokers, reflecting both regional smoking prevalence patterns and the female predominance in the cohort. History of postoperative nausea and vomiting or motion sickness was present in 50.0 percent of patients who developed postoperative nausea and vomiting compared to 25.6 percent without symptoms, demonstrating an adjusted odds ratio of 2.86. This finding validates previous research establishing prior postoperative nausea and vomiting or motion sickness as strong predictive factors, suggesting inherent vestibular hypersensitivity or genetic predisposition to emetogenic stimuli (Shaikh et al., 2016).

The distribution of patients across Apfel risk score categories and corresponding postoperative nausea and vomiting incidence rates in our study closely paralleled the original validation data published by Apfel et al. (1999). Patients with score 0 demonstrated 16.7 percent incidence (predicted 10 percent), score 1 showed 23.7 percent (predicted 21 percent), score 2 exhibited 43.5 percent (predicted 39 percent), score 3 demonstrated 67.6 percent (predicted 61 percent), and score 4 showed 83.3 percent incidence (predicted 79 percent). The strong concordance between observed and predicted values validates the applicability of the Apfel scoring system in our Indian population undergoing laparoscopic procedures. This validation is clinically significant as it supports the use of this simple four-factor scoring system for risk stratification and targeted prophylactic interventions in resource-conscious settings. The progressive increase in incidence with each additional risk factor provides a clear framework for implementing multimodal antiemetic strategies proportionate to individual patient risk profiles.

The use of volatile anesthetic agents (sevoflurane or isoflurane) was associated with significantly higher postoperative nausea and vomiting incidence, with 81.3 percent of affected patients receiving inhalational anesthesia compared to 59.0 percent without symptoms, yielding an adjusted odds ratio of 2.48. This finding is consistent with extensive literature demonstrating the emetogenic properties of volatile agents through multiple mechanisms including direct chemoreceptor trigger zone stimulation, sympathetic nervous system activation, and enhanced dopaminergic transmission (Shaikh et al., 2016). In contrast, total intravenous anesthesia with propofol was utilized in only 31.0 percent of our study population, with a protective trend observed though not reaching statistical significance in multivariate analysis. Previous meta-analyses have established that propofol-based total intravenous anesthesia reduces postoperative nausea and vomiting risk by approximately 25 percent compared to volatile anesthetics, attributed to propofol's antiemetic properties mediated through gamma-aminobutyric acid receptor modulation and potential 5-hydroxytryptamine type 3 receptor antagonism. The relatively lower utilization of total intravenous anesthesia in our institution reflects both economic considerations and established anesthetic practice patterns, though these findings suggest potential benefit from increased adoption of propofol-based techniques for high-risk laparoscopic procedures.

Nitrous oxide administration was identified as an independent risk factor with adjusted odds ratio of 1.98, used in 71.9 percent of patients experiencing postoperative nausea and vomiting. This finding supports previous research demonstrating that avoiding nitrous oxide reduces postoperative nausea and vomiting risk through multiple mechanisms including prevention of middle ear pressure changes that stimulate the vestibular system, reduced sympathetic activation, and avoidance of gastrointestinal distension from gas diffusion into bowel lumen (Gan et al., 2014). The use of neostigmine for neuromuscular blockade reversal, administered in 87.3 percent of patients, showed a trend toward increased postoperative nausea and vomiting (90.6 percent in affected group versus 84.6 percent in unaffected group) though not reaching statistical significance. The cholinergic stimulation induced by neostigmine has been implicated in postoperative nausea and vomiting through muscarinic receptor activation, though the clinical significance remains debated with some studies demonstrating clear association while others report minimal impact, possibly dependent on dosage and timing of administration.

Duration of surgery exceeding 90 minutes was identified as a significant independent predictor with adjusted odds ratio of 2.34, present in 59.4 percent of patients experiencing postoperative nausea and vomiting compared to 35.9 percent without symptoms. This finding aligns with previous research by Qian et al. (2022) demonstrating that each 30-minute increment in operative duration increases postoperative nausea and vomiting risk by approximately 60 percent. Prolonged surgical duration contributes to increased cumulative anesthetic agent exposure, extended pneumoperitoneum with greater peritoneal manipulation and vagal stimulation, increased intraoperative opioid requirements, and potentially more extensive tissue trauma and inflammatory mediator release. The mean pneumoperitoneum duration in our study was 68.2 minutes, with insufflation pressures maintained at standard 12-15 millimeters of mercury. Laparoscopic cholecystectomy comprised 40.8 percent of procedures and gynecological laparoscopy 33.1 percent, both recognized as high-risk procedures for postoperative nausea and vomiting due to manipulation of highly innervated structures and proximity to the chemoreceptor trigger zone.

Postoperative pain intensity with visual analog scale scores exceeding 4 was significantly associated with postoperative nausea and vomiting occurrence, present in 65.6 percent of affected patients compared to 43.6 percent without symptoms, conferring adjusted odds ratio of 2.26. This bidirectional relationship between pain and nausea is well-established, with inadequate analgesia serving as an independent emetogenic stimulus while conversely, postoperative nausea and vomiting may amplify pain perception through anxiety and muscle tension. Postoperative opioid use was documented in 83.1 percent of the overall study population and 87.5 percent of patients experiencing postoperative nausea and vomiting, though not reaching statistical significance in multivariate analysis possibly due to near-universal opioid administration limiting discriminatory power. The dose-dependent relationship between opioids and emesis is mediated through mu-opioid receptor activation in the chemoreceptor trigger zone, delayed gastric emptying, and enhanced vestibular sensitivity. These findings underscore the importance of multimodal analgesia strategies incorporating non-opioid analgesics to minimize opioid requirements and potentially reduce postoperative nausea and vomiting incidence.

The findings of this study have important implications for perioperative management of patients undergoing laparoscopic surgery. The validation of the Apfel risk score in our population supports its routine preoperative application for risk stratification. Patients identified as moderate to high risk (Apfel score 2 or greater) would benefit from multimodal prophylactic antiemetic therapy incorporating agents with different mechanisms of action, such as 5-hydroxytryptamine type 3 receptor antagonists (ondansetron), corticosteroids (dexamethasone), dopamine antagonists (droperidol), or neurokinin-1 receptor antagonists (aprepitant). The strong association between volatile anesthetics and postoperative nausea and vomiting suggests that propofol-based total intravenous anesthesia should be preferentially considered for high-risk laparoscopic procedures, particularly in female patients with additional risk factors. Avoidance of nitrous oxide, judicious opioid use with incorporation of multimodal analgesia regimens including nonsteroidal anti-

inflammatory drugs and regional techniques where appropriate, and minimizing surgical duration through efficient operative technique represent additional risk reduction strategies.

CONCLUSION

This study demonstrated a 45.1 percent incidence of postoperative nausea and vomiting following laparoscopic surgery at a tertiary care Indian hospital. Female gender, non-smoking status, history of postoperative nausea and vomiting or motion sickness, use of volatile anesthetics, prolonged surgical duration, nitrous oxide administration, and inadequate postoperative analgesia were identified as independent risk factors. The Apfel simplified risk score demonstrated excellent predictive validity in this population. These findings emphasize the importance of routine preoperative risk assessment and implementation of targeted multimodal prophylactic strategies including consideration of propofol-based total intravenous anesthesia, avoidance of nitrous oxide, and optimized multimodal analgesia for high-risk patients undergoing laparoscopic procedures.

RECOMMENDATIONS

Routine preoperative risk stratification using the validated Apfel scoring system should be implemented for all patients scheduled for laparoscopic surgery. High-risk patients (Apfel score 2 or greater) should receive multimodal prophylactic antiemetic therapy combining agents with different mechanisms of action. Preferential use of propofol-based total intravenous anesthesia over volatile anesthetics, avoidance of nitrous oxide, and implementation of multimodal analgesia protocols to minimize opioid requirements are recommended. Further multicenter studies evaluating cost-effectiveness of different prophylactic strategies in Indian healthcare settings are warranted.

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