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SYSTEMATIC REVIEW GENERAL ANESTHESIA

Comparative efficacy of medications in preventing postoperative nausea and vomiting following general anesthesia in adults: a systematic review and meta-analysis

Mohammed AlJahdali [1], Raghad AlSaeed *[2], Abdulmohsen Alanazi [3], Reem Alghamdi [4], Esraa Al-Nawab [5]

Authors affiliations:

1. Mohammed AlJahdali. Department of Anesthesia, King Abdulaziz Medical City, Ministry of National Guard, Riyadh, Saudi Arabia.
2. Raghad AlSaeed. Department of Anesthesia, King Abdulaziz Medical City, Ministry of National Guard, Riyadh, Saudi Arabia.
3. Abdulmohsen Alanazi. College of Medicine, Imam Mohammed Ibn Saud Islamic University (IMSIU), Riyadh 13317, Saudi Arabia.
4. Reem Alghamdi. Department of Anesthesia, Alhada Armed Forces Hospital, Taif, Saudi Arabia.
5. Esraa Al-Nawab. College of Medicine, Ibn Sina National College, Jeddah, Saudi Arabia.

Correspondence: Mohammed Aljahdali; **Email:** ralsaeed96@outlook.sa

ABSTRACT

Background: A prevalent adverse effect of general anesthesia is postoperative nausea and vomiting (PONV), resulting in considerable suffering for many surgical patients. Several medicines have been used to prevent PONV. Although these medications are commonly used, it remains unclear which ones are most effective—whether used alone or in combination—due to the absence of thorough head–to-head trials.

Methods: This research was performed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. A thorough literature review was performed utilizing databases such as PubMed and Google Scholar. Keywords such as "general anesthesia" OR "anesthesia," "postoperative nausea" OR "postoperative vomiting" OR "PONV," "drug" OR "medication" OR "prophylaxis," were used to locate pertinent studies.

Results: There was a substantial decrease in the incidence of PONV risk with interventions, particularly 1 mg intravenous haloperidol, which demonstrated superior efficacy compared with 5 mg dexamethasone and other interventions (RR=0.27, 95% CI: 0.13–0.55). The overall heterogeneity among studies assessing PONV prevention efficacy was high (I^2 = 74%, P = 0.00001). Adverse events associated with interventions were minimal, with little heterogeneity for severe adverse events (I^2 = 0%, P = 0.23) or adverse events overall (I^2 = 40%, P = 0.10). The risk of bias assessment indicated that most studies were of good quality, with 18 studies having a low or unclear risk of bias and one study being classified as high risk.

Conclusions: This study revealed a statistically significant difference between pharmacological medicines used for preventing PONV in adults. Specifically, 1 mg intravenous haloperidol was found to be more effective than 5 mg intravenous dexamethasone and other interventions used in other studies. However, generally, it can be concluded that all the interventions used in general anesthesia were successful in lowering PONV among adults.

Keywords: PONV, Haloperidol, General Anesthesia, Adverse Events.

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1. INTRODUCTION

PONV is an undesirable consequence of anesthesia and surgery, impacting approximately 30–50% of surgical patients.[1] These symptoms result in considerable discomfort and dissatisfaction, resulting in increased medical expenses and prolonged hospitalizations.[2-5] Annually, approximately 3 million general anesthetics are administered in the UK. Consequently, the effective eradication of PONV could significantly enhance public health. Strategies such as improved rehabilitation programs and an increased emphasis on day-case surgery highlight the importance of successful PONV prevention.[6]

To mitigate the burden of postoperative nausea and vomiting (PONV), various antiemetic agents have been formulated, including corticosteroids, antihistamines, 5-hydroxytryptamine 3 (5-HT3) receptor antagonists, dopamine-2 (D2) receptor antagonists, and anticholinergic neurokinin-1 (NK1) receptor antagonists.[7] Each category of these drugs is linked to a certain array of negative effects. For example, 5-HT3 receptor antagonists may induce migraines and constipation, whereas D2 receptor antagonists are associated with QT prolongation, sedation, arrhythmias, and extrapyramidal symptoms. Conversely, corticosteroids may result in immunosuppression, hyperglycemia, and protracted wound healing.[8,9] Moreover, anticholinergics are recognized for their ability to induce adverse effects, including visual disturbances and xerostomia, whereas antihistamines are linked to urinary complications, xerostomia, and somnolence.[8] Research indicates that NK1 receptor antagonists may induce headaches and heightened dizziness; however, evidence regarding their side effects is sparse.[9]

Since the 1960s, numerous clinical trials have investigated methods for preventing PONV.[10,11] However, there is currently no evidence-based, complete analysis of all relevant pharmacological types, let alone a therapeutically meaningful ranking of antiemetic medications based on safety and effectiveness, despite the growing number of clinical trials on PONV. Therefore, to maximize treatment and reduce unnecessary overtreatment, which may have detrimental effects, a thorough systematic review and meta-analysis are urgently needed.[12] By examining all pertinent single and combination medications and comparing them to alternative medications, this systematic review and meta-analysis seeks to bridge that gap and determine the effectiveness of each medication.[13] The findings of the analysis will be applied to provide a thorough, empirically supported basis for revising clinical guidelines and enhancing PONV patient care. This study, titled "Comparative Efficacy of Medications in Preventing Postoperative Nausea and Vomiting Following General Anesthesia in Adults: A Systematic Review and Meta-analysis," aims to provide comprehensive insights into the relative efficacy and safety of pharmacological interventions for preventing PONV in adults.

2. METHODOLOGY

2.1. Literature Search Strategy

This systematic review and meta-analysis adhered to the PRISMA guidelines. Ethical approval was not required for this study, as it is a systematic review that involves the analysis of previously published data. Systematic reviews rely on secondary data sources and do not involve the collection of new data directly from human participants. This study focused on evaluating the efficacy of pharmacologic interventions in preventing postoperative nausea and vomiting (PONV) in adult patients undergoing general anesthesia for various types of surgery. A thorough literature search was conducted to identify relevant studies via databases such as PubMed and Google Scholar. Keywords including "general anesthesia" OR "anesthesia,"

"Postoperative nausea" OR "postoperative vomiting" OR "PONV," "drug" OR "medication" OR "prophylaxis," were employed to locate pertinent articles. The literature search included studies published between January 2000 and December 2023.

2.2. Inclusion and Exclusion Criteria

This systematic review and meta-analysis focused on comparing treatments for postoperative nausea and vomiting (PONV) in adult patients receiving general anesthesia for surgery.

The inclusion criteria included retrospective observational studies; randomized controlled trials; and prospective, open, nonrandomized, observational interventional studies. Studies that document the incidence of PONV within 24 hours following surgery and its downstream consequences include rescue antiemetics, adverse events, nausea, and vomiting.

On the other hand, the exclusion criteria were as follows: all systematic reviews and meta-analyses; case studies; non-age-related studies; patients aged less than 18 years; duplicate studies; studies with irretrievable outcome data; and studies not assessing pharmacologic therapy for PONV prophylaxis in adult surgical patients.

2.3. Selection of Articles / Data Extraction

Every article that was obtained in the primary search was imported into Mendeley to eliminate duplication. Following the removal of duplicates, the results of the studies were imported into Rayyan and separately screened by two reviewers according to the abstract and title. The two reviewers extracted data from the studies and recorded the study characteristics, population details, and intervention details. Patient demographics, risk factors, and medication types for PONV prevention were recorded. This review compares active antiemetic medications or placebo to treatments such as dopamine, 5-HT3 antagonists, corticosteroids, NK-1 receptor antagonists, anticholinergics, antihistamines, and 5-HT3 antagonists. The primary outcome was PONV incidence within 24 hours, whereas the secondary outcomes included nausea and vomiting. This meta-analysis evaluated the effectiveness of various pharmacologic treatments for preventing PONV in surgical patients. Additionally, the Newcastle–Ottawa Scale (NOS) and the Cochrane risk of bias assessment tool were used to evaluate the risk of bias of the included studies, whereas a funnel plot was used to assess the risk of publication bias. This comprehensive data extraction ensures a robust evaluation of the efficacy of PONV prevention interventions in the surgical setting.

2.4. Statistical Analysis

To analyze the data, RevMan software version 5.1.2 was used. Risk ratios (RRs) for categorical outcomes were calculated with 95% confidence intervals (CIs) via a random effects model. The heterogeneity of the studies basis of the Q test and I^2 statistic. These levels was assessed and categorized into four levels, namely, low, moderately low, moderately high, and high, on the corresponded to the following ranges: 0% to <25%, 25% to <50%, >50% to <75%, and >75%, respectively. The results are presented via forest plots with 95% CIs. A p value of less than 0.05 was considered statistically significant. The Newcastle–Ottawa Scale (NOS) was used to assess the quality of observational studies, while the Cochrane risk of bias tool was used to evaluate randomized controlled trials (RCTs).

3. RESULTS

Table 1 shows the publications included in the review; each study evaluation compared different medications used for preventing postoperative nausea and vomiting following general anesthesia in adults. The included studies spanned diverse regions, with sample sizes ranging from 47 to 3,140 participants. The study designs included randomized controlled trials (n = 19) and prospective cohort studies (n = 2). All the studies included were conducted in different regions across the globe: two in Belgium; two in Germany; three in China; two in Korea; two in the USA; and one each in Japan, Austria, the Netherlands, Chicago, Brazil, Indonesia, Thailand, India, Iran, Canada, and France. The articles were all published in the English language. A total of 8654 participants were included in the research; the study with the smallest sample size had 47 participants, whereas the study with the greatest sample size had 3140 participants. Various medications intended to reduce postoperative nausea and vomiting in adults after general anesthesia were employed as interventions in all the studies.

Table 1: Characteristics of the studies included in the systematic review

Authors	Country/ Region	Design of Study	Sample	Inclusion Criteria	Intervention Characteristics	Outcome
Boogaerts et al., 2000[14]	Belgium	A nonrandomized, observational, open, prospective, interventional study	1132	For elective surgery, patients who are at least 15 years old and are literate in French were admitted to the hospital	Because tropisetron has a longer half-life than other 5-HT3-antagonists, the trial assessed how well it prevents PONV in high-risk adult inpatients having elective surgery	Prophylactic tropisetron can lower the incidence of vomiting episodes and postoperative nausea (VAS ratings) inn high-risk inpatients undergoing surgery, if the patient requests it or the physician determines it is needed
Fujii et al., 1995[15]	Japan	Randomized, double-blind trial	100	One hundred female patients with ASA physical status I or II, ages 23 to 67, who were scheduled for major gynecological surgery and gave their informed consent participated in study	Prior to anesthesia, patients received a single, randomized, double-blind IV dosage of either granisetron, droperidol or a placebo	Postoperative nausea and vomiting were less common in individuals treated with granisetron, droperidol 1.25 mg, or droperidol 2.5 mg than in those treated with a placebo. There were no variations in side

						effects or awakening times. Extrapyramidal effects were linked to droperidol.
Greif et al., 1999[16]	San Francisco, Austria	Randomized double-blind trial	231	Patient aged 18-80 without prior history of fever, infection, obesity, antiemetic drugs or emesis who were not included in study	30% and 80% of supplementation was given to the first and second groups, respectively	Oxygen administration reduced postoperative nausea or vomiting by 43% after colorectal surgery, possibly due to subtle intestinal ischemia, although mechanism remains unknown
Leeser et al., 1991[17]	Netherlands	Randomized, double-blinded trial	84	General anesthesia is used to schedule abdominal gynecologic procedures for individuals between ages of 18 and 65	Given 10mg of diazepam orally, with exception of one patient and 16mg of ondansetron or a placebo one hour prior to surgery, followed by a second dosage eight hours later	Patients who received ondansetron treatment experienced a significant decrease in nausea and vomiting and there were no adverse effects associated with the study drug
Rothenber et al., 1991[18]	Chicago	A double-blind, randomized, prospective study	97	Individuals in physical state I or II	Patients who were given a standardized general anesthetic, ephedrine, droperidol, or saline intramuscularly prior to surgery; there were no changes in their weight, age or length of anesthesia	It was discovered that droperidol and ephedrine were equally effective at reducing nausea and vomiying and that patients needed less antiemetic medication throughout the recovery phase
Wallenbor et al., 2006[19]	Germany	Randomized controlled trial with double blinding	3140	Patients who are 18 years of age or older need regional or balances anesthesia for procedures including arthroscopy, otolaryngological surgery, thyroidectomy, cholecystectomy, herniotomy, hysterectomy, or total knee or hip replacement	Patients were randomized to receive metoclopramide and dexamethasone intravenously 30-60 minutes before surgery or immediately after anesthesia. In the event of nausea and vomiting, a rescue medication of 12.5 mg dolasetron or 62 mg diphenhydrate was administered.	A lower dose of 25 mg with postoperative prophylaxis may be just as effective as 50 mg metoclopramide plus 8 mg dexamethasone in preventing postoperative nausea and vomiting.
Rusch et al., 2007[20]	Germany	Randomized double-blind trail	242 Analysis involved 228	Individuals who were scheduled for elective treatments under general anesthesia and ranged in age from 18 to 75	Random assignment was used to allocate patients to receive either dexamethasone and dolasetron/haloperidol or a placebo	The combination of dexamethasone and haloperidol is more effective in treating PONV because it increases their anti-emetic activity. It is a minor option, though
Grigio et al., 2023[21]	Brazil	Randomized, prospective, parallel-group, placebo-controlled trial	100	patients aged 18-60 from ICESP, Brazil, who underwent major surgery related to their cancer, had a history of chemotherapy-induced nausea and vomiting, and were at high risk of PONV	Patients were given 10 mg olanzapine or placebo before surgery, with total intravenous anesthesia, dexamethasone, and ondansetron administered post induction and post surgery	The olanzapine group had a lower incidence of PONV in the first 24 hours post-operatively (26%) compared to the control group (63%). This medication can cause symptoms such as dry mouth, itchiness, sleepiness, hypotension, headache, restlessness, anxiety, sleep disturbance, dizziness, urinary

						retention, akinesia, akathisia, dyskinesia, dystonia, and drug-induced muscle rigidity
Yan et al., 2023[22]	China	Prospective, randomized controlled single-center study	212	For gynecological surgery under total intravenous anesthesia, women aged 18–65 who had a history of PONV, were nonsmokers, and had used opioids after surgery were suitable. The surgery was expected to last at least one hour	Patients in a combination group received acupuncture and ondansetron, while the control group received only ondansetron	Along with a decrease in postoperative pain, acupoint discomfort, stomach pain, and skin rash, the combination group also demonstrated a decreased incidence of postoperative nausea within 24 hours following surgery
Cho et al., 2022[23]	South Korea	Retrospective observational study	1699	Individuals between the ages of 30 and 90 who had peripheral vascular surgery performed under general anesthesia for end-stage renal disease (ESRD)	A target-controlled infusion system was used to maintain anesthesia in a patient undergoing a procedure that involved lidocaine, propofol, remifentanil, and a volatile anesthetics group	Due to longer anesthetic durations and larger intraoperative crystalloid infusion volumes, the incidence of PONV was greater in the volatile group and PACU than in the TIVA group. Nevertheless, no noteworthy distinctions between the two groups were discovered
Heriwardito et al., 2022[24]	Indonesia	Randomized double-blind clinical trial	80	Computer-based randomization was used to evaluate the patients, and they were divided into two groups. One hour prior to surgery, Group A received 5 mg of dexamethasone, while Group B received 1 mg of haloperidol	Patients in Group A received 5 mg intravenous dexamethasone after induction, while in Group B, 1 mg intravenous haloperidol was administered one hour before surgery	After laparoscopic surgery, haloperidol and dexamethasone have a significantly different incidence of nausea; haloperidol causes no adverse effects 24 hours after surgery and lower VAS pain scores
Wongyingsinn et al., 2022[25]	Thailand	Prospective randomized controlled study	156	ASA physical status 1 to 3 patients, ages 18 to 70	For fifteen minutes before to surgery, patients in the fluid group got intravenous Ringer's lactate solution and ondansetron, while the control group received no therapy at all	The incidence of PONV within 24 hours after the operation and the duration of hospital stay post operation
Zhong et al., 2019[26]	China	Randomized, single-blind, placebo-controlled study	110	The American Society of Anesthesiologists grade I or II must be met by patients with osteoarthritis between the ages of 55 and 80 who match the diagnostic criteria of the 1995 American College of Rheumatology and are undergoing unilateral total knee arthroplasty (TKA) under general anesthesia without any surgical contraindications	Patients will receive three daily treatments of acupuncture analgesia between 24 and 72 hours following surgery	Primary outcomes include knee function, postoperative pain, edema, anxiety, nausea, and vomiting; secondary outcomes require extra opioids and analgesics

Lee et al., 2015[27]	Memphis, Tennessee, USA	Randomized, double-blinded, placebo-controlled clinical trial	47	One gynecologic oncologist is doing robotic-assisted gynecologic surgery cases on women	An adhesive bandage was applied over a transdermal scopolamine patch in the experimental group, while the bandage was the only treatment given to the control group	The study assessed the severity of nausea and vomiting postoperatively, antiemetic use, discharge time, patient's PONV well-being, and overall patient well-being
Xu et al., 2020[28]	China	Randomized Controlled Trial	98	Included were patients with idiopathic TN (ITN) who met grades I and II of the American Society of Anesthesiologists (ASA)	A group of 50 patients received a patient-controlled intravenous analgesia (PCIA) pump, whereas another group of 48 patients had a drug–drug interaction	PONV incidence and severity 72 hours post-operatively, along with opiate intake, sedation, and pain intensity
Aasim et al., 2020[29]	India	Double-blind, randomized controlled trial	100	Individuals aged 18 to 65 who are scheduled for elective general anesthesia LC, are nonsmokers, and are classified as grade I or II by the American Society of Anesthesiologists (ASA)	Before being put under anesthesia,patients in groups A and B were given 500 milliliters of lactated Ringer's solution along with 5% dextrose	The T1 and T2 groups showed significant differences in nausea and vomiting scores before and after surgery ($P < 0.05$)
Emami et al., 2018[30]	Iran	Single-blind randomized controlled trial	140	Patients who had laparoscopic cholecystectomy ranged in age from 20 to 70	Two groups of patients were created: one group received 5 mL of normal saline intravenously after surgery, and the other group received 8 mg of dexamethasone intravenously after surgery and before to extubation	For patients having laparoscopic cholecystectomy, dexamethasone dramatically decreased postoperative pain and nausea (POP). Because of its low cost and capacity to treat mild to severe pain, it is a recommended antiemetic medication
Shanthanna et al., 2019[31]	Canada	Randomized controlled trial	402	Patients with moderate to severe pain who were fluent in English and between the ages of 18 and 70 underwent elective day operations	Morphine versus hydromorphone	An OR of 1.00 indicated that the groups' chances of reaching SAME were comparable. Sedation and severe itching were similar in only 13 and 7 patients, respectively
Beloeil et al., 2019 [32]	France	A multicenter, prospective, double-blind, randomized controlled clinical trial	237	Patients over 18 years old, with a social security system, who planned surgery requiring morphine PCA for postoperative pain, and who provided written informed consent	Ketoprofen, paracetamol, and nefopam. During the first 48 hours following surgery, patients got their daily doses of each medication intravenously four times a day	The PNK group consumed significantly less morphine over 24 hours than the C and N groups, experienced less pain 48 hours after surgery, and had no change in morphine-related side effects
Bang et al., 2017[33]	Korea	Double-blind, randomized, placebo-controlled study	87	ASA physical status I-II female patients aged 20–49	Before anesthesia, 30 minutes prior to surgery, and 30 minutes following surgery, they were given a combination of palonosetron and regular saline. A nurse who was not participating in the study prepared the drugs.	Ramosetron and palonosetron have shown equally effective preventative effects against PONV as prophylactic therapy. Patients in the ramosetron group experienced mild headache and dizziness, but the

						results did not reach statistical significance.
Bharti et al., 2020[34]	Belgium	Randomized controlled double-blind trial	160	ASA physical status I-II female patients, aged 19–60	Propofol, fentanyl, and oxygen-maintained N2o-isoflurane	For PONV prophylaxis, the combination of dexamethasone and palonosetron is more effective than Ondansetron and palonosetron alone. However, for patients at moderate risk, palonosetron 0.150 mg does not significantly improve above 0.075mg
PONV represents postoperative nausea and vomiting. POP for pain and nausea, anesthesiologists (ASA), PNK (polynucleotide kinase), the odds ratio (OR-OR), pain and nausea (POP), the visual analog scale (VAS), total knee arthroplasty (TKA), the postanesthesia care unit (PACU), total intravenous anesthesia (TIVA), and end-stage renal disease (ESRD) are some examples of patient-controlled intravenous analgesia (PCIA) and PCA.						

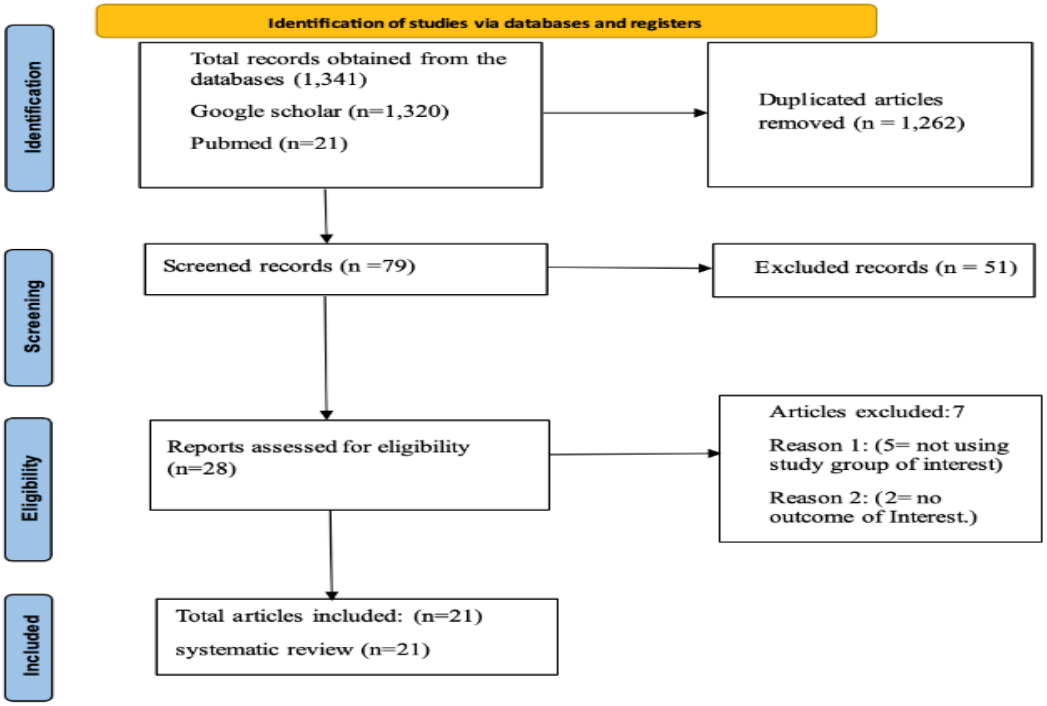

Figure 1The PRISMA flow diagram

The literature search yielded a total of 1,341 articles, with 21 from PubMed and 1,320 from Google Scholar. After excluding 1,262 duplicates, 79 unique articles remained for title and abstract screening. Fifty-one publications were eliminated throughout this screening process because they did not fit the inclusion criteria or were unrelated to the topic. The PRISMA flow diagram describing the study selection procedure is shown in Figure 1. All the texts of the remaining 28 articles were used to determine their eligibility. Seven articles were excluded during this review because they either did not focus on the levant research group (n = 5) or failed to report key results (n = 2). In the end, 21 papers were included in the study after meeting the predetermined inclusion criteria: systematic reviews (n = 21) and meta-analyses (n = 19).[14-34] (See Figure 1).

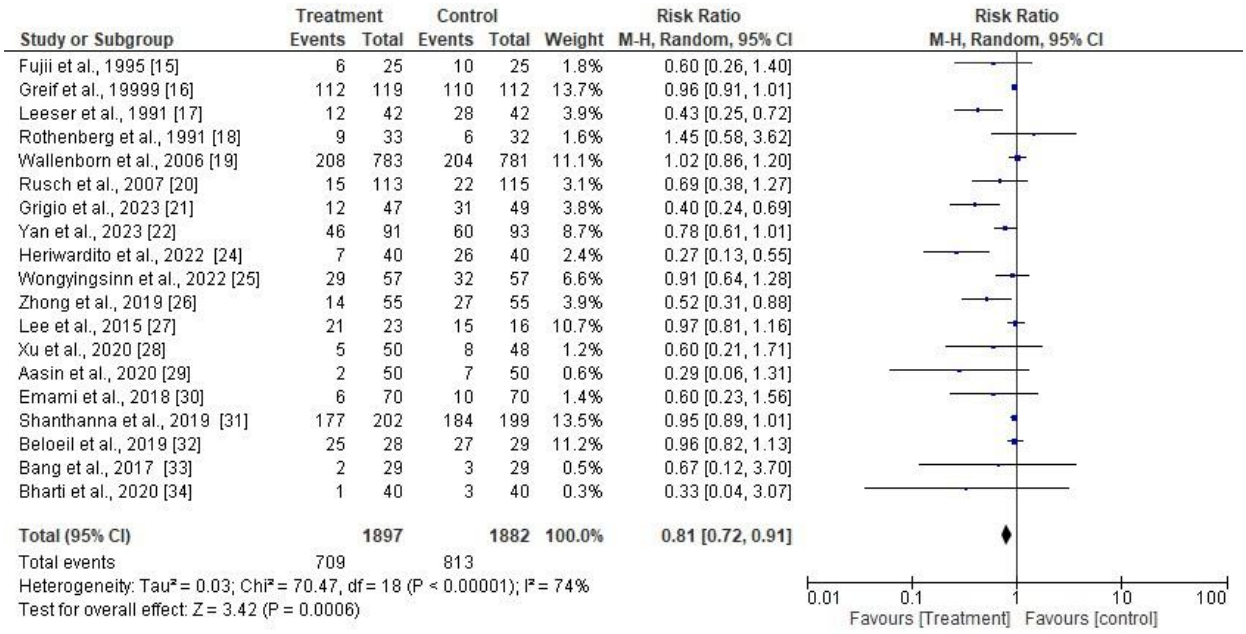

Figure 2. Efficacy of the interventions in preventing PONV

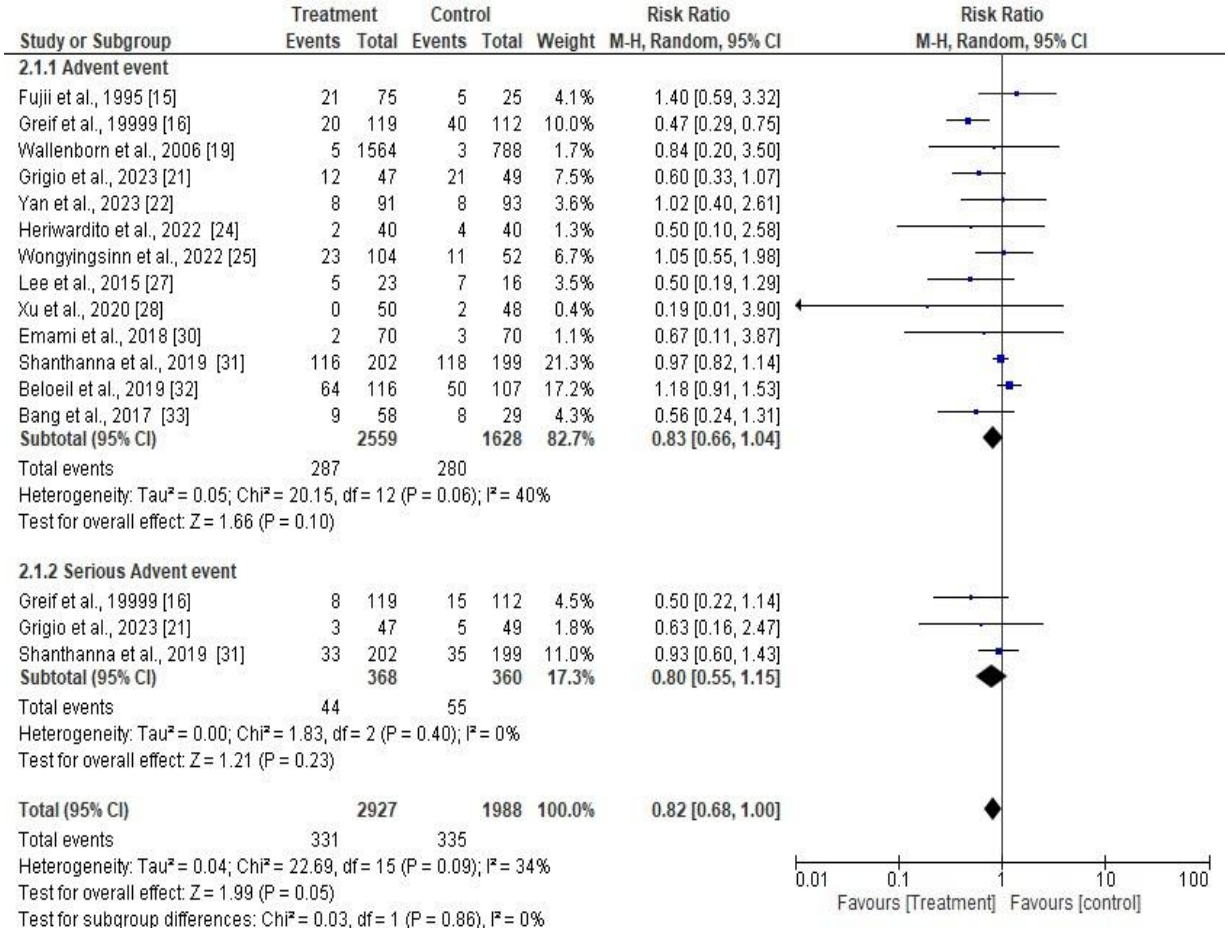

Figure 3. Overall advent event and serious advent reported.

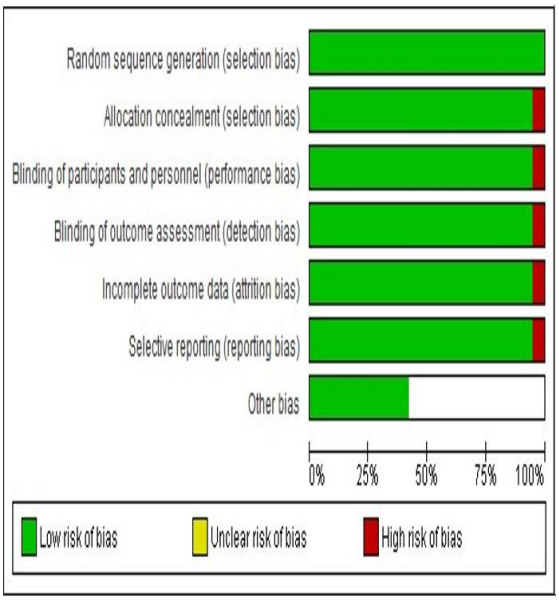

Figure 4: Summary of critical appraisal of included RCTs using the Cochrane risk of bias assessment tool

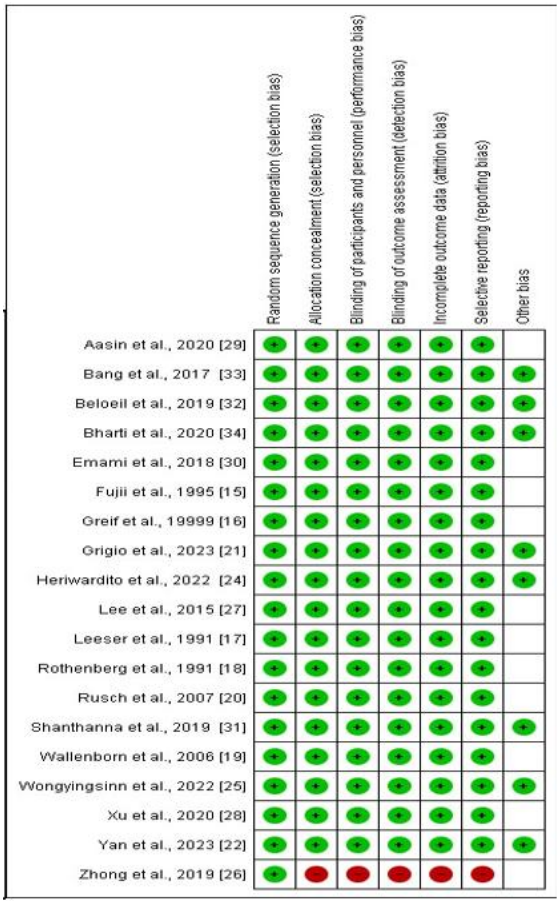

Figure 4 shows that eight studies had a low risk of bias.[21, 22, 24,25, 31-34] On the other hand, ten studies had an unclear risk of bias,[15-20,27-30] whereas only one study had a high risk of bias attributed to selection, performance, detection, attrition and reporting.[26] However, generally, most of the studies 18/19 were of good quality.

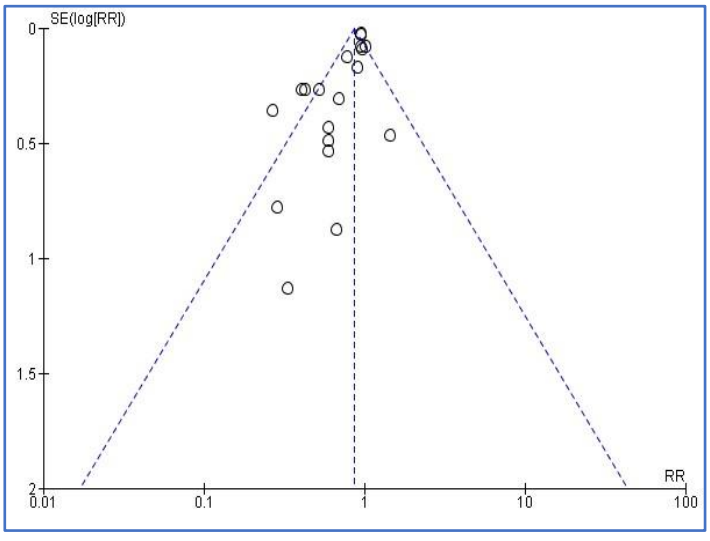

Figure 5. Funnel plot assessment of the risk of publication bias.

Figure 5 shows an asymmetric funnel plot, indicating the nce of outliers and a greater number of studies on

he left side than on the right. The clustering of studies on the left suggests potential publication bias, possibly favoring the intervention group, as studies showing positive results may have been more likely to be published.

4. DISCUSSION

PONV is a significant challenge in perioperative care among adults who are receiving general anesthesia.[2] Despite recent advancements in pharmacological prevention, uncertainty persists regarding the optimal medication or the right combination of medications to effectively reduce the incidence of PONV.[5] This study employed a meta-analysis to investigate the effectiveness of ious medications in reducing postoperative nausea and vomiting (PONV) in patients who underwent general anesthesia. The results revealed a risk ratio (RR) of 0.33 (95% CI 0.04--

3.07), with an I^2 of 74% (P = 0.00001), indicating considerable heterogeneity among the studies and suggesting variability in the trial outcomes. Boogaerts et al. revealed that prophylactic use of tropisetron significantly reduced PONV in high-risk patients.[14] Another study by Fujii et al. revealed that patients who received granisetron, droperidol (1.25 mg and 2.5 mg), or a placebo had a lower incidence of PONV. However, droperidol is associated with extrapyramidal symptoms, and there are no significant differences in awakening times or side effects.[15]

Despite significant variation between the studies, a statistically significant P value of 0.0006 indicated that the therapies were generally effective in preventing postoperative nausea and vomiting (PONV). A study by Greif et al. revealed that oxygen treatment reduced PONV by 43% following colorectal surgery, which could be due to possible alleviation of mild intestinal ischemia, although the precise mechanism remains unclear.[16] The use of oxygen as a preventive measure for PONV is particularly interesting, as it suggests that improving tissue oxygenation during the postoperative period may help reduce the risk of nausea and vomiting, which are thought to be linked to decreased gut motility and ischemia. Additionally, a study by Leeser et al. revealed that ondansetron significantly reduced nausea and vomiting in patients without causing any adverse drug side effects.[17]

The study also revealed low heterogeneity for both severe adverse events (I^2 = 0%, RR = 0.80, 95% CI 0.55–1.15) and adverse events (I^2 = 40%, RR= 0.83, 95% CI 0.66–1.04), indicating consistent results across studies for these outcomes. This shows that the occurrence of adverse events was relatively consistent across the trials, with no significant variations in how these events were reported. The low heterogeneity further suggests that these interventions are safe and have predictable outcomes across different populations. According to research by Rothenberg et al., droperidol and ephedrine were similarly effective at reducing nausea and vomiting, with fewer patients requiring additional antiemetic treatment after surgery.[18]

Additionally, Wallenborn et al. demonstrated that a combination of 50 mg metoclopramide and 8 mg dexamethasone effectively prevented PONV, whereas a lower dose of 25 mg metoclopramide showed comparable efficacy.[19] These findings imply that the interventions employed were generally successful in preventing PONV in most cases.

The study further revealed that there was no statistically significant variation in either serious adverse events (P = 0.23) or adverse events (P = 0.10) among the studies. Rusch et al. reported that the combination of dexamethasone and haloperidol is more effective in treating PONV because it has increased antiemetic effects, although it is still a moderate therapeutic option.[20] Grigio et al. reported that olanzapine reduced the incidence of PONV during the first 24 hours following surgery (26% in the treated group vs. 63% in the control group), although it was associated with side effects such as dry mouth, sleepiness, dizziness, and other symptoms.[21] According to Yan et al., combination therapy decreases the incidence of postoperative nausea within 24 hours and relieves skin rash and pain, including postoperative, acupoint, and abdominal pain.[22]

The reviewed papers provide a wealth of information regarding the incidence and management of postoperative nausea and vomiting (PONV). Although no significant differences were found between the two groups, Cho et al. reported that the incidence of PONV was greater in the volatile anesthetic group than in the TIVA group, despite longer anesthesia durations and larger intraoperative crystalloid volumes.[23] According to Heriwardito et al., haloperidol was better than dexamethasone at reducing nausea after laparoscopic surgery, lowering VAS pain levels and having no negative side effects after 24 hours. According to the meta-analysis results, 1 mg intravenous haloperidol was more efficacious than 5 mg intravenous dexamethasone was (RR = 0.27, 95% CI 0.13–0.55).[24] Wongyingsinn et al, reported fewer instances of PONV and shorter hospital stays after surgery.[25] For secondary outcomes, further opioid use was documented, whereas Zhong et al. reported pain, nausea, and knee function.[26] Lee et al. reported that the use of antiemetic drugs led to improved postoperative patient outcomes and quicker discharge times.[27]

Xu and colleagues noted alterations in pain levels, sedation, and opioid intake with patient-controlled analgesia.[28] Finally, Aasim and colleagues reported that pre- and postoperative nausea and vomiting scores were significantly different between two groups that received various intravenous solutions before anesthesia, with the T1 group having lower values.[29]

Important information about various strategies for preventing postoperative nausea and vomiting (PONV) was provided by the analyzed studies. According to Emami et al., dexamethasone is a suggested and reasonably priced antiemetic with the added advantage of pain treatment because it dramatically decreases PONV in patients with laparoscopic cholecystectomy.[30] With few variations in adverse effects, such as intense itching and drowsiness, Shanthanna et al. reported that the chances of obtaining identical analgesic effects (SAME) were comparable across treatment groups.[31] Compared with other groups, Beloeil et al. reported that patients in the PNK group had no increase in morphine-related adverse effects, lower morphine use over a 24-

hour period, and reduced pain 48 hours after surgery.[32] Ramosetron and palonosetron were reported to be similarly effective at preventing PONV by Bang et al., although the Ramosetron group experienced slight headaches and dizziness; however, the results were not statistically significant.[33] Finally, Bharti et al. reported that 0.150 mg of palonosetron did not significantly improve the risk of moderately high-risk patients over 0.075 mg and that the combination of dexamethasone and palonosetron was more beneficial than either medication alone.[34] This is a clear indication that there is variation in the effects of various medications on preventing PONV.

The current meta-analysis included a larger number of patients, and studies have been carried out in the past in this context to date. However, the study had the following limitations: the study was unable to search for potential studies from the EMBASE database because of limited access to the database. However, all the studies included access to general anesthetics to reduce PONV. Another limitation is that the studies included did not concentrate on similar interventions for the treatment and control groups. However, to address the research objective, the analysis focused on the overall efficacy of each study intervention. Therefore, precautions should be taken when interpreting the findings of this study.

5. CONCLUSIONS

The studied interventions effectively reduced the incidence of PONV, highlighting their general utility in perioperative care. However, variations in the relative efficacy of these interventions suggest that context-specific factors such as patient risk profiles are at play. Specifically, 1 mg intravenous haloperidol was found to be more effective than 5 mg intravenous dexamethasone and other interventions used in other studies. However, generally, it can be concluded that all the interventions used in general anesthesia were successful in lowering PONV among adults. To confirm the results of this study, future research should focus solely on a particular intervention and comparator medication while considering the cost effectiveness of the medication.

6. Conflict of interest

The authors declare that they have no competing interests.

7. Funding

This research received no external funding.

8. Ethical approval

Not applicable.

9. Data availability

Data available upon request to the corresponding author.

10. Author contribution

All authors took equal part in data search and manuscript preparation.

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