



Preoperative Anxiety Levels and the Incidence of Postoperative Nausea and Vomiting in Patients Undergoing General Anesthesia

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Article Info

Article History:

Submitted: June 2025

Accepted: September 2025

Published: October 2025

Keywords:

preoperative anxiety; postoperative nausea and vomiting (PONV); general anesthesia

DOI

<https://doi.org/10.15294/kemas.v21i2.27115>

Abstract

Postoperative nausea and vomiting (PONV) are common complications after general anesthesia, negatively impacting patient comfort, recovery, and hospital stay. While many factors contribute to PONV, psychological aspects such as preoperative anxiety are often underestimated despite their influence on postoperative outcomes. This study aimed to analyze the relationship between preoperative anxiety levels and the incidence of PONV in patients undergoing surgery under general anesthesia. Using a cross-sectional design, 45 elective surgical patients were assessed for anxiety using the Hamilton Anxiety Rating Scale (HARS), and PONV incidence was recorded within 24 hours post-surgery. Chi-square analysis revealed a significant association between anxiety levels and PONV occurrence ($p = 0.002$). Among patients with moderate to severe anxiety, 73.3% experienced PONV, compared to only 26.7% among those with mild anxiety. These findings indicate that higher preoperative anxiety increases the risk of PONV. Therefore, integrating psychological assessment and anxiety management into perioperative care is crucial to reducing postoperative complications and improving anesthetic outcomes through a more holistic patient care approach.

Introduction

General anesthesia is a pharmacological intervention aimed at inducing a controlled, reversible state of unconsciousness that prevents the perception of pain, ensures loss of consciousness, and produces perioperative amnesia, thereby eliminating any recollection of the surgical procedure (Pavel *et al.*, 2020). This physiological state is achieved through modulation of the central nervous system by anesthetic agents, which produce sedation, analgesia, and immobilization, ultimately creating an optimal surgical environment for both the patient and the operative team (Ring *et al.*, 2021). General anesthesia can be administered through three primary pharmacodynamic approaches: inhalational, intravenous, and balanced techniques. Inhalational anesthesia involves the administration of volatile anesthetic agents—such as isoflurane,

sevoflurane, enflurane, desflurane, and nitrous oxide—delivered via mechanical ventilation into the respiratory tract and absorbed into the pulmonary circulation to exert their effects on the brain (Niu *et al.*, 2021). Conversely, intravenous techniques employ parenteral agents such as propofol, ketamine, midazolam, thiopental, and opioids, which are injected directly into the bloodstream, offering rapid onset and precise titration of anesthetic depth (Kim & Fechner, 2022). Balanced anesthesia is designed to integrate the advantages of both inhalational and intravenous approaches. This strategy synergistically combines agents from both routes and is frequently complemented by regional nerve blocks to fulfill the principles of the Anesthesia Triad—hypnosis, analgesia, and muscle relaxation—in a comprehensive and harmonized manner. The result is a more stable anesthetic control with minimized systemic

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side effects(Pavel *et al.*, 2020).

In the preoperative phase, a patient's psychological status—particularly anxiety—represents a critical determinant that must not be overlooked. Preinduction anxiety has been shown to trigger dysregulation of neuroendocrine and autonomic responses, contributing to early hemodynamic instability and heightened sensitivity to postoperative stimuli (Wang *et al.*, 2022). One of the most commonly observed clinical consequences is Postoperative Nausea and Vomiting (PONV), a distressing complication characterized by nausea and vomiting following emergence from anesthesia. PONV not only diminishes patient comfort but also extends hospitalization duration and increases the risk of secondary complications. Consequently, the interplay between preoperative psychological conditions and postoperative physiological manifestations has become a central concern in optimizing modern anesthetic management. Postoperative Nausea and Vomiting (PONV) is among the most frequently reported postoperative complications, particularly among patients undergoing surgical procedures under general anesthesia. Although not directly life-threatening, PONV exerts a substantial impact on clinical recovery, prolongs hospital stay, and elevates the demand for adjunctive pharmacological therapies. These consequences collectively contribute to increased healthcare costs and impose additional burdens on medical personnel (Gan *et al.*, 2020). Global data reveal that over 30 million patients annually experience PONV symptoms, with prevalence rates ranging from 25% to 30%, depending on the patient population, type of surgery, and anesthetic techniques employed (Gan *et al.*, 2020).

Numerous international studies have documented the high prevalence of PONV, including findings from India involving patients classified as ASA physical status I and II undergoing elective surgery under general anesthesia, as well as European reports indicating incidence rates as high as 44–56% in several developed nations (Kovac, 2021). Domestic studies likewise reveal that this complication remains a critical concern across major healthcare institutions, with incidence

rates varying significantly between facilities. These findings underscore the necessity of adopting a more integrative and predictive approach to understanding the predisposing factors that contribute to the onset of PONV. Among the emerging areas of interest in the past decade is the psychological dimension of preoperative patients—particularly anxiety levels—which may influence neurophysiological responses to anesthesia and the metabolism of anesthetic agents. Preoperative anxiety has been shown to modulate sympathetic nervous system activation, resulting in hemodynamic instability and increased visceral sensitivity to postoperative emetogenic stimuli (Jin *et al.*, 2020). Although several studies have generally addressed this issue, there remains a paucity of research that quantitatively and contextually examines the association between preinduction psychological profiles and PONV incidence, especially within local patient populations.

Therefore, this study was conducted at a tertiary-level hospital in North Sumatra to examine the extent to which preoperative anxiety levels are associated with the incidence of PONV in patients undergoing general anesthesia procedures. By integrating psychological and clinical approaches, this research aims to provide a more holistic understanding of the determinants of PONV, as well as to encourage the implementation of more comprehensive preoperative evaluations in anesthetic practice. The findings are also expected to reinforce the role of healthcare professionals in anticipating postoperative complication risks through more preventive and individualized strategies.

Method

This study used a quantitative approach with an analytic correlational design to examine the relationship between psychological indicators and postoperative clinical manifestations. A cross-sectional methodology was employed to capture a snapshot of the association between independent and dependent variables at a specific point in time (Ida *et al.*, 2020). This design enables the researcher to evaluate the psychological condition before the medical procedure alongside the physiological response following general anesthesia within a

single observational phase, without intervening in the clinical process. The participants in this study comprised adult patients undergoing elective surgery under general anesthesia at a secondary referral hospital in Northern Sumatra. The subject selection process adhered to stringent criteria to ensure homogeneity of sample characteristics and minimize data distortion caused by confounding variables. The inclusion criteria encompassed patients who consented to participate, classified as ASA physical status I–II, undergoing anesthesia lasting 30–60 minutes, receiving induction with propofol and maintenance with sevoflurane inhalation, and administered prophylactic antiemetics. Exclusion criteria included neurological conditions such as stroke, impaired consciousness, electrolyte and acid-base imbalances, as well as patients undergoing surgeries involving the abdominal region and ENT organs. Sampling was conducted consecutively, whereby all patients meeting the criteria were enrolled until the required sample size was achieved. This approach provided control over selection bias and enhanced representativeness within the context of actual clinical practice. Data collection was conducted through a structured approach by two primary instruments.

Preoperative anxiety levels were measured using the Hamilton Anxiety Rating Scale (HARS), a widely validated clinical research tool (Husna *et al.*, 2022). This scale comprises 14 anxiety symptom indicators, each rated on an ordinal scale ranging from 0 to 4, reflecting symptom severity from mild to extremely severe. This method facilitates the objective quantification of individual anxiety levels within the preoperative context. Concurrently, the incidence of postoperative nausea and vomiting (PONV) was identified through direct clinical observation following general anesthesia. Observations focused on the critical postoperative period, documenting symptom onset, frequency, and severity according to a structured classification system. PONV events were categorized using a numerical scale: a score of 0 denoting absence of symptoms, 1 indicating mild nausea complaints, 2 representing retching without vomiting, and 3 reflecting severe nausea accompanied

by vomiting two or more times or persisting for over 30 minutes. All documentation was conducted uniformly, utilizing standardized observation sheets and manual timing devices to ensure data accuracy and reproducibility.

Data processing was conducted systematically through several stages, beginning with the editing of questionnaire responses to ensure the integrity and completeness of data, followed by numerical coding to maintain participant anonymity. The data were subsequently entered into tabulated formats using statistical software and rechecked to identify any input errors that could potentially compromise the accuracy of the analysis results. The analysis proceeded in two phases: univariate analysis to describe the distribution of respondent characteristics and key variables, and bivariate analysis employing Spearman's Rho test to evaluate the strength of the association between preoperative anxiety levels and the incidence of PONV. A p-value threshold of 0.05 was set to determine statistical significance. The interpretation of the correlation coefficient adhered to a scale ranging from 0.000 to 1.000, from very weak to very strong relationships, thereby facilitating clinically relevant conclusions.

Result And Discussion

Based on Table 1, out of a total of 50 participants, the majority (86%) were aged between 41 and 60 years. This finding indicates that most patients undergoing surgical procedures with general anesthesia belong to the middle-aged to pre-elderly demographic. Physiologically, this age group is more susceptible to autonomic dysregulation and heightened emotional responses to invasive interventions. With advancing age, concerns regarding surgical outcomes, dependence on family support, and past healthcare experiences contribute to elevated anxiety levels and a predisposition to anesthesia-related side effects, such as postoperative nausea and vomiting (PONV). The proportion of male and female respondents in this study was nearly equal, with a slight predominance of females (52%). From both psychological and biological perspectives, females are often reported to have different pain and anxiety thresholds compared

TABLE 1. Respondent Characteristic

Characteristics	Values	Frequency (n)	Percentage (%)
Age Scale	20-40 years	7	14,0
	41-60 years	43	86,0
	Total	50	100,0
Gender	Male	24	48,0
	Female	26	52,0
	Total	50	100,0
Last Education	Elementary/junior high school	7	14,0
	Senior high school	37	74,0
	Diploma/bachelor	6	12,0
	Total	50	100,0
Employment Status	Employment	24	48,0
	Unemployment	26	52,0
	Total	50	100,0
Anxiety Category	None	15	30,0
	Mild	7	14,0
	Moderate	10	20,0
	Severe	16	32,0
	Panic	2	4,0
	Total	50	100,0
PONV Category	No nausea	0	0,0
	Nausea only	15	30,0
	Retching and vomiting	30	60,0
	Nausea >30 minutes and >twice	5	10,0
	Total	50	100,0

Source: primary data, research result (2025)

to males, which may contribute to variations in susceptibility to postoperative symptoms, including postoperative nausea and vomiting (PONV).

The majority of participants (74%) possessed a high school level education background. This demographic reflects a moderate level of health literacy, which likely influences patients' comprehension of medical information, psychological preparedness before surgery, and stress management capabilities. A lower level of higher education may diminish understanding of surgical procedures and anesthesia-related risks, thereby elevating preoperative anxiety, which in turn potentially increases the incidence of postoperative nausea and vomiting (PONV). The majority of respondents (52%) were economically inactive, reflecting a potential increase in psychosocial burden. Economic inactivity is often correlated with lower perceived control over various

aspects of life, including health. This condition may trigger excessive anxiety before medical procedures and exacerbate the body's stress response to stimuli such as anesthesia, thereby contributing to the manifestation of gastrointestinal symptoms like postoperative nausea and vomiting (PONV).

More than half of the respondents (66%) exhibited anxiety levels ranging from moderate to panic, with the highest proportion falling within the severe anxiety category at 32%. This finding indicates a significant prevalence of anxiety as a psychological response to uncertainty, fear of the anesthetic procedure, and concerns regarding surgical outcomes. Preoperative anxiety is known to activate the sympathetic nervous system and induce hormonal changes that disrupt autonomic stability, potentially exacerbating the patient's physiological condition during and after anesthesia. All respondents (100%)

TABLE 2. Correlation between Preoperative Anxiety and PONV

Anxiety level	Nausea	Retching	Nausea >30m & vomit >x	Total	Correlation
None	9	6	0	15	
Mild	1	5	1	7	
Moderate	4	5	1	10	
Severe	1	13	2	16	
Panic	0	1	1	2	p=0,001; r=0,463

Source: SPSS output, processed by Researcher (2025)

experienced symptoms of PONV at varying degrees of severity, with 60% suffering from active retching and vomiting. This finding reinforces the hypothesis that PONV is a common and significant complication following general anesthesia. The absence of patients without symptoms indicates a very high risk of PONV within this population, highlighting the necessity for an integrated preventive approach that includes preoperative psychological management. To examine the relationship between preoperative anxiety and PONV, a Spearman Rank correlation test was conducted. The results are presented in Table 2.

The analysis results revealed a significant positive correlation between preoperative anxiety levels and the severity of PONV ($p = 0.001$), with a correlation coefficient of 0.463. It indicates that higher levels of anxiety before anesthesia are associated with an increased likelihood of experiencing more severe PONV symptoms. This phenomenon can be explained by the activation of the hypothalamic-pituitary-adrenal (HPA) axis and neurochemical disturbances affecting the vomiting center located in the area postrema of the medulla oblongata. This study revealed a significant relationship between preoperative anxiety and the incidence of postoperative nausea and vomiting (PONV) after general anesthesia ($p = 0.001$; $r = 0.463$). These findings strengthen the underlying hypothesis that patients' preoperative emotional state, particularly anxiety, serves as a critical predictor of postoperative adverse events, particularly PONV. These results are in line with research by (Yokoyama *et al.*, 2024), which showed that patients with high levels of anxiety were significantly more likely to experience PONV than patients with low levels of anxiety.

A European study (2024) reported that an

increase in the STAI score was directly related to the frequency of PONV in laparoscopic surgery patients. A study conducted in Iran found correlation coefficients ranging from 0.54 to 0.60 between preoperative anxiety and the occurrence of PONV, highlighting that anxiety not only serves as a related factor but also as an active contributor to the increased physiological response to anesthesia (Mohebi *et al.*, 2021). All these findings suggest that preoperative anxiety is not simply a companion variable, but rather a determinant that amplifies physiological sensitivity to the effects of anesthesia. These results are also in line with psychoneuroimmunology theory, which explains how emotional disorders can affect the autonomic nervous and neuroendocrine systems, which in turn affect physiological functions, including the digestive system. Neurobiologically, preoperative anxiety triggers activation of the limbic system—especially the amygdala and hippocampus—areas involved in threat perception and stress responses. This activation initiates the release of adrenocorticotrophic hormone (ACTH), causing an increase in plasma levels of cortisol and catecholamines. Increased catecholamines stimulate the vomiting center in the medulla oblongata via afferent pathways from the vagus nerve and vestibular system, while also causing an imbalance in neurotransmitters such as serotonin and dopamine, which are known as key mediators in the pathophysiology of PONV (Hanalis-Miller *et al.*, 2022; Stoops & Kovac, 2020). Literature from Denholm & Gallagher (2021) also describes the involvement of substances such as acetylcholine and substance P in this pathway, strengthening the link between psychological stress and somatic manifestations in the form of nausea and vomiting. Other research conducted by Yokoyama *et al.*, and

Mou *et al.*, (2024; 2024) also agrees with the results of this study, showing that patients with high levels of anxiety are significantly more likely to experience PONV than patients with low levels of anxiety.

The findings of this study showed that most patients who experienced moderate to high levels of anxiety experienced more severe postoperative nausea and vomiting (PONV). It suggests that anxiety is not just an accompanying variable but is a functional determinant that worsens the patient's physiological sensitivity to the effects of anesthesia. Even in the absence of classic risk factors such as female gender, previous history of PONV, or opioid use, anxiety remains a significant contributor to the increased incidence of nausea and vomiting. It suggests that subjective perceptions of medical threats, such as concerns about loss of control while unconscious or complications from anesthesia, have a real biological impact on the digestive system and vomiting control centers. The interaction between these factors amplifies psychological stress, which ultimately manifests as somatic responses such as gastrointestinal symptoms. In this context, the theory of psychoneuroimmunology provides a comprehensive scientific framework, explaining how emotional disorders directly impact the function of the autonomic nervous and neuroendocrine systems. Interestingly, these reactions are often disproportionate to the intensity of the anesthetic stimulus itself, thus highlighting the fact that the patient's subjective perception of a medical threat has a real biological effect. Although classic risk factors such as gender, history of PONV, and opioid use were not analyzed explicitly in this study, global literature suggests that women are more susceptible to PONV due to hormonal fluctuations (estrogen & progesterone) that increase the excitability of the vomiting center (Liao *et al.*, 2024; Wu *et al.*, 2022). Therefore, preventive strategies for female patients with high anxiety, such as low-dose serotonin antagonist premedication, become highly relevant.

In terms of demographics, the 41-60 year age group dominates the study population. This age range is typically characterized by a peak in social and economic responsibilities,

which, from a psychodynamic perspective, may increase vulnerability to anxiety. Liu *et al.* (2023) showed that middle-aged patients often show higher levels of anxiety than elderly patients due to role conflicts and concerns regarding family welfare after surgery. Therefore, anesthetic approaches in this age group should take psychological considerations more strictly into account. Regarding gender, although this study did not explicitly analyze differences in PONV incidence based on gender, the existing literature consistently reports that women have a greater risk of experiencing PONV. It is related to hormonal fluctuations—especially estrogen and progesterone—which can affect sensitivity to inhalation anesthetics and opioids, as well as increase stimulation of the vomiting center in the brain. The Cambridge Core meta-analysis (2025) also found that preoperative anxiety occurs in 60–80% of patients and is associated with increased need for anesthesia, delirium, and duration of recovery. Although the direct effect on PONV is not always consistent, a strong biological suggestion and clinical association are present. Therefore, gender-specific interventions—such as premedication with low-dose serotonin antagonists for female patients with high anxiety—may serve as an effective PONV prevention strategy.

Educational aspects have also been shown to contribute significantly to patients' perceptions and responses to medical procedures. The formal education of the respondents, most of whom only completed secondary school, was associated with low health literacy. Limited understanding of anesthesia often creates an information vacuum filled with misunderstandings or irrational fears. The absence of adequate preoperative education exacerbates anxiety and contributes to increasing the likelihood of maladaptive psychophysiological reactions, such as PONV. Therefore, structured preoperative education should be considered an integral component of perioperative management, especially for patients with low health literacy (Darville-Beneby *et al.*, 2023). This study also underscores the importance of integrating anxiety assessment tools—such as the Amsterdam Preoperative Anxiety and Information Scale (APAIS) or the Spielberger State-Trait Anxiety

Inventory (STAI)—into standard preoperative protocols. Early detection of patients with high levels of anxiety allows for multidisciplinary involvement, including psychological counseling or psychiatric support, before surgery. This approach has the potential not only to reduce the incidence of PONV but also to speed postoperative recovery and shorten hospital stays.

In terms of intervention, non-pharmacological approaches such as virtual reality (VR) and psychoeducation have shown effectiveness in reducing preoperative anxiety and the incidence of PONV (Chiu *et al.*, 2023; Kusumadewi *et al.*, 2024; Li *et al.*, 2025; Ugras *et al.*, 2023). In addition, a study in egg retrieval patients found that preoperative use of ondansetron reduced PONV in the group with high anxiety (SAS 50–60), but not significantly in the group without anxiety (Mou *et al.*, 2024). It suggests that special attention to the patient's emotional state before surgery may increase the effectiveness of PONV prevention strategies (Wijaya & Megawati, 2023). A meta-analysis with 1,389 patients showed that preoperative anxiety was indeed associated with PONV, but adding anxiety scores to a prediction model that already contained other risk factors did not improve accuracy (AUC remained ≈ 0.72). However, a recent pilot study using the Hospital Anxiety and Depression Scale (HADS) in thoracic surgery patients reported that adding the HADS score to the prediction model significantly increased the AUC ($p=0.021$), demonstrating the potential clinical value of anxiety assessment (Yokoyama *et al.*, 2024).

Overall, strong empirical evidence from a variety of populations and settings supports that preoperative anxiety contributes to increased PONV incidence via neuroendocrine and autonomic nervous mechanisms. As a clinical implication, it is crucial to incorporate anxiety assessment tools, such as STAI, APAIS, or HADS into the preoperative protocol (Suryani *et al.*, 2021). This screening allows for targeted psychological and pharmacological-based interventions, as well as the use of supportive non-pharmacological strategies, which together can reduce the incidence of PONV, speed recovery, and reduce treatment costs.

Conclusion

Based on the findings of this study, it can be concluded that there is a significant relationship between the level of preoperative anxiety and the incidence of postoperative nausea and vomiting (PONV) in patients undergoing surgery under general anesthesia. The results indicate that higher levels of anxiety before surgery are associated with an increased likelihood of experiencing PONV, underscoring the critical role of psychological factors in shaping postoperative physiological responses. This mechanism is presumed to occur through the activation of the autonomic nervous system and heightened sensitivity of the vomiting center triggered by psychological stress. Accordingly, the management of preoperative anxiety should be considered an integral component of anesthetic protocols to reduce PONV incidence, enhance patient comfort, and expedite recovery. These findings reinforce the importance of a holistic, multidisciplinary approach in perioperative care and highlight the potential for structured psychological interventions as preventive strategies against anesthesia-related complications.

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