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Incidence and predictors of postoperative nausea and vomiting after laparoscopic cholecystectomy: a prospective observational study in Nepal

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Purpose: The incidence of postoperative nausea and vomiting (PONV) is variable across different settings. In our setting, no standardized risk assessment strategies exist, leading to sporadic use of antiemetics. This study aims to assess the incidence of PONV in adult patients undergoing laparoscopic cholecystectomy (LC), its predictors, and the effectiveness of the Apfel score and Koivuranta score in predicting PONV after LC in Nepalese patients.

Methods: A prospective observational study was conducted among patients undergoing elective LC. Apfel score and Koivuranta score were calculated for each patient. Postoperatively, patients were monitored for nausea and vomiting for 24 hours. Bivariate and multivariate analyses were performed to find the predictors. The receiver operating characteristic (ROC) curve was constructed to compare the scores.

Results: A total of 100 patients were analyzed with mean age of 36 years and female predominance (82%). The mean hospital stay was 2.51 days. Incidence of PONV was 43%. Absence of smoking (odds ratio [OR], 7.66; 95% confidence interval [CI], 1.91–30.78), history of motion sickness (OR, 9.51; 95% CI, 2.63–34.38), and use of postoperative opioids (OR, 7.18; 95% CI, 2.24–23.01) were significantly associated with PONV. The Apfel score (area under the curve [AUC] of 0.809) had slightly superior performance than Koivuranta score (AUC of 0.79).

Conclusion: There is a higher incidence of PONV after LC, with a higher risk in nonsmokers, patients with history of motion sickness, and use of postoperative opioids. Apfel score is an accurate and simpler score than Koivuranta score that can be used for the risk stratification of these patients.

Keywords: Postoperative nausea and vomiting, Laparoscopic cholecystectomy, Risk assessment

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INTRODUCTION

The prevalence of gallstone disease is increasing, affecting an estimated 10% to 20% of the global population [1,2]. Laparoscopic cholecystectomy (LC) is the gold standard treatment for gallstones. Although LC is safe and effective, studies have shown a high incidence of postoperative nausea and vomiting (PONV) (20%–40%) after LC, making accurate risk prediction crucial [3]. Most patients consider PONV to be more debilitating than pain [4] and frequently name it as a "big little problem" [5,6]. Prevention of PONV is important as it can prolong hospital stay and cause complications ranging from aspiration, wound dehiscence, incisional hernia, and esophageal rupture to pneumothorax [7]. With increasing attention to the quality of life postsurgery, PONV has emerged as a critical concern that warrants thorough consideration.

The application of risk stratification score and antiemetic prophylaxis demonstrates considerable variability across the countries, shaped by local healthcare practices, cultural perceptions regarding pharmacological interventions, and resource availability [8,9]. In Western nations, the Apfel score is integrated into electronic health records and is routinely employed, facilitating standardized protocols for antiemetics predicated on calculated risk scores [10,11]. Koivuranta score is next used for the same purpose [12]. In contrast, in low and middle-income countries such as Nepal, the absence of standardized risk assessments results in the underutilization or ineffective application of antiemetics, resulting in a higher incidence of patients reporting PONV.

This study aims to assess the incidence of PONV in patients undergoing LC and to identify its associated factors. In addition, it will compare the two most common scores, Apfel and Koivuranta, in our patients.

METHODS

A prospective observational design was adopted, and the study was reported adhering to the STROCSS 2024 criteria [13]. It was carried out from March 2022 to February 2023 at the Department of General Surgery, National Medical College and Teaching Hospital, a tertiary care hospital in Nepal that serves patients from the Terai region and nearby areas of India. The sample size was calculated using the following formula:

$$n = \frac{(Z^2 \times p \times q)}{e^2}$$

Where n = sample size; Z = Z statistic for a given level of confidence (tabulated value of Z at 95% confidence interval = 1.96); p = prevalence of PONV after LC = 49.2% [14]; q = 1–p; and e = allowable error (typically 5%–10%; here, 10% = 0.1).

Substituting the values, the required sample size was 97. Non-probability sampling (i.e., consecutive sampling) was used to enroll patients.

Patients included were over 18 years old, with an American Society of Anesthesiologists (ASA) physical status classification of I to III, and those scheduled for elective LC. Patients who had received prophylactic antiemetics, were undergoing emergency procedures, had an ASA classification of IV to VI, were on opioid analgesics for reasons unrelated to the procedure, were pregnant, underwent reoperation, or were discharged or transferred to the intensive care unit within 24 hours postanesthesia were excluded. Additionally, cases converted to open cholecystectomy were excluded.

All patients presenting with symptomatic cholelithiasis were screened based on inclusion and exclusion criteria. After informed consent was obtained, clinical history, examination, and laboratory investigations (complete hemogram, renal function test, electrolytes, etc.) were entered into a proforma by the surgery resident. LC was carried out under general anesthesia by experienced surgeons (performed at least 50 LC), and Apfel score was calculated for each patient. Apfel score (range, 0–4) was calculated, scoring 1 point each for female sex, history of PONV or motion sickness, nonsmoking status, and postoperative opioid use. Koivuranta score (range, 0–5) was calculated, including all 4 points of Apfel score; and additionally, intraoperative duration >60 minutes was scored as 1. Postoperatively, patients were monitored for nausea and vomiting for 24 hours [12]. In the case of PONV, the management approach included maintaining the airway, administering 4 mg of ondansetron or 10 mg of metoclopramide, and ensuring adequate hydration.

Dependent variables included PONV, while independent variables encompassed sociodemographic variables (e.g., age, sex), smoking history, previous history of PONV, history of motion sickness, and postoperative use of opioids. The primary outcome was the incidence of PONV (nausea or vomiting within the first 24 hours after surgery) after LC. Secondary outcomes included timing of PONV, risk factors for PONV, and evaluating the relationship between Apfel score, Koivuranta score, and PONV.

The data collected were entered into Microsoft Excel 2011 and analyzed using the IBM SPSS version 26.0 (IBM Corp.). Continuous variables were presented as mean ± standard deviation and were compared using the Mann-Whitney *U* test or independent t-test, categorical variables were expressed as frequencies and percentages, and their differences were assessed using the chi-square test or Fisher exact test, as appropriate. Each variable was first analyzed using binary logistic regression, and those with a *p*-value of <0.2 were included in the multivariable model to ensure potentially relevant predictors were not excluded prematurely. Analytic data were analyzed to construct the receiver operating characteristic (ROC) curve to find the sensitivity, specificity, and area under the curve (AUC) of Apfel score and Koivuranta score. A two-sided *p*-value of less than 0.05 was considered statistically significant.

RESULTS

Demographics

134 patients underwent LC during the study period, of which 100 were included (Fig. 1). The female-to-male ratio was 4.5:1, and the mean age was 36.4 ± 16 years (range, 18–90 years). The proportion of nonsmokers was 61%. The mean hospital stay was 2.51 ± 1.068 days (range, 1–6 days).

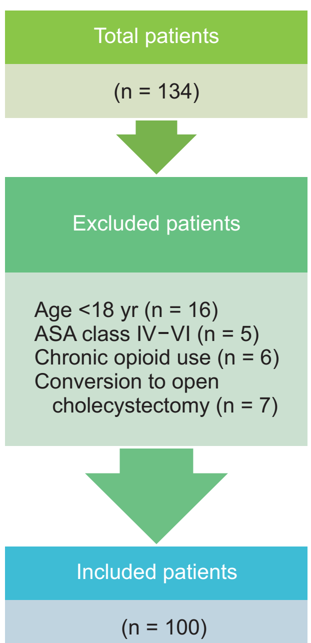

Fig. 1. Flow diagram showing included patients. ASA, American Society of Anesthesiologists.

Table 1. Distribution of patients according to postoperative nausea and vomiting (n = 100)

Nausea	Vomiting		Total
	No	Yes	
No	57 (57.0)	15 (15.0)	72 (72.0)
Yes	22 (22.0)	6 (6.0)	28 (28.0)

Values are presented as number (%).

Postoperative nausea and vomiting

The incidence of PONV was 43.0%. Fifteen patients (15.0%) had only vomiting, 22 (22.0%) had only nausea, and 6 (6.0%) had both nausea and vomiting (Table 1).

Twenty-seven (62.8%) PONV occurred in 0 to 8 hours, 11 (47.8%) in 8 to 16 hours, and seven (16.3%) in 16 to 24 hours of surgery (Fig. 2). Among them, two patients experienced PONV at 8 to 16 hours, which recurred after 8 hours following the first PONV.

Postoperative nausea and vomiting and its predictors

Bivariate analysis showed that female sex, nonsmoking, history of motion sickness, and postoperative opioid use were significantly associated with PONV (Table 2). In binary logistic regression, nonsmoking, history of motion sickness, and postoperative opioid use were significant (Table 3).

Predictive scores and postoperative nausea and vomiting

For Apfel score, four patients (3.4%) had a score of 0, 25 (21.6%) had a score of 1, 16 (13.8%) had a score of 2, 38 (32.8%) had a score of 3, and 17 (14.7%) had the highest score of 4. Similarly, for Koivuranta score, three patients (2.6%) had a score of 0, 22 (19.0%) had a score of 1, 15 (12.9%) had a score of 2, 41 (35.3%) had a score of 3, 16 (13.8%) had a score of 4, and three (2.6%) had the highest score of 5.

The predictive percentage of PONV for Apfel scores 0, 1, 2, 3, and 4 were 0%, 8%, 25%, 63.2%, and 76.5%, respectively. The predictive percentage of PONV for Koivuranta scores 0, 1, 2, 3, 4, and 5 were 0%, 4.5%, 26.7%, 56.1%, 75%, and 66.7%,

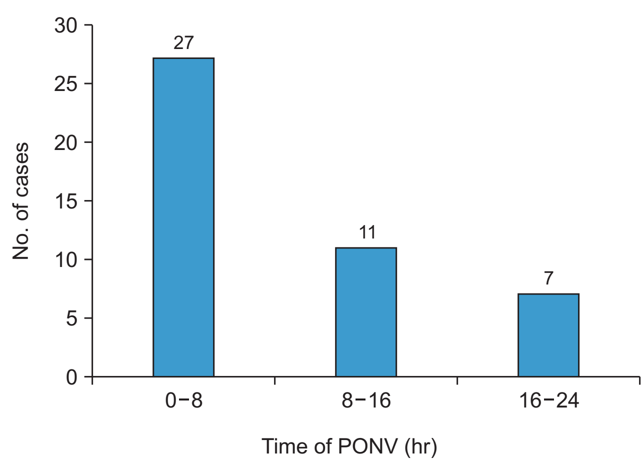

Fig. 2. Time of postoperative nausea and vomiting (PONV).

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respectively. Sensitivity and specificity were 100% and 93%, respectively, with an AUC of 0.809 for a cutoff of Apfel score of 0.5 (Fig. 3). Sensitivity and specificity were 100% and 94.7%, respectively, with an AUC of 0.79 for the cutoff of Koivuranta score of 0.5 (Fig. 4).

DISCUSSION

The incidence of PONV was 43%, higher than reported in previous studies [15,16], attributed to the lack of risk stratification and prophylactic measures for PONV in our setting. Nearly two-thirds of them occurred within the first 8 hours after surgery. This trend underscores the importance of extended observation during this vulnerable period, particularly as more surgical procedures are transitioning to daycare settings. Ensuring a minimum of 8 hours of postoperative monitoring could facilitate timely intervention and improve safety.

The identification of nonsmoking [17–19], history of motion sickness [8], and postoperative administration of opioids as risk factors for PONV aligns with findings established in previous studies [20–23]. The protective effect of smoking is thought to result from the induction of hepatic enzyme activity (such as CYP1A2) by smoking, enhancing the metabolism of emetogenic agents and reducing susceptibility to nausea and vomiting [17–19]. A prior history of motion sickness was the strongest

Table 3. Binary logistic regression analysis of factors associated with postoperative nausea and vomiting

Variable	Odds ratio (95% CI)	*p*-value
Sex	3.35 (0.657–17.096)	0.146
Nonsmoking	7.66 (1.91–30.78)	0.004*
Motion sickness	9.51 (2.63–34.38)	0.001*
Postoperative opioids	7.18 (2.24–23.01)	0.001*

CI, confidence interval.
*$p < 0.05$, statistically significant.

Table 2. Comparisons of variables among patients with and without postoperative nausea and vomiting (PONV)

Variable	PONV		Total	*p*-value
	Yes	No		
Sex				0.012*
Male	3 (16.7)	15 (83.3)	18 (18.0)	
Female	40 (48.2)	42 (51.2)	82 (82.0)	
Age group (yr)				0.727
<30	13 (52.0)	12 (48.0)	25 (25.0)	
30–39	7 (26.9)	19 (73.1)	26 (26.0)	
40–49	14 (63.6)	8 (36.4)	22 (22.0)	
50–59	3 (18.8)	13 (81.2)	16 (16.0)	
>60	6 (54.6)	5 (45.4)	11 (11.0)	
Smoking				0.007*
Smoker	6 (15.4)	33 (84.6)	39 (39.0)	
Nonsmoker	37 (60.6)	24 (39.4)	61 (61.0)	
Previous history of PONV				0.928
Yes	4 (44.4)	5 (55.6)	9 (9.0)	
No	39 (42.8)	52 (57.2)	91 (91.0)	
Motion sickness				<0.001*
Yes	23 (67.6)	11 (32.4)	34 (34.0)	
No	20 (30.3)	46 (69.7)	66 (66.0)	
Postoperative use of opioid				<0.001*
Yes	35 (66.1)	18 (33.9)	53 (53.0)	
No	8 (17.1)	39 (82.9)	47 (47.0)	
Duration of surgery (min)	53.49 ± 21.0	57.98 ± 22.3		0.172
Total	43 (43.0)	57 (57.0)	100 (100)	

Values are presented as number (%) or mean ± standard deviation
*$p < 0.05$, statistically significant.

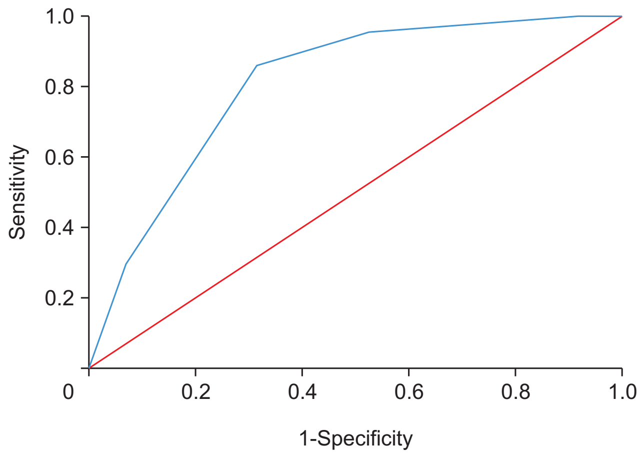

Fig. 3. The receiver operating characteristic curve of Apfel score. Diagonal segments are produced by ties.

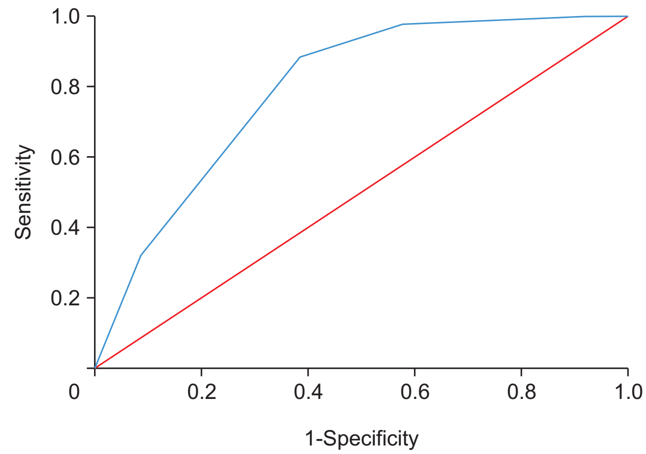

Fig. 4. The receiver operating characteristic curve of Koivuranta score. Diagonal segments are produced by ties.

predictor in our study, reinforcing its link to heightened vestibular sensitivity and a lower threshold for nausea and vomiting triggers, emphasizing the need for heightened vigilance and early prophylactic intervention in such patients. Likewise, opioids stimulate the chemoreceptor trigger zone and impair gastric motility, both of which contribute to nausea and vomiting, highlighting the importance of employing opioid-sparing analgesic strategies whenever feasible to minimize PONV risk.

Other variables recognized as potential risk factors for PONV, including the female sex [19], and prior occurrences of PONV [24,25], did not demonstrate significant associations in this study. While female sex is widely acknowledged as a risk factor, its influence may be modulated by hormonal fluctuations, menstrual cycle phases, or differences in pharmacological sensitivity, factors not assessed in our study [26]. The absence of a significant association with prior PONV episodes may reflect recall bias or incomplete patient histories.

The cutoff values for the Apfel and Koivuranta scales were established at 0.5 and 1 point, respectively, indicating that patients who exceed these scores could be initiated on PONV prophylaxis. It signifies that patients with an Apfel score of 1 (since a score of 0.5 is not possible) and Koivuranta score of 1 or higher should be considered at sufficient risk to warrant prophylactic antiemetics. This low threshold emphasizes the need for early intervention in populations with minimal risk factors, particularly in settings where routine PONV prophylaxis may not yet be standard practice. Although the Apfel score demonstrated a slightly higher AUC (0.809) compared to the Koivuranta score (0.79), the difference was modest, and given the discrete nature of both scores, the clinical significance of this numerical difference should be interpreted with caution [27].

Notably, the Apfel score can be calculated entirely from preoperative factors, i.e., nonsmoking status, prior history of PONV or motion sickness, female sex, and anticipated postoperative opioid use. This allows for early risk stratification in contrast to the Koivuranta score, which requires information about the duration of surgery, potentially delaying preventive strategies.

One of the notable strengths of our study is its focus on a population from a region where PONV prophylaxis is often underutilized, offering insights that can directly inform clinical practices. Calculating optimal cutoff values for PONV prediction scores provides actionable guidance for initiating prophylactic antiemetics at a lower threshold, potentially improving patient outcomes.

The limitations include the observation period confined to 24 hours and the omission of systemic factors that could affect PONV from our analysis. The effect of anesthetic agents was not explored. Future quality improvement initiatives are essential to assess the efficacy of integrating Apfel scale into routine clinical practice and its subsequent impact on PONV management, patient satisfaction, patient outcomes, and cost-effectiveness.

In conclusion, nearly half of the patients undergoing LC experienced PONV, with a higher risk in nonsmokers, history of motion sickness, and use of postoperative opioids. Apfel score is an accurate and simple score that can be used for the risk stratification of these patients. Further studies on the efficacy of prophylactic treatment based on the risk score are recommended.

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Notes

Ethics statements

The study adhered to the ethical standards outlined in the Declaration of Helsinki and was registered with the clinical registry (Clinicaltrials.gov: NCT06669325). It was reviewed and approved by Institutional Review Board of National Medical College and Teaching Hospital (No. PG-NMC/541/078-079). All participants provided written informed consent, and patient confidentiality was maintained throughout the study.

Authors' contributions

Conceptualization, Investigation, Methodology, Project administration, Visualization: All authors
Data curation, Formal analysis, Funding acquisition: RD, PSU, PL
Writing–Original Draft: All authors
Writing–Review & Editing: All authors
All authors read and approved the final manuscript.

Conflict of interest

All authors have no conflicts of interest to declare.

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