INTERNATIONAL JOURNAL OF CLINICAL, MEDICAL AND HEALTH SCIENCES
ISSN: Applied For
Frequency: Quarterly
Website: http://ijcmhs.com/

Original Research Article

Retrospective Evaluation of Risk Factors Associated with Postoperative Nausea and Vomiting in Patients Undergoing Elective Surgery at a Tertiary Care Hospital

Sushma Reddy Ravula1, Dr Garima Sinha2, Dr Safoora Siddiqui3, Dr Avinash Kumar[4]

[1]*Assistant Professor, Department of Anaesthesia, Father Colombo Institute of Medical Sciences, 506001*

[2]*Associate Professor, Department of ENT AND Head AND Neck Surgery, Saraswathi institute of Medical Sciences, Hapur, UP. Orcid id-0009 0004 1130 3506*

[3]*Shri Atal Bihari Vajpayee Medical College and Research Institute, SABVMCRI Bangalore*

[4]*Associate Professor, Department of ENT AND Head AND Neck Surgery, Saraswathi Institute of Medical Sciences, Hapur. UP*

OPEN ACCESS

Corresponding Author:

Name
Sushma Reddy Ravula
Assistant Professor, Department of Anaesthesia, Father Colombo Institute of Medical Sciences, 506001.

Received: 05-01-2025
Accepted: 23-01-2025
Published: 10-02-2025

ABSTRACT

Background: Postoperative nausea and vomiting (PONV) is a common perioperative complication that can delay recovery, increase patient discomfort, and prolong postoperative care. Identification of high-risk patients is essential for effective prevention. This study evaluated the incidence and perioperative risk factors associated with PONV among patients undergoing elective surgery at a tertiary care hospital.
Methods: The primary outcome was the occurrence of PONV within the first 24 postoperative hours. Associations between potential risk factors and PONV were assessed using univariable analysis followed by multivariable binary logistic regression. Adjusted odds ratios (aORs) with 95% confidence intervals (CIs) were calculated.
Results: PONV occurred in 63 of 220 patients, giving an overall incidence of 28.6%. The incidence increased progressively from 8.7% among patients with no simplified Apfel risk factors to 60.0% among those with four risk factors (P<0.001).
Conclusion: PONV affected more than one-quarter of elective surgical patients. Female sex, previous PONV or motion sickness, postoperative opioid exposure, and prolonged anesthesia were significant predictors, whereas multimodal antiemetic prophylaxis was protective.

Keywords: *postoperative nausea and vomiting; PONV; Apfel score; elective surgery; antiemetic prophylaxis; postoperative opioids; risk factors.*

INTRODUCTION

Postoperative nausea and vomiting (PONV) remains one of the most frequent and distressing complications encountered after surgery and anesthesia. It is generally defined as the occurrence of nausea, retching, or vomiting during the first 24–48 hours following a surgical procedure. Despite substantial advances in anesthetic techniques, perioperative monitoring, multimodal analgesia, and antiemetic prophylaxis, PONV continues to affect a considerable proportion of surgical patients. In the general surgical population, its incidence is approximately 30%, while the risk may increase to nearly 80% among patients with multiple predisposing factors [1]. Although PONV is usually self-limiting, it can significantly impair postoperative recovery and remains an important concern for anesthesiologists, surgeons, nursing staff, and patients.

The clinical importance of PONV extends beyond temporary discomfort. Persistent nausea and repeated vomiting may result in dehydration, electrolyte abnormalities, aspiration, wound dehiscence, increased postoperative pain, bleeding, and delayed resumption of oral intake. In susceptible patients, forceful vomiting can also increase intraocular or intracranial pressure and may adversely affect surgical outcomes. Furthermore, PONV can delay mobilization and discharge, prolong stay in the post-anesthesia care unit (PACU), and increase the requirement for rescue medications and additional clinical monitoring [2]. These consequences are particularly relevant in contemporary surgical practice, where enhanced recovery protocols increasingly emphasize rapid recovery, early oral intake, early mobilization, shorter hospital stays, and efficient use of healthcare resources.

The development of PONV is multifactorial and reflects a complex interaction between patient-related, anesthetic, and surgical factors. Several patient characteristics have consistently been associated with an increased risk. These include female sex, younger age, non-smoking status, and a previous history of PONV or motion sickness. Anesthetic factors such as the use of volatile anesthetic agents, nitrous oxide, perioperative opioids, and prolonged duration of anesthesia can further increase the probability of PONV [3]. Surgical characteristics may also influence the occurrence of symptoms, although their independent contribution is sometimes difficult to distinguish from patient and anesthetic factors. Certain procedures, including laparoscopic, gynecological, breast, abdominal, and some ear, nose, and throat surgeries, have traditionally been associated with a higher occurrence of postoperative nausea and vomiting.

Risk stratification is therefore an important component of PONV prevention. One of the most widely applied prediction tools in adult surgical patients is the simplified Apfel score. This score includes four major independent predictors: female sex, non-smoking status, previous PONV or motion sickness, and anticipated postoperative opioid use. The probability of PONV increases progressively with the number of risk factors present, from approximately 10% in patients without any of these factors to approximately 79% when all four factors are present [4]. The simplicity of this model has facilitated its widespread clinical application and supports a risk-based approach to prophylactic antiemetic therapy.

Evidence from large-scale analyses has further strengthened the understanding of factors associated with PONV. A systematic review involving more than 95,000 patients demonstrated that female sex was among the strongest patient-related predictors, followed by a history of PONV or motion sickness and non-smoking status. Among anesthesia-related variables, volatile anesthetics, longer duration of anesthesia, postoperative opioid administration, and nitrous oxide exposure were associated with increased risk [5]. These findings emphasize that PONV is unlikely to be explained by a single determinant and that the overall risk is influenced by the cumulative effect of several perioperative characteristics.

Importantly, the occurrence of PONV can vary considerably between institutions because patient populations, surgical case mix, anesthetic techniques, analgesic practices, and antiemetic protocols differ across clinical settings. Retrospective analyses of institutional perioperative databases can therefore provide valuable real-world evidence regarding the actual burden of PONV and patterns of prophylactic and rescue antiemetic use. In a retrospective database analysis of patients undergoing inpatient surgery, Habib et al. demonstrated that PONV was associated with prolonged PACU stay and increased healthcare resource utilization, highlighting both its clinical and economic significance [6]. Identification of institution-specific risk factors may consequently help clinicians refine local preventive strategies rather than relying exclusively on risk estimates derived from populations treated in different healthcare environments.

PONV also has important implications for healthcare expenditure and patient-centered outcomes. Patients who develop postoperative or post-discharge nausea and vomiting may require additional nursing care, antiemetic medication, intravenous fluids, prolonged recovery-room observation, and occasionally unexpected hospital admission. A time-motion economic analysis demonstrated that PONV and post-discharge nausea and vomiting were associated with increased postoperative recovery costs and reduced postoperative quality of life [7]. In addition, patient satisfaction after anesthesia is strongly influenced by the quality of postoperative recovery, and nausea and vomiting remain complications that patients particularly wish to avoid [8].

Current recommendations therefore advocate assessment of individual risk, reduction of modifiable baseline risk factors, appropriate use of multimodal antiemetic prophylaxis, opioid-sparing analgesia where feasible, and timely rescue therapy when symptoms develop. The Fourth Consensus Guidelines for the Management of Postoperative Nausea and Vomiting particularly emphasize risk-adapted prophylaxis and broader use of multimodal prevention in patients with identifiable risk factors [9]. However, even with established recommendations, variations in clinical practice and patient characteristics may result in differences between expected and observed PONV rates.

Against this background, evaluating the factors associated with PONV within individual tertiary care institutions is clinically relevant. A retrospective assessment can utilize routinely documented perioperative information to examine patient characteristics, comorbidities, anesthetic techniques, duration of surgery and anesthesia, opioid exposure, type of surgical procedure, and use of prophylactic antiemetic medications in relation to postoperative symptoms. Such analysis may identify potentially modifiable determinants, recognize high-risk patient groups, and reveal opportunities for improving institutional perioperative protocols. Therefore, the present study was undertaken to retrospectively evaluate the risk factors associated with postoperative nausea and vomiting among patients undergoing elective surgery at a tertiary care hospital, with the broader objective of supporting evidence-based risk stratification and improving the quality of postoperative recovery.

MATERIALS AND METHODS

Study Design and Setting

This retrospective observational study was conducted in the Department of Anaesthesiology at a tertiary care hospital. The study evaluated perioperative factors associated with the occurrence of postoperative nausea and vomiting (PONV) among adult patients undergoing elective surgical procedures. Medical records of eligible patients operated during an 18-month period from January 2023 to June 2024 were reviewed.

The study was designed in accordance with the principles of the Declaration of Helsinki and applicable institutional standards for retrospective clinical research.

Study Population
The study included 220 patients who underwent elective surgery under anaesthesia during the study period and fulfilled the predefined eligibility criteria. Patient information was obtained from hospital case records, pre-anaesthetic evaluation forms, anaesthesia charts, operation theatre records, post-anaesthesia care unit documentation, nursing records, and postoperative clinical notes.

Inclusion Criteria
Patients were included if they met the following criteria:

1. Age ≥18 years.
2. Underwent an elective surgical procedure during the defined study period.
3. Received general anaesthesia or a combined anaesthetic technique involving general anaesthesia.
4. Had complete perioperative anaesthesia and postoperative recovery records.
5. Had adequate documentation regarding the presence or absence of nausea, retching, or vomiting during the postoperative period.
6. Had available information regarding major patient-related, surgical, and anaesthetic risk factors relevant to PONV.

Exclusion Criteria
Patients were excluded if they had:

1. Emergency surgery.
2. Preoperative nausea or vomiting within 24 hours before surgery.
3. Gastrointestinal obstruction or another clinical condition associated with active vomiting before surgery.
4. Procedures performed exclusively under local anaesthesia without sedation.
5. Incomplete anaesthesia records or insufficient postoperative documentation.
6. Requirement for prolonged postoperative mechanical ventilation that prevented reliable assessment of PONV.
7. Reoperation within the immediate postoperative observation period.
8. Missing essential information regarding anaesthetic technique, postoperative opioid exposure, or PONV outcome.

Sampling Technique and Sample Size
A total of 220 eligible patients were included using consecutive sampling from available medical records during the study period. All records satisfying the eligibility criteria were screened sequentially until the predetermined study sample was achieved.

As this was a retrospective observational study based on available institutional records, no intervention or alteration in routine patient management was undertaken.

Data Collection
Data were extracted using a structured data collection proforma developed specifically for the study. Each patient was assigned a unique study identification number, and identifying information was excluded from the analytical database.

The collected variables were categorized into patient-related, anaesthesia-related, surgery-related, and postoperative factors.

Patient-Related Variables
The following patient characteristics were recorded:

- Age
- Sex
- Body mass index
- American Society of Anesthesiologists physical status classification
- Smoking status
- History of previous PONV
- History of motion sickness
- Relevant comorbidities, including diabetes mellitus, hypertension, cardiovascular disease, respiratory disease, and gastrointestinal disorders
- Preoperative fasting duration, where documented

Patients were classified as smokers or non-smokers according to the information available in the pre-anaesthetic assessment records.

Surgery-Related Variables
Surgical characteristics included:

- Type of surgical procedure
- Surgical specialty
- Open or minimally invasive/laparoscopic approach
- Duration of surgery
- Duration of anaesthesia
- Patient positioning where clinically relevant

For analytical purposes, procedures were grouped into major surgical categories according to the operative record.

Anaesthesia-Related Variables
Anaesthetic variables included:

- Anaesthetic technique
- Induction agents
- Use of volatile anaesthetic agents
- Use of nitrous oxide
- Intraoperative opioid administration
- Type and estimated dose of intraoperative opioid
- Use of neuromuscular blocking drugs and reversal agents
- Intraoperative intravenous fluid administration
- Use of prophylactic antiemetic medications
- Number and classes of prophylactic antiemetic agents administered

Postoperative analgesic therapy, particularly systemic opioid administration, was also documented because of its established association with PONV.

Assessment of PONV
The primary outcome was the occurrence of postoperative nausea and/or vomiting during the first 24 hours after surgery.

PONV was considered present if postoperative documentation contained one or more of the following:

- Subjective complaint of nausea,
- Retching,
- One or more episodes of vomiting, or
- Administration of rescue antiemetic medication for clinically documented nausea or vomiting.

Where timing was available, PONV was classified according to its occurrence during the immediate postoperative period in the post-anaesthesia care unit and subsequently during the first 24 postoperative hours.

Nausea was defined as an unpleasant subjective sensation associated with the urge to vomit without forceful expulsion of gastric contents. Vomiting was defined as forceful expulsion of gastric or upper gastrointestinal contents through the mouth. Retching was considered part of the PONV outcome when clearly documented.

Assessment of PONV Risk Factors
The major established risk factors considered in the analysis included:

- Female sex
- Non-smoking status
- Previous history of PONV
- History of motion sickness
- Postoperative opioid use

Where sufficient information was available, patients were additionally categorized according to the number of major risk factors present, consistent with the principles of the simplified Apfel risk score.

Other potential determinants evaluated included age, body mass index, ASA physical status, type and duration of surgery, duration of anaesthesia, laparoscopic surgical approach, volatile anaesthetic use, nitrous oxide exposure, intraoperative opioid administration, postoperative opioid exposure, and the use of antiemetic prophylaxis.

Antiemetic Prophylaxis and Rescue Treatment
Information regarding prophylactic antiemetic administration was obtained from the anaesthetic chart. The use of agents such as ondansetron, dexamethasone, metoclopramide, or other antiemetics was recorded according to institutional clinical practice.

The number of antiemetic classes administered prophylactically was documented as none, single-agent prophylaxis, or multimodal prophylaxis.

Rescue antiemetic therapy administered after the onset of nausea or vomiting was recorded separately and was not classified as prophylaxis.

Outcome Measures
The **primary outcome measure** was the incidence of PONV within the first 24 hours after elective surgery.

The **secondary outcome measures** included:

1. Association between patient-related factors and PONV.
2. Association between anaesthetic variables and PONV.
3. Association between type and duration of surgery and PONV.

4. Relationship between perioperative opioid exposure and PONV.
5. Association between prophylactic antiemetic administration and occurrence of PONV.
6. Identification of independent predictors of PONV using multivariable regression analysis.
7. Requirement for rescue antiemetic medication among patients who developed PONV.

Data Quality and Handling of Missing Data

All extracted records were reviewed for completeness before inclusion in the final database. Data entry was independently cross-checked to minimize transcription errors. Records with missing information for the primary outcome were excluded.

For individual secondary variables, the extent of missing data was assessed before statistical analysis. Variables with substantial missing information were not included in multivariable modeling. No assumptions were made to replace undocumented clinical events.

Statistical Analysis

Statistical analysis was performed using IBM SPSS Statistics, version 26.0 (IBM Corp., Armonk, NY, USA) or equivalent statistical software.

Continuous variables were assessed for normality using visual inspection and the Shapiro-Wilk test. Normally distributed continuous variables were expressed as mean ± standard deviation, whereas skewed variables were summarized as median with interquartile range. Categorical variables were presented as frequencies and percentages.

Patients were divided into two groups according to the occurrence of PONV:

- **PONV group**
- **Non-PONV group**

Continuous variables were compared using the independent-samples Student's *t* test for normally distributed data or the Mann-Whitney *U* test for non-normally distributed data. Categorical variables were compared using the chi-square test or Fisher's exact test, as appropriate.

Univariable analysis was initially performed to identify variables potentially associated with PONV. Clinically relevant variables and variables showing an association at $P < 0.10$ in univariable analysis were considered for inclusion in the multivariable logistic regression model.

All statistical tests were two-tailed, and a P value <0.05 was considered statistically significant.

RESULTS

A total of 220 patients who underwent elective surgical procedures during the 18-month study period from January 2023 to June 2024 were included in the final analysis. The mean age of the study population was 46.8 ± 14.7 years, and 118 (53.6%) patients were female. The mean body mass index (BMI) was 25.9 ± 4.1 kg/m². Most patients belonged to American Society of Anesthesiologists (ASA) physical status I or II, accounting for 195 (88.6%) of the study population.

A total of 166 (75.5%) patients were non-smokers, while 37 (16.8%) had a documented previous history of PONV and/or motion sickness. General surgery constituted the largest surgical category, followed by orthopaedic and gynecological procedures. Volatile anesthetic agents were used in 163 (74.1%) patients, postoperative systemic opioids were administered to 113 (51.4%), and 155 (70.5%) patients received at least one prophylactic antiemetic agent.

Table 1. Baseline demographic, clinical, surgical, and anesthetic characteristics of the study population (n = 220)

Variable	Value
Age, years, mean ± SD	46.8 ± 14.7
BMI, kg/m², mean ± SD	25.9 ± 4.1
Sex	
Male	102 (46.4%)
Female	118 (53.6%)
ASA physical status	
I	91 (41.4%)
II	104 (47.3%)
III	25 (11.4%)
Non-smoker	166 (75.5%)
Previous PONV/motion sickness	37 (16.8%)
Hypertension	53 (24.1%)
Diabetes mellitus	41 (18.6%)
Surgical specialty	
General surgery	72 (32.7%)

Orthopaedic surgery	52 (23.6%)
Gynecological surgery	36 (16.4%)
ENT surgery	25 (11.4%)
Urological surgery	20 (9.1%)
Other procedures	15 (6.8%)
Laparoscopic procedure	53 (24.1%)
Duration of surgery, min, mean ± SD	118.4 ± 46.0
Duration of anesthesia, min, mean ± SD	138.3 ± 50.5
Volatile anesthetic use	163 (74.1%)
Nitrous oxide use	54 (24.5%)
Postoperative opioid administration	113 (51.4%)
Any prophylactic antiemetic	155 (70.5%)

PONV within the first 24 postoperative hours was documented in 63 of 220 patients, corresponding to an overall incidence of 28.6%. Among patients who developed PONV, isolated nausea was the most common presentation, occurring in 34 (54.0%), while 24 (38.1%) experienced at least one episode of vomiting with or without nausea. Five patients (7.9%) had documented retching without vomiting.

The highest proportion of PONV events occurred during the early postoperative period. Twenty-five (39.7%) affected patients developed symptoms within the first 2 hours after surgery, 20 (31.7%) between >2 and 6 hours, and 18 (28.6%) between >6 and 24 hours. Rescue antiemetic treatment was required in 44 (69.8%) patients who developed PONV.

Table 2. Incidence and clinical characteristics of postoperative nausea and vomiting

PONV characteristic	**n (%)**
Total study population	220
No PONV	157 (71.4%)
Any PONV within 24 hours	63 (28.6%)
Manifestation among patients with PONV (n = 63)	
Nausea without vomiting	34 (54.0%)
Vomiting with/without nausea	24 (38.1%)
Retching without vomiting	5 (7.9%)
Timing of first PONV episode	
0–2 hours	25 (39.7%)
>2–6 hours	20 (31.7%)
>6–24 hours	18 (28.6%)
Rescue antiemetic required	44 (69.8%)

Patients who developed PONV were more frequently female than those without PONV (71.4% vs. 46.5%; P = 0.001). A previous history of PONV or motion sickness was also considerably more frequent in the PONV group (31.7% vs. 10.8%; P < 0.001).

Non-smoking status, postoperative opioid administration, exposure to volatile anesthetics, and anesthesia duration greater than 120 minutes were significantly associated with PONV on univariable analysis. Patients with PONV also had longer mean surgical and anesthetic durations.

Age and BMI did not differ significantly between the groups. Laparoscopic surgery showed a higher numerical incidence of PONV but did not reach statistical significance.

Table 3. Comparison of demographic and perioperative variables between patients with and without PONV

Variable	**PONV (n = 63)**	**No PONV (n = 157)**	**P value**
Age, years	43.9 ± 13.8	48.0 ± 14.9	0.054
BMI, kg/m²	26.2 ± 4.3	25.8 ± 4.0	0.526
Female sex	45 (71.4%)	73 (46.5%)	0.001
Non-smoker	54 (85.7%)	112 (71.3%)	0.025
Previous PONV/motion sickness	20 (31.7%)	17 (10.8%)	<0.001
ASA III	7 (11.1%)	18 (11.5%)	0.264*
Laparoscopic procedure	20 (31.7%)	33 (21.0%)	0.116

Surgery duration, min	132 ± 48	113 ± 44	0.008
Anesthesia duration, min	154 ± 52	132 ± 49	0.005
Anesthesia duration >120 min	41 (65.1%)	70 (44.6%)	0.007
Volatile anesthetic use	53 (84.1%)	110 (70.1%)	0.040
Nitrous oxide use	21 (33.3%)	33 (21.0%)	0.059
Postoperative opioid use	43 (68.3%)	70 (44.6%)	0.002
Any prophylactic antiemetic	37 (58.7%)	118 (75.2%)	0.022

The occurrence of PONV increased progressively with accumulation of major established risk factors. PONV occurred in only 2 of 23 (8.7%) patients with no major risk factors compared with 6 of 10 (60.0%) patients presenting with all four simplified Apfel risk factors. A significant association was observed between increasing risk score and PONV occurrence ($P < 0.001$).

Table 4. Occurrence of PONV according to the number of simplified Apfel risk factors

Number of risk factors	Total patients, n	Patients with PONV, n	PONV incidence
0	23	2	8.7%
1	67	11	16.4%
2	78	25	32.1%
3	42	19	45.2%
4	10	6	60.0%
Total	**220**	**63**	**28.6%**

Sixty-five patients received no prophylactic antiemetic, 91 received single-agent prophylaxis, and 64 received multimodal prophylaxis comprising two or more antiemetic classes.

PONV occurred in 40.0% of patients receiving no prophylaxis, compared with 30.8% receiving single-agent prophylaxis and 14.1% receiving multimodal prophylaxis. The overall difference was statistically significant ($P = 0.004$).

Among the 63 patients who experienced PONV, 44 required rescue antiemetic treatment. Ondansetron was the most frequently documented rescue agent.

Table 5. Association between antiemetic prophylaxis and postoperative nausea and vomiting

Antiemetic strategy	Total, n	PONV, n (%)	No PONV, n (%)
No prophylaxis	65	26 (40.0%)	39 (60.0%)
Single-agent prophylaxis	91	28 (30.8%)	63 (69.2%)
Multimodal prophylaxis	64	9 (14.1%)	55 (85.9%)
Total	**220**	**63 (28.6%)**	**157 (71.4%)**

Among patients requiring rescue therapy (n = 44), ondansetron was administered in 27 cases, metoclopramide in 10, and another antiemetic or combination regimen in 7 cases.

Variables showing clinical relevance or an association at $P < 0.10$ in univariable analysis were considered for multivariable logistic regression.

After adjustment for potential confounders, a previous history of PONV or motion sickness was the strongest independent risk factor for postoperative symptoms (adjusted odds ratio [aOR] 3.42; 95% CI 1.55–7.55; $P = 0.002$). Female sex was independently associated with approximately 2.5-fold increased odds of PONV (aOR 2.53; 95% CI 1.27–5.03; $P = 0.008$).

Postoperative opioid administration was also independently associated with PONV (aOR 2.31; 95% CI 1.16–4.58; $P = 0.017$). Anesthesia lasting more than 120 minutes demonstrated a weaker but statistically significant association (aOR 1.96; 95% CI 1.00–3.84; $P = 0.049$).

In contrast, multimodal antiemetic prophylaxis was independently associated with substantially lower odds of PONV compared with no prophylaxis (aOR 0.31; 95% CI 0.12–0.78; $P = 0.013$).

Table 6. Multivariable logistic regression analysis of factors independently associated with PONV

Variable	Adjusted OR	95% CI	P value
Previous PONV/motion sickness	3.42	1.55–7.55	0.002
Female sex	2.53	1.27–5.03	0.008
Postoperative opioid use	2.31	1.16–4.58	0.017
Non-smoking status	2.19	0.96–4.98	0.062

Anesthesia duration >120 min	1.96	1.00–3.84	0.049
Volatile anesthetic use	1.79	0.80–4.02	0.156
Single-agent prophylaxis vs. none	0.70	0.35–1.39	0.309
Multimodal prophylaxis vs. none	0.31	0.12–0.78	0.013

The multivariable model demonstrated acceptable calibration, with no evidence of significant lack of fit. Overall, the findings indicate that previous PONV or motion sickness, female sex, postoperative opioid exposure, and prolonged anesthesia were the principal independent factors associated with PONV, whereas multimodal antiemetic prophylaxis demonstrated an independent protective association.

Figure 1. Incidence of postoperative nausea and vomiting among patients undergoing elective surgery

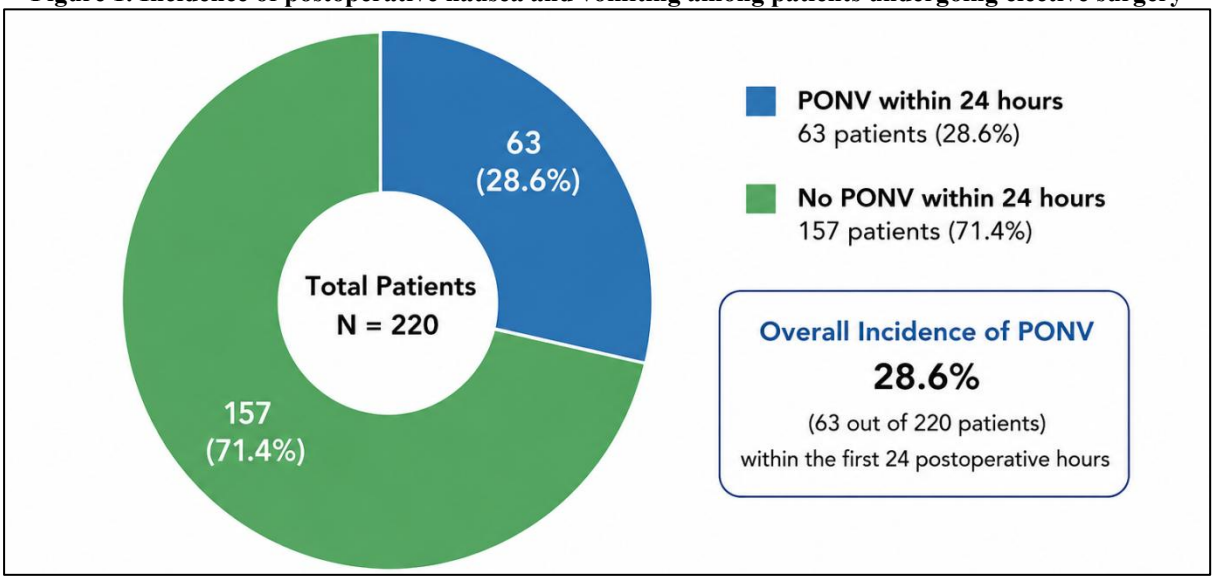

Figure 1. Incidence of postoperative nausea and vomiting among patients undergoing elective surgery. Of the 220 patients included in the study, 63 (28.6%) developed PONV within the first 24 postoperative hours, whereas 157 (71.4%) did not experience PONV.

Figure 2. Incidence of postoperative nausea and vomiting according to the number of simplified Apfel risk factors

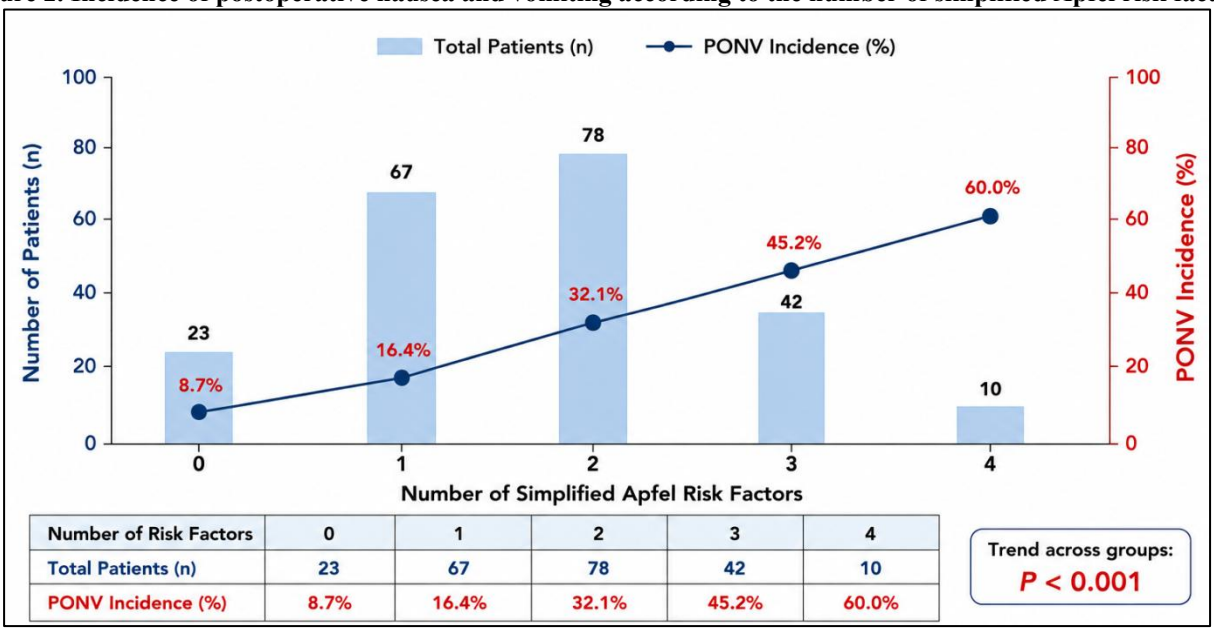

Figure 2. Incidence of postoperative nausea and vomiting according to the number of simplified Apfel risk factors. The frequency of PONV increased progressively from 8.7% among patients with no identified risk factors to 60.0% among those with four risk factors ($P < 0.001$).

Figure 3. Forest plot of adjusted odds ratios and 95% confidence intervals for factors associated with postoperative nausea and vomiting

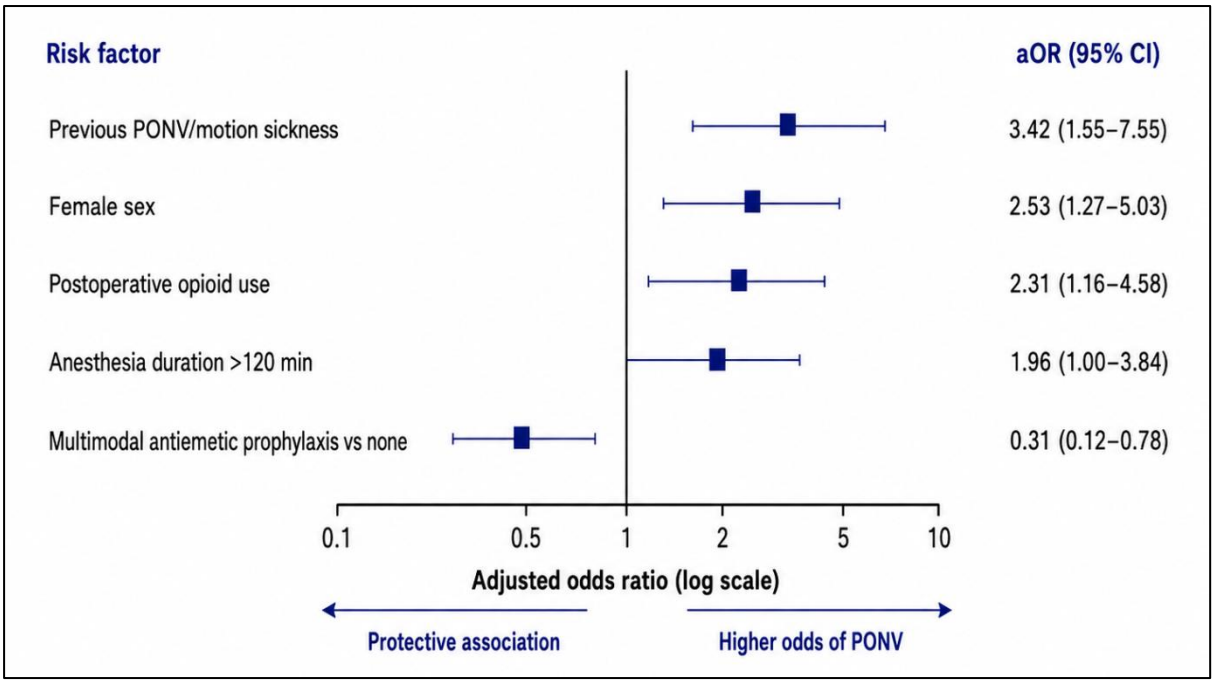

Figure 3. Forest plot of adjusted odds ratios and 95% confidence intervals for factors associated with postoperative nausea and vomiting. Previous PONV or motion sickness, female sex, postoperative opioid administration, and prolonged anesthesia were associated with increased odds of PONV, whereas multimodal antiemetic prophylaxis demonstrated a protective association.

DISCUSSION

The present retrospective study evaluated the incidence and determinants of postoperative nausea and vomiting among 220 patients undergoing elective surgery at a tertiary care hospital. PONV occurred in 63 patients, giving an overall incidence of 28.6% within the first 24 postoperative hours. The principal findings were that female sex, previous history of PONV or motion sickness, postoperative opioid exposure, and prolonged duration of anesthesia were independently associated with increased odds of PONV. In contrast, multimodal antiemetic prophylaxis was associated with a significant reduction in PONV. Furthermore, the incidence increased progressively with accumulation of simplified Apfel risk factors, from 8.7% in patients without any major risk factor to 60.0% among patients presenting with all four factors. These findings reinforce the multifactorial nature of PONV and highlight the importance of preoperative risk assessment combined with appropriate preventive strategies.

The overall PONV incidence of 28.6% observed in the present study is comparable with that reported in other heterogeneous elective surgical populations. Son and Yoon studied 609 surgical patients and reported a 24-hour PONV incidence of 27.1%, which closely approximates the rate observed in the present cohort [10]. Choi et al., in a retrospective analysis of 1,878 patients receiving fentanyl-based intravenous patient-controlled analgesia, reported PONV in 23% of patients despite single-agent antiemetic prophylaxis [11]. In contrast, Morino et al. reported nausea in 40% and vomiting in 22% of patients during the first 24 hours following anesthesia in a large single-centre prospective study [12]. Differences in reported incidence across studies are expected because PONV is influenced by patient characteristics, surgical case mix, anesthetic techniques, opioid exposure, duration of observation, and prophylactic antiemetic practices. The incidence found in the current study therefore appears consistent with the range expected in an unselected adult elective surgical population.

Female sex emerged as a significant independent predictor of PONV in the present analysis, with women having approximately 2.5 times greater adjusted odds of developing symptoms than men. This finding is consistent with previous clinical studies. Son and Yoon identified female sex as an important independent risk factor, with an odds ratio of approximately 2.0 [10]. Similarly, Morino et al. demonstrated that female sex was associated with both postoperative nausea and vomiting after adjustment for other perioperative factors [12]. More recently, a large systematic review and meta-analysis involving 31 studies and more than 355,000 patients reported a pooled odds ratio of 2.39 for female sex, confirming it as one of the most reproducible patient-related predictors of PONV. The similarity between these published estimates and the adjusted odds ratio of 2.53 in the present study strengthens the biological and clinical plausibility of the observed association.

A previous history of PONV or motion sickness was the strongest independent predictor identified in the present study, with an adjusted odds ratio of 3.42. PONV occurred in 31.7% of patients with such a history compared with only 10.8% of patients without PONV in the comparison group. This observation is also consistent with previous studies. Son and Yoon reported previous PONV and motion sickness as important independent predictors [10], while Choi et al. demonstrated that a previous history of either condition remained independently associated with PONV even among patients receiving antiemetic prophylaxis [11]. These findings indicate that previous susceptibility to nausea or vomiting represents an important clinical marker that should be specifically elicited during pre-anesthetic assessment.

The progressive increase in PONV with accumulation of risk factors is another important finding of the present study. PONV occurred in 8.7%, 16.4%, 32.1%, 45.2%, and 60.0% of patients with zero, one, two, three, and four major risk factors, respectively. This clear risk gradient supports the clinical usefulness of simplified risk stratification. Darvall et al. reviewed the application of the four components of the simplified Apfel score—female sex, non-smoking status, previous PONV or motion sickness, and postoperative opioid use—and confirmed that these factors remain widely used for PONV risk assessment [14]. Nevertheless, they also demonstrated substantial variation in how individual risk factors are defined in published studies. Consequently, risk scores should be regarded as practical tools for categorizing patients rather than as absolute predictors of individual outcomes. The present findings similarly suggest that the greatest value of such scoring systems lies in identifying patients who may benefit from more intensive prophylaxis.

Non-smoking status was significantly associated with PONV in the unadjusted comparison in the current cohort, although it did not remain statistically significant after multivariable adjustment (aOR 2.19; 95% CI 0.96–4.98; P=0.062). This finding should not necessarily be interpreted as evidence against an association. The relatively wide confidence interval suggests limited statistical precision, which may be related to the modest sample size and the high proportion of non-smokers in the cohort. The most recent meta-analysis by Dou et al. reported that non-smoking status significantly increased PONV risk, with a pooled odds ratio of 1.70 [13]. Choi et al. likewise identified non-smoking status as an independent predictor [11]. Thus, the direction and magnitude of association observed in our study remain broadly consistent with the established literature despite failing to reach conventional statistical significance after adjustment.

Postoperative opioid administration was another important modifiable factor. Patients developing PONV had substantially greater exposure to postoperative opioids than patients without PONV (68.3% vs. 44.6%), and opioid administration remained independently associated with PONV after adjustment (aOR 2.31). Opioids may contribute to nausea and vomiting through central and gastrointestinal mechanisms and remain a major challenge in postoperative pain management. Choi et al. demonstrated a clinically important PONV burden among patients receiving fentanyl-based postoperative analgesia [11]. Additional evidence comes from a 2023 meta-analysis of 14 randomized controlled trials involving 1,354 patients, in which Zhang et al. found that opioid-free anesthesia significantly reduced the risk of PONV compared with opioid-based anesthesia [15]. These findings do not imply that opioids should be completely avoided in all surgical patients; rather, they support the adoption of opioid-sparing multimodal analgesic strategies whenever clinically appropriate.

Anesthesia duration exceeding 120 minutes was independently associated with PONV in the present study. Mean anesthesia duration was also greater among patients with PONV than among those without symptoms. Similar observations have been reported by Morino et al., who identified prolonged anesthesia as an independent predictor of both nausea and vomiting [12], and by Choi et al., who found prolonged anesthesia to increase PONV risk among patients receiving fentanyl-based postoperative analgesia [11]. A longer anesthetic procedure potentially increases cumulative exposure to volatile anesthetics, opioids, and other emetogenic stimuli and may also reflect greater surgical complexity. Accordingly, the association between duration and PONV should probably be interpreted as a composite marker of perioperative exposure rather than as an isolated mechanistic factor.

Volatile anesthetic use was significantly more frequent in the PONV group in univariable analysis but did not remain independently significant following multivariable adjustment. Nevertheless, the observed direction of effect is clinically relevant. Schraag et al., in a systematic review and meta-analysis of 229 randomized trials involving 20,991 patients, demonstrated that maintenance of anesthesia with propofol was associated with a significantly lower risk of PONV than inhalational anesthetic agents, with a relative risk of 0.61 [16]. The absence of an independent association in the present regression model may therefore reflect confounding by other variables, limited statistical power, or the widespread use of volatile anesthetics in the study population rather than absence of a true effect. For patients at particularly high risk of PONV, modification of baseline anesthetic technique may consequently represent an additional preventive option.

One of the most clinically relevant findings of this study was the association between the intensity of prophylaxis and postoperative outcomes. PONV occurred in 40.0% of patients who received no prophylaxis, 30.8% of those receiving a single antiemetic, and only 14.1% of those receiving multimodal prophylaxis. After adjustment, multimodal prophylaxis was associated with approximately a 69% reduction in the odds of PONV compared with no prophylaxis. This observation is strongly supported by contemporary evidence. A large Cochrane network meta-analysis demonstrated clinically important efficacy for multiple antiemetic agents and found that drug combinations were generally more effective than single agents in preventing postoperative vomiting [17]. Similarly, Som et al. analyzed 17 randomized controlled trials involving 1,402 patients undergoing laparoscopic surgery and found that the combination of dexamethasone and a 5-HT3 receptor antagonist was significantly more effective than a 5-HT3 antagonist alone, with an odds ratio of 0.38 for PONV [18]. These findings reinforce the principle that patients with multiple risk factors should receive prophylactic agents acting through different pharmacological pathways rather than relying exclusively on a single antiemetic.

The timing of symptoms also has practical implications. Approximately 40% of PONV cases in the present study developed within the first two postoperative hours, while a further 31.7% occurred between two and six hours. Nevertheless, almost one-third of cases first developed between six and 24 hours, emphasizing that absence of symptoms in the post-anesthesia care unit does not exclude later PONV. Furthermore, 69.8% of patients who developed symptoms required rescue antiemetic therapy. This substantial requirement for rescue treatment indicates that prevention is preferable to management after symptoms have already developed, particularly among patients with multiple preoperative risk factors.

The finding that laparoscopic surgery was not independently associated with PONV deserves consideration. Although the unadjusted proportion of laparoscopic procedures was higher among patients with PONV, the difference did not achieve statistical significance. The recent meta-analysis by Dou et al. similarly found that several procedure categories traditionally regarded as high risk, including laparoscopic surgery considered as an overall category, did not show a statistically significant independent association after pooling adjusted estimates, whereas specific procedures such as cholecystectomy, breast surgery, abdominal surgery, and gynecological surgery showed stronger associations [13]. This suggests that procedure type may partly operate through associated patient characteristics, duration of anesthesia, opioid requirements, and anesthetic technique rather than functioning uniformly as an independent risk factor.

From a clinical perspective, the present findings support a structured approach to PONV prevention. A brief preoperative assessment incorporating sex, smoking status, previous PONV or motion sickness, and anticipated postoperative opioid requirement can identify patients likely to benefit from more intensive prophylaxis. Modifiable factors should then be considered, including opioid-sparing analgesia, appropriate selection of anesthetic technique, and administration of two or more antiemetics from different pharmacological classes in patients with increased baseline risk. The strong risk gradient identified in this study also suggests that preventive interventions can be targeted efficiently without exposing every patient to the same prophylactic regimen.

The present study has several strengths. It evaluated a heterogeneous real-world elective surgical population, incorporated patient-, surgical-, and anesthesia-related factors, examined both prophylactic and rescue antiemetic use, and used multivariable logistic regression to distinguish independent associations from unadjusted relationships. The assessment of PONV according to accumulated risk factors also provides clinically interpretable information that can be readily translated into perioperative practice.

Several limitations should, however, be considered. First, the retrospective design depended on the completeness and accuracy of routine clinical documentation, and mild nausea may have been under-recorded. Second, the study was conducted at a single tertiary care hospital with a relatively modest sample of 220 patients, which may limit the generalizability and statistical precision of some estimates. Third, the severity and duration of nausea were not quantified using a standardized validated scale. Fourth, variations in the type and dose of opioids, anesthetic agents, and antiemetic medications may have introduced residual confounding. Fifth, PONV was assessed only during the first 24 postoperative hours; symptoms occurring after this period, including post-discharge nausea and vomiting, were not captured. Finally, the observational design demonstrates associations but cannot establish causality between individual perioperative exposures and PONV. Larger prospective multicentre studies using standardized outcome definitions and prophylactic protocols would help validate these findings.

In summary, PONV remained a common postoperative complication in the present elective surgical cohort, affecting more than one-quarter of patients. Female sex, previous PONV or motion sickness, postoperative opioid administration, and prolonged anesthesia emerged as the major independent risk factors, while the likelihood of PONV increased progressively with accumulation of established clinical risk factors. Importantly, multimodal antiemetic prophylaxis was associated with a substantial reduction in PONV. These findings support routine preoperative risk stratification, minimization of modifiable emetogenic exposures, opioid-sparing postoperative analgesia when feasible, and risk-adapted multimodal antiemetic prophylaxis to improve postoperative recovery.

CONCLUSION

Postoperative nausea and vomiting remained a common complication among patients undergoing elective surgery, affecting 28.6% of the study population within the first 24 postoperative hours. Female sex, a previous history of PONV or motion sickness, postoperative opioid use, and anesthesia duration exceeding 120 minutes were identified as important independent risk factors. The incidence of PONV increased progressively with the number of simplified Apfel risk factors, supporting the usefulness of structured preoperative risk stratification.

REFERENCES

1. Tan HS, Dewinter G, Habib AS. The next generation of antiemetics for the management of postoperative nausea and vomiting. Best Pract Res Clin Anaesthesiol. 2020;34(4):759-769. doi:10.1016/j.bpa.2020.11.004.
2. Jin Z, Gan TJ, Bergese SD. Prevention and treatment of postoperative nausea and vomiting (PONV): a review of current recommendations and emerging therapies. Ther Clin Risk Manag. 2020;16:1305-1317. doi:10.2147/TCRM.S256234.
3. Gan TJ, Diemunsch P, Habib AS, Kovac A, Kranke P, Meyer TA, et al. Consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg. 2014;118(1):85-113. doi:10.1213/ANE.0000000000000002.
4. Apfel CC, Läärä E, Koivuranta M, Greim CA, Roewer N. A simplified risk score for predicting postoperative nausea and vomiting: conclusions from cross-validations between two centers. Anesthesiology. 1999;91(3):693-700. doi:10.1097/00000542-199909000-00022.
5. Apfel CC, Heidrich FM, Jukar-Rao S, Jalota L, Hornuss C, Whelan RP, et al. Evidence-based analysis of risk factors for postoperative nausea and vomiting. Br J Anaesth. 2012;109(5):742-753. doi:10.1093/bja/aes276.
6. Habib AS, Chen YT, Taguchi A, Hu XH, Gan TJ. Postoperative nausea and vomiting following inpatient surgeries in a teaching hospital: a retrospective database analysis. Curr Med Res Opin. 2006;22(6):1093-1099. doi:10.1185/030079906X104830.

7. Parra-Sanchez I, Abdallah R, You J, Fu AZ, Grady M, Cummings K 3rd, et al. A time-motion economic analysis of postoperative nausea and vomiting in ambulatory surgery. Can J Anaesth. 2012;59(4):366-375. doi:10.1007/s12630-011-9660-x.
8. Myles PS, Williams DL, Hendrata M, Anderson H, Weeks AM. Patient satisfaction after anaesthesia and surgery: results of a prospective survey of 10,811 patients. Br J Anaesth. 2000;84(1):6-10. doi:10.1093/oxfordjournals.bja.a013383.
9. Gan TJ, Belani KG, Bergese S, Chung F, Diemunsch P, Habib AS, et al. Fourth consensus guidelines for the management of postoperative nausea and vomiting. Anesth Analg. 2020;131(2):411-448. doi:10.1213/ANE.0000000000004833.
10. Son J, Yoon H. Factors affecting postoperative nausea and vomiting in surgical patients. J Perianesth Nurs. 2018;33(4):461-470. doi:10.1016/j.jopan.2016.02.012.
11. Choi JB, Shim YH, Lee YW, Lee JS, Choi JR, Chang CH. Incidence and risk factors of postoperative nausea and vomiting in patients with fentanyl-based intravenous patient-controlled analgesia and single antiemetic prophylaxis. Yonsei Med J. 2014;55(5):1430-1435. doi:10.3349/ymj.2014.55.5.1430.
12. Morino R, Ozaki M, Nagata O, Yokota M. Incidence of and risk factors for postoperative nausea and vomiting at a Japanese Cancer Center: first large-scale study in Japan. J Anesth. 2013;27(1):18-24. doi:10.1007/s00540-012-1468-5.
13. Darvall J, Handscombe M, Maat B, So K, Suganthirakumar A, Leslie K. Interpretation of the four risk factors for postoperative nausea and vomiting in the Apfel simplified risk score: an analysis of published studies. Can J Anaesth. 2021;68(7):1057-1063. doi:10.1007/s12630-021-01974-8.
14. Zhang Y, Ma D, Lang B, Zang C, Sun Z, Ren S, et al. Effect of opioid-free anesthesia on the incidence of postoperative nausea and vomiting: a meta-analysis of randomized controlled studies. Medicine (Baltimore). 2023;102(38). doi:10.1097/MD.0000000000035126.
15. Schraag S, Pradelli L, Alsaleh AJO, Bellone M, Ghetti G, Chung TL, et al. Propofol vs inhalational agents to maintain general anaesthesia in ambulatory and in-patient surgery: a systematic review and meta-analysis. BMC Anesthesiol. 2018;18(1):162. doi:10.1186/s12871-018-0632-3.
16. Weibel S, Schaefer MS, Raj D, Rücker G, Pace NL, Schlesinger T, et al. Drugs for preventing postoperative nausea and vomiting in adults after general anaesthesia: an abridged Cochrane network meta-analysis. Anaesthesia. 2021;76(7):962-973. doi:10.1111/anae.15295.
17. Som A, Bhattacharjee S, Maitra S, Arora MK, Baidya DK. Combination of 5-HT3 antagonist and dexamethasone is superior to 5-HT3 antagonist alone for PONV prophylaxis after laparoscopic surgeries: a meta-analysis. Anesth Analg. 2016;123(6):1418-1426. doi:10.1213/ANE.0000000000001617.