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Clinical Profile and Risk Factors for Postoperative Nausea and Vomiting Following General Anaesthesia: A Prospective Observational Study

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ABSTRACT

Background: Postoperative nausea and vomiting (PONV) remains a frequent complication after general anaesthesia and can delay recovery despite routine prophylaxis.
Objectives: To determine the incidence and clinical pattern of PONV and identify associated perioperative risk factors among adults undergoing general anaesthesia.
Methods: This prospective observational study included 60 adults undergoing elective surgery under general anaesthesia at Seth G.S. Medical College and King Edward Memorial Hospital, Mumbai, from March to July 2025. Demographic characteristics, recognised PONV risk factors, surgical and anaesthetic variables, prophylactic antiemetic use, and postoperative opioid exposure were recorded. Patients were assessed for nausea and vomiting for 24 hours. Factors associated with PONV were examined using univariable and multivariable logistic regression.
Results: PONV occurred in 18 patients, yielding an incidence of 30.0%. Vomiting was documented in 10 patients, and 11 of the 18 affected patients developed symptoms within two postoperative hours. Rescue antiemetic therapy was required in 11 affected patients. Female sex, previous PONV or motion sickness, laparoscopic surgery, surgical duration exceeding 120 minutes, postoperative opioid use, and absence of prophylactic antiemetics were significant unadjusted factors. Female sex, previous PONV or motion sickness, and postoperative opioid use remained independent predictors. PONV was associated with a longer post-anaesthesia care unit stay.
Conclusion: PONV affected nearly one-third of patients after general anaesthesia. Preoperative risk assessment, opioid-sparing analgesia, and risk-adapted antiemetic prophylaxis are important components of perioperative care.

Keywords*: General anaesthesia; postoperative nausea and vomiting; risk factors; antiemetic prophylaxis; postoperative opioids.*

INTRODUCTION

Postoperative nausea and vomiting (PONV) is one of the most frequent and distressing adverse events following anaesthesia and surgery. It encompasses nausea, retching, or vomiting occurring during the early postoperative period, commonly assessed within the first 24 hours. Although rarely life-threatening, PONV can produce dehydration, electrolyte disturbance, aspiration, wound stress, bleeding, and disruption of surgical repair. It also reduces patient satisfaction and can interfere with oral intake, mobilisation, analgesic administration, and discharge planning. Contemporary consensus guidance therefore recognises PONV prevention as an essential component of safe perioperative care.[1]

The reported frequency of PONV varies according to case mix, surgical procedure, anaesthetic technique, outcome definition, and prophylactic practice. Pooled evidence indicates that approximately one-quarter to one-third of unselected surgical patients develop PONV, whereas the risk can approach 70-80% in highly susceptible individuals.[2] Its clinical and

economic consequences are substantial. Patients who experience PONV require more nursing interventions and rescue medication and often remain longer in the post-anaesthesia care unit (PACU), thereby increasing resource use and delaying theatre turnover or discharge.[3]

PONV has a multifactorial origin involving patient-, surgery-, and anaesthesia-related determinants. The simplified Apfel score incorporates four established predictors: female sex, non-smoking status, a history of PONV or motion sickness, and anticipated postoperative opioid administration.[4] Subsequent evidence has confirmed the importance of these characteristics and has also identified younger age, prolonged anaesthetic exposure, volatile agents, nitrous oxide, and certain procedures as relevant contributors.[5,6] The emetogenic contribution of opioids is particularly important because their use extends from intraoperative anaesthesia to postoperative analgesia and is potentially modifiable.

Current preventive strategies include baseline-risk reduction, propofol-based total intravenous anaesthesia, avoidance or minimisation of volatile agents and nitrous oxide, multimodal opioid-sparing analgesia, adequate hydration, and administration of antiemetics with different mechanisms of action.[1,7] Network evidence supports several antiemetic classes, including serotonin 5-hydroxytryptamine-3 antagonists, corticosteroids, dopamine antagonists, anticholinergics, and neurokinin-1 antagonists.[8] Propofol-based anaesthesia and opioid-free or opioid-sparing techniques also reduce postoperative emetic symptoms in selected surgical populations.[9,10] Nevertheless, residual PONV remains common because risk profiles, prophylactic prescribing, and perioperative practices differ between institutions.

Local prospective data are useful for measuring the clinical burden of PONV and determining whether routinely recognised predictors remain relevant within a specific perioperative setting. Accordingly, the present study aimed to determine the incidence, timing, severity, and recovery consequences of PONV during the first 24 hours after general anaesthesia. It also sought to evaluate demographic, clinical, surgical, and anaesthetic factors associated with PONV and to identify independent predictors among adult patients undergoing elective surgical procedures.

METHODOLOGY

Study design and setting: This prospective observational study was conducted in the Departments of Anaesthesiology and Surgery at Seth G.S. Medical College and King Edward Memorial Hospital, Parel, Mumbai, Maharashtra, India, from March 2025 to July 2025. The manuscript was prepared in accordance with the Strengthening the Reporting of Observational Studies in Epidemiology recommendations.[11] No alteration was made to the planned anaesthetic or surgical management for study purposes.

Study population: Adults aged 18-75 years with American Society of Anesthesiologists physical status I-III who were scheduled for elective surgery under general anaesthesia and expected to remain under observation for at least 24 hours were eligible. Patients with nausea or vomiting during the preceding 24 hours, pregnancy, emergency surgery, planned postoperative ventilation, severe cognitive impairment, inability to communicate symptoms, or incomplete postoperative observation were excluded. Consecutive eligible patients were approached before surgery, and written informed consent was obtained.

Sample size and sampling: Assuming an expected PONV incidence of 30%, a 95% confidence level, and an absolute precision of 12%, the minimum estimated sample was 56 patients. To allow for incomplete observations, 60 patients were included. Participants were enrolled by consecutive sampling. Anaesthetic induction, airway management, maintenance technique, use of volatile agents or nitrous oxide, analgesia, and antiemetic prophylaxis were selected by the attending anaesthesiologist according to clinical requirements. These exposures were documented without investigator-directed allocation.

Data collection and outcome assessment: A structured case-record form captured age, sex, body mass index, smoking status, previous PONV or motion sickness, ASA status, type and duration of surgery, maintenance technique, nitrous oxide exposure, prophylactic antiemetics, and postoperative opioid use. The primary outcome was PONV, defined as any nausea, retching, or vomiting occurring within 24 hours after extubation, consistent with standard clinical definitions.[1] Assessments were performed in the PACU and at 2, 6, and 24 hours. Severity was graded as mild when symptoms did not require medication, moderate when rescue medication was required, and severe when symptoms were recurrent, persistent, or poorly responsive to initial treatment. The time of first episode, recurrent events, rescue antiemetic administration, PACU duration, and PONV-related unplanned observation were recorded.

Statistical analysis: Data were analysed using IBM SPSS Statistics, version 26.0. Continuous variables were summarised as mean and standard deviation and compared with Welch's independent-samples t-test. Categorical variables were presented as frequency and percentage and assessed using the chi-square test or Fisher's exact test. Unadjusted odds ratios (ORs) and 95% confidence intervals (CIs) were calculated. Because 18 PONV events occurred, multivariable logistic regression was restricted to four clinically selected variables to limit model overfitting. Model

calibration was assessed with the Hosmer-Lemeshow test, and explanatory performance was reported using Nagelkerke R^2. A two-sided p-value <0.05 was considered statistically significant.

Ethical considerations: Necessary Permissions were obtained before starting the study. Written informed consent was obtained from each participant. Confidential identifiers were removed from the analytical dataset, and study procedures conformed to applicable ethical principles for research involving human participants.

RESULTS

Participant recruitment

During the study period, 64 patients scheduled to undergo surgical procedures under general anaesthesia were assessed for eligibility. Four patients were excluded: two did not fulfil the eligibility criteria, one declined participation, and one had incomplete postoperative follow-up data. The remaining 60 patients were enrolled and included in the final analysis. Complete perioperative and 24-hour postoperative data were available for all participants.

Demographic and perioperative characteristics

The mean age of the study population was 43.6 ± 13.9 years, with a range of 18-72 years. Thirty-two (53.3%) patients were females and 28 (46.7%) were males. The mean body mass index was 24.9 ± 3.7 kg/m², and 26 (43.3%) patients were overweight or obese. ASA physical status I was recorded in 34 (56.7%) patients, while 14 (23.3%) reported previous PONV or motion sickness. Laparoscopic procedures were the most frequent surgical category. Volatile anaesthetic agents were used in 48 (80.0%) patients, postoperative opioids in 32 (53.3%), and prophylactic antiemetics in 39 (65.0%) patients (Table 1).

Table 1. Demographic and perioperative characteristics of the study participants

Characteristic	Value
Total participants	60
Age, years, mean ± SD	43.6 ± 13.9
Age range, years	18-72
Age group	
18-39 years	23 (38.3)
40-59 years	27 (45.0)
≥60 years	10 (16.7)
Sex	
Male	28 (46.7)
Female	32 (53.3)
Body mass index, kg/m², mean ± SD	24.9 ± 3.7
Overweight or obesity	26 (43.3)
ASA physical status	
ASA I	34 (56.7)
ASA II	22 (36.7)
ASA III	4 (6.7)
Non-smoker	43 (71.7)
Previous PONV or motion sickness	14 (23.3)
Type of surgery	
Laparoscopic surgery	21 (35.0)
Open abdominal surgery	17 (28.3)
Otorhinolaryngological surgery	9 (15.0)
Orthopaedic surgery	8 (13.3)
Other procedures	5 (8.3)
Duration of surgery, minutes, mean ± SD	108.7 ± 42.6
Duration >120 minutes	23 (38.3)
Volatile anaesthetic use	48 (80.0)
Nitrous oxide use	38 (63.3)
Postoperative opioid use	32 (53.3)
Prophylactic antiemetic administration	39 (65.0)

Values are presented as n (%) unless otherwise indicated. ASA: American Society of Anesthesiologists; PONV: postoperative nausea and vomiting; SD: standard deviation.

Incidence and clinical pattern of postoperative nausea and vomiting

PONV occurred in 18 of the 60 patients, giving an overall incidence of 30.0% (95% CI: 19.9-42.5%). Nausea was reported by all 18 affected patients, while vomiting occurred in 10 (16.7%) patients. Eleven (61.1%) affected patients

experienced their first episode within the initial two postoperative hours. Seven (38.9%) episodes were mild, 8 (44.4%) were moderate, and 3 (16.7%) were severe. Rescue antiemetic medication was required in 11 (61.1%) affected patients, and 6 (33.3%) experienced recurrent symptoms (Table 2).

Table 2. Incidence, timing, and severity of postoperative nausea and vomiting

PONV characteristic	Value
Overall PONV	18 (30.0)
Nausea	18 (30.0)
Vomiting	10 (16.7)
Nausea without vomiting	8 (13.3)
Nausea with vomiting	10 (16.7)
Time of first PONV episode among affected patients, n = 18	
0-2 hours	11 (61.1)
>2-6 hours	5 (27.8)
>6-24 hours	2 (11.1)
Severity among affected patients, n = 18	
Mild	7 (38.9)
Moderate	8 (44.4)
Severe	3 (16.7)
Recurrent PONV episodes	6 (33.3)
Rescue antiemetic required	11 (61.1)

Percentages for timing, severity, recurrence, and rescue treatment were calculated using the 18 patients who developed PONV as the denominator.

Comparison between patients with and without PONV

Patients who developed PONV had a mean age of 41.2 ± 12.8 years compared with 44.7 ± 14.3 years among those without PONV (p = 0.355). Mean body mass index was also comparable (25.1 ± 3.5 versus 24.8 ± 3.8 kg/m²; p = 0.769). PONV occurred in 15 of 32 females (46.9%) and 3 of 28 males (10.7%), corresponding to significantly greater odds among females. A previous history of PONV or motion sickness was present in 9 (50.0%) affected patients and 5 (11.9%) unaffected patients. Non-smoking status showed an increased but non-significant association.

Laparoscopic surgery, surgical duration exceeding 120 minutes, postoperative opioid use, and absence of prophylactic antiemetics were significantly associated with PONV. The incidence was 43.8% among patients receiving postoperative opioids compared with 14.3% among those who did not receive opioids. It was 47.6% among patients without prophylactic antiemetics and 20.5% among those given prophylaxis (Table 3).

Table 3. Factors associated with postoperative nausea and vomiting

Variable	PONV present, n = 18	PONV absent, n = 42	Unadjusted OR (95% CI)	p-value
Age ≥50 years	7 (38.9)	19 (45.2)	0.77 (0.25-2.37)	0.779
Female sex	15 (83.3)	17 (40.5)	7.35 (1.84-29.35)	0.004
ASA grade II or III	8 (44.4)	18 (42.9)	1.07 (0.35-3.25)	1.000
Previous PONV or motion sickness	9 (50.0)	5 (11.9)	7.40 (1.99-27.53)	0.003
Non-smoker	16 (88.9)	27 (64.3)	4.44 (0.90-22.01)	0.066
Laparoscopic surgery	10 (55.6)	11 (26.2)	3.52 (1.11-11.20)	0.040
Surgery duration >120 minutes	11 (61.1)	12 (28.6)	3.93 (1.23-12.54)	0.023
Postoperative opioid use	14 (77.8)	18 (42.9)	4.67 (1.31-16.59)	0.023
Absence of antiemetic prophylaxis	10 (55.6)	11 (26.2)	3.52 (1.11-11.20)	0.040

Values are presented as n (%). ASA: American Society of Anesthesiologists; CI: confidence interval; OR: odds ratio; PONV: postoperative nausea and vomiting. Fisher's exact test was used where appropriate.

Multivariable analysis of predictors of PONV

Because only 18 PONV events occurred, the multivariable logistic regression model was restricted to four clinically relevant variables. After adjustment, female sex, previous PONV or motion sickness, and postoperative opioid use remained independently associated with PONV. Female patients had approximately fivefold greater adjusted odds, and previous PONV or motion sickness was the strongest independent predictor. Surgical duration longer than 120 minutes showed elevated adjusted odds but did not retain statistical significance (Table 4). The model had acceptable calibration (Hosmer-Lemeshow p = 0.721) and a Nagelkerke R^2 of 0.42.

Table 4. Multivariable logistic regression analysis of predictors of PONV

Predictor	Adjusted OR	95% CI	p-value
Female sex	5.21	1.29-21.10	0.021
Previous PONV or motion sickness	5.87	1.42-24.26	0.014
Postoperative opioid use	3.76	1.02-13.86	0.046
Surgery duration >120 minutes	2.69	0.76-9.51	0.126

CI: confidence interval; OR: odds ratio; PONV: postoperative nausea and vomiting.

Relationship between cumulative risk factors and PONV

The incidence of PONV increased progressively with the number of established patient-related risk factors. No PONV was observed among patients without a risk factor. The incidence was 11.1% with one risk factor, 31.6% with two, 58.3% with three, and 60.0% with four risk factors. Each additional risk factor was associated with a 2.78-fold increase in the odds of PONV (95% CI: 1.46-5.30; p for trend = 0.002) (Table 5).

Table 5. Incidence of PONV according to the number of established risk factors

Number of risk factors	Total patients	Patients with PONV	PONV incidence
0	6	0	0.0%
1	18	2	11.1%
2	19	6	31.6%
3	12	7	58.3%
4	5	3	60.0%

The evaluated risk factors were female sex, non-smoking status, previous PONV or motion sickness, and postoperative opioid use.

Postoperative recovery outcomes

Patients who developed PONV had a significantly longer mean PACU stay than those without PONV (112.4 ± 28.6 versus 82.7 ± 18.9 minutes; $p < 0.001$). Unplanned overnight observation due specifically to persistent PONV was required in 2 (3.3%) patients. No episode of pulmonary aspiration, reintubation, or other major PONV-related complication was recorded during the study period.

DISCUSSION

The present prospective study found that 30.0% of adults undergoing general anaesthesia developed PONV during the first 24 postoperative hours. This estimate lies within the commonly reported 20-30% range for unselected surgical populations and is consistent with pooled evidence describing PONV as a persistent complication despite improvements in anaesthetic practice.[2] Most episodes began early: more than three-fifths of affected patients reported symptoms within two hours. This pattern supports close surveillance in the PACU, while continued assessment remains necessary because a smaller proportion developed symptoms between 6 and 24 hours.

Female sex and a previous history of PONV or motion sickness were the strongest patient-related determinants. These findings align with the simplified Apfel score and later evidence-based analyses, which consistently identify female sex and prior susceptibility as robust predictors.[4,5] Non-smoking status showed increased odds but did not reach statistical significance, probably because only 17 smokers were enrolled and the confidence interval was wide. The progressive rise in PONV across cumulative risk-factor categories further supports structured preoperative risk stratification rather than reliance on a single characteristic.

Postoperative opioid administration remained independently associated with PONV. Opioids activate central and gastrointestinal emetic pathways, reduce gut motility, and increase vestibular sensitivity; their effect also varies with dose and individual susceptibility.[6,7] This observation reinforces the value of multimodal analgesia using non-opioid drugs and regional techniques when clinically appropriate. Evidence from opioid-free total intravenous anaesthesia has demonstrated meaningful reductions in PONV in high-risk surgical settings, although analgesic adequacy and procedure-specific requirements must remain central to clinical decisions.[10]

Laparoscopic surgery and procedures lasting longer than 120 minutes were significant in unadjusted analysis. Prolonged exposure to volatile anaesthetics and opioids, pneumoperitoneum, visceral manipulation, and delayed gastric motility can contribute to symptoms after laparoscopy. A 2024 cross-sectional study of laparoscopic cholecystectomy reported a PONV rate of approximately 31%, closely resembling the present estimate, and identified motion sickness as an important predictor.[12] Nevertheless, surgical site alone has lower predictive value than a combined risk score, explaining why procedure duration did not remain significant after adjustment.[13] Similar ambulatory-surgery data have also linked female sex and operations lasting longer than one hour with increased PONV risk.[14]

Prophylactic antiemetic administration was associated with a lower PONV incidence. This result is compatible with current recommendations favouring multimodal prophylaxis based on individual risk and with network evidence supporting several effective drug classes.[1,8] PONV also prolonged PACU stay by approximately 30 minutes, consistent with prior evidence linking postoperative emetic symptoms to increased resource utilisation and delayed recovery.[3] These findings support routine documentation of risk factors, timely prophylaxis, opioid-sparing care, and explicit rescue protocols. The single-centre design and modest event count require cautious interpretation, but the observations provide practical local data for improving perioperative PONV prevention.

LIMITATIONS

This study was conducted at a single tertiary-care centre with a modest sample and only 18 PONV events, limiting precision and the number of variables included in regression. Anaesthetic and prophylactic practices were not standardised because management remained observational. Symptom severity depended partly on patient reporting, and follow-up ended at 24 hours; consequently, later postdischarge nausea and vomiting were not captured.

CONCLUSION

Postoperative nausea and vomiting occurred in 30.0% of adults undergoing general anaesthesia and commonly developed during the first two postoperative hours. Female sex, previous PONV or motion sickness, and postoperative opioid exposure were independent predictors, while laparoscopic surgery, prolonged procedures, and absence of antiemetic prophylaxis were significant unadjusted factors. Increasing cumulative risk was accompanied by a clear rise in PONV incidence. Affected patients required more rescue treatment and had longer PACU stays. Systematic preoperative risk assessment, risk-adapted multimodal antiemetic prophylaxis, careful selection of anaesthetic technique, and opioid-sparing postoperative analgesia should be incorporated into routine perioperative pathways to improve recovery and resource utilisation using structured institutional prevention and rescue protocols.

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