

1145--1156---id-913_1789723570203.pdf

Document Details

Submission ID

trn:oid::3117:626103664

Submission Date

Sep 18, 2026, 9:31 AM UTC

Download Date

Sep 18, 2026, 9:32 AM UTC

File Name

1145--1156---id-913_1789723570203.pdf

File Size

314.5 KB

12 Pages**5,364 Words****31,521 Characters**

13% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Filtered from the Report

- Bibliography

Match Groups

-  **41 Not Cited or Quoted 9%**
Matches with neither in-text citation nor quotation marks
-  **19 Missing Quotations 4%**
Matches that are still very similar to source material
-  **0 Missing Citation 0%**
Matches that have quotation marks, but no in-text citation
-  **0 Cited and Quoted 0%**
Matches with in-text citation present, but no quotation marks

Top Sources

- 10%  Internet sources
- 10%  Publications
- 0%  Submitted works (Student Papers)

Match Groups

- 41 Not Cited or Quoted 9%**
Matches with neither in-text citation nor quotation marks
- 19 Missing Quotations 4%**
Matches that are still very similar to source material
- 0 Missing Citation 0%**
Matches that have quotation marks, but no in-text citation
- 0 Cited and Quoted 0%**
Matches with in-text citation present, but no quotation marks

Top Sources

- 10% Internet sources
- 10% Publications
- 0% Submitted works (Student Papers)

Top Sources

The sources with the highest number of matches within the submission. Overlapping sources will not be displayed.

1	Internet	fahruddin.org	2%
2	Internet	www.ekja.org	1%
3	Internet	pmc.ncbi.nlm.nih.gov	<1%
4	Publication	&NA;, . "Abstracts of Posters Presented at the International Anesthesia Research ...	<1%
5	Internet	ejournal.unuja.ac.id	<1%
6	Internet	hal.science	<1%
7	Internet	www.medrxiv.org	<1%
8	Publication	Daito Funaki, Hideaki Kaneda, Akinori Miyakoshi, Kohei Saito, Hatoko Sasaki, Eiji ...	<1%
9	Publication	Shouse, Gerald. "Apfel Score for Reduction of Postoperative Nausea and Vomiting...	<1%
10	Internet	jurnalkeperawatanglobal.com	<1%

11	Publication	Qing-Ren Liu, Qian-Kun Zong, Li-Li Ding, Hong-Yan Dai, Yan Sun, Yong-Yan Dong, ...	<1%
12	Publication	Park, Garrett Saisho. "Optimizing Analgesia: Opioid-Sparing Alternatives for Obst...	<1%
13	Internet	jurnal.poltekkes-kemenkes-bengkulu.ac.id	<1%
14	Publication	Yan-guo Xin, Jun-li Li, Xiaofan Cao, Xiao-jing Liu. "Efficacy and Safety of Different ...	<1%
15	Internet	e-journal.poltekkesjogja.ac.id	<1%
16	Internet	impactfactor.org	<1%
17	Internet	digitalcommons.wustl.edu	<1%
18	Internet	www.statpearls.com	<1%
19	Publication	Charlotte Sørensen, I. Kåreholt, G. Kalpouzos, C.T. Udeh-Momoh et al. "Daytime SI...	<1%
20	Publication	John Pickering, Marcoandrea Giorgi, Aurora Pryor. "Chapter 58-1 Postoperative N...	<1%
21	Publication	Kelvin Wynn, Patrece Barker, Kyle Cotner. "Is 6 hours of foley balloon placement ...	<1%
22	Publication	Mohamed Aziz Daghmouri, Mohamed Ali Chaouch, Laurent Ben Ayoun, Amine Go...	<1%
23	Publication	Yaping Hou, Wentao Sang, Ying Deng, Jiaqi Zheng et al. "Impact of the coronaviru...	<1%
24	Internet	archiv.ub.uni-marburg.de	<1%

25	Internet	bmcanesthesiol.biomedcentral.com	<1%
26	Internet	repository.charlotte.edu	<1%
27	Publication	Chaoxin Lu, Xiuwen Chen, Xiaochen Yan, Jiqun He, Zhifang Nie. "The preventive a...	<1%
28	Publication	Hsin-Yun Wu, Cihun-Siyong Alex Gong, Shih-Pin Lin, Kuang-Yi Chang, Mei-Yung Ts...	<1%
29	Publication	Rustiana Tasya Ariningpraja, Endah Panca Lydia Fatma, Retno Lestari, Laely Hida...	<1%
30	Internet	academic.oup.com	<1%
31	Internet	bionursing.fikes.unsoed.ac.id	<1%
32	Internet	ejournal-nawalaedu.com	<1%
33	Internet	etheses.whiterose.ac.uk	<1%
34	Internet	pure.eur.nl	<1%
35	Internet	www.anzca.edu.au	<1%
36	Internet	www.researchgate.net	<1%
37	Publication	Xue-Song, Ying-Yan Xu, Hua-Ping Xiong, Li-Tang, Qing-Ren Liu, Deng-Xin Zhang. "...	<1%
38	Publication	Yazhou Wen, Mingjie Mao, Xian Wang, Chenyang Xu, Xueduo Shi, Ping Li, Zijun Ti...	<1%

EFFECT OF PRE ANESTHETIC INTRAVENOUS KETAMINE ADMINISTRATION ON THE INCIDENCE OF POSTOPERATIVE NAUSEA AND VOMITING IN PATIENT UNDERGOING REGIONAL ANESTHESIA WITH SPINAL ANESTHESIA (SAB) TECHNIQUE

Nimas Ayu Lintangari^{1*}, Ircham Saifudin², Sindu Sintara³, Agus Budi Prasetyo⁴

Bachelor of Applied Science in Anesthesia Nursing, ITSK Hospital. dr. Soepraen,
Malang, Indonesia

nimaslintang24@gmail.com^{1*}, irchamsaifudin8@gmail.com²,

sindusintara@itsk@gmail.com³, agus.bp71@gmail.com⁴

*Corresponding author

Received July 31, 2026; Revised Sept 18, 2026; Accepted Sept 18, 2026; Published Sept 19, 2026

ABSTRACT

Patient recovery is disrupted by PONV, affecting 20%-30% and up to 80% in high risk groups. Although Subarachnoid Block carries lower PONV risk than general anesthesia, incidence remains significant when using neuraxial opioids. Administering low dose intravenous ketamine (0.25 mg/kg) may reduce PONV through opioid sparing effects, despite concerns regarding potential proemetic stimulation of the medulla oblongata. This study evaluates the effects of pre anesthetic intravenous ketamine on PONV occurrences in patients undergoing Subarachnoid Block (SAB). This is an experimental, quantitative clinical trial approach, included 100 SAB patients allocated into an intervention group (pre anesthetic intravenous ketamine), and a control group. Collected baseline characteristics included age, gender, and ASA status. Univariate and bivariate analyses (Chi Square test with Continuity Correction) evaluate categorical variable relationships. Most participants were aged 40–59 years (50.0% intervention vs. 60.0% control). Female subjects made up 64.0% of the intervention group, while the control group consisted mostly of male subjects (70.0%). The prevailing physical status was ASA 1 for the intervention group (56.0%) and ASA 2 for the control group (52.0%). Bivariate analysis shows a significantly lower PONV incidence in the intervention group 10.0% (5 patients) compared to control group (28.0%, 14 patients). This was confirmed via Chi Square testing ($p = 0.022$). Pre anesthetic intravenous ketamine significantly decreases PONV incidence in patient undergoing SAB. Low dose serves an effective and safe intervention to mitigate postoperative nausea risks in regional anesthesia.

Keywords: Intravenous ketamine, pre-anesthesia, PONV, subarachnoid block (SAB), opioid-sparing.

INTRODUCTION

Surgery is an important medical intervention for saving lives and improving the quality of life, where the success of surgery depends heavily on the role of anesthesia in ensuring the comfort and safety of patients during the procedure. One of the increasingly popular anesthetic techniques used is regional anesthesia, such as spinal anesthesia that offers faster recovery advantages, decreased opioid requirements, and a lower risk of systemic complications than general anesthesia (Reysner et al., 2025). Despite clinical advancements, post surgical complication remain an inevitable challenge in anesthesia, notably the occurrence of postoperative nausea and vomiting (PONV). While typical baseline rates hover between 20% and 30% globally, this frequency surges up to 80%

9 within high-risk patient cohorts (Huh, 2023). Not only does PONV cause severe discomfort, but it can also cause serious complications such as aspiration, dehydration, increased intracranial pressure, wound healing disorders, and extended hospitalization and increased health care costs.

26 Various factors can affect the occurrence of PONV, including factors from patients (such as gender, age, and history of travel sickness), factors from anesthesia (such as opioids, inhalation agents, and certain adjuvant), and factors from the type and duration of surgical actions (Gan et al., 2020). To control these complications, standard antiemetic prophylaxis strategies such as ondansetron and dexamethasone are often used, but their effectiveness does not always reach 100% and can cause certain side effects (Qasemi et al., 2023). This limitation promotes the exploration of nonopioid alternative agents or adjuvants, one of which is by using low doses of ketamine, which has become part of multimodal analgesia to suppress the use of opioids during surgery and reduce the risk of PONV (Toleska et al., 2022).

27 In anesthesia practice, although the incidence of PONV in patients undergoing regional anesthesia tends to be lower than general anesthesia due to the minimal use of inhalation agents and systemic opioids, PONV remains a must-anticipated complication, this is especially true when neural opioids are used as analgesic adjuvants. Therefore, the identification of patient risk factors and prevention strategies, including the administration of prophylactic antiemetics in high-risk patients, remains crucial (Jd et al., 2012; Komann et al., 2024). In this context, the use of preoperative ketamine as an analgesic adjuvant raises a separate issue with the occurrence of PONV. Several studies have shown that low-dose ketamine does not significantly increase the risk of PONV (Samuel et al., 2022; Zhou et al., 2022), but other studies have found variations in results that are contradictory, depending on the dose and type of surgery.

3 22 12 For instance, a randomized controlled trial in video-assisted thoracic surgery reported that perioperative S-ketamine infusion significantly lowered PONV incidence compared with placebo (9.7% vs. 30.5%) alongside a marked reduction in opioid consumption (Qi et al., 2024), whereas a systematic review of ERAS protocols following open abdominal surgery found no significant difference in PONV and related adverse effects between ketamine and control groups (log OR = -0.19; 95% CI -0.81 to 0.43; $I^2 = 72.7\%$), reflecting substantial heterogeneity across surgical contexts and dosing regimens. Similarly, a large-scale meta-analysis by Seo et al. (2025) confirmed that the antiemetic benefit of ketamine is highly comparator-dependent, being evident against opioid-based regimens but not against non-opioid controls. These inconsistencies underscore that the net effect of ketamine on PONV cannot be generalized across anesthesia techniques, and further strengthen the rationale for isolating its effect specifically within a regional, opioid-minimizing technique such as SAB.

12 Ketamine is a compound that acts as an antagonist of the NMDA receptor that has analgesic and antihyperalgesic effects at subanesthetic doses. Low doses of ketamine (<0.25 mg/KgBB) are widely used in multimodal analgesia protocols to reduce the need for opioids and postoperative pain (Zhou et al., 2022). Several studies and meta-analysis

11 have reported that perioperative administration of low-dose ketamine can lower the incidence of PONV over placebo, although the effects tend to be small and the clinical significance of it is still disputed. As the need for opioids decreases, the incidence of PONV can also be reduced because opioids are one of the main triggers of postoperative nausea and vomiting (Chen et al., 2023). On the other hand, in some studies ketamine has been reported to trigger nausea and mild vomiting due to its effects that affect the center of vomiting in the medulla oblongata through stimulation of dopamine and serotonin (Qi et al., 2024). Thus, ketamine has two potential opposite effects to PONV, which is to lower the risk of PONV occurrence through the opioid sparing mechanism, but may also increase the risk through stimulation of the vomiting center.

17 Crucially, studies that specifically tested the effects of preanesthetic intravenous low-dose ketamine as a prophylaxis of PONV on regional anesthesia settings, such as SAB, are still very limited. This gap persists despite recent large-scale evidence: a 2025 systematic review and meta-analysis of 55 studies (n = 6,676) reported that ketamine and esketamine did not significantly reduce pooled PONV risk overall compared with placebo (RR = 0.95; 95% CI 0.87–1.04), yet significantly lowered PONV when compared with opioid-based regimens (RR = 0.50; 95% CI 0.32–0.77), while paradoxically increasing PONV risk relative to non-opioid controls (RR = 1.46; 95% CI 1.03–2.05) (Seo et al., 2025). Because the vast majority of the trials pooled in that review were conducted under general anesthesia, the comparator-dependent and dose-dependent nature of ketamine's antiemetic effect remains largely untested in patients receiving regional or neuraxial techniques, reinforcing the need for dedicated evidence in the SAB population. Among the various regional techniques, SAB is the most commonly used technique due to its effectiveness in producing rapid sensory and motor blockades. However, hemodynamic manipulation and the use of adjuvants in SAB techniques are often significant triggers for vomiting nausea that may interfere with the success of the procedure. This leaves a gap in knowledge of the benefits of ketamine intervention when the neural blockade has provided primary analgesia (Qi et al., 2024).

24 The high incidence of PONV in patients with SAB techniques encourages preventive efforts so as not to have a negative impact on the patient's comfort and recovery period. The selection of low-dose ketamine is part of the multimodal management of anesthesia, to obtain pain suppression effects without causing adverse psychomimetic side effects. Low-dose ketamine (0.25 mg/kg) is expected to serve as an effective preventive strategy for PONV because, at this sub-dissociative dose, its clinical action is dominated by NMDA-receptor antagonism at spinal and supraspinal levels, which blunts central pain transmission and thereby reduces the perioperative demand for systemic and neuraxial opioids, the principal pharmacological trigger of the Chemoreceptor Trigger Zone. This dose also remains well below the threshold generally associated with clinically significant psychomimetic and direct emetogenic stimulation of the medulla oblongata, which is more consistently observed at conventional anesthetic doses (≥ 0.5 mg/kg). In addition, ketamine's sympathomimetic property helps preserve hemodynamic stability during the sympathetic blockade induced by SAB, limiting the

transient hypotension and visceral hypoperfusion that independently provoke PONV. This combination of opioid-sparing analgesia and hemodynamic stabilization, at a dose kept below the psychomimetic threshold, provides the physiological basis for expecting a net antiemetic benefit. This study was important to solve the clinical controversy over the double effect of low-dose Ketamine on PONV. While providing stronger scientific evidence on the safety of the use of low-dose ketamine to enhance the comfort of preanesthetic patients and provide practice guidance in the management of premised regional anesthesia. In addition, this study used the Apfel Score as an instrument to balance the patient's innate risk factors, so that the effectiveness of intravenous ketamine would be seen, and could evaluate more objectively in populations with equivalent risk levels. Therefore, the purpose of this study is to clinically prove the extent of the effect of administering intravenous ketamine in lowering the incidence of PONV in regional anesthesia patients using the SAB technique.

The scientific novelty of this study lies in its specific focus on the SAB population, a regional anesthesia setting that has been largely excluded from prior ketamine-PONV research, which has predominantly been conducted under general anesthesia (Seo et al., 2025). Unlike previous trials that examined ketamine's antiemetic effect against a background of full systemic opioid exposure, this study isolates the ketamine effect in a setting where the neural blockade already provides primary analgesia, thereby minimizing systemic opioid confounding and allowing a clearer view of ketamine's independent opioid-sparing and hemodynamic-stabilizing contributions to PONV prevention. The use of the Apfel Score to match baseline PONV risk between groups, combined with structured, time-interval-specific PONV monitoring at 30 minutes, 1 hour, and 2 hours post-anesthesia (T1–T3), further distinguishes this study from earlier single-timepoint designs and provides a more granular, clinically relevant characterization of the temporal course of ketamine's antiemetic action following SAB.

RESEARCH METHOD

Research Design

A prospective, quasi-experimental methodology based on a post-test only control group design was employed for this quantitative study. This design was chosen because PONV is an acute postoperative outcome that, by definition, cannot be meaningfully measured before the anesthetic intervention and surgery have occurred; a preoperative baseline measurement of an event that has not yet happened would therefore offer no informative comparison and could not reduce bias in this context. Random allocation to a true experimental design was also not ethically or logistically feasible within routine perioperative care at a single-center surgical installation, since patients could not be assigned outside the standard clinical scheduling process. A post-test only control group design, comparing PONV incidence between the ketamine and control arms after intervention, was therefore considered the most appropriate and pragmatic approach to isolate the treatment effect while minimizing testing effects and observer expectation bias associated with repeated preoperative assessment. To assess the clinical effects without

the constraints of a pre-test, observations were conducted within the Central Surgical Installation at Pindad General Hosipital from April to May 2026.

Population

The study population encompassed the total cohort of patients receiving Subarachnoid Block (SAB) Anesthesia. To be enrolled in this investigation, subjects had to meet the following inclusion criteria: categorized strictly under American Society of Anesthesiologists (ASA) physical status I or II; having reached adulthood, defined as being older than 18 years of age; exhibiting a body mass exceeding 40 Kg; undergoing regional anesthesia; presenting with a PONV (Apfel score) risk score of at least 2; having no history of psychiatric disorders or history of seizures; and having no severe liver or kidney dysfunction.

The exclusion criteria in this study were patients with ASA III physical status; patients with a PONV (Apfel score) risk score of less than 2; patients undergoing general anesthesia or who were subject to conversion from regional to general anesthesia (e.g., due to severe intraoperative bleeding requiring conversion); patients who did not meet Apfel's minimum risk score; and patients who refused to continue participation or withdrew during the observation period.

Large Research Sample

Based on Lemeshow's formula calculation and 10% drop out correction, a minimum sample of 92 respondents was obtained. However, the researchers managed to collect data on up to a total of 100 evenly divided subjects (50 respondents in the intervention group and 50 respondents in the control group) by determining the sample using purposive sampling methods. Purposive sampling was selected, rather than simple random sampling, because eligible subjects had to simultaneously satisfy several strict clinical criteria (ASA I–II status, an Apfel score of at least 2, and an elective SAB procedure) within a fixed two-month enrollment window at a single surgical installation; this non-probability approach allowed the researchers to efficiently reach the calculated minimum sample size within the available time frame while ensuring that every enrolled subject met the full eligibility profile required for a valid group comparison. To preserve internal validity, allocation into the intervention and control groups followed the patients' sequential surgical schedule, and both groups were drawn from the same source population and time period to minimize selection bias.

Research Instruments

The research instruments used by researchers in this study were informed consent and observation sheets using Apfel Score as a filter for inclusion criteria, consisting of four independent risk factors (female gender, PONV history or motion sickness, non-smoker status, and postoperative opioid use plan) to ensure respondents have a minimum score of 2. The Apfel Score was selected as the risk-screening instrument because it is a validated and cross-institutionally reproduced tool, originally derived and cross-validated

in a combined cohort of 1,040 adult surgical patients across two independent centers, where it demonstrated consistent discriminative accuracy for identifying patients at meaningful risk of PONV (Apfel et al., 1999; Gan et al., 2020). The observation sheet used to record PONV events at each time interval was developed based on this validated risk framework and was reviewed by the attending anesthesiologists at the study site to ensure its content corresponded appropriately to the clinical variables under investigation prior to data collection. The collection of data is done through real time direct observation methods and documentation studies on the patient's medical record (including age, gender, physical ASA status, type of surgery and weight for Ketamine dose determination). Observations of PONV events are made periodically at three post SAB time intervals, namely T1 (30 minutes post-anesthesia), T2 (1 hour post-anesthesia), and T3 (2 hours post-anesthesia).

Data Analysis

For data processing, a univariate analysis was first utilized to illustrate characteristic frequencies and percentage distributions of PONV events using descriptive tables. Subsequently, a bivariate analysis using the Chi-Square test was implemented to examine proportional differences in PONV outcomes across both study arms, serving to determine whether low-dose ketamine acts as an effective preventive strategy.

RESULTS AND DISCUSSION

Respondent Characteristic of Pindad General Hospital

This section presents the frequency distribution and percentage of respondents demographic and clinical characteristics, including age, gender, and American Society of Anesthesiologists (ASA) physical status, across both study groups.

Table 1. The Baseline Characteristic of Respondent

Respondent Characteristics	Intervention Group		Control Group	
	Frequency	Percentage (%)	Frequency	Percentage (%)
Age				
19-39	24	48	15	30
40-59	25	50	30	60
>60	1	2	5	10
Gender				
Female	32	64	15	30
Male	18	36	35	70
ASA Status				
ASA 1	28	56	24	48
ASA 2	22	44	26	52
Total	50	100	50	100

Table 1 shows that the majority of respondents in the intervention group were adults aged 40–59 years, accounting for 25 respondents (50.0%). Similarly, the control group

was also dominated by the 40–59 age range, with 30 respondents (60.0%). Regarding gender characteristics, the intervention group was predominantly female, comprising 32 respondents (64.0%), whereas the control group was mostly male, accounting for 35 respondents (70.0%). In terms of ASA physical status, most respondents in the intervention group had an ASA 1 status, totaling 28 respondents (56.0%), while the majority of the control group had an ASA 2 status, consisting of 26 respondents (52.0%).

PONV Incidence Between the Two Study Groups

To evaluate variations in emetic outcomes, a Chi-Square analysis was performed on the data collected from both cohorts.

Table 2. Comparison of PONV Incidence Between the Two Study Group

Variable	Intervention Group		Control Group		<i>p</i> -Value
	N	%	N	%	
Non-PONV	45	90.0	36	72.0	0,022
PONV	5	10.0	14	28.0	
Total	50	100	50	100	

As detailed in Table 2, the vast majority of the 50 participants within the intervention arm did not present with post-operative emesis, with 45 individuals (90.0%) remaining symptom-free. Conversely, within the control cohort, a total of 14 subjects (28.0%) developed postoperative nausea and vomiting (PONV). The mathematical evaluation yielded a significance metric of 0.022 ($p < 0.05$), thereby confirming the validation of the alternative hypothesis (H_1). Beyond statistical significance, the magnitude of this association was also clinically meaningful: the relative risk (RR) of developing PONV in the intervention group compared with the control group was 0.36 (95% CI 0.14–0.92), corresponding to a relative risk reduction of approximately 64%. The odds ratio (OR) for PONV in the intervention group relative to the control group was 0.29 (95% CI 0.09–0.87), and the number needed to treat (NNT) was approximately 6, indicating that for every six patients receiving preanesthetic low-dose intravenous ketamine, one additional case of PONV was prevented. These effect-size estimates confirm that the observed difference reflects a substantial and clinically relevant protective association, not merely a statistically detectable one.

These findings underscore a substantial prophylactic impact of preemptive, low-dose ketamine delivery on suppressing PONV occurrences following Subarachnoid Block procedure at Pindad General Hospital. Clinically, this finding suggests that a single, low-cost preanesthetic ketamine bolus could be incorporated as a routine adjunct in the perioperative management of patients scheduled for SAB, particularly those already flagged as high-risk by an Apfel score of 2 or more, without requiring additional monitoring infrastructure beyond standard perioperative vital sign surveillance. For perioperative nursing and anesthesia practice, this translates into a practical, low-resource preventive measure that can be integrated into existing pre-induction checklists, potentially reducing the downstream burden of rescue antiemetic administration,

prolonged post-anesthesia care unit stay, and the discomfort and dissatisfaction associated with PONV episodes in the immediate postoperative recovery period.

Preemptive delivery of intravenous ketamine sub-anesthetic levels prior to initiating a Subarachnoid Block demonstrated a clear capacity to restrict PONV development among surgical candidates at Pindad General Hospital. This outcome highlights the clinical value of utilizing low-dose adjuvants to suppress emetogenic pathway following neuraxial anesthesia, and is consistent with, though more favorable than, the comparator-dependent pattern reported by the most recent large-scale meta-analysis on this topic, which found that ketamine conferred a significant PONV benefit specifically when compared with opioid-based regimens (RR = 0.50) rather than against placebo or non-opioid controls (Seo et al., 2025)—a pattern that aligns closely with the present SAB setting, where the intervention's principal mechanism of action is opioid displacement rather than direct antiemetic pharmacology. This dynamic is statistically supported by our bivariate cross-tabulation via Chi-Square testing, where the calculated alpha fell securely beneath the critical threshold. Consequently, these empirical metrics substantiate the H_1 hypothesis, illustrating a genuine variance in emetic frequency between the intervention arm and the non-treated group. This clinical reality verifies that minimizing post-surgical emesis via targeted pharmacological pathway is an objective therapeutic outcome rather than a random variation.

Regional anesthesia techniques are highly regarded for modern surgical recovery due to their ability to optimize patient stabilization and limit systemic complications relative to general anesthesia (Reysner et al., 2025). Nonetheless, mitigating PONV challenges remains essential for preserving patient comfort during the post-SAB recovery phase (Huh, 2023). From a physiological standpoint, the capacity of sub-anesthetic ketamine to attenuate emetic responses relies on dual, complementary neuropharmacological pathways. Primarily, the agent functions as a potent inhibitor blocking NMDA pathways, which effectively disrupts the conduction of noxious pain signals, delivers central analgesia, and strengthens opioid-sparing mechanics (Zhou et al., 2022). This reduction in perioperative opioid needs is vital, given that exogenous opioids directly trigger the Chemoreceptor Trigger Zone (CTZ) localized within the postrema of medulla oblongata area that inherently activates the emetic reflex (Gan et al., 2020). This approach to opioid minimization through adjuvant agents has been shown to clinically reduce emetogenic stimulation directly in the vomiting center (Chen et al., 2023).

In point two, ketamine plays an important role in maintaining hemodynamic stability during the SAB procedure. Sympathetic blockades due to spinal anesthesia often trigger sudden hypotension, which physiologically leads to decreased cerebral perfusion and focal systemic hypoxia in the digestive tract (Huh, 2023). This gastrointestinal hypoxia condition stimulates the release of serotonin from enterochromaffin cells in the intestines which then activates the vagus afferent nerve to trigger vomiting reflexes. The sympathomimetic properties of ketamine help maintain blood pressure and heart rate, thus preventing post-SAB transient hypotension which is the main trigger for PONV in regional anesthesia (Griffiths et al., 2012; Komann et al., 2024). Although at conventional

doses of ketamine potentially triggers vomiting nausea through direct stimulation of the dopaminergic and serotonergic systems in the medulla oblongata, the use of subanesthetic doses in this study has been shown to be more dominated by their protective effect (Qi et al., 2024). This reinforced previous clinical evidence that low-dose ketamine did not increase immediate emetogenic effects, but effectively decreased postoperative pain intensity and systemic opioid requirements (Samuel et al., 2022; Zhou et al., 2022).

Other interesting findings related to the analysis of respondent characteristics by gender. Women's is the strongest index risk factor in predicting PONV based on the Apfel Score (3 instrument). This was reinforced by Karnina & Ismah's study, in the act of dilation of curetase which confirmed a very high susceptibility of female patients in experiencing complications of nausea and vomiting after gynecological obstetrics procedures (Karnina & Ismah, 2021). In this study, the intervention group naturally had a higher risk burden due to female patients' predominance due to high volume of obstetric actions such as sectionosesearea, which were clinically highly susceptible to emetogenesis due to hormonal fluctuations and uterine manipulation (Komann et al., 2024). In fact, the intervention group actually experienced much lower PONV events than the male-dominated control group. This pattern provides strong clinical implications that the emetogenic preventive effects of subanesthetic dose ketamine are capable of dominating and neutralizing the patient's inherent risk vulnerabilities, including gender sensitivity risks.

Judging from age characteristics, the majority of respondents were in the middle-aged range with a moderate category of PONV risk level (3). The equality of age distribution and physical status (ASA 1 and ASA 2) between the two groups is essential to eliminate disruptive factors. As explained by Karnina & Salmah (2022), ASA's age, gender, and physical status variables are important determinants that have been shown to be significantly related to the number of PONV events in post-surgery patients (Karnina & Salmah, 2022). With age factors and systemic conditions affecting the central sensitivity of vomiting, control of the characteristics of this subject ensures that the clinical differences that occur purely reflect the direct influence of ketamine pharmacological treatment (Komann et al., 2024).

Practically speaking, although standard antiemetic approaches such as ondansetron and dexamethasone have been widely used, the effectiveness of this single therapy is often limited by the potential systemic side effects or less adherent clinical responses in a given population (Qasemi et al., 2023). Therefore, the application of multimodal anesthesia strategies by adding intravenous low-dose ketamine before SAB offers optimal perioperative pain control while being proven to reliably lower the risk of PONV without triggering adverse psychomimetic side effects (Qi et al., 2024; Toleska et al., 2022). The novelty of the present study lies in demonstrating a lower incidence of PONV following preanesthetic low-dose intravenous ketamine specifically in patients undergoing regional anesthesia with the SAB technique. In this study, PONV occurred in 10.0% of patients receiving ketamine compared with 28.0% in the control group ($p = 0.022$), corresponding to an RR of 0.36 (95% CI 0.14–0.92). This finding extends previous evidence because

recent studies have reported heterogeneous effects of ketamine on nausea and vomiting across different clinical settings. A systematic review and meta-analysis in patients undergoing spinal anesthesia for cesarean section found no significant reduction in nausea (RR = 0.66; 95% CI 0.40–1.09) or vomiting (RR = 0.94; 95% CI 0.53–1.67) with intravenous ketamine compared with placebo (Liang et al., 2022). More recent pooled evidence from general anesthesia similarly showed no significant overall reduction in PONV with ketamine or esketamine (RR = 0.95; 95% CI 0.87–1.04), although a significant reduction was observed when these agents were compared with opioid-based regimens (RR = 0.50; 95% CI 0.32–0.77) (Seo et al., 2025). Therefore, the present study contributes specific clinical evidence from an SAB population with an Apfel score of ≥ 2 , showing a significant association between preanesthetic low-dose ketamine administration and lower PONV incidence in this regional anesthesia setting.

More broadly, these findings suggest that preanesthetic low-dose intravenous ketamine may have potential as an adjunctive strategy for PONV prevention in patients undergoing SAB, particularly among patients with an elevated baseline risk of PONV. However, its clinical application should consider the individual patient's risk profile and the potential neuropsychiatric and sedative adverse effects associated with ketamine. Recent pooled evidence indicates that ketamine and esketamine may increase the risks of hallucinations and drowsiness, emphasizing the importance of appropriate dosing and postoperative monitoring (Seo et al., 2025). Therefore, the present findings provide a basis for further controlled studies to determine the effectiveness, safety, and clinical applicability of low-dose ketamine for PONV prevention specifically in regional anesthesia.

CONCLUSION

Synthesizing the experimental outcomes, it is evident that preemptive low-dose intravenous ketamine delivery successfully reduces the development of PONV in the context of spinal anesthesia. This clear divergences between the intervention and control groups mathematically substantiates the H_1 hypothesis. Pathophysiologically, the antiemetic efficacy of sub-anesthetic ketamine is mediated via NMDA pathway blockades that facilitate opioid-sparing effects and sustain hemodynamic stability, which collectively counteracts visceral hypoxia induced by abrupts post-block hypotension. Furthermore, this preventative approach proves robust in offsetting non-modifiable patient risk profiles, notably the elevated biological predisposition found among female subjects.

REFERENCES

Apfel, C. C., Laara, E., Koivuranta, M., Greim, C.-A., & Roewer, N. (1999). A simplified risk score for predicting postoperative nausea and vomiting: Conclusions from cross-validations between two centers. *Anesthesiology*, 91(3), 693–700. <https://doi.org/10.1097/00000542-199909000-00022>

- Chen, H. Y., Meng, X. Y., Gao, H., Liu, H., Qiu, H. B., Lu, J., & Song, J. C. (2023). Esketamine-based opioid-free anaesthesia alleviates postoperative nausea and vomiting in patients who underwent laparoscopic surgery: Study protocol for a randomized, double-blinded, multicentre trial. *Trials*, 24(1), 1-7. <https://doi.org/10.1186/s13063-022-07003-3>
- Gan, T. J., Belani, K. G., Bergese, S., Chung, F., Diemunsch, P., Habib, A. S., Jin, Z., Kovac, A. L., Meyer, T. A., Urman, R. D., Apfel, C. C., Ayad, S., Beagley, L., Candiotti, K., Englesakis, M., Hedrick, T. L., Kranke, P., Lee, S., Lipman, D., ... Philip, B. K. (2020). Fourth consensus guidelines for the management of postoperative nausea and vomiting. *Anesthesia & Analgesia*, 131(2), 411–448. <https://doi.org/10.1213/ANE.00000000000004833>
- Huh, H. (2023). Postoperative nausea and vomiting in spinal anesthesia. *Korean Journal of Anesthesiology*, 76(2), 87–88. <https://doi.org/10.4097/kja.23157>
- Karnina, R., & Ismah, M. N. (2021). Gambaran kejadian postoperative nausea and vomiting (PONV) pada pasien pasca tindakan dilatasi kuretase dengan anestesi umum di RSIA B pada tahun 2019. *Muhammadiyah Journal of Midwifery*, 2(1), 10–20. <https://doi.org/10.24853/myjm.2.1.10-20>
- Karnina, R., & Salmah, M. (2022). Hubungan usia, jenis kelamin, lama operasi dan status ASA dengan kejadian PONV pada pasien pasca operasi laparatomi bedah digestif. *Health and Medical Journal*, 4(1), 16–22. <https://doi.org/10.33854/heme.v4i1.867>
- Komann, M., Rabe, Y., Lehmann, T., Dreiling, J., Weinmann, C., Kranke, P., & Meißner, W. (2024). Operation-specific risk of postoperative nausea: A cross-sectional study comparing 72 procedures. *BMJ Open*, 14(2), 1-8. <https://doi.org/10.1136/bmjopen-2023-077508>
- Liang, X., Yang, X., Liang, S., Zhang, Y., Ding, Z., Guo, Q., & Huang, C. (2022). Effect of intravenous ketamine on hypocranial pressure symptoms in patients with spinal anesthetic cesarean sections: A systematic review and meta-analysis. *Journal of Clinical Medicine*, 11(14), 1-12. <https://doi.org/10.3390/jcm11144129>
- Qasemi, F., Aini, T., Ali, W., Dost, W., Rasully, M. Q., Anwari, M., Dost, W., Zaheer, R., Dost, R., & Talpur, A. S. (2023). The effectiveness of ondansetron and dexamethasone in preventing postoperative nausea and vomiting after laparoscopic cholecystectomy. *Cureus*, 15(4), 3-7. <https://doi.org/10.7759/cureus.37419>
- Qi, Y., Zhou, M., Zheng, W., Dong, Y., Li, W., Wang, L., Xu, H., Zhang, M., Yang, D., Wang, L., & Zhou, H. (2024). Effect of S-ketamine on postoperative nausea and vomiting in patients undergoing video-assisted thoracic surgery: A randomized controlled trial. *Drug Design, Development and Therapy*, 18, 1189–1198. <https://doi.org/10.2147/DDDT.S449705>
- Reysner, T., Wieczorowska-Tobis, K., Mularski, A., Kowalski, G., Daroszewski, P., & Reysner, M. (2025). Revolutionizing pediatric surgery: The transformative role of regional anesthesia—A narrative review. *Surgeries*, 6(1), 1-7. <https://doi.org/10.3390/surgeries6010009>
- Samuel, H., Aweke, S., & Tuni, J. (2022). Effect of low-dose intravenous ketamine on postoperative pain following cesarean section under spinal anesthesia: A

prospective cohort study, Ethiopia. *Annals of Medicine and Surgery*, 3(77), 1-6.
<https://doi.org/10.1016/j.amsu.2022.103570>

- Seo, K. H., Choi, S. C., Kwak, J., & Kim, N. J. (2025). The effect of perioperative ketamine and esketamine administration on postoperative nausea and vomiting in patients undergoing general anesthesia: A systematic review and meta-analysis. *Korean Journal of Anesthesiology*, 79(2), 182–200.
<https://doi.org/10.4097/kja.24930>
- Toleska, M., Shosholcheva, M., Dimitrovski, A., Kartalov, A., Kuzmanovska, B., & Dimitrovska, N. (2022). Is multimodal anesthesia effecting postoperative nausea and vomiting in laparoscopic cholecystectomy? *Prilozi*, 43(2), 51–58.
<https://doi.org/10.2478/prilozi-2022-0018>
- Zhou, L., Yang, H., Hai, Y., & Cheng, Y. (2022). Perioperative low-dose ketamine for postoperative pain management in spine surgery: A systematic review and meta-analysis of randomized controlled trials. *Pain Research and Management*, 31, 1-20.
<https://doi.org/10.1155/2022/1507097>