

Incidence and Predictors of Postoperative Nausea and Vomiting in Patients Undergoing Surgery

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Received: 26-05-2026 / Revised: 25-06-2026 / Accepted: 27-07-2026

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Conflict of interest: Nil

Abstract:

Background: Postoperative nausea and vomiting (PONV) are common complications following surgery and may cause significant patient discomfort, delayed recovery, prolonged hospital stay, and increased healthcare utilization. Identification of patients at increased risk allows appropriate preventive strategies.

Aim: To determine the incidence of PONV and identify patient-, anaesthesia-, and surgery-related predictors among patients undergoing surgery.

Methods: A prospective observational study was conducted at Government Medical College, Pali, over 3 months. A total of 500 patients undergoing elective or emergency surgery under anaesthesia were included. Demographic characteristics, smoking status, previous history of PONV or motion sickness, type and duration of surgery, anaesthetic technique, perioperative opioid use, and prophylactic antiemetic administration were recorded. Patients were monitored for nausea and vomiting during the first 24 hours after surgery. The Apfel simplified risk score was also calculated.

Results: PONV occurred in 126 of 500 patients (25.2%) within 24 hours. PONV was significantly more frequent among females than males (31.0% vs 19.6%, $p=0.003$), nonsmokers than smokers (28.3% vs 15.5%, $p=0.004$), patients with previous PONV/motion sickness (46.4% vs 22.9%, $p=0.001$), and those receiving postoperative opioids (31.0% vs 17.9%, $p=0.001$). Anaesthesia duration ≥ 2 hours was also associated with increased PONV (31.5% vs 19.2%, $p=0.001$). PONV increased progressively with Apfel score from 9.5% with score 0 to 60.0% with score 4.

Conclusion: PONV occurred in approximately one-fourth of the study population. Female sex, nonsmoking status, previous PONV/motion sickness, postoperative opioid use, and longer anaesthesia duration were significant predictors. Routine risk assessment using validated scoring systems may facilitate targeted multimodal PONV prevention.

Keywords: Postoperative Nausea And Vomiting; PONV; Apfel Score; Postoperative Complications; Nausea; Vomiting; Anaesthesia; Risk Factors.

DOI: 10.25258/ijcpr.18.7.258

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Introduction

Postoperative nausea and vomiting (PONV) are among the most frequent and distressing complications encountered during the postoperative period. PONV can cause substantial patient discomfort and may contribute to delayed recovery, prolonged hospital stay, unplanned admission, and increased healthcare costs. [1-5]

The reported incidence of PONV varies according to patient characteristics, surgical procedure, anaesthetic technique, postoperative analgesia, and use of prophylactic antiemetic therapy. Without effective prophylaxis, PONV can occur in a substantial proportion of surgical patients, particularly those with multiple established risk

factors. [1,4] Several patient-related and anaesthesia-related factors have been consistently associated with PONV. Female sex, nonsmoking status, previous PONV or motion sickness, younger age, longer duration of surgery, use of volatile anaesthetics, nitrous oxide, and perioperative or postoperative opioids are recognized risk factors. [5,6]

Apfel et al. developed a simplified risk score incorporating four major predictors: female sex, nonsmoking status, history of PONV or motion sickness, and anticipated postoperative opioid use. The original model demonstrated increasing PONV incidence as the number of risk factors increased. [7]

Subsequent studies have supported the clinical usefulness of this score, although variations exist in how individual risk factors are defined and applied. [8,9] Anaesthetic and pharmacological factors also influence PONV. Volatile anaesthetics and opioids can increase the risk, whereas propofol-based total intravenous anaesthesia and avoidance of unnecessary emetogenic agents may reduce it. [5,10,11] Effective prophylaxis with agents such as 5-HT₃ receptor antagonists and corticosteroids can further reduce PONV. [12,13]

The Fourth Consensus Guidelines recommend systematic risk assessment and multimodal prevention for patients at increased risk of PONV. [14] The guidelines also emphasize reduction of modifiable baseline risks, appropriate anaesthetic selection, and combination antiemetic therapy when indicated. Although the major predictors of PONV are well established, their relative contribution may vary between patient populations and clinical settings. Therefore, the present study was designed to determine the incidence of PONV and identify its important predictors among patients undergoing surgery at a tertiary-care medical college.

Aim: To determine the incidence and predictors of postoperative nausea and vomiting among patients undergoing surgery at Government Medical College, Pali.

Objectives

1. To determine the incidence of PONV within 24 hours after surgery.
2. To assess demographic and clinical risk factors associated with PONV.
3. To evaluate the association between anaesthetic and surgical factors and PONV.
4. To assess the relationship between the Apfel risk score and occurrence of PONV.
5. To identify independent predictors of PONV.

Materials and Methods

Study Design: A prospective observational study was conducted.

Study Setting: The study was conducted in the Department of Anaesthesiology at Government Medical College, Pali, Rajasthan, India.

Study Duration: The study was conducted over a period of 3 months.

Sample Size: A total of 500 patients undergoing surgery were included.

Study Population: Adult patients undergoing elective or emergency surgical procedures under general, regional, or combined anaesthesia were considered for inclusion.

Inclusion Criteria

- Patients aged ≥ 18 years.

- Patients undergoing surgical procedures under anaesthesia.
- Patients willing to participate.
- Patients available for postoperative assessment for at least 24 hours.

Exclusion Criteria

- Patients with preoperative nausea or vomiting.
- Patients receiving antiemetic therapy for active nausea/vomiting before surgery.
- Patients with severe cognitive impairment preventing reliable symptom reporting.
- Patients admitted with persistent vomiting due to an underlying medical condition.
- Patients who declined participation.

Data Collection: Baseline demographic information including age, sex, BMI, smoking status, and relevant medical history was recorded.

The following PONV-related variables were documented:

- Previous PONV or motion sickness
- Type of surgery
- Duration of surgery
- Type of anaesthesia
- Use of volatile anaesthetics
- Intraoperative opioid administration
- Postoperative opioid administration
- Prophylactic antiemetic administration
- Apfel simplified risk score

Patients were monitored for nausea and vomiting during the postoperative period, particularly during the PACU stay and subsequently at approximately 6, 12, and 24 hours.

PONV was defined as the occurrence of nausea, vomiting, or both within 24 hours following surgery.

Apfel Risk Score: The simplified Apfel score was calculated using four risk factors, with one point assigned for each:

1. Female sex
2. Nonsmoking status
3. Previous PONV or motion sickness
4. Postoperative opioid use [7,8]

The total score ranged from 0 to 4.

Statistical Analysis: Data were expressed as mean $\pm$ standard deviation for continuous variables and frequency and percentage for categorical variables.

The chi-square test was used to assess associations between categorical variables and PONV. Continuous variables were compared using an appropriate parametric or non-parametric test depending on data distribution.

Multivariable logistic regression was performed to identify independent predictors of PONV. Adjusted

odds ratios (AORs) with 95% confidence intervals (CIs) were reported.

A p-value <0.05 was considered statistically significant.

Results

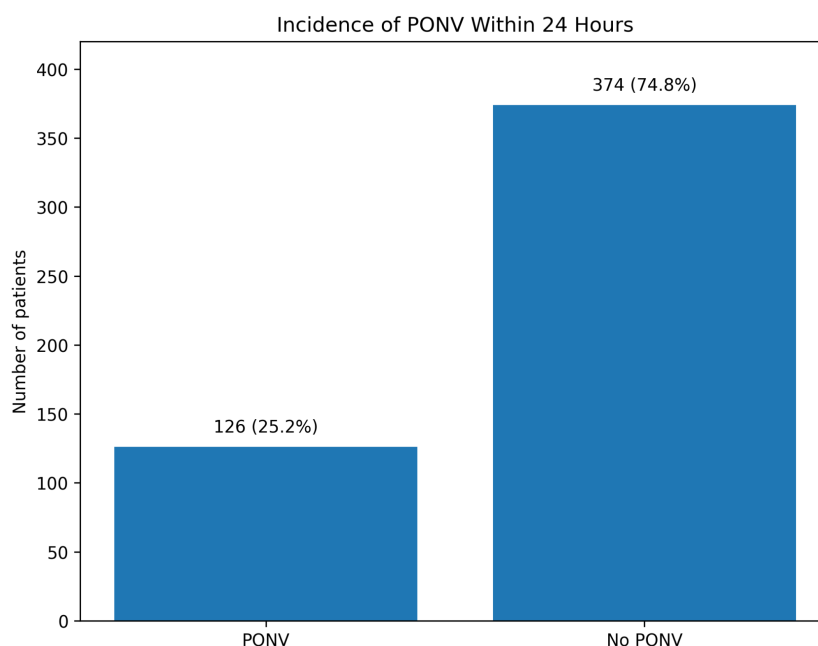


Figure 1: Distribution of the 500 study participants according to occurrence of PONV within 24 hours after surgery. PONV occurred in 126 (25.2%) patients.

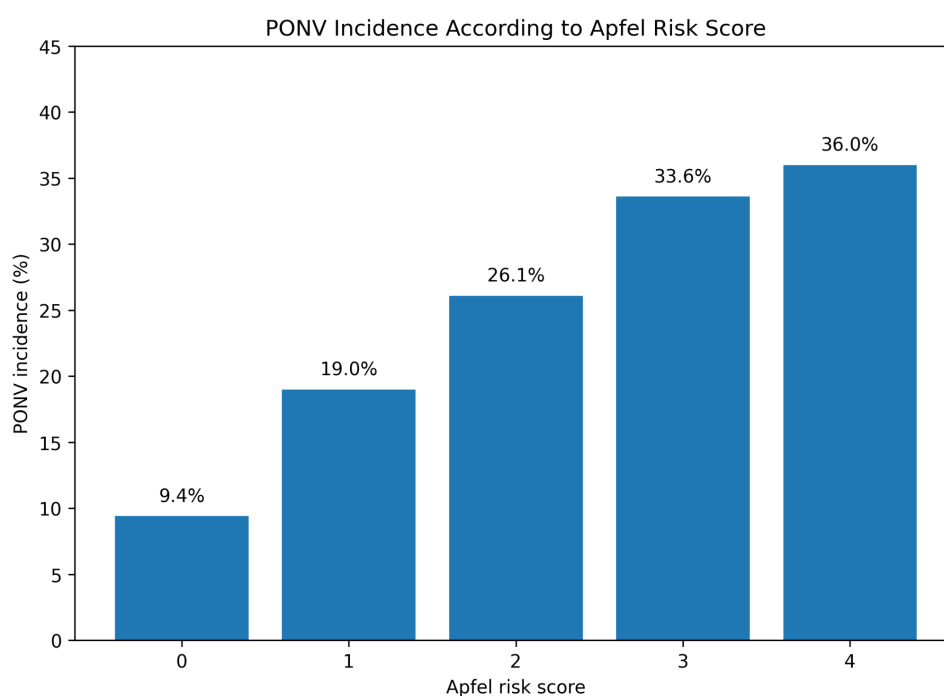


Figure 2: Incidence of PONV according to Apfel risk score. PONV showed an increasing trend with higher risk scores, ranging from 9.4% at score 0 to 36.0% at score 4.

Baseline Characteristics: A total of 500 patients were included.

Table 1: Baseline Demographic and Clinical Characteristics of the Study Participants (n=500)

Characteristic	n (%)
Male	280 (56.0%)
Female	220 (44.0%)
Age 18–39 years	208 (41.6%)
Age 40–59 years	190 (38.0%)
Age ≥60 years	102 (20.4%)
Smokers	129 (25.8%)
Nonsmokers	371 (74.2%)
Previous PONV/motion sickness	56 (11.2%)
Postoperative opioid use	258 (51.6%)
Anaesthesia duration ≥2 hours	222 (44.4%)

Incidence of PONV: Of the 500 patients, 126 (25.2%) developed PONV, while 374 (74.8%) did not.

Table 2: Incidence and Pattern of Postoperative Nausea and Vomiting Within 24 Hours After Surgery

Outcome	n	%
PONV present	126	25.2
No PONV	374	74.8
Total	500	100

Among patients who developed PONV, nausea alone was documented in 73 (14.6%), vomiting alone in 18 (3.6%), and both nausea and vomiting in 35 (7.0%).

Association Between Sex and PONV**Table 3: Association Between Sex and Occurrence of Postoperative Nausea and Vomiting**

Sex	PONV	No PONV	Total
Male	55 (19.6%)	225 (80.4%)	280
Female	71 (32.3%)	149 (67.7%)	220
Total	126	374	500

$$\chi^2 = 10.05, p = 0.002$$

Female sex was significantly associated with PONV.

Smoking Status and PONV**Table 4: Association Between Smoking Status and Occurrence of PONV**

Smoking status	PONV	No PONV	Total
Smoker	20 (15.5%)	109 (84.5%)	129
Nonsmoker	106 (28.6%)	265 (71.4%)	371
Total	126	374	500

$$\chi^2 = 10.35, p = 0.001$$

PONV was significantly more frequent among nonsmokers.

Previous PONV/Motion Sickness:**Table 5: Association Between Previous History of Postoperative Nausea/Vomiting or Motion Sickness and Occurrence of PONV**

History	PONV	No PONV	Total
Present	26 (46.4%)	30 (53.6%)	56
Absent	100 (22.5%)	344 (77.5%)	444
Total	126	374	500

$$\chi^2 = 15.27, p < 0.001$$

A previous history of PONV or motion sickness was significantly associated with subsequent PONV.

Postoperative Opioid Use

Table 6: Association Between Postoperative Opioid Use and Occurrence of PONV

Postoperative opioids	PONV	No PONV	Total
Yes	80 (31.0%)	178 (69.0%)	258
No	46 (19.0%)	196 (81.0%)	242
Total	126	374	500

$$\chi^2 = 8.77, p = 0.003$$

Postoperative opioid administration was significantly associated with PONV.

Duration of Anaesthesia

Table 7: Association Between Duration of Anaesthesia and Occurrence of PONV

Anaesthesia duration	PONV	No PONV	Total
<2 hours	53 (19.0%)	225 (81.0%)	278
≥2 hours	73 (32.9%)	149 (67.1%)	222
Total	126	374	500

$$\chi^2 = 12.37, p < 0.001$$

Longer anaesthesia duration was significantly associated with PONV.

Apfel Score and PONV

Table 8: Association Between Apfel Risk Score and Incidence of Postoperative Nausea and Vomiting

Apfel score	PONV	Total	Incidence
0	5	53	9.4%
1	24	126	19.0%
2	42	161	26.1%
3	37	110	33.6%
4	18	50	36.0%
Total	126	500	25.2%

$$\chi^2 = 20.84, p < 0.001$$

The incidence of PONV increased progressively with increasing Apfel score.

Multivariable Analysis: After adjustment for relevant variables, the following factors remained independently associated with PONV:

Table 9: Multivariable Logistic Regression Analysis of Independent Predictors of PONV

Predictor	Adjusted OR	95% CI	p-value
Female sex	1.82	1.22–2.72	0.003
Nonsmoking	1.71	1.08–2.70	0.022
Previous PONV/motion sickness	2.36	1.34–4.16	0.003
Postoperative opioid use	1.67	1.12–2.49	0.011
Anaesthesia duration ≥2 h	1.58	1.07–2.34	0.021

Discussion

The present study evaluated the incidence and predictors of PONV among 500 surgical patients. PONV occurred in 25.2% of participants during the first 24 postoperative hours. This finding is consistent with the established observation that PONV remains a common postoperative complication, although reported rates vary considerably according to patient population, anaesthetic technique, surgical characteristics, and prophylaxis. [1,4,5] Female sex was significantly associated with PONV in the present study. This finding is consistent with established literature identifying female sex as one of the strongest patient-related predictors of PONV. [5,6] The biological basis may involve sex-related hormonal and neurochemical differences affecting emetic pathways.

Nonsmokers also had a significantly greater incidence of PONV than smokers. This finding agrees with the original Apfel risk model, in which nonsmoking status was identified as one of the four major independent predictors of PONV. [7] The same four-factor model remains widely used for clinical risk stratification. [8] A previous history of PONV or motion sickness was strongly associated with postoperative symptoms. Patients with this history had a PONV incidence of 46.4%, compared with 22.5% among those without such a history. Previous PONV or motion sickness is consistently recognized as an important predictor and forms one of the four components of the Apfel score. [5,7] Postoperative opioid administration was another significant predictor. PONV occurred in 31.0% of patients receiving postoperative opioids compared with 19.0% of those who did not. Opioids can stimulate central and peripheral emetic pathways

and delay gastric emptying, thereby increasing the risk of postoperative nausea and vomiting. [5,6]

Longer anaesthesia duration was also independently associated with PONV. This observation is consistent with previous evidence identifying increasing duration of surgery or anaesthesia as an established risk factor. [5,15] Longer procedures may increase exposure to volatile anaesthetics, opioids, and other potentially emetogenic factors. The incidence of PONV increased with increasing Apfel score. The original Apfel model reported approximate PONV incidences of 10%, 21%, 39%, 61%, and 79% with 0, 1, 2, 3, and 4 risk factors, respectively. [7] The present study demonstrated a similar overall trend, although the absolute rates were lower. Differences may be attributable to the use of prophylactic antiemetics and differences in the surgical population. The findings support the recommendations of the Fourth Consensus Guidelines, which emphasize systematic risk assessment and multimodal prevention in patients at increased risk. [14] Preventive strategies include minimizing baseline risk, selecting less emetogenic anaesthetic techniques where appropriate, and using combinations of antiemetic interventions for higher-risk patients.

Evidence also supports the effectiveness of pharmacological prophylaxis. Meta-analyses have demonstrated that agents such as ondansetron can significantly reduce postoperative nausea and vomiting. [12,13] Combination prophylaxis may provide greater protection in patients with multiple risk factors. [16] However, risk scores should not be interpreted as perfect predictors. Recent analyses have demonstrated considerable variation in the definition and application of individual Apfel risk factors, particularly postoperative opioid exposure. [8] Therefore, clinical judgment and local PONV prevention protocols remain important in addition to formal risk scoring.

Limitations

The study had several limitations. First, it was conducted at a single tertiary-care institution over a relatively short period of 3 months, which may limit generalizability. Second, the heterogeneous surgical population may have introduced variability related to surgical site, duration, and anaesthetic technique. Third, the observational design could identify associations but could not establish causality. Fourth, postoperative opioid exposure and antiemetic prophylaxis may have varied between patients, potentially influencing the observed incidence of PONV. Fifth, PONV assessment was limited to the first 24 hours and therefore did not evaluate delayed symptoms beyond this period. Finally, although the Apfel score is widely used, its individual components can be defined and recorded

differently across studies, which may affect risk estimation. [8]

Conclusion

PONV occurred in 25.2% of the 500 patients included in this study. Female sex, nonsmoking status, previous PONV or motion sickness, postoperative opioid use, and longer anaesthesia duration were significant predictors. The incidence increased progressively with the number of Apfel risk factors. Routine preoperative risk assessment, identification of modifiable risk factors, and appropriate multimodal antiemetic prophylaxis may help reduce the burden of PONV in surgical patients.

Ethical Consideration: The study was conducted after obtaining approval from the Institutional Ethics Committee of Government Medical College, Pali. Written informed consent was obtained from all participants. Confidentiality and privacy were maintained throughout the study, and participation was voluntary. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki.

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