Jurnal Kesehatan dr. Soebandi
ISSN : 2302-7932 (Print)
ISSN : 2527-7529 (OnLine)

Association Between the Use of Sevoflurane Inhalation Anesthesia and The Incidence of Postoperative Nausea and Vomiting Patients with General Anesthesia

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Submited : 11th February 2025 ; Accepted : 21th October 2025
Doi :https://doi.org/10.36858/jkds.v13i2.851

ABSTRACT

Postoperative nausea and vomiting (PONV) or post-operative nausea and vomiting is a side effect that often occurs after anesthesia, occurring in the first 24 hours after surgery and occurs in 30% and reaches 80% in the high-risk group. Many factors cause PONV, including patient age, gender, smoking history, and history of motion sickness; from anesthesia, namely the use of opioids, volatile anesthetic agents such as sevoflurane and from surgery, namely the duration of surgery and type of surgery. The aim of this study was to determine the relationship between the use of sevoflurane inhalation anesthesia and the incidence of post-operative nausea and vomiting in post-general anesthesia patients at Karangasem District Hospital. This research methodology uses quantitative research with this type of research being correlative analytical research with a cross-sectional research design. The output of this research is that anesthetists can think critically about the risk of complications from using sevoflurane inhalation anesthesia in patients with general anesthesia, including post-operative nausea and vomiting, which is a problem in anesthesia nursing care so that it can be overcome. The results of this study showed that the majority of respondents with sevoflurane inhalation anesthesia duration > 30 minutes were 46 (59.7%), and the majority of respondents experienced PONV incidents, namely 41 (53.2%). Chi-Square Test Results (p) 0.000 where the value (p) is smaller than 0.05 so it can be interpreted that there is a relationship between the use of sevoflurane inhalation anesthesia and the incidence of Post Operative Nausea and Vomiting (PONV) in patients after general anesthesia at Karangasem District Hospital. This study shows that there is a relationship between the use of sevoflurane inhalation anesthesia and the incidence of Post Operative Nausea and Vomiting (PONV) in patients after general anesthesia at Karangasem District Hospital.

Keyword: Anestesi Inhalation, Sevofluran, PONV

ABSTRAK

Mual dan muntah pascaoperasi (Postoperative Nausea and Vomiting/PONV) merupakan salah satu komplikasi yang paling sering terjadi setelah anestesi. Kondisi ini biasanya muncul dalam 24 jam pertama pascaoperasi dan dapat dialami oleh sekitar 30% pasien, bahkan mencapai hingga 80% pada kelompok berisiko tinggi. Beragam faktor dapat memengaruhi terjadinya PONV, meliputi faktor pasien (usia, jenis kelamin, riwayat merokok, dan riwayat mabuk perjalanan), faktor anestesi (penggunaan opioid dan agen anestesi volatil seperti sevoflurane), serta faktor pembedahan (jenis dan durasi operasi). Penelitian ini bertujuan untuk mengetahui hubungan antara penggunaan anestesi inhalasi sevoflurane dengan kejadian PONV pada pasien pasca anestesi umum di RSUD Karangasem. Penelitian ini merupakan penelitian kuantitatif dengan desain analitik korelasional dan pendekatan potong lintang (cross-sectional). Populasi penelitian adalah pasien yang menjalani anestesi umum menggunakan sevoflurane di RSUD Karangasem. Data dianalisis menggunakan uji Chi-Square untuk mengetahui hubungan antara variabel penggunaan anestesi inhalasi sevoflurane dengan kejadian PONV. Hasil penelitian menunjukkan bahwa sebagian besar responden menjalani anestesi inhalasi sevoflurane dengan durasi lebih dari 30 menit sebanyak 46 orang (59,7%), dan mayoritas responden mengalami kejadian PONV sebanyak 41 orang (53,2%). Hasil uji Chi-Square menunjukkan nilai p = 0,000 (< 0,05), yang berarti terdapat hubungan yang signifikan antara penggunaan anestesi inhalasi sevoflurane dengan kejadian mual dan muntah pascaoperasi (PONV) pada pasien pasca anestesi umum di RSUD Karangasem. Terdapat hubungan yang bermakna antara penggunaan anestesi inhalasi sevoflurane dengan kejadian mual dan muntah pascaoperasi (PONV) pada pasien yang menjalani anestesi umum di RSUD Karangasem. Hasil penelitian ini diharapkan dapat menjadi bahan pertimbangan bagi perawat anestesi dalam melakukan asuhan keperawatan perioperatif untuk meminimalkan risiko terjadinya PONV.

Kata Kunci: *Anestesi Inhalasi, Sevofluran, PONV*

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How to Cite : Ileatan Lewar, E., Yustina Ni Putu, Y., Sudiana, I. ketut, I Gusti Ayu Nandita Arta Putri, Shuarsedana Putra, I. G. A., & Juniawan, P. D. Association Between the Use of Sevoflurane Inhalation Anesthesia and The Incidence of Postoperative Nausea and Vomiting Patients with General Anesthesia. *Jurnal Kesehatan Dr. Soebandi*, *13*(2). https://doi.org/10.36858/jkds.v13i2.851

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Introduction:

Post-operative nausea and vomiting is a side effect that often occurs after anesthesia, occurring in the first 24 hours after surgery and occurs in 30% and reaches 80% in the high-risk group (ScienceDirect_articles_21Oct2025_02-49-39 n.d.). Research from Italy, study was conducted on 198 patients, and 97 people experienced PONV using general anesthesia. A study was also conducted in Bangkok; Thailand related to PONV and obtained the results that as many as 390 patients who were given general anesthesia experienced (Domene et al. 2025) (Firdaus, Britta, and Setiani 2020)

PONV most often causes discomfort to patients after undergoing anesthesia. In addition, it can also cause aspiration, open wounds, *esophageal rupture*, dehydration and can lead to an extension of the monitoring period in *the post-anesthesia care* (PACU) and increase the incidence of unexpected rehospitalizations thereby increasing medical costs (Apfel et al. 2012)

Many factors that cause the occurrence of PONV include the patient's age, gender, smoking history, and history of motion sickness; from anesthesia, namely the use of opioids, *volatile agents* of anesthesia, and from surgery, which includes the length of surgery and the type of surgery (Shaikh et al. 2016). Sevoflurane is one of the *volatile* anesthetic agents used for the induction and maintenance of anesthesia that can cause (Ramos, Bullard, and Barnum 2008)

The incidence of PONV includes nausea and vomiting reflexes occurring due to the coordination of many sensory pathways and receptors in the periphery and in the central nervous system. The sensory impulse is transmitted by the afferent nerve to the center of vomiting is *the Central Vomiting Center* (CVC). It is further integrated and transmitted to motor and autonomic pathways to trigger nausea and vomiting (Pierre and Whelan 2013) This Research is in line with the research of Horn, et al., (2013) Clinical research indicates that postoperative nausea and vomiting (PONV) is primarily caused by the use of inhaled anesthetics and opioid analgesics. The risk of PONV is also increased by several risk predictors, including young age, female gender, non-smoking, and a history of motion sickness. Genetic studies are beginning to explain differences in patient experiences with PONV by assessing gene polymorphisms in targets known to play a role in the gag reflex, such as the serotonin type 3 (5-HT3) receptor, opioid receptors, muscarinic receptors, and dopamine type 2 (D2) receptor, as well as genes that influence the metabolism of antiemetic drugs (e.g., ondansetron)(Chatterjee, Rudra, and Sengupta 2011; Pierre and Whelan 2013; Shaikh et al. 2016).

The central nervous system located in the brainstem region, there are structures that are considered to be the coordination center of the vomiting, namely *the chemoreceptor trigger zone* (CTZ), *the central vomiting center* (CVC) and the nucleus tract solitarius. The three structures are located in the brainstem region (Firdaus et al. 2020; Juliana, Irawan, and Hamidy 2013) The excites of the vomiting reflex come from the gastrointestinal, vestibule-ocular, higher cortical afferent that leads to the CVC, then begins symptoms of nausea, retching, and vomiting (Pierre and Whelan 2013; Shaikh et al. 2016)

Based on the above data description, the administration of general anesthesia to patients can result in the occurrence of PONV. Although it almost always goes away on its own, this postoperative incidence of nausea and vomiting can cause discomfort to the patient. Therefore, researchers are interested in conducting research on the use of sevoflurane inhalation anesthesia with the incidence of *post-operative nausea and vomiting* in patients after general anesthesia. The aim of this study was to determine the relationship between sevoflurane inhalation anesthesia and the incidence of postoperative nausea and vomiting in patients with general anesthesia.

Methods:

Research method in this study is observational analysis with *consecutive sampling* using *a cross-sectional approach*. The sample in this study was patients who underwent general anesthesia using sevoflurane inhalation anesthesia at Karangasem Hospital as many as 77 respondents, where the determination of the

Jurnal Kesehatan dr. Soebandi
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ISSN : 2527-7529 (OnLine

sample size was using the Slovin sample calculation formula.

The inclusion and exclusion criteria in this panelist are as inclusion criteria: patients who are willing to be respondents, patients who are treated with general anesthesia of sevoflurane inhalation, age of children to the elderly, physical status classifications of ASA (American Society of Anesthesiologists) I-II. and exclusion criteria: post-general anesthesia patients with indications for ICU admission.

The research was carried out at Karangasem Hospital for 4 months, from May 1, 2023 to August 31, 2023 in the Central Surgical Installation room. The data collection instrument used is a pre-anesthesia observation sheet from Karangasem Hospital which has been used by all officers in observing the incidence of PONV in patients in the operating room. The researcher made observations on the incidence of PONV in patients who were treated under general anesthesia with general inhalation anesthesia.

Data analysis in this study was carried out using univariate and bivariate. Univariate was carried out by identifying the characteristics of respondents in the form of age, gender and anesthesia used. The Bivariate test is to see the relationship between the incidence of PONV using the rho sperm statistical test because the data is not distributed normally.

This research has received ethical qualifications from the ITEKES Bali ethics commission with ethical number: 04.0364/KEPITEKES-BALI/VII/2023 and a research permit from Karangasem Hospital.

Results :

This section will present: demographic data of respondents, analysis of PONV events with sevoflurane inhalation administration within 30 minutes, and the relationship between sevoflurane inhalation administration events in patients with PONV.

Table 1. Respondent Demographic Data (n= 77)

Respondent Data	n	f (%)
Gender		
Man	40	60
Woman	37	40
Age Group		
25-35 years old	30	40
35-45 years old	10	13
45-55 years old	12	16
55-65 years old	10	13
>65 years old	15	18
ASA (American Society of Anesthesiologists)		
ASA 1	35	45
ASA 2	42	55
Anesthesia used		
Inhalation of sevoflurane	77	100

Table 1, data shows that the majority of respondents were male 40 (60%), with the majority aged 25-35 years (40%), the majority ASA 2 as many as 42 (55%) and using general anesthesia with inhalation as many as 77 (100%).

Table 2 Analysis of Sevoflurane Inhalation with PONV (n=77)

	PONV Incidence		Jumlah
	PONV (Not Occur	PONV (Occured)	
≤ 30 minutes	28	3	31
>30 minutes	8	38	46
Total	36	41	77

Table 2, shows that of the 77 respondents who were given sevoflurane inhalation anesthesia with two types of administration times: >30 minutes and <30 minutes, 46 respondents who were given sevoflurane inhalation anesthesia for >30 minutes experienced PONV (38 respondents), and 31 respondents who were given sevoflurane inhalation anesthesia for <30 minutes experienced PONV (3 respondents).

Table 3 Relationship Between the use of Sevoflurane Inhalation Anesthesia and the Incidence of PONV

Variabel	Mean Rank	P-value	Korelasi (r)
PONV	80,50	0,000	0,799

Table 3 explains that the results of the relationship between the use of sevoflurane inhalation anesthesia and the incidence of PONV in general inhalation anesthesia patients are that

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there is a strong relationship between the use of sevoflurane and the incidence of PONV in general inhalation anesthesia patients with a very strong relationship.

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Discussion:

The results of the research that have been presented in the previous chapter, so in this chapter will be discussed in succession in accordance with the research objectives to determine the relationship between the use of sevoflurane inhalation anesthesia and postoperative *nausea and vomiting* in post-general anesthesia patients.

Based on the length of operation, the highest number of respondents was the duration of the operation ≤ 30 minutes, which was 31 (40.3%). This is different from research that conducted by (Pierre and Whelan 2013; Shaikh et al. 2016) which the most surgery duration is 1 hour, which is 24 (80%). According to (Damayanti, Yudono, and ... 2022; Firdaus et al. 2020; Juliana et al. 2013)Longer surgery can cause patients to receive anesthetic agents for a longer period of time which is potentially hemogenic thus increasing the percentage of patients with PONV.

This study, which was conducted on 77 respondents, obtained the most respondents with the duration of sevoflurane inhalation anesthesia > 30 minutes, totaling 46 (59.7%). According to (Domene et al. 2025; Juliana et al. 2013) Sevoflurane is an inhalation anesthetic volatile agent used for the induction and maintenance of anesthesia during the operating room. Where the duration of anesthesia, which is closely related to the duration of surgery, can help predict the risk of PONV patients because the duration of anesthesia describes the patient's exposure to emetogenic stimuli such as volatile anesthesia and intraoperative opioids. This suggests that longer duration of anesthesia is associated with a greater incidence of PONV. This is in line with research(Apfel et al. 2012) It was found that of the total respondents with a duration of surgery and anesthesia > 30 minutes, there were 24 (53.3%). Sinclair's research in (Apfel et al. 2012) established that for every 30-minute increase in anesthesia duration there was a 59% increased risk of PONV.

Based on the results of this study, the results of the chi square test were obtained that the use of sevoflurane inhalation anesthesia was related to the incidence of *post operative nausea and vomiting* (PONV) in patients after general anesthesia, with the sig value in the Chi-Square person showing a sig<0.05 value of 0.000. This shows that the use of sevoflurane inhalation anesthesia is associated with the incidence of PONV. This is in line with research conducted by (Mangku and Senapathi 2010; Matsusaki and Sakai 2011; Widyastuti, Zulfa, and Sari 2021) which stated that patients given the inhaled anesthetic drug sevoflurane experienced a PONV incidence of 50.0%. The use of inhalation volatile anesthesia was associated with a two-fold increase in the risk of PONV and was the single most important factor for predicting emesis in the first 2 hours post operative (Razak, Lorna Lolo, and Aminuddin 2020; Riantini 2022; Wiryana et al. 2017)

The results of this study indicate that the use of sevoflurane inhalation anesthesia for more than 30 minutes has a significant relationship with the incidence of postoperative nausea and vomiting (PONV) in patients undergoing general anesthesia. Based on the Chi-Square test, a significance value of 0.000 (<0.05) was obtained, indicating a statistically significant relationship between the two variables. This finding strengthens the scientific evidence that the longer the exposure to volatile anesthetic agents—particularly sevoflurane—the higher the likelihood of patients experiencing PONV after surgery. PONV is a postoperative complication that is frequently encountered and represents an important concern in modern anesthetic management. The incidence of PONV is reported to range from 20–30% in the general population and can reach up to 80% in high-risk

groups.Although not life-threatening, this condition causes discomfort, prolongs recovery, delays hospital discharge, and increases healthcare costs. Therefore, identifying risk factors such as type of anesthesia, duration of exposure, and patient characteristics is essential for PONV prevention (AANA 2012; Marsaban et al. 2016; Razak et al. 2020; Riantini 2022).

The duration of anesthesia is one of the key determinants in the occurrence of PONV. According to the longer the duration of surgery, the longer the patient is exposed to anesthetic agents, intraoperative opioids, and other emetogenic stimuli. This prolonged exposure increases the likelihood of activation of the chemoreceptor trigger zone (CTZ) in the area postrema of the brain, which plays a central role in nausea and vomiting mechanisms. In addition, longer surgeries often involve more extensive tissue manipulation, additional opioid use, and greater physiological stress—all of which increase the risk of PONV(Mangku and Senapathi 2010; Matsusaki and Sakai 2011; Widyastuti et al. 2021). Wallenborn et al. (2007) emphasized that every additional 10 minutes of anesthesia increases the risk of PONV by up to 36%. This finding highlights that the duration of exposure is a highly sensitive variable. When extrapolated, a 30-minute increase in anesthesia duration may raise the risk of PONV by approximately 60%. This study's findings are consistent with those results, showing that the majority of respondents (59.7%) who received sevoflurane inhalation anesthesia for more than 30 minutes experienced PONV within the first 24 hours postoperatively(Hendro, Pradian, and Indriasari 2018; Pajares et al. 2018; Vadlamudi and Sniecinski 2013).

According to (Hendro et al. 2018; Pajares et al. 2018; Vadlamudi and Sniecinski 2013)anesthesia lasting more than 30 minutes is an indicator of increased exposure to volatile agents and intraoperative opioids. Their study found that among respondents with anesthesia durations exceeding 30 minutes, 53.3% experienced PONV. This supports the view that prolonged exposure to volatile anesthesia is an important predictor of PONV, aligning with the findings of the present study. Sevoflurane is one of the most widely used inhalational anesthetic agents in modern anesthetic practice due to its advantageous characteristics, including rapid induction, good cardiovascular stability, and quick recovery. According to Mangku & Senapathi (2010), sevoflurane belongs to the non-ether volatile anesthetic group, characterized by a low blood-gas partition coefficient that provides rapid onset and offset. However, this advantage is accompanied by a side effect—namely, increased stimulation of the vomiting center in the brainstem(Apfel et al. 2012; Domene et al. 2025; Hendro et al. 2018; Pajares et al. 2018; ScienceDirect_articles_21Oct2025_02-49-39 n.d.; Vadlamudi and Sniecinski 2013).

A study by Chen et al. (2013) found that patients who received sevoflurane inhalation anesthesia had a PONV incidence rate of 50%. The study also confirmed that the use of volatile anesthesia such as sevoflurane doubles the risk of PONV compared with total intravenous anesthesia (TIVA) using propofol. This result was supported by Wu et al. (2022), who conducted a systematic review and meta-analysis of colorectal cancer patients under general anesthesia, revealing that the incidence of PONV in the sevoflurane group was significantly higher (Odds Ratio 1.73; 95% CI: 1.38–2.17; $p<0.0001$) compared to the propofol group(Apfel et al. 2012; Apipan, Rummasak, and Wongsirichat 2016; Pierre and Whelan 2013; Shaikh et al. 2016; Sholihah, Sikumbang, and Husairi 2016).

Exposure lasting more than 30 minutes potentially increases the cumulative effects of sevoflurane. Although sevoflurane is easily eliminated through the lungs, prolonged exposure allows for partial accumulation in fatty tissue, delaying postoperative elimination and extending the central nervous system's exposure to emetogenic stimuli. Physiologically, PONV occurs due to stimulation of various neurotransmitter pathways, including dopamine (D2), serotonin (5-HT3), histamine (H1), acetylcholine (M1), and substance P. Sevoflurane can affect these pathways through activation of the area postrema and the nucleus tractus solitarius in the brainstem, which function as the vomiting center. Prolonged anesthesia increases the exposure of these receptors to emetogenic

agents, thus heightening the likelihood of PONV occurrence. Additionally, Ahn et al. (2025) reported that the use of sevoflurane disrupts postoperative heart rate variability (HRV), indicating delayed recovery of autonomic nervous system function, which is associated with higher PONV incidence. In their study, the sevoflurane group experienced a PONV rate of 35%, compared to only 10% in the propofol group. This difference was particularly evident within the first 30 minutes after surgery, reinforcing the notion that the duration of volatile anesthetic exposure plays an important role in triggering PONV.(Apfel et al. 2012; Apipan et al. 2016; Sholihah et al. 2016)

The limitations of this study include the fact that data collection was conducted at a single hospital, without involving multiple hospital settings, which may limit the generalizability of the findings. In addition, this study focused specifically on the effects of sevoflurane, without evaluating the potential impact of other anesthetic agents that may also contribute to the incidence of Postoperative Nausea and Vomiting (PONV) in patients.

Conclusion:

There is a strong association between sevoflurane use and PONV in patients undergoing inhalational general anesthesia. Anesthesiologists are advised to closely monitor PONV complications following inhalational sevoflurane administration to prevent worsening of the patient's condition. Further research is recommended to investigate the use of sevoflurane for cardiovascular and respiratory complications.

Acknowledgement:

Authors would like to express their sincere gratitude to the Institute of Technology and Health Bali for providing internal research grant funding, which supported the completion of this study.

Conflict of Interest:

The authors declare that there were no conflicts of interest during the conduct of this research, either from the researchers or from the hospital where the study was carried out.

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