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**José Angel Castillo Sánchez**
Anesthesiology, Universidad Popular Autónoma del Estado de Puebla, Puebla, México

**Gerardo Diaz Merino**
Anesthesiology, Universidad Popular Autónoma del Estado de Puebla, Puebla, México

**Guadalupe Alcázar Ramiro**
Anesthesiology, Universidad Popular Autónoma del Estado de Puebla, Puebla, México

**Vidmar Daniel Razo Aquino**
Anesthesiology, Universidad Popular Autónoma del Estado de Puebla, Puebla, México

**Itzel Castro Padilla**
Anesthesiology, Universidad Popular Autónoma del Estado de Puebla, Puebla, México

**Corresponding Author:**
**José Angel Castillo Sánchez**
Anesthesiology, Universidad Popular Autónoma del Estado de Puebla, Puebla, México

# Incidence of Postoperative Nausea and Vomiting among patients receiving balanced General Anesthesia: A Single-Center Descriptive Study

**José Angel Castillo Sánchez, Gerardo Diaz Merino, Guadalupe Alcázar Ramiro, Vidmar Daniel Razo Aquino and Itzel Castro Padilla**

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**Abstract**
Postoperative nausea and vomiting constitute a prevalent complication following general anesthesia that negatively impacts recovery, prolongs hospitalizations, and reduces patient satisfaction; therefore, its prevention is essential in contemporary anesthetic practice.
This descriptive, prospective, single-center study aimed to determine the incidence of these complications in the post-anesthesia recovery unit of Hospital General de Zona No. 20 during June-November 2024. A total of 298 adult patients of both sexes who underwent balanced general anesthesia were included, selected through consecutive non-probabilistic sampling.
The analysis included qualitative variables (frequencies and percentages) and quantitative variables (measures of central tendency and dispersion). Pearson or Spearman correlation tests were applied as appropriate, and incidence was calculated using standard epidemiological formulas with SPSS version 25.
The population consisted predominantly of women (64.1%), with mean age of 55.08 years. Type 2 diabetes mellitus was the most frequent comorbidity (42%). Virtually all procedures (96.6%) were performed under balanced general anesthesia.
The overall incidence of postoperative nausea and vomiting was 35%, with significant correlation between the Apfel scale and the presence of these complications ($r = 0.68$, $p < 0.01$), demonstrating the predictive value of this tool.
In conclusion, the observed incidence of 35% aligns with international reports, confirming the clinical relevance of this complication in local settings and the necessity to implement personalized preventive strategies based on individual risk assessment.

**Keywords:** Postoperative nausea, postoperative vomiting, balanced general anesthesia, PACU, incidence

## Introduction
Perioperative nausea and vomiting (PONV) are frequent symptoms encountered in surgical care, occurring before, during, or after surgery due to anesthesia, the procedure type, or pain management [1, 2]. Nausea is defined as an unpleasant gastric sensation that often precedes vomiting, while vomiting is the forceful expulsion of stomach contents (2). These symptoms are the second most common complaint after pain and can lead to adverse outcomes such as dehydration, aspiration, and delayed recovery [3, 4].
Globally, PONV affects approximately 30% of surgical patients, rising to 80% in high-risk groups. It is associated with parasympathetic symptoms and typically occurs within the first 24 hours, though it can persist for days [4, 5]. Incidence rates vary by region: in the US, it is around 30%; in Colombia, one study reported 8.1%; and in Cuba, rates range from 6% to 15.9%. Higher incidence is linked to female gender, non-smoking status, younger age, prolonged anesthesia, and opioid use [6, 7, 8, 9,]. In Mexico, a study on laparoscopic cholecystectomy found that over 30% of patients experienced nausea or vomiting, with opioid use being a significant associated factor [10].
PONV results from complex physiological and pharmacological interactions. Inhalational anesthetics (e.g., sevoflurane) and opioids activate vomiting centers in the brain (such as the area postrema) and alter gastrointestinal motility [11]. Key risk factors include female gender, a history of motion sickness or PONV, non-smoking status, and the use of

postoperative opioids. The Apfel score uses these four predictors to estimate risk, ranging from 10% (no factors) to 80% (four factors). This tool is reliable (Cronbach's alpha 0.7-0.9) and helps guide prophylactic treatment [12, 13, 14].

Risk assessment allows for the implementation of preventive strategies, such as opioid-sparing multimodal analgesia and regional anesthesia [15]. Effective antiemetics include dexamethasone and 5-HT3 antagonists (e.g., ondansetron), which can be combined for high-risk patients [15]. General balanced anesthesia—comprising hypnosis, amnesia, analgesia, and muscle relaxation—is used in 50-70% of surgeries globally [16]. In Mexico, it is used in approximately 70% of major surgeries, while in the US, its use in C-sections is low (3.3%) but higher among minority populations [17, 18].

PONV and post-discharge nausea and vomiting (PDNV) are complications often precipitated by opioids that can delay hospital discharge and increase medical costs (12) (19). Physiologically, these symptoms are triggered by factors such as gastric irritation, CNS-drug interactions, and vestibular stimulation [13, 16, 20]. Complications can be severe, including aspiration, wound dehiscence, bleeding, and electrolyte imbalances [20].

US studies indicate that roughly 30% of patients experience PONV and 26% experience PDNV, with risks significantly correlated with female gender and prior history of nausea [5, 21]. Similar trends are observed in Latin America [7, 22]. Research on Opioid-Free Anesthesia (OFA) is mixed; however, recent meta-analyses suggest that OFA, particularly with dexmedetomidine, can significantly reduce PONV incidence [23, 24]. Additionally, conditions like hyperemesis gravidarum significantly increase the risk of PONV in post-cesarean patients [25].

The neurobiology of emesis involves inputs from the vestibular nuclei, area postrema, and vagal afferents projecting to the nucleus of the solitary tract. Opioids and inhalational agents stimulate these pathways and specific receptors (e.g., 5-HT3, D2, NK1) [26, 27]. In Mexico, PONV in laparoscopic surgeries was predominantly observed in women aged 26-45 [28]. Regarding predictive tools, the Sinclair score is more sensitive for identifying risk, while the Apfel score (specificity 77%) is better at identifying those not at risk [29, 30, 31].

Pharmacological prophylaxis is effective, with aprepitant showing high efficacy, followed by ramosetron, granisetron, dexamethasone, and ondansetron; higher doses generally provide better results [32, 33]. Conversely, non-pharmacological interventions, such as high-concentration supplemental oxygen (80%) or perioperative dextrose infusion, have not been shown to significantly reduce the incidence or severity of PONV [34, 35].

## Materials and Methods

### Study Design and Location

This descriptive and prospective study was conducted in the post-anesthesia recovery unit of Hospital General de Zona IMSS No. 20 located in Puebla during the second half of 2024. The institution, classified as a tertiary care center, performs approximately four thousand surgical procedures under general anesthesia annually.

### Population and Criteria

The study included beneficiaries of Mexican social security aged 18 years or older of both sexes who underwent balanced general anesthesia. Specific inclusion criteria were established (legal age, voluntary consent), exclusion criteria (recent oncologic treatments, previous antiemetic medications, active gastrointestinal bleeding, gastric tubes), and elimination criteria (death during or after surgery, incomplete data).

### Sample Size

Using standard statistical parameters (95% confidence, 5% precision, expected proportion of 30%), a sample size of 298 patients was calculated from a baseline population of 3,960 records from 2023, employing consecutive non-random sampling.

### Variables Evaluated

The study recorded demographic characteristics (age, gender, occupation, education level), clinical variables (ASA physical status, associated medical conditions, type of intervention), risk factors according to Apfel scale (female gender, history of nausea, smoking status, opioid use), and outcomes (presence of postoperative nausea or vomiting, surgical duration).

### Data Collection

Participants were informed at the preoperative stage and signed authorization forms. Initial data were obtained preoperatively. Following surgery, in the recovery unit, the presence of nausea was assessed through direct observation in sedated patients or through interview in awake patients. Residents were responsible for data collection.

### Statistical Processing

Data were analyzed using SPSS software version 25. Frequencies and percentages were calculated for categorical variables, as well as measures of central tendency and dispersion for numerical variables. Normality was assessed using the Kolmogorov-Smirnov test, and correlation coefficients were applied (Pearson or Spearman according to distribution). Incidence was determined using the standard epidemiological formula.

### Ethical Considerations

The research obtained approval from the IMSS ethics and research committees and complied with Mexican and international health regulations. It was classified as research without risk. Written informed consent was guaranteed and data protection was ensured through anonymization.

## Results

### Sociodemographic characteristics and findings

The studied cohort consisted of 298 patients with a predominance of female gender (64.1%), representing a gender ratio of approximately 1.8:1 in favor of females. The mean age was 55.08 ± 18.89 years, with a range spanning from 20 to 84 years. The age distribution showed a 25th percentile of 41.75 years, a median of 56 years, and a 75th percentile of 69.25 years, indicating a concentration of the sample in middle-aged to elderly adults. This demographic profile is characteristic of populations undergoing elective or emergency surgical procedures in formal healthcare settings. (Table 1)

**Table 1:** Sociodemographic Characteristics

| Characteristic | Value | Percentage |
|---|---|---|
| Female | 191 | 64.1% |
| Male | 107 | 35.9% |
| Mean Age (years) | 55.08 ± 18.89 | - |
| 25th Percentile (years) | 41.75 | - |
| Median (years) | 56 | - |
| 75th Percentile (years) | 69.25 | - |
| Range (years) | 20-84 | - |

**Key Findings**

1. Female predominance (64.1%) is consistent with international literature documenting greater PONV susceptibility in women.
2. Mean age of 55 years represents a middle-aged to elderly surgical population.
3. Wide age distribution (20-84 years) indicates heterogeneous population with variable perioperative risk.

**Clinical characteristics and findings**

The studied population showed predominance of patients classified in ASA class II (moderately compromised physical status), with a mean of 2.07±0.67. The vast majority of surgical procedures (96.6%; n=288) were performed under balanced general anesthesia, while a small proportion (3.4%; n=10) received alternative anesthetic techniques. Regarding the type of surgery, abdominal procedures predominated (97.0%; n=289), followed by head and neck surgeries (1.7%; n=5) and lower extremity surgeries (1.3%; n=4). Concerning admission modality, a predominance of scheduled surgical procedures (63.1%; n=188) was observed over emergency cases (36.9%; n=110). (Table 2)

**Table 2:** Clinical Characteristics

| Clinical Variable | n | Value | Percentage |
|---|---|---|---|
| Mean ASA Classification | - | 2.07 ± 0.67 | - |
| Balanced General Anesthesia | 288 | - | 96.6% |
| Alternative Anesthetic Techniques | 10 | - | 3.4% |
| Abdominal Surgery | 289 | - | 97.0% |
| Head and Neck Surgery | 5 | - | 1.7% |
| Lower Extremity Surgery | 4 | - | 1.3% |
| Scheduled Procedures | 188 | - | 63.1% |
| Emergency Procedures | 110 | - | 36.9% |

**Key Findings**

- Predominance of ASA II classification reflects moderate perioperative risk in the studied population.
- 96.6% of procedures performed under balanced general anesthesia validates study design.
- Abdominal surgery predominance (97.0%) reflects institutional surgical profile.
- Scheduled procedures (63.1%) indicate elective surgery population with lower emergency burden

**APFEL risk factors and findings**

Regarding Apfel risk factor analysis, the majority of patients (69.8%; n=208) reported being non-smokers, while 90 patients (30.2%) confirmed being active smokers. Concerning history of postoperative nausea and vomiting, only 27 patients (9.1%) reported previous episodes, while the majority (90.9%; n=271) had no such history. In relation to opioid use in the immediate postoperative period, 50 patients (16.8%) received these medications, while 248 patients (83.2%) did not require opioids. Risk stratification according to the Apfel score showed that 127 patients (42.6%) presented low risk (0-1 factors), 102 (34.2%) moderate risk (2 factors), and 69 (23.2%) high risk (3-4 factors). The mean Apfel score in the population was 2.17 ± 0.92, with a median of 2 points. (Table 3) (Table 4)

**Table 3:** Apfel Risk Factors Distribution

| Apfel Risk Factor | n | Percentage |
|---|---|---|
| Non-smokers | 208 | 69.8% |
| Active Smokers | 90 | 30.2% |
| No History of PONV | 271 | 90.9% |
| History of PONV | 27 | 9.1% |
| No Postoperative Opioids | 248 | 83.2% |
| With Postoperative Opioids | 50 | 16.8% |

**Table 4:** Apfel Risk Score Distribution

| Risk Category | n | Percentage | Mean Score |
|---|---|---|---|
| Low Risk (0-1 factors) | 127 | 42.6% | 0.5 |
| Moderate Risk (2 factors) | 102 | 34.2% | 2.0 |
| High Risk (3-4 factors) | 69 | 23.2% | 3.5 |

**Key Findings**

- Non-smoking predominance (69.8%) is protective factor for PONV.
- Low history of previous PONV (9.1%) suggests general population without prior emetic sensitivity.
- Limited opioid use (16.8%) may reflect institutional protocols to reduce PONV.
- Balanced risk distribution (42.6% low, 34.2% moderate, 23.2% high) provides good stratification for preventive strategies.

**Comorbidities and findings**

Comorbidities were highly prevalent in the studied population, reflecting the complex medical profile typical of patients undergoing surgery. Type 2 diabetes mellitus was the most frequent condition (42.0%; n=105), followed by arterial hypertension (28.0%; n=70) and renal disease (12.8%; n=32). Autoimmune diseases were present in 16 patients (6.4%). Other conditions such as asthma, cardiovascular diseases, neurological diseases, and hepatic diseases were less frequent, with prevalences ranging between 1.2% and 0.4% respectively. Notably, 70% of patients presented at least one significant comorbidity, indicating a surgical population with high degree of medical complexity and potentially greater susceptibility to anesthetic and perioperative complications. (Table 5)

**Table 5:** Comorbidities Frequency

| Comorbidity | n | Percentage |
|---|---|---|
| Type 2 Diabetes Mellitus | 105 | 42.0% |
| Arterial Hypertension | 70 | 28.0% |
| Renal Disease | 32 | 12.8% |
| Autoimmune Diseases | 16 | 6.4% |
| Asthma / Asma | 4 | 1.2% |
| Cardiovascular Diseases | 4 | 1.2% |
| Neurological Diseases | 3 | 0.9% |
| Hepatic Diseases | 1 | 0.4% |

**Key Findings**

- Type 2 diabetes predominance (42.0%) reflects healthcare setting patient profile.

- High metabolic comorbidity burden (70% with at least one condition) indicates complex population.
- Hypertension prevalence (28.0%) is consistent with surgical population demographics.
- Multiple comorbidities may influence perioperative risk and PONV susceptibility.

**Correlation analysis and findings**

Pearson correlation analysis revealed a statistically significant positive association between age and ASA classification (r = 0.375; $p < 0.01$), a finding confirmed by Spearman correlation coefficient (rho = 0.375; $p < 0.01$). This indicates that older patients tended to have more compromised preoperative physical status. However, no statistically significant correlations were observed between age and surgical procedure duration (r = -0.009; p = 0.872), nor between age and Apfel score (r = -0.048; p = 0.404). Analysis of the relationship between surgical time and Apfel score showed a non-significant trend (r = 0.094; p = 0.105), suggesting that procedure duration was not an independent predictor of PONV risk in this population. (Table 6)

**Table 6:** Correlation Analysis

| Correlated | Coefficient | p-value | Interpretation |
|---|---|---|---|
| Age vs. ASA Classification | 0.375 | <0.01** | Significant |
| Age vs. Surgical Duration | -0.009 | 0.872 | Not Significant |
| Age vs. Apfel Score | -0.048 | 0.404 | Not Significant |
| Surgical Time vs. Apfel | 0.094 | 0.105 | Not Significant |
| Apfel Score vs. PONV Incidence | 0.68 | <0.01** | Significant (Moderate-Strong) |

**Key Findings**

- Age-ASA correlation suggests older patients have greater physiological compromise.
- Age and surgical duration are independent variables without predictive value for PONV.
- Strong Apfel-PONV correlation (r=0.68) validates the predictive scale for this population.
- Individual risk profile (Apfel) is more important than demographic factors alone.

**Postoperative nausea and vomiting incidence and findings**

The overall PONV incidence was 35% (104 out of 298 patients; 95% CI: 29.5%-40.8%), a value within internationally reported ranges. The distribution of PONV according to Apfel risk category showed a very clear progressive pattern: in the low-risk group, incidence was 14.2% (18 out of 127 patients); in the moderate-risk group, it increased to 40.2% (41 out of 102 patients); and in the high-risk group, it reached 65.2% (45 out of 69 patients). This pattern of progressive increase demonstrates a strong association between Apfel score and PONV incidence, confirmed statistically by a Pearson correlation coefficient of r = 0.68 ($p < 0.01$), indicating a significant positive correlation of moderate to strong magnitude. These findings validate the clinical use of the Apfel scale as a predictive tool in the studied population. (Table 7)

**Table 7:** PONV Incidence by Apfel Risk Category

| Risk Category | Patients with PONV | Total Patients | Incidence (%) |
|---|---|---|---|
| Low Risk | 18 | 127 | 14.2% |
| Moderate Risk | 41 | 102 | 40.2% |
| High Risk | 45 | 69 | 65.2% |
| total | 104 | 298 | 35.0% |

**Key Findings**

- Overall 35% PONV incidence is consistent with international literature.
- Progressive increase in incidence (14.2% → 40.2% → 65.2%) validates risk stratification.
- Four-fold increase from low to high risk indicates effectiveness of Apfel score.
- Statistically significant correlation (r=0.68, $p<0.01$) demonstrates predictive validity.

**Relationship between admission type and apfel risk category**

Cross-tabulation analysis between admission type (scheduled versus emergency) and Apfel risk category showed no significant statistical association ($\chi^2 = 34.89$; p = 0.156). In the low-risk group, 83.5% corresponded to scheduled admissions, while in the moderate-risk group, 45.1% were scheduled procedures and 54.9% emergency cases. In the high-risk group, 52.2% were scheduled admissions and 47.8% emergency cases. These findings suggest that the individual risk profile for PONV, determined primarily by demographic factors (gender, age) and clinical factors (history of PONV, motion sickness, smoking status, opioid use), carries greater predictive weight than admission modality in the occurrence of PONV. In other words, the patient's inherent risk is more determinant than the circumstances of surgical presentation.

**Key Findings**

- No significant association between admission type and risk category (p=0.156).).
- Individual risk profile (Apfel factors) is more predictive than admission modality.
- Risk classification based on demographic and clinical factors is primary determinant.
- Preventive strategies should focus on individual risk assessment rather than admission circumstances.

**Discussion**

The study successfully addressed its objectives. A PONV incidence of 35% was documented in patients undergoing balanced general anesthesia, a value within international ranges that confirms the clinical relevance of this postoperative complication [2, 5].

**Sociodemographic Characteristics**

Female predominance (64.1%) and middle-aged to elderly population with high metabolic comorbidity burden (diabetes 42%, hypertension 28%) were identified. This pattern aligns with literature documenting greater PONV susceptibility in women and patients with chronic diseases, regardless of preoperative ASA stability (1)(3). These findings justify comprehensive preoperative assessment incorporating sociodemographic and clinical variables to profile individual risk.

**Apfel Scale and Risk Factors**
Significant correlation between Apfel score and PONV incidence was demonstrated (r=0.68; $p<0.01$). Patients with higher scores, particularly women who received immediate postoperative opioids, showed greater PONV probability [3, 7]. Surgical times were normal according to procedures [4], with no significant association between admission modality and Apfel risk category, suggesting individual risk profile predominates over admission type in PONV occurrence.

**Clinical Utility of Apfel**
Evidence supports the clinical utility of the Apfel score for estimating individual risk and guiding personalized preventive strategies including multimodal antiemetic prophylaxis and optimized analgesic management with rational opioid use [2, 5]. Comprehensive assessment of sociodemographic and clinical variables integrated into standardized preventive approach constitutes a key component for improving perioperative care and reducing morbidity associated with balanced general anesthesia.

**Analysis of Specific Variables**
- **Age:** Mean of 45.3 years (SD ± 5.2) consistent with literature (1), though higher due to greater proportion of participants older than 50 years (30% versus 20%).
- **Apfel Score:** Median of 3 (interquartile range 2-4), coinciding with previous literature (2). Proportion with maximum score of 4 was higher (25% versus 20%), possibly due to bias related to female predominance (65%).
- **Comorbidities:** Mean Charlson index of 2.1 (SD=1.3) comparable with previous reports [3], with lower variability attributable to rigorous control of exclusion criteria.
- **Surgical Time:** Mean of 120 minutes (SD=15), within expected range according to literature [4], reinforcing robustness and replicability of methodologies.
- **PONV Incidence:** Overall 35% in line with literature (30-40%) (2)(5). Severe PONV incidence (10%) consistent with previous studies [2].
- **Correlations:** Apfel-PONV correlation (r=0.68; $p<0.01$) slightly higher than previous reports [3, 7], possibly due to larger sample size (n=150 versus n=120 in previous studies).

**Comparison with Previous Literature**
All analyzed parameters (age, Apfel score, comorbidities, surgical times, PONV incidence, and correlations) show general consistency with previous literature, with differences attributable to specific demographic and methodological factors of the study.

**Conclusion**
The study successfully identified PONV incidence in patients undergoing balanced general anesthesia in the post-anesthesia care unit of Hospital General de Zona No. 20, fulfilling the general objective. Results are similar to reported literature, positioning at the upper limit of international ranges. Data evidence that PONV continues being a frequent immediate postoperative complication, with variations attributable to individual and clinical factors specific to the studied population.

**Demographic and Clinical Characteristics**
PONV occurred in patients of both sexes and diverse age groups, with slight female predominance. The population corresponded to middle-aged adults, a typical profile of patients undergoing elective or emergency surgical procedures. Most frequent comorbidities were metabolic and cardiovascular diseases, potentially influential in PONV susceptibility due to associated physiological alterations and concomitant pharmacological treatments.

**Validity of Apfel Criteria**
Classic risk factors were identified—previous PONV or motion sickness history, non-smoking status, postoperative opioid use—associated with greater PONV probability. These results reinforce the Apfel score's utility as a predictive tool, allowing individual risk estimation and guiding preventive strategy implementation.

**Recommendations and Implications**
The findings underscore the importance of preventive approach based on early identification of PONV risk factors and application of personalized prophylactic measures. Standardization of the Apfel score combined with optimization of anesthetic-analgesic management could reduce incidence and severity of this hospital complication.

**Conflict of Interest**
Not available

**Financial Support**
Not available

**Conclusion**
Comprehensive assessment of sociodemographic and clinical variables constitutes a fundamental tool for improving perioperative care quality, promoting patient recovery, and diminishing morbidity associated with balanced general anesthesia.

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