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ORIGINAL STUDY

Prevention of Postoperative Nausea and Vomiting in Early Recovery: A Comparative Study of Ondansetron and Metoclopramide in Adults Undergoing Elective Lower Abdominal Surgery

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ABSTRACT

Postoperative nausea and vomiting (PONV) remain common complications following surgery, despite the availability of various prophylactic antiemetic agents. This study aimed to compare the effectiveness of ondansetron and metoclopramide in preventing PONV in patients undergoing elective lower abdominal surgery under general anesthesia. In this double-blind, randomized controlled trial, 80 adult patients were equally allocated into two groups: one receiving 0.1 mg/kg of intravenous ondansetron and the other 0.2 mg/kg of intravenous metoclopramide at the end of surgery. The incidence, frequency, and need for rescue antiemetics were evaluated over 24 hours postoperatively. The overall incidence of nausea was higher in the ondansetron group (65%) compared to the metoclopramide group (52.5%), though not statistically significant ($p = 0.071$). Conversely, ondansetron was associated with a lower incidence of vomiting (47.2% vs. 52.8%) and significantly reduced need for rescue antiemetic therapy (38.1% vs. 61.9%, $p = 0.023$). Age group analysis revealed significantly higher PONV incidence among patients aged 20–39 years ($p < 0.001$). Gender and BMI were not predictive of nausea or vomiting occurrence but were associated with symptom recurrence. Although both agents were effective for PONV prophylaxis, ondansetron demonstrated clinical advantages by reducing vomiting frequency and the need for rescue therapy. Younger age was identified as a significant risk factor for PONV. These findings support the preferential use of ondansetron, particularly in high-risk patients, and emphasize the value of individualized prophylactic strategies.

Keywords: Postoperative nausea and vomiting, Antiemetic, Postoperative recovery, Ondansetron, Metoclopramide, Biology

1. Introduction

Postoperative nausea and vomiting (PONV) remain among the most common and distressing complications following anesthesia and surgery [1]. PONV is a complex physiological process involving multiple neurophysiological pathways and both central and peripheral receptor mechanisms [2]. The primary control center for nausea and vomiting is in the medulla oblongata, specifically within the vomiting center [3]. Multiple afferent pathways can activate this center, including inputs from the chemoreceptor trigger zone (CTZ) [4], the vagal mucosal pathway of the gastrointestinal tract, the cerebral cortex,

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the vestibular system, and midbrain structures [5]. These pathways communicate through a variety of neurotransmitter receptors, cholinergic (muscarinic), dopaminergic, histaminergic, and serotonergic, each of which may serve as a therapeutic target in the prevention or treatment of PONV, for example after oral carbohydrate loading [6].

A wide range of pharmacologic agents are currently available to manage PONV. These include 5-hydroxytryptamine type 3 (5-HT3) receptor antagonists [7]; (e.g., ondansetron, granisetron, palonosetron), neurokinin-1 (NK-1) receptor antagonists (e.g., aprepitant), corticosteroids (e.g., dexamethasone), butyrophenones (e.g., droperidol), dopamine antagonists (e.g., metoclopramide and phenothiazines), antihistamines (e.g., dimenhydrinate), and anticholinergics (e.g., scopolamine) [8]. Among these, droperidol, dexamethasone, and ondansetron are considered standard options due to their well-established efficacy when used for prophylaxis [9].

Metoclopramide is one of the most frequently used agents for the treatment of PONV, especially when prophylactic regimens involving 5-HT3 antagonists or droperidol are ineffective [10]. Although high doses of metoclopramide (e.g., 0.5–1 mg/kg), commonly used in oncology, are associated with extrapyramidal side effects, the lower doses typically administered in the perioperative setting (5–10 mg) are generally well tolerated. A systematic review supports the efficacy and safety of 10 mg metoclopramide for the prophylaxis of early PONV, particularly in obstetric populations undergoing cesarean delivery under neuraxial anesthesia [11]. This is supported and updated by Heckroth M in 2021 [12].

Ondansetron, a selective 5-HT3 receptor antagonist, is widely used to prevent nausea and vomiting associated with chemotherapy, radiotherapy, and surgery [13]. Although generally well tolerated, higher doses of ondansetron (e.g., 32 mg IV) have been linked to QT interval prolongation and an increased risk of torsade de pointes, a potentially fatal arrhythmia. However, this risk appears minimal at lower doses typically used for postoperative prophylaxis (4–8 mg), which suggests that ondansetron remains a safe and effective choice for managing PONV in the surgical setting [14]. Despite the widespread use of ondansetron and metoclopramide for postoperative nausea and vomiting prophylaxis, direct comparisons between these agents in a uniform perioperative setting remain limited. Most previous studies have evaluated these drugs within multimodal regimens or across heterogeneous surgical populations and anesthesia techniques, leading to inconsistent conclusions regarding their relative efficacy. In particular, randomized controlled trials directly comparing ondansetron and metoclopramide in adults undergoing elective lower abdominal surgery under general anesthesia are scarce. The present study was therefore designed to address this gap by providing a focused head-to-head comparison of these two agents under standardized surgical and anesthetic conditions, with emphasis on early postoperative outcomes and the need for rescue antiemetic therapy.

2. Patients and methods

This double-blind, randomized controlled trial was conducted at Al-Hussein Teaching Hospital between October 15, 2021, and April 15, 2022, following approval by the institutional ethics committee. The study included 80 patients of both sexes, aged 18 to 60 years, classified as American Society of Anesthesiologists (ASA) physical status I or II, and scheduled for elective lower abdominal surgeries as shown in Fig. 1. Written informed consent was obtained from all participants. The study protocol adhered to the ethical principles outlined in the Declaration of Helsinki.

A priori sample-size estimation was performed for the primary outcome (incidence of postoperative nausea and/or vomiting within 24 h). The calculation was based on comparing two independent proportions (ondansetron vs metoclopramide), with a two-sided $\alpha = 0.05$ and power $(1-\beta) = 0.80$.

Based on published data in similar lower abdominal surgery populations receiving prophylactic antiemetics, we assumed the incidence of PONV would be approximately 25% in the ondansetron group and 55% in the metoclopramide group (absolute risk reduction 30%). Using these assumptions, the required sample size was $\approx$ 38 participants per group. To compensate for potential dropouts/non-evaluable patients ($\sim$5%), we increased the target enrollment to 40 per group, yielding a total sample size of 80 patients.

Exclusion criteria included patients with known cardiopulmonary, gastrointestinal, neurologic, or psychiatric disorders; history of alcohol or substance abuse; known hypersensitivity to study medications; BMI greater than 30 kg/m^2; or refusal to participate in clinical research. All patients underwent a comprehensive preoperative medical evaluation. Preoperative fasting was initiated six hours prior to surgery, with clear fluids permitted up to two hours before anesthesia induction. Participants were randomly assigned in a 1:1 ratio into two equal groups (n = 40 each) based on the antiemetic prophylaxis to be administered as shown in Fig. 1:

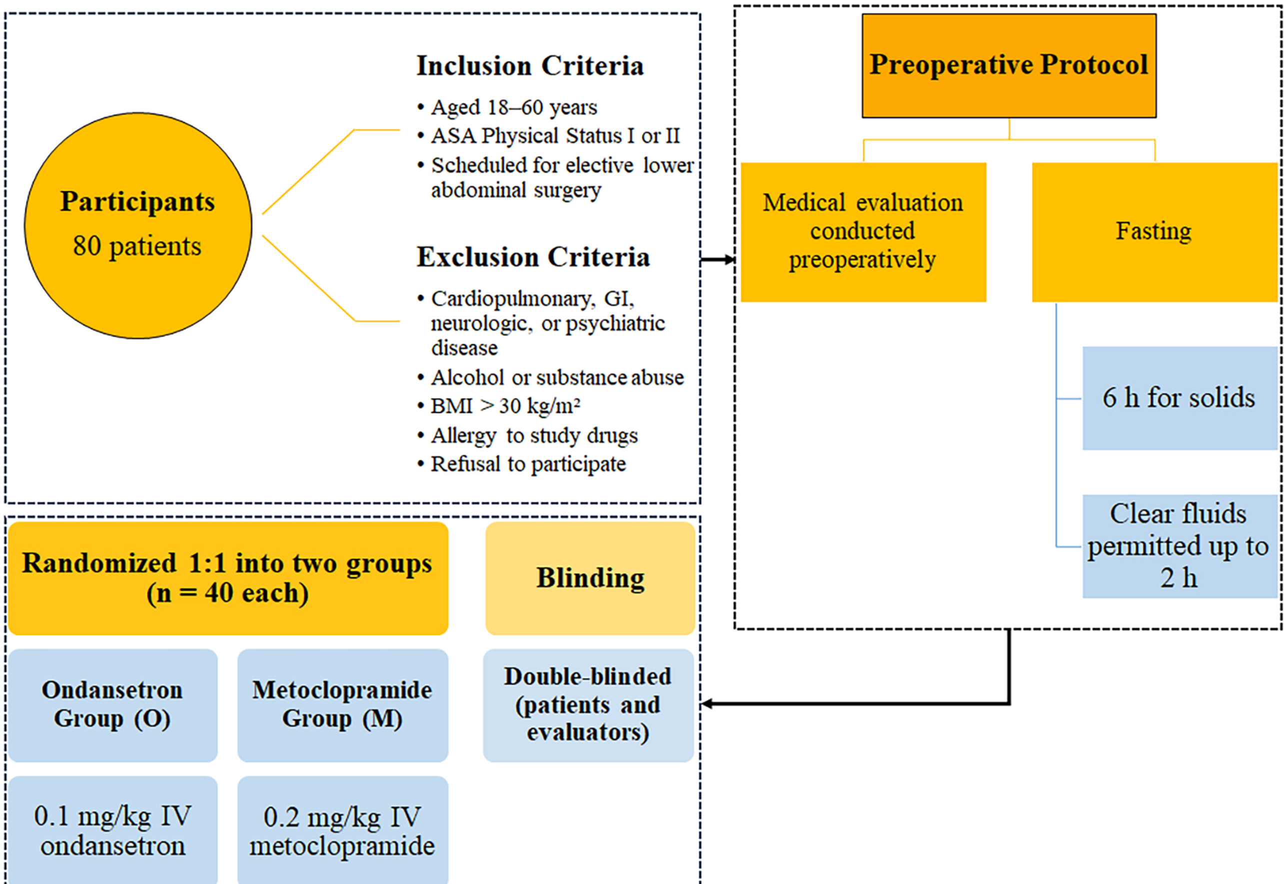

Fig. 1. Infograph illustrates the design and participant flow of a double-blind, randomized controlled trial conducted at Al-Hussein Teaching Hospital to compare the prophylactic efficacy of ondansetron and metoclopramide in preventing PONV.

1. Ondansetron Group (O): Patients received 0.1 mg/kg of intravenous ondansetron.
2. Metoclopramide Group (M): Patients received 0.2 mg/kg of intravenous metoclopramide.

Randomization and blinding were maintained throughout the study to ensure objectivity in treatment administration and outcome assessment.

3. Results and discussion

A total of 97 patients were initially assessed for eligibility. Of these, 17 patients were excluded from participation; 10 did not meet the inclusion criteria and 7 declined to participate. The remaining 80 patients were randomized equally into two groups: the Metoclopramide group ($n = 40$) and the Ondansetron group ($n = 40$). All randomized patients completed the study and were included in the final analysis.

Baseline demographic and clinical characteristics of the patients are presented in Table 1. There were no statistically significant differences between the metoclopramide and ondansetron groups with respect to age, sex distribution, body mass index, ASA physical status, type of surgery, or duration of surgery ($p > 0.05$ for all), indicating that the two groups were comparable before intervention.

3.1. Incidence of nausea and vomiting

As shown in Table 2, the incidence of nausea was higher in the ondansetron group (65%) compared to the metoclopramide group (52.5%), though this difference did not reach statistical significance ($p = 0.071$). Interestingly, Table 3 reveals that ondansetron was associated with a lower incidence of vomiting (47.2%) than metoclopramide (52.8%), yet again without statistical significance ($p = 0.203$). These findings suggest a nuanced difference in the clinical effects of the two agents: ondansetron may be more effective in suppressing the emetic reflex (vomiting), while metoclopramide may offer slightly better control over nausea perception this aligns with the recent findings by Wills et al. [15]. Although these trends did not reach statistical significance, they may still hold clinical relevance particularly in patient

Table 1. Baseline clinical and demographic characteristics of the study groups.

Variable	Metoclopramide (n = 40)	Ondansetron (n = 40)	P value
Age (years)	38.6 ± 10.4	37.9 ± 9.8	0.74
Sex (male/female)	18/22	17/23	0.82
BMI (kg/m^2)	26.1 ± 2.8	25.7 ± 2.9	0.56
ASA physical status (I/II)	21/19	23/17	0.65
Type of surgery			0.88
• Gynecological	16 (40%)	17 (42.5%)	
• General lower abdominal	24 (60%)	23 (57.5%)	
Duration of surgery (min)	78.4 ± 15.6	76.9 ± 14.8	0.63

Table 2. Chi-Square tests of nausea according to antiemetic agent.

	Non- Nausea		Nausea		Total	
Cases & Agent	NO.	%	NO.	%	NO.	%
Metoclopramide	19.0	47.5	21.0	52.5	40.0	100
Ondansetron	14.0	35.0	26.0	65.0	40.0	100
Total	33.0	41.3	47.0	58.7	80.0	100
P. value		0.071			df:1	

Table 3. Chi-Square tests of vomiting according to antiemetic agent.

	Non-Vomiting		Vomiting		Total	
Antiemetic Agent	NO.	%	NO.	%	NO.	%
Metoclopramide	12.0	44.4	28.0	52.8	40.0	100
Ondansetron	15.0	55.6	25.0	47.2	40.0	100
Total	27.0	100	53.0	100	80.0	100
P. value		0.203			df:1	

populations where minimizing vomiting is a priority [16]. The lack of significance could be attributed to sample size limitations or symptom variability, indicating a need for further studies with larger cohorts to confirm these observations.

3.2. Nausea frequency and timing

Detailed analysis of nausea incidence by frequency (Table 4) revealed important distinctions. While the incidence of single-episode nausea did not differ significantly between groups ($p = 0.689$), patients in the ondansetron group experienced significantly more two-time episodes ($p = 0.005$). Notably, there were no cases of three-time nausea episodes in the ondansetron group, whereas two such episodes occurred in the metoclopramide group [17]. Detailed analysis of nausea frequency showed no significant difference between groups when episodes were categorized as one episode versus recurrent nausea (≥2 episodes) (Fisher's exact test, $p = 0.772$). In the original unmerged categories, three-episode nausea occurred in only two patients (both in the metoclopramide group), therefore this category was not analyzed separately to avoid unstable estimates and violation of chi-square assumptions.

3.3. Age-related patterns

As shown in Tables 5 and 6, age group analysis revealed a significantly higher incidence of nausea among patients aged 20–39 years, who accounted for more than 76% of all nausea cases across both treatment groups ($p < 0.001$). This statistically significant association suggests that younger adults are more susceptible to postoperative nausea, regardless of the antiemetic agent administered. The increased risk in this age group may be attributed to heightened chemoreceptor sensitivity, hormonal influences, or psychological factors such as anxiety, which are more prevalent among younger patients. These findings underscore the importance of age-based risk stratification when planning PONV prophylaxis and highlight the potential benefit of more aggressive or multimodal antiemetic strategies in younger adult populations.

3.4. Gender and BMI influence

Gender-based analysis (Table 7) showed that females experienced a slightly higher frequency of repeated nausea and vomiting episodes compared to males [18]. Although overall incidence differences between genders were not significant, the number of repeated events was statistically significant

Table 4. Chi-Square tests of nausea according to incidence time.

Group	1 episode n (%)	≥2 episodes n (%)	Total (nausea cases)
Metoclopramide	11 (52.4)	10 (47.6)	21
Ondansetron	12 (46.2)	14 (53.8)	26
P value (between groups)	*	0.772	

Table 5. Incidence of postoperative nausea according to age groups.

Age group (years)	Total patients in age group (n)	Patients with nausea (n)	Incidence of nausea (%)
< 20	n_1	1	$(1/n_1) \times 100$
20–39	n_2	36	$(36/n_2) \times 100$
40–59	n_3	10	$(10/n_3) \times 100$
Total	80	47	58.8

Table 6. Chi-Square tests of nausea according to age groups.

	1		2		3		Total	
Age Groups	NO.	%	NO.	%	NO.	%	NO.	%
< 20 Years	1.00	4.30	0.00	0.00	0.00	0.00	1.00	2.10
20–39 Years	17.0	73.9	17.0	77.3	2.00	100	36.0	76.6
40–59 Years	5.00	21.7	5.00	22.7	0.00	0.00	10.0	21.3
Total	23.0	100	22.0	100	2.00	100	47.0	100
P. value			< 0.001**				df:4	

($p < 0.001$). Similarly, Table 8 shows a significant association between BMI and frequency of nausea/vomiting events ($p < 0.001$), with patients in the overweight range (BMI 25–29) being more prone to multiple episodes.

3.5. Vomiting frequency

Vomiting incidence categorized by frequency (Table 9) further supports the superior profile of ondansetron. Patients in the metoclopramide group were more likely to experience repeated vomiting episodes, including one patient with three occurrences. Analysis of vomiting frequency showed that patients receiving metoclopramide had a higher number of recurrent vomiting episodes (≥2 episodes) compared with those receiving ondansetron; however, after combining multiple-episode categories to ensure adequate cell counts and applying Fisher's exact test, the difference between groups was not statistically significant ($p = 0.31$). The occurrence of three vomiting episodes was limited to a single patient in the metoclopramide group and was therefore not analyzed as a separate category.

3.6. Antiemetic rescue requirements

As shown in Table 10, the need for rescue antiemetic therapy was significantly higher in the metoclopramide group (61.9%) compared to the ondansetron group (38.1%), with a p-value of 0.023 indicating statistical significance. This finding highlights a key clinical advantage of ondansetron, suggesting it provides more sustained and effective control of postoperative nausea and vomiting, thereby reducing the likelihood of treatment failure and the need for additional intervention. The reduced reliance on rescue medication not only

Table 7. Chi-Square tests of nausea & vomiting according to gender.

	1		2		3		Total	
Gender	NO.	%	NO.	%	NO.	%	NO.	%
Male	12.0	52.2	9.00	40.9	0.00	0.00	21.0	44.7
Female	11.0	47.8	13.0	59.1	2.00	100	26.0	55.3
Total	23.0	100	22.0	100	2.00	100	47.0	100
P.value			< 0.001**				df:2	

Table 8. Chi-square tests of nausea & vomiting according to BMI.

	1		2		3		Total	
BMI	NO.	%	NO.	%	NO.	%	NO.	%
18–24	10.0	43.5	10.0	45.5	0.00	0.00	20.0	42.6
25–29	13.0	56.5	12.0	54.5	2.00	100	27.0	57.4
Total	23.0	100	22.0	100	2.00	100	47.0	100
P.value			< 0.001**				df:2	

Table 9. Chi-Square tests of vomiting according to incidence time.

Antiemetic agent	1 episode n (%)	≥2 episodes n (%)	Total vomiting cases n (%)
Metoclopramide (n = 40)	15 (53.6)	13 (46.4)	28 (52.8)
Ondansetron (n = 40)	17 (68.0)	8 (32.0)	25 (47.2)
P value (between groups)	*	0.31	

Table 10. Chi-Square tests of antiemetic rescue according to antiemetic agent.

Antiemetic agent	Needed rescue n (%)	No rescue needed n (%)	Total (n)
Metoclopramide (n = 40)	13 (32.5)	27 (67.5)	40
Ondansetron (n = 40)	8 (20.0)	32 (80.0)	40
P value	0.023*		

improves patient comfort and satisfaction but may also contribute to more efficient postoperative care and resource utilization. The requirement for rescue antiemetic therapy was significantly higher in the metoclopramide group compared with the ondansetron group. Rescue medication was required in 32.5% of patients receiving metoclopramide versus 20.0% of those receiving ondansetron ($p = 0.023$). This finding indicates a greater need for additional antiemetic intervention following metoclopramide prophylaxis, supporting the superior efficacy of ondansetron in preventing postoperative nausea and vomiting.

4. Comparative analysis with existing literature

The findings of our study, which compared the efficacy of ondansetron and metoclopramide in preventing PONV, align with and expand upon existing literature examining antiemetic practices and outcomes across different clinical contexts. In the cross-sectional study by Admass et al. (2022) on PONV prophylaxis in cesarean sections, a substantial gap in adherence to evidence-based guidelines was observed, with only 47% of anesthetists following local protocols and just 17% administering antiemetics to patients who eventually developed PONV [19]. In contrast, our study applied structured prophylaxis based on clear inclusion criteria and standardized dosing, which improved consistency in antiemetic administration. While the Admass study highlights the importance of institutional adherence to antiemetic guidelines, our results reinforce the need for both standardized protocols and individualized prophylactic strategies particularly in patients at higher risk, such as those aged 20–39, who in our study showed significantly greater PONV incidence ($p < 0.001$).

Comparatively, Asgari et al. (2017) reported a 28.3% incidence of nausea and 11.7% vomiting among hemodialysis patients, indicating a lower burden of emesis in that setting [20]. These differences likely reflect procedural, physiological, and pharmacological variations, yet underscore that nausea remains a prevalent and distressing symptom across medical populations. Similarly, Smit et al. (2021) noted that even with guideline-consistent antiemetic prophylaxis, nausea persisted in over 50% of chemotherapy patients, often independent of vomiting [21]. This observation resonates with our findings: although ondansetron reduced vomiting episodes and the need for rescue antiemetics, nausea rates remained relatively high, particularly in younger patients highlighting nausea as a distinct and under-addressed symptom requiring targeted interventions.

In their randomized trial, Amin et al. (2022) demonstrated that midazolam significantly delayed the onset of PONV and reduced the need for rescue antiemetics, regardless of timing of administration [22]. This supports our conclusion that early prophylactic intervention—particularly with agents like ondansetron can reduce overall emetic burden and need for secondary treatment. Finally, Pozhhan et al. (2023) showed that non-pharmacological methods such as music therapy effectively reduced both frequency and severity of chemotherapy-induced nausea and vomiting [23]. These complementary findings suggest that a multimodal approach, incorporating both pharmacologic and supportive therapies, may offer the most robust protection against PONV and related syndromes.

As summarized in Table 11, the findings of the present study are consistent with previous head-to-head comparisons demonstrating superior control of postoperative vomiting and reduced rescue antiemetic requirements with ondansetron compared with metoclopramide in abdominal surgeries under general anesthesia.

While our study confirms ondansetron's clinical advantage over metoclopramide in reducing vomiting

Table 11. Comparison of studies evaluating ondansetron versus metoclopramide for PONV prevention.

Study	Surgical setting/ anesthesia	Antiemetic regimen	Main outcomes	Key findings
Previous RCTs (abdominal & gynecological surgeries)	Lower abdominal procedures under general anesthesia	Ondansetron vs metoclopramide (standard perioperative doses)	Incidence of PONV, vomiting severity, rescue antiemetic use	Ondansetron consistently reduced postoperative vomiting and rescue antiemetic requirement more effectively than metoclopramide; differences in nausea were less consistent
Comparative perioperative studies	Mixed surgical populations under general anesthesia	Prophylactic ondansetron vs metoclopramide	Early and late PONV	Ondansetron showed superior control of vomiting with a better safety profile; metoclopramide efficacy was variable at standard doses
Present study	Elective lower abdominal surgery under general anesthesia	Ondansetron 0.1 mg/kg vs metoclopramide 0.2 mg/kg	Nausea, vomiting frequency, rescue antiemetic need	Ondansetron reduced vomiting episodes and need for rescue therapy compared with metoclopramide; nausea remained relatively frequent in both groups

and rescue medication use, it also echoes a broader consensus in the literature: nausea, distinct from vomiting, remains a persistent challenge across settings and patient populations. Future protocols should therefore prioritize multimodal, individualized approaches that not only follow evidence-based pharmacologic strategies but also consider adjunctive therapies and patient-specific risk factors to improve overall outcomes.

5. Conclusion

This randomized controlled study compared the prophylactic efficacy of ondansetron and metoclopramide in preventing PONV in patients undergoing elective lower abdominal surgery. While no statistically significant difference was found in the overall incidence of nausea and vomiting between the two agents, ondansetron demonstrated a favorable trend with fewer vomiting episodes and significantly reduced need for rescue antiemetic therapy. Younger patients (aged 20–39 years) were found to be more susceptible to PONV, regardless of the antiemetic used. Additionally, although gender and BMI did not independently predict nausea or vomiting, they were significantly associated with the frequency of symptom recurrence. Taken together, these findings suggest that ondansetron may offer superior clinical benefits, particularly in reducing the severity and recurrence of vomiting and minimizing the need for rescue medication. Tailoring antiemetic prophylaxis based on individual risk factors such as age and symptom patterns may further enhance patient outcomes.

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Conflict of interest

The authors declare no conflict of interest.

Ethical approval

Not applicable.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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Author contributions

Majid Fakhir Al-Hamaidah, Ali Ihsan Abdul Mahdi, and Maytham Alaa Shahid contributed to conceptualization, methodology, and data collection. Sajjad Salih Rasan and Lina M. Shaker performed data analysis and interpretation. Shahab Abdulla and Ralela Makline contributed to writing original draft preparation and critical review. All authors reviewed and approved the final manuscript.

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