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The Role of Gabapentin in Enhanced Recovery After Surgery (ERAS) for Patients Undergoing Abdominal Procedures, A Systematic Review and Meta-Analysis

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ABSTRACT

Background and Aims: Postoperative pain management remains a significant challenge for patients undergoing abdominal surgery, with poorly managed pain adversely affecting recovery, leading to increased opioid use and associated side effects. Gabapentin, an anticonvulsant, has been proposed as an effective analgesic within enhanced recovery after surgery (ERAS) protocols to minimize opioid consumption and reduce postoperative nausea and vomiting (PONV). However, its role in perioperative pain management lacks consensus, necessitating a systematic review and meta-analysis.

Methods: A systematic review and meta-analysis of randomized controlled trials and observational studies were conducted, following PRISMA guidelines. Databases including PubMed, Scopus, and EMBASE were searched up to August 2024 using terms such as "gabapentin," "postoperative pain," and "ERAS." Studies involving gabapentin or pregabalin in abdominal surgery were included. Pain was assessed using the visual analog scale (VAS), opioid consumption was converted to morphine equivalents, and PONV rates were analyzed. Meta-analysis was performed using STATA 17 software with a random-effects model due to high clinical heterogeneity.

Results: Twenty-two studies with 1812 patients (909 in the gabapentin group and 903 in the control group) were included. Gabapentin significantly reduced postoperative pain (Hedges's g = −1.65, 95% CI: −2.34 to −0.97, $p < 0.001$) and opioid consumption (Hedges's $g = -2.25$, 95% CI: −4.29 to −0.20, $p = 0.03$). Gabapentin also significantly reduced PONV (log OR = −0.67, 95% CI: −1.25 to −0.09, $p = 0.02$). Adverse effects were mild, including sedation and dizziness.

Conclusion: Gabapentin demonstrates efficacy in reducing postoperative pain, opioid consumption, and PONV in patients undergoing abdominal surgery. Despite substantial heterogeneity across studies, the results suggest gabapentin as a valuable addition to ERAS protocols. Further research is necessary to optimize dosing strategies and address safety concerns, especially regarding sedation in vulnerable populations.

Abbreviations: ASA, American Society of Anesthesiologists; ERAS, Enhanced Recovery After Surgery; FDA, Food and Drug Administration; GRADE, Grades of Recommendation, Assessment, Development and Evaluation; MME, Morphine Milligram Equivalents; NSAID, nonsteroidal anti-inflammatory drugs; PONV, postoperative nausea and vomiting; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; RCT, Randomized Controlled Trial; ROB, Risk of Bias; ROBINS, Risk of Bias in Non-Randomized Studies - of Interventions (ROBINS-I); VAS, Visual Analogue Scale.

1 | Introduction

Over 80% of patients undergoing surgical procedures experience acute postoperative pain, and around 75% of those affected describe the intensity of this pain as moderate, severe, or extreme [1, 2]. Research indicates that fewer than 50% of patients who have surgery experience sufficient relief from postoperative pain. Poorly managed pain can adversely impact quality of life, daily functioning, recovery outcomes, the likelihood of complications following surgery, and the chances of developing chronic pain after the procedure [3].

Numerous interventions and management strategies for preoperative, intraoperative, and postoperative phases are available and are continually advancing to mitigate and manage postoperative pain. The American Pain Society (APS), in collaboration with the American Society of Anesthesiologists (ASA), has developed a guideline focused on the management of postoperative pain. This initiative aims to enhance evidence-based practices for safer and more effective postoperative pain management in both children and adults. The guideline encompasses various critical areas, including preoperative education, planning for perioperative pain management, the application of diverse pharmacological and nonpharmacological approaches, organizational policies and procedures, and the transition to outpatient care. The ASA published a practice guideline for acute pain management in the perioperative setting in 2012 [4].

Enhanced recovery after surgery (ERAS) denotes a patient-focused, evidence-informed approach developed by multidisciplinary teams tailored to specific surgical specialties and institutional cultures. The primary aim is to minimize the surgical stress response in patients, enhance their physiological functioning, and promote recovery. These care pathways create a cohesive continuum that guides patients from their home environment through various stages: pre-hospital/preadmission, preoperative, intraoperative, postoperative, and ultimately back home [5]. The ERAS approach has demonstrated its effectiveness in reducing surgical stress by prioritizing the preservation of patients' normal physiological functions. Consequently, all patients undergoing surgery may find advantages in adopting this methodology [6].

The management of postoperative pain, along with complications like nausea and vomiting, remains a significant challenge in postoperative care. Addressing these issues is crucial for facilitating early mobilization and ensuring the overall well-being of surgical patients. Opioid analgesics, despite their widely recognized side effects, remain a fundamental component of postoperative pain management. Investigating new analgesics and exploring combinations of existing ones to minimize opioid reliance is an essential focus in acute pain research [3, 7]. Effective management of postoperative pain alleviates suffering, facilitates earlier mobilization, shortens hospital stays, reduces healthcare costs, and enhances patient satisfaction [8–10].

The management of postoperative pain after abdominal procedures has traditionally relied on opiate analgesics, particularly through patient-controlled analgesia. However, the use of opiate analgesia is associated with several adverse effects, including postoperative ileus, constipation, and nausea, as well as drowsiness, confusion, and bradypnea. These side effects can hinder timely progression to early feeding and mobilization. Epidural analgesia can also serve as a valuable alternative after extensive abdominal incisions, helping to reduce the reliance on opioids, enhance mobilization by providing better pain management, and diminish nausea associated with lower opioid levels. Epidural analgesia, while beneficial, may lead to hypotension due to peripheral vasodilation. It can also result in a delay in the removal of urinary catheters, restrict mobility due to excessively extensive epidural blocks, and negatively impact the postoperative diet by causing prolonged nausea linked to episodes of hypotension [11]. Numerous ERAS protocols currently recommend a narcotic-sparing strategy that includes regular, scheduled administration of NSAIDs and acetaminophen. Audits of the implementation of gynecologic ERAS protocols have demonstrated that this approach effectively reduces opioid usage and the related adverse effects [12, 13].

Gabapentin, marketed under the brand name Neurontin, is an analogue of α-amino butyric acid. The US Food and Drug Administration (FDA) initially approved Gabapentin in 1994 as an adjunctive treatment for partial seizures, demonstrating effectiveness when used alongside other anticonvulsant medications. In 2002, its indications were expanded to include the management of post-herpetic neuralgia, which is neuropathic pain that occurs following shingles, as well as other painful neuropathies and nerve-related pain [14]. Gabapentin is classified as an anticonvulsant and has demonstrated efficacy in managing neuropathic and chronic pain [15, 16]. However, the analgesic benefits associated with its use in the perioperative setting have not been entirely clarified [17]. While the precise mechanism by which it operates remains unclear, it is believed that its therapeutic effects on neuropathic pain are linked to the modulation of voltage-gated N-type calcium ion channels [18].

There is a lack of consensus regarding the use of gabapentinoids for managing postoperative pain. The American Pain Society, based in Glenview, Illinois, endorses its perioperative application, whereas the European Society of Regional Anesthesia and Pain Therapy, located in Geneva, Switzerland, does not support this approach [19, 20]. This systematic review, accompanied by a meta-analysis of randomized controlled trials and observational studies, aimed to assess the overall advantages and potential adverse effects associated with the perioperative administration of gabapentinoids in adult surgical patients undergoing abdominal surgeries.

2 | Methods

2.1 | Study Design

This systematic review and meta-analysis was conducted following the recommendations of the Cochrane Handbook for Systematic Reviews and Meta-Analyses, and our results were reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Figure 1) [21].

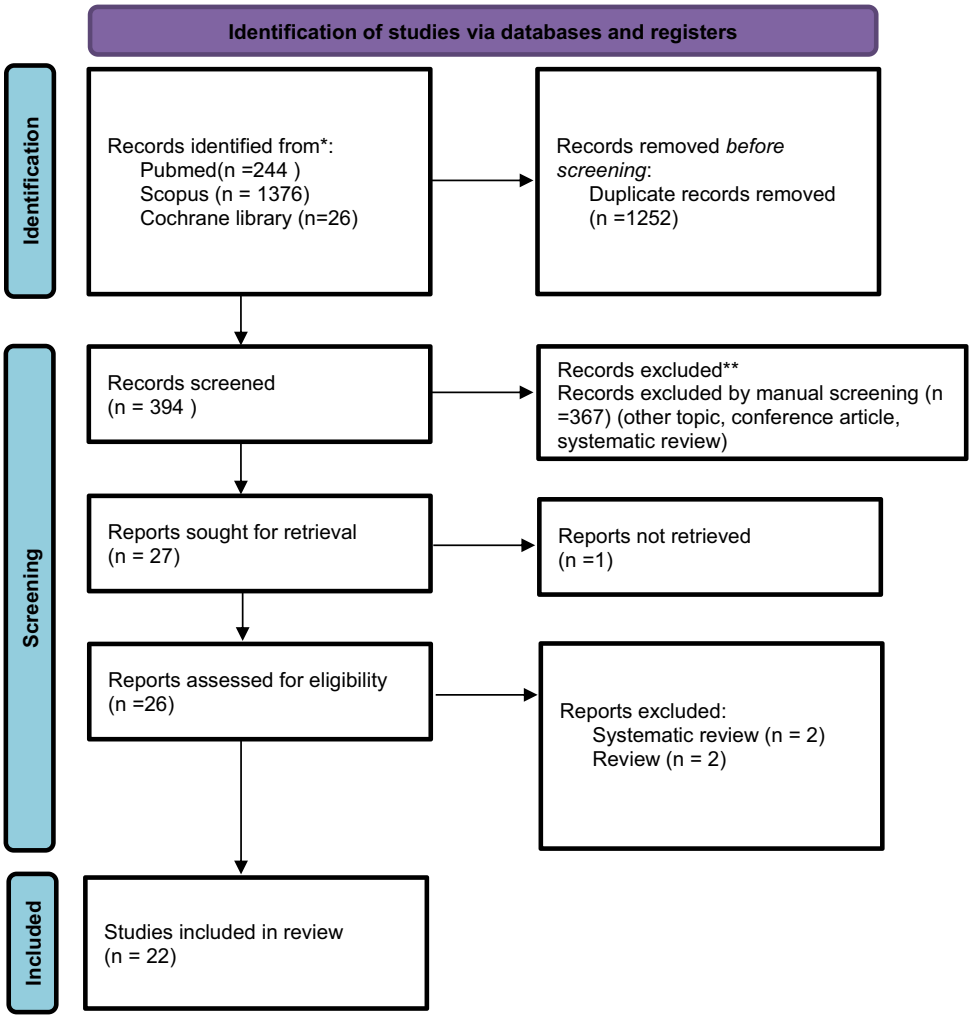

FIGURE 1 | Flow diagram of trails included in the meta-analysis.

2.2 | Search Strategy

A comprehensive review of randomized controlled trials (RCTs) and observational studies was performed by utilizing prominent medical databases, including PubMed, Scopus, EMBASE, and Google Scholar, up to August 2024. The search was conducted using the following keywords: Gabapentin, gabapentinoids, enhanced recovery after surgery, ERAS, enhanced recovery, postoperative pain, abdominal operations, gastrointestinal surgery, abdominal gynecologic surgery, abdominal procedures, laparotomy, and postoperative pain. Titles, abstracts, and full-text articles underwent screening. Studies that qualified included randomized clinical trials and observational studies assessing the effects of gabapentin in comparison to a control group, with at least one reported outcome. Risk of bias was assessed using the Cochrane Risk of Bias tool 2 (ROB 2) [22] and Risk of Bias in Non-Randomized Studies - of Interventions (ROBINS-I) [23]. The overall methodological quality of each trial was reported using the worst score obtained across the five and seven domains. Prospective observational and quasi-randomized trials were included to assess harm and identify rare serious adverse events, but they were not considered for evaluating benefits. Furthermore, these trials are excluded from all meta-analyses of outcomes.

2.3 | Eligibility Criteria

RCTs and observational studies that compared gabapentinoids (gabapentin and pregabalin) to a placebo, alternative analgesic treatments, or standard care were included. Trials involving adults, defined as individuals aged 18 years and older, who were undergoing either elective or emergent abdominal surgery under any form of anesthesia were considered. Eligible trials needed to assess gabapentinoids (specifically pregabalin or gabapentin) that were initiated within a timeframe of 24 h before and up to 12 h following the surgical procedure. To qualify for inclusion, at least one outcome measure had to be evaluated. There were no restrictions regarding language or publication type.

The trials were evaluated, and the following data points were extracted: study design, publication year, gabapentin dosage and regimen, number of patients, pain assessment methodologies, types of rescue narcotics utilized and adverse outcomes observed. Most studies documented pain assessment using the VAS, where pain was measured on a scale from 0 (indicating no pain) to 10 (indicating maximum pain). In instances where pain ratings were recorded on a 0–100 scale, these scores were converted to a 0–10 scale for consistency. Due to variations in

the intervals at which pain scores were documented across studies, we chose to analyze mean pain scores recorded within the first 24 h after surgery. Most trials reported cumulative narcotic consumption; therefore, we compared the 24-h total narcotic doses between the gabapentin group and the control group. Given that different narcotics were utilized as rescue analgesics in the trials, we standardized all narcotics to morphine equivalents for comparison based on recent recommendations [24]. The visual analog scale (VAS) and cumulative narcotic doses were presented graphically in only a subset of studies. We made efforts to extract the values from the accessible graphs utilizing GetData Graph Digitizer [25].

The main outcomes of the study consist of postoperative pain, assessed using VAS scores, along with the amount of opioids consumed post-surgery. Secondary outcomes encompass PONV, significant complications that may influence patient comfort and recovery. Furthermore, patient satisfaction is measured to gain insights into the overall experience and quality of care provided during the postoperative phase. Additional secondary outcomes encompass drug-related adverse effects that may influence the safety and tolerability of the treatment plan. Furthermore, the duration of hospital stay and the return of bowel function were evaluated.

The meta-analysis was conducted using the STATA 17 software package, specifically the metaphor module. Due to the presence of considerable clinical heterogeneity, as indicated by the Q-test, among the studies—which included variations in initial dosages and dosage strategies (either preoperative only or both preoperative and postoperative)—a random effects model was employed. The significance level was established at 0.05. The studies were aggregated under the assumption of a common variance component across the different studies [26]. Statistical heterogeneity was evaluated using the I^2 statistic, with values exceeding 50% indicating substantial heterogeneity [21]. Additionally, the possibility of publication bias was investigated through funnel plots when there were 10 or more trials available for a specific outcome.

The findings from the meta-analysis studies were presented as the standardized mean difference accompanied by 95% confidence intervals (CIs) for continuous outcomes such as morphine consumption and VAS scores. For binary outcomes, specifically postoperative nausea and vomiting, relative risk was reported along with 95% CIs. The use of standardized mean difference, rather than the original mean difference, was implemented to maintain a consistent scale of outcomes across the various studies. This is to account for the fact that morphine consumption and VAS varied significantly across studies selected in this meta-analysis. The statistical analysis and reporting adhered to the "Guidelines for reporting of statistics for clinical research in urology" [27].

2.4 | Study Selection and Data Extraction

Two reviewers, Y.M. and H.A., independently evaluated the studies by screening titles, abstracts, and full publications as necessary to determine eligibility. They extracted data utilizing a standardized and pre-tested data extraction form. Any disagreements that arose were resolved through discussion. Duplicate citations were eliminated using Excel. Publications in languages other than English were translated with the assistance of an online Google translator.

2.5 | Ethical Approval and Consent to Participate

Not applicable.

2.6 | Strength of Evidence

The strength of evidence for each outcome was assessed in accordance with the Grades of Recommendation, Assessment, Development and Evaluation (GRADE) working group statement, utilizing the GRADEpro guideline development tool (McMaster University, 2015, created by Evidence Prime Inc, Canada) [28]. The GRADE approach assessed the quality of evidence on a continuum ranging from high to moderate, low, or very low for each outcome, following a structured methodology. This grading was conducted independently.

3 | Results

A total of 22 RCT studies were included in the meta-analysis [7, 16, 29–47], encompassing a pooled sample of 909 patients in the gabapentin group and 903 patients in the control group. These studies were published from 2004 to 2023, with each study involving between 20 and 153 participants. In 17 of the studies, gabapentin was administered solely in the preoperative phase [7, 16, 29–32, 34, 37–40, 42, 43, 45–48], while the remaining four studies provided gabapentin both preoperatively and postoperatively [33, 35, 36, 44, 49] The Cochrane Collaboration's tool for evaluating bias risk in RCTs indicates that 16 trials exhibit a low risk of bias [7, 16, 29, 30, 32–35, 39, 42–47, 49] while six studies raised some concerns and had unclear risk of bias [31, 36–38, 40, 48].

3.1 | Postoperative Pain (VAS Score)

Eleven studies report VAS score in the first 24 h after surgery [7, 30–32, 36, 38, 40, 44–47]. The results of the meta-analysis indicate that gabapentin has a significant effect on reducing postoperative pain compared to placebo, as measured by the VAS. The overall effect size, represented by Hedges's g, is −1.65 with a 95% confidence interval (CI) ranging from −2.34 to −0.97 ($p < 0.001$) indicating that patients who received gabapentin experienced significantly lower postoperative pain scores than those who received a placebo. The magnitude of the effect, −1.65, representing a standardized mean difference, showing a strong reduction in pain favoring gabapentin.

The analysis also reveals a high degree of heterogeneity across the included studies, with an I^2 value of 95.64% and τ^2 of 1.27,

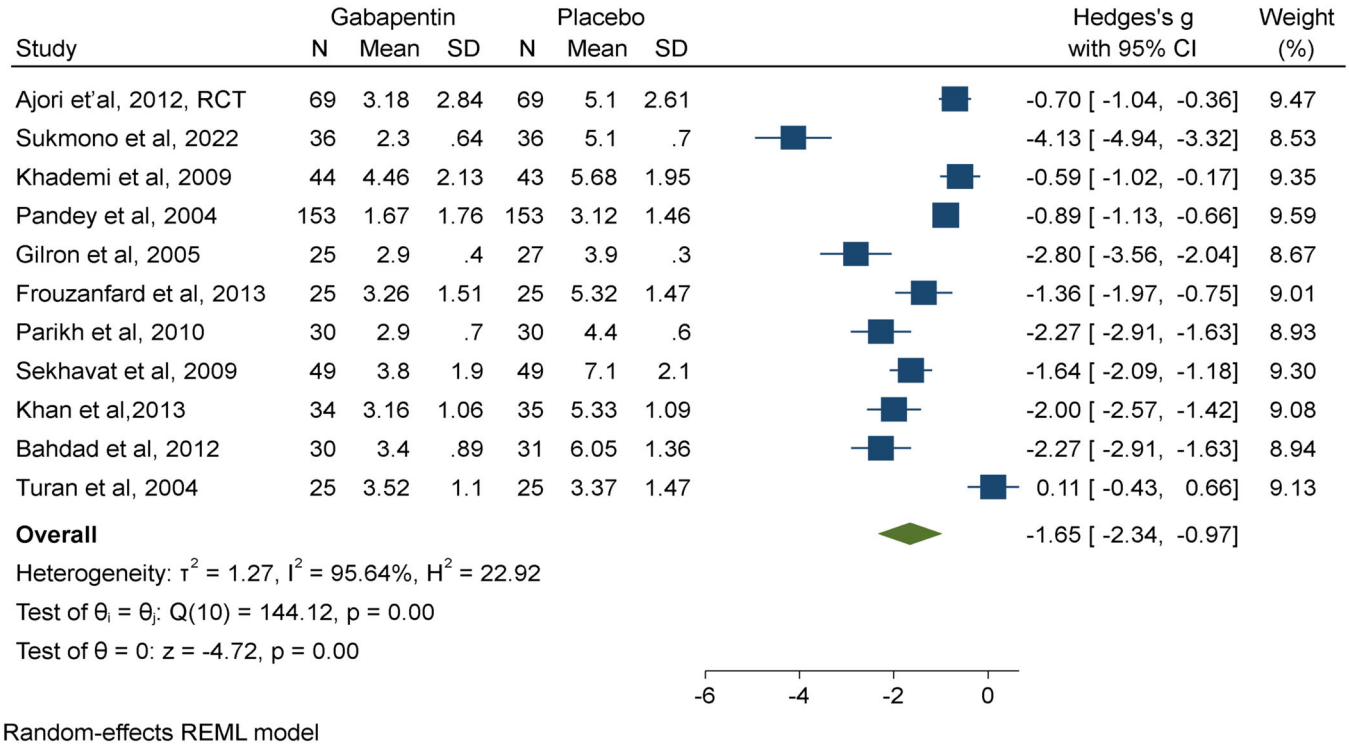

FIGURE 2 | Summary estimates from meta-analyses with the assessment of the statistical heterogeneity for postoperative VAS score.

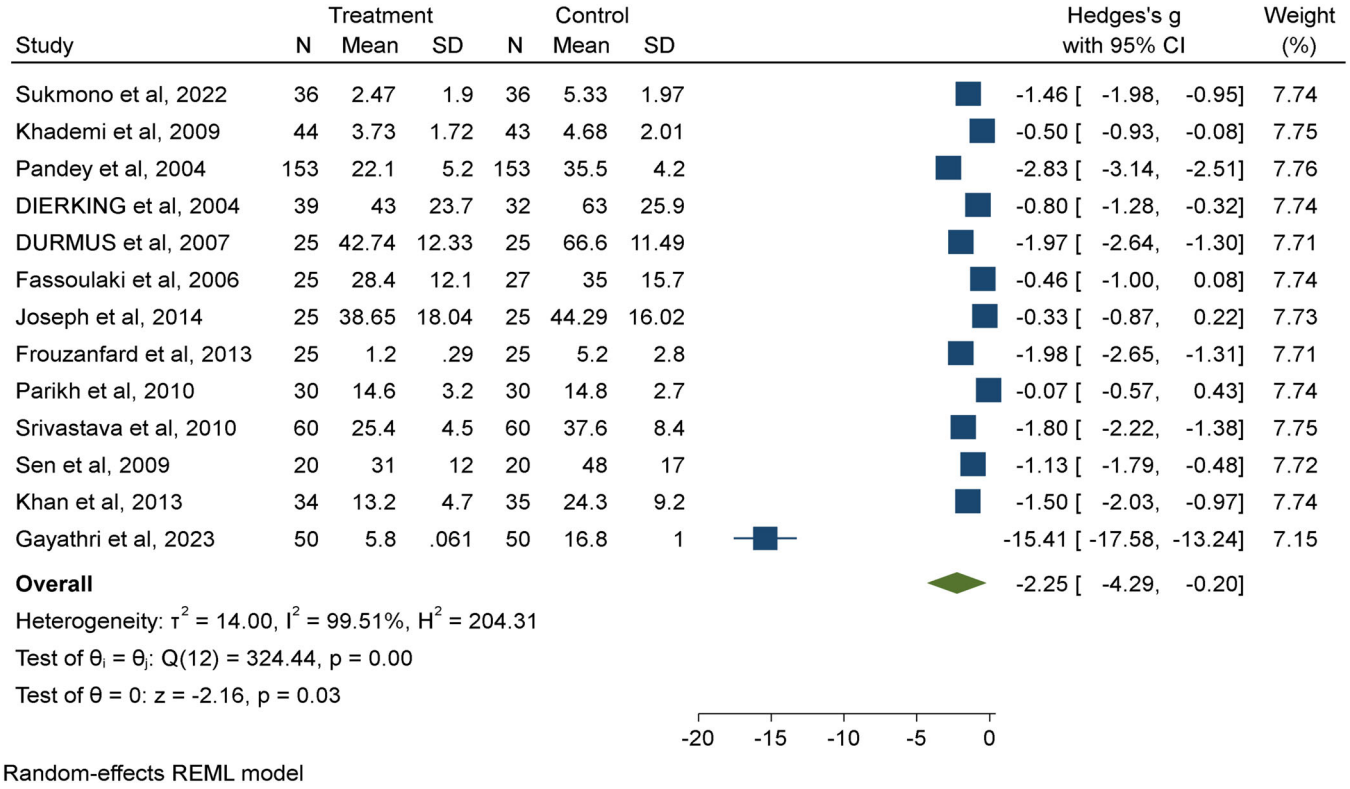

FIGURE 3 | Summary Estimates from meta-analyses with the assessment of the statistical heterogeneity for postoperative opioid consumption.

suggesting substantial variability in the results across different studies. Exploring factors such as variations in gabapentin dosage, surgical procedures, and patient populations may explain the observed heterogeneity. Despite this variability, the overall finding remains that gabapentin is effective in reducing postoperative pain (Figure 2).

3.2 | Opioid-Sparing Effect

Thirteen studies reported postoperative narcotic consumption [16, 29–35, 37, 38, 40, 42, 45]. The 24-h cumulative narcotic consumption was reported in all of these trials. The meta-analysis showed that gabapentin significantly reduced 24-h

cumulative opioid consumption compared to placebo (Hedges's $g = -2.25$, 95% CI = −4.29 to −0.20, $p = 0.03$). However, high heterogeneity ($I^2 = 99.51\%$) across studies suggests that the impact of gabapentin on opioid consumption may vary depending on factors such as patient populations and surgical procedures. This high degree of variability means that the effect of gabapentin on reducing opioid consumption is inconsistent across the different studies, potentially due to differences in patient populations, surgical procedures, dosing protocols, or other factors related to study design (Figure 3).

3.3 | Postoperative Nausea and Vomiting (PONV)

Twelve studies report PONV after surgery in the first 24 h [7, 30–33, 36, 39, 41–43, 47, 48, 50]. The results of the meta-analysis indicate that Gabapentin significantly reduced post-operative nausea and vomiting (log OR = −0.67, 95% CI = −1.25 to −0.09, $p = 0.02$), although heterogeneity remained high ($I^2 = 74.75\%$), suggesting variability in its effectiveness across different studies. This means that the studies included in the analysis report different magnitudes of gabapentin's effect on PONV, which could be due to differences in drug dosage, patient populations, or clinical settings (Figure 4).

3.4 | Drug Related Adverse Effects

3.4.1 | Sedation

The meta-analysis conducted to evaluate the risk of sedation associated with gabapentin compared to placebo showed a pooled log odds ratio of 0.44 (95% CI: 0.12–0.76; $p = 0.01$), indicating a significantly increased risk of sedation in patients receiving gabapentin. Minimal heterogeneity was observed among the studies ($I^2 = 0.0\%$, $\tau^2 = 0.00$). These findings suggest that sedation is a notable adverse effect associated with perio-perative gabapentin use, suggesting the necessity of balancing gabapentin's benefits against its risk profile, particularly in vulnerable populations such as elderly patients or those with comorbidities [29, 32–34, 36, 51] (Figure 5).

3.4.2 | Length of Hospital Stay

The effect of gabapentin on the length of hospital stay was assessed in four studies (Figure 2). The pooled Hedges' g was −0.66 (95% CI: −1.86 to 0.55; $p = 0.29$), indicating no statistically significant difference in LOS between the gabapentin and placebo groups. Substantial heterogeneity was also observed ($I^2 = 95.17\%$, $\tau^2 = 1.44$), reflecting variability across the included studies. Despite the lack of statistical significance, gabapentin's potential to contribute to earlier mobilization and improved pain management may play an indirect role in reducing LOS for certain patient populations [39, 50, 51] (Figure 6).

3.4.3 | Bowel Function and Recovery

The meta-analysis evaluating the effect of gabapentin on the return of bowel function compared to placebo showed a pooled effect size of Hedges' $g = -1.81$ (95% CI [−4.26, 0.64]; $p = 0.15$), suggesting a trend favoring gabapentin. However, the results were not statistically significant, and high heterogeneity was also observed ($I^2 = 97.55\%$). The earlier return of bowel function

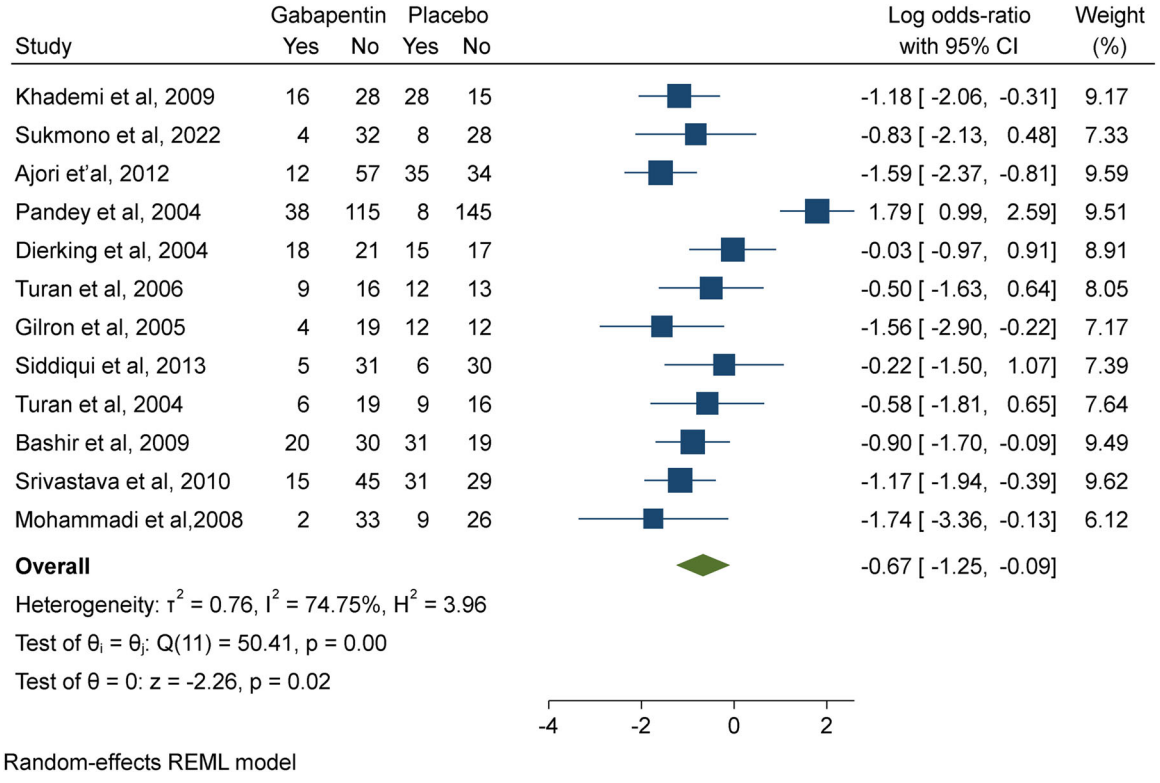

FIGURE 4 | Summary estimates from meta-analyses with the assessment of the statistical heterogeneity for postoperative nausea and vomiting.

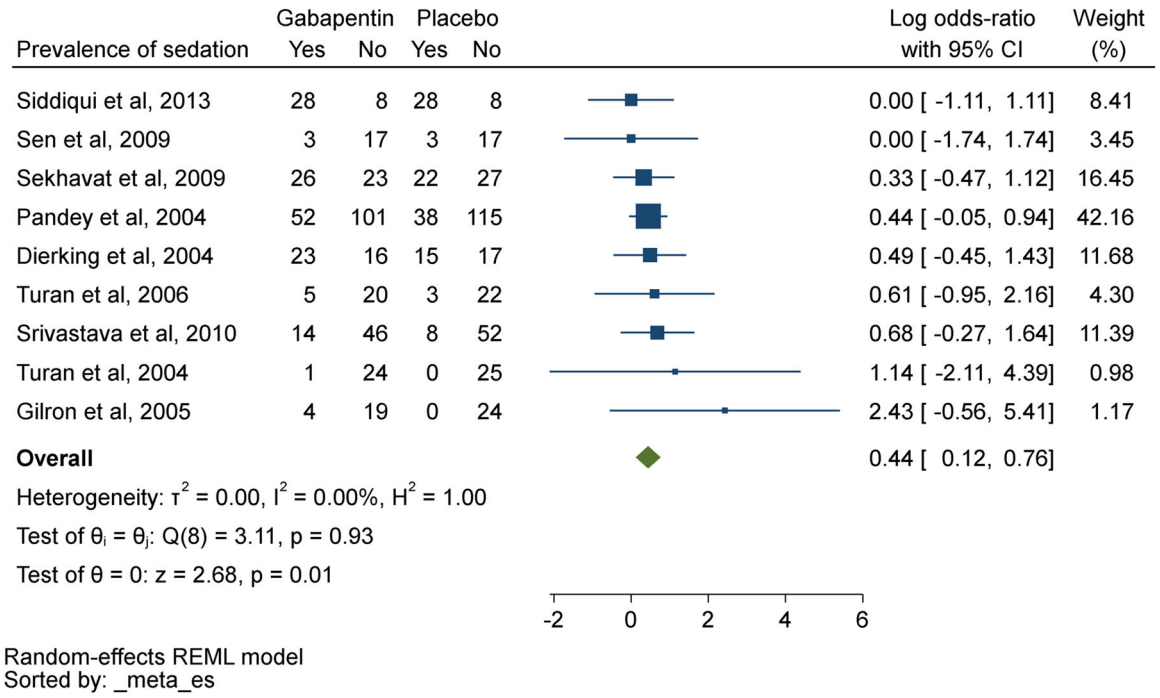

FIGURE 5 | Summary estimates from meta-analyses with the assessment of the statistical heterogeneity for prevalence of sedation.

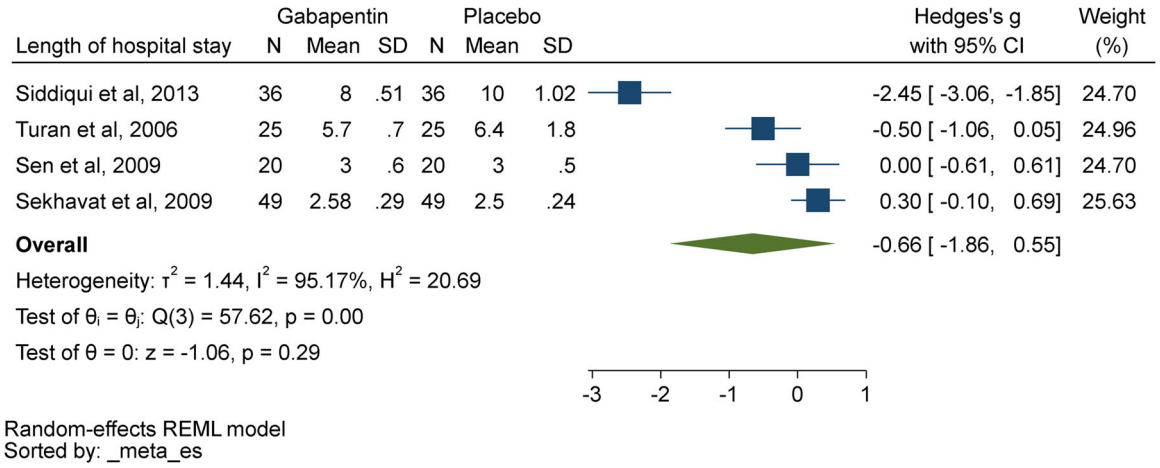

FIGURE 6 | Summary estimates from meta-analyses with the assessment of the statistical heterogeneity for duration of hospital stay.

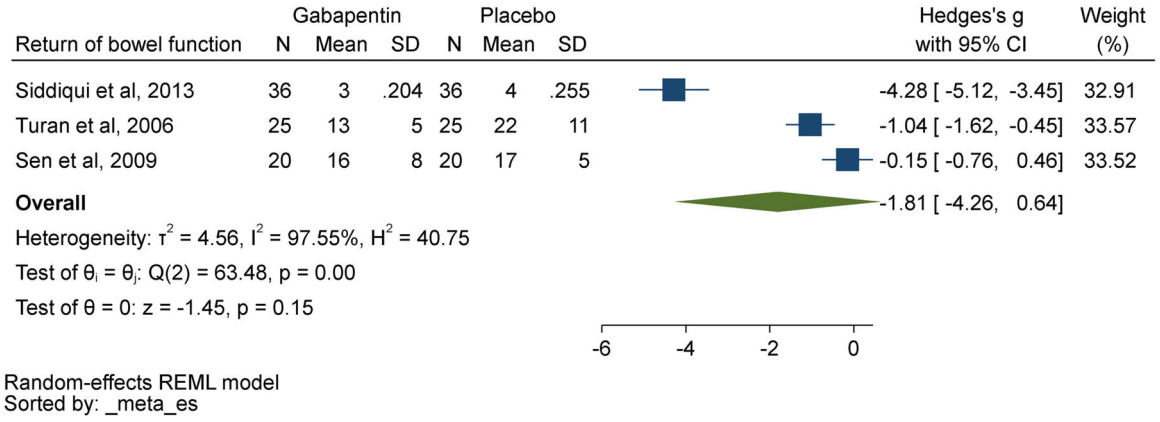

FIGURE 7 | Summary estimates from meta-analyses with the assessment of the statistical heterogeneity for return of bowel function.

observed in some studies may be attributed to gabapentin's ability to reduce opioid consumption, thereby mitigating opioid-induced bowel dysfunction. However, differences in study designs, such as variations in surgical procedures and gabapentin dosing regimens, may have influenced the outcomes [38, 50] (Figure 7).

3.4.4 | Patient Satisfaction

Patient satisfaction relates to the overall postoperative experience rather than pain alone. Specifically, patient satisfaction encompasses multiple dimensions, including the adequacy of pain management, the occurrence and management of adverse effects, and the perceived quality of care provided during the recovery process. The meta-analysis assessing patient satisfaction rates demonstrated a pooled effect size of 1.35 (95% CI: 0.61–2.09), favoring gabapentin over placebo. This statistically significant result ($z = 3.57$, $p < 0.01$) indicates that patients receiving gabapentin report higher satisfaction compared to those on placebo. The heterogeneity analysis revealed moderate variability among the included studies ($I^2 = 61.19\%$) [34, 36, 50] (Figure 8).

4 | Discussion

This systematic review and meta-analysis sought to assess the effectiveness of gabapentin in alleviating postoperative pain, minimizing opioid use, and decreasing the incidence of PONV in patients undergoing abdominal surgery. The findings indicate that gabapentin offers a notable analgesic benefit and promotes opioid-sparing effects, while also contributing to a reduction in PONV. However, there is considerable variability in the outcomes reported across different studies.

Our quantitative analysis of the combined data indicated a noteworthy decrease in the cumulative narcotic consumption over 24 h post-surgery when contrasted with the control group. This observation aligns with earlier systematic reviews that investigated the impact of preemptive gabapentin across different surgical procedures, such as dental, orthopedic, and spinal surgeries [52–56]. An alternative approach to assess the impact of gabapentin involved evaluating postoperative VAS scores. We selected the mean VAS score during the 24 h post-surgery as our comparative measure. A notable decrease in mean VAS scores was observed when gabapentin was administered as a preoperative dose in comparison to a placebo. This finding aligns with the results presented by Ho et al. in their meta-analysis of various surgical procedures utilizing preemptive gabapentin [52, 53].

A meta-analysis by Verret et al. [57] evaluated the effectiveness of gabapentinoids, specifically gabapentin and pregabalin, in managing postoperative pain and reducing opioid consumption across different surgical procedures. Consistent with our findings, Verret et al. found that gabapentin notably decreased both postoperative opioid use and pain intensity. Nonetheless, their aggregated analysis indicated a more moderate reduction in opioid consumption than what we observed in our study. This variation may stem from the wider range of surgical procedures considered in their review, encompassing not only abdominal surgeries but also other types. The differences in dosing protocols, types of surgeries, and outcome metrics probably played a role in the discrepancies observed in effect size.

Conversely, the findings from the meta-analysis on PONV by Fabritius et al., which involved a systematic review, indicated that gabapentin was associated with a reduction in PONV. However, the effect size was relatively small, and its clinical significance was called into question because of considerable heterogeneity in the results [58]. Our analysis revealed a significant reduction in postoperative nausea and vomiting (PONV), with a log odds ratio of −0.67, suggesting that gabapentin consistently offers benefits in mitigating these symptoms. The observed variability among the studies may be attributed to differences in the populations studied, the surgical techniques employed, and whether multimodal antiemetic prophylaxis protocols were utilized.

A review conducted by Mathiesen et al. [59] further corroborates the opioid-sparing effects of gabapentin in the postoperative context. Their findings indicate that gabapentin led to a decrease in morphine consumption, which is consistent with our results that show significant reductions in opioid

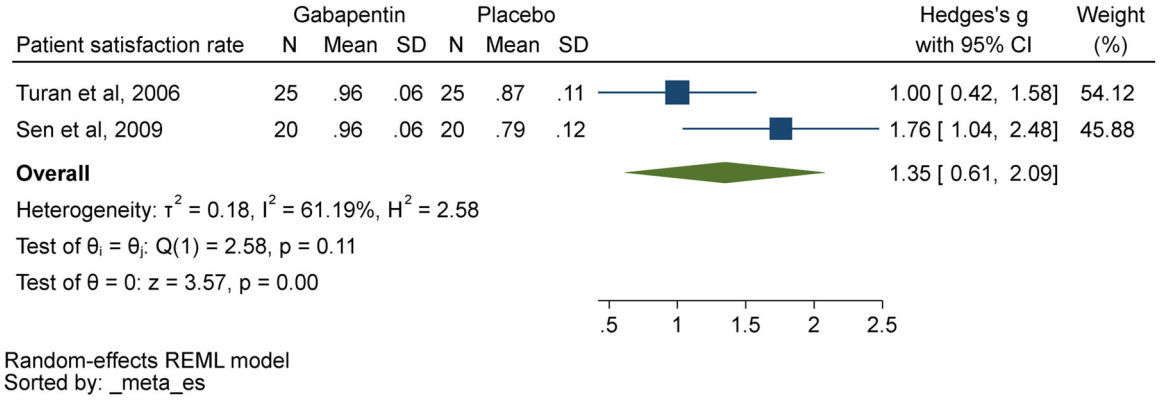

FIGURE 8 | Summary estimates from meta-analyses with the assessment of the statistical heterogeneity for patient satisfaction rate.

requirements. Nevertheless, they pointed out that the clinical significance of this reduction remains contentious due to the considerable heterogeneity observed. This mirrors the findings of our review, where high heterogeneity ($I^2 = 99.51\%$) for opioid consumption raises questions about the consistency of gabapentin's effects across different surgical contexts.

However, a recent research by Sohn et al. (2024) utilizing advanced statistical techniques, including latent variable analysis, the study identified factors associated with positive composite postoperative outcomes. While gabapentin has traditionally been associated with significant reductions in postoperative pain, opioid consumption, and nausea/vomiting, the study observed that perioperative gabapentin use was associated with lower odds for positive primary and secondary composite outcomes, such as reduced hospital length of stay and lower readmission rates [60]. These findings highlight the need for further investigations to assess the context-dependent effects of gabapentinoids on comprehensive postoperative outcomes.

One limitation of this meta-analysis is the variability introduced by converting opioid consumption into morphine milligram equivalents (MME). While this standardization is necessary to enable comparisons across studies that utilized different types of narcotics, differences in the reported conversion factors and inconsistencies in how cumulative opioid consumption was presented may have contributed to the high heterogeneity observed. In some studies, opioid consumption was presented graphically, and numerical values were extracted using software, which may introduce minor inaccuracies. Despite these challenges, the use of established conversion guidelines and sensitivity analyses helps mitigate this variability.

Regarding adverse effects, our findings are consistent with other reviews suggesting that gabapentin is typically well-tolerated, with mild sedation and dizziness identified as the most prevalent side effects. This is in line with the conclusions drawn by Peng et al., who noted that although gabapentinoids may decrease opioid consumption, their use carries a heightened risk of sedation [54]. Therefore, while gabapentin's side effect profile is manageable, caution should be exercised in populations at risk for sedation, especially in the elderly.

In summary, our findings not only support the conclusions drawn from earlier systematic reviews about gabapentin's effectiveness in alleviating pain and decreasing opioid use but also offer a more targeted examination of its role in abdominal surgeries. Furthermore, the more pronounced effect sizes identified in our study especially concerning PONV and opioid reduction could indicate variations in the criteria for study selection, the specific surgical procedures involved, and the characteristics of the populations studied. Notwithstanding these variations, there is a prevailing agreement that gabapentin serves as an effective part of multimodal analgesia in the perioperative context; however, additional research is necessary to address the considerable heterogeneity noted among studies.

The limitations of our findings stem from the heterogeneity observed across the studies. Several factors, such as the type of abdominal incision, the duration of surgery, and the occurrence of complications, may influence the level of pain experienced by patients. Many trials presented their results solely in graphical form, and we were unable to reach out to the authors for further clarification. Consequently, data were extracted from the reported figures, which may impact the accuracy of the obtained numbers. Another constraint was the variability in dosages and administration intervals of gabapentin. Some trials utilized a single preoperative dose ranging from 300 to 1800 mg, while others involved multiple doses that extended into the postoperative period.

We cannot provide specific commentary on the preferred dosages indicated in this meta-analysis; however, it appears that doses as low as 300 mg demonstrate efficacy comparable to that of 1800 mg. Most researchers administered gabapentin 1–2 h before the procedure. In three trials, gabapentin was administered in multiple doses preoperatively. In two of these studies, it was given the night before surgery along with an additional dose 1–2 h before the operation [35, 46]. In the third trial, gabapentin was administered every 6 h, beginning 18 h before the surgery.

The inclusion of trials involving patients undergoing abdominal procedures in our meta-analysis negatively impacted its precision as some procedures are generally anticipated to be less painful than others. Previous systematic reviews and meta-analyses encompassed a diverse array of operative procedures, which included various gynecologic surgeries, spinal surgeries, laparoscopic cholecystectomy, and dental surgeries [52–56]. Consequently, it seems that administering 300 mg of gabapentin orally 1–2 h before abdominal procedures may be effective in minimizing postoperative pain, reducing opioid consumption, and alleviating postoperative nausea and vomiting. Notably, the outcomes were similar regardless of whether pregabalin or gabapentin was utilized. In contrast to prior research, our study did not differentiate between the types of drugs; instead, it encompassed trials assessing the use of gabapentin or pregabalin, given that these medications possess similar pharmacologic properties [61–63].

This systematic review and meta-analysis show that gabapentin significantly reduces postoperative pain, opioid consumption, and PONV in abdominal surgeries. These findings align with ERAS protocols, but their relationship with existing society recommendations is nuanced.

The American Pain Society endorses perioperative gabapentinoids as part of multimodal analgesia [19]. Our findings support this recommendation, as gabapentin effectively reduced pain and opioid use in abdominal surgeries. However, significant heterogeneity among studies highlights the need for individualized application across surgical contexts. On the other hand, ESRA's caution against routine perioperative gabapentinoid use stems from concerns about inconsistent efficacy and adverse effects [64–66]. While this review confirms gabapentin's benefits, variability in dosing regimens and patient populations supports ESRA's reservations. Adverse effects, though mild, underscore the importance of careful patient selection. These findings affirm APS's support for gabapentinoids in abdominal surgeries but align with ESRA's caution in other contexts due to heterogeneity and potential side effects. Future research should refine dosing strategies and identify patient populations most likely to benefit from gabapentin.

4.1 | Implications for ERAS Protocols

Gabapentin plays a significant role in ERAS protocols due to its effectiveness in providing analgesia while simultaneously minimizing opioid usage and the incidence of postoperative nausea and vomiting (PONV). ERAS pathways highlight the necessity of multimodal analgesia aimed at decreasing opioid reliance and fostering expedited recovery. By alleviating pain and curtailing opioid consumption, gabapentin contributes to early mobilization, improved bowel function, and reduced hospital stays—essential elements for the successful application of ERAS principles.

Nevertheless, due to the significant heterogeneity present in the data, additional research is essential to determine the optimal dosing regimen for gabapentin in the perioperative context. Future investigations should also concentrate on particular patient demographics, including elderly individuals or those undergoing high-risk surgical procedures, to gain a clearer understanding of the potential risks and benefits associated with gabapentin in these populations.

GRADE:

- Postoperative Pain and Opioid Consumption: Gabapentin demonstrates effectiveness in decreasing postoperative pain levels and reducing opioid consumption (moderate evidence).
- Postoperative Nausea and Vomiting (PONV): Gabapentin significantly decreases the incidence of PONV (moderate evidence).
- Adverse Effects: Gabapentin is generally well-tolerated; however, some studies indicate a potential increase in the risk of sedation and respiratory complications (low evidence).
- Other outcomes (patient satisfaction, length of stay, return of bowel function): Limited and inconsistent evidence (Low evidence).

5 | Conclusion

In conclusion, gabapentin serves as a valuable adjunct in managing postoperative pain, demonstrating notable opioid-sparing effects for patients who have undergone abdominal surgeries. Although there is considerable variability among studies, the overall advantages of incorporating gabapentin into enhanced recovery after surgery protocols are evident. Future investigations should aim to refine dosing strategies and further assess gabapentin's safety profile, especially concerning cognitive side effects and long-term outcomes.

5.1 | Limitation

This study has several limitations. First, none of the included studies reported postoperative complications using the Clavien-Dindo classification, which limits the ability to evaluate the severity of complications in a standardized manner. Second, the reliance on VAS for pain assessment introduces subjectivity, as patients' perceptions of pain can vary widely. This subjectivity may have been further influenced by whether patients were aware of receiving a gabapentinoid, potentially introducing bias in reported outcomes. Future studies should aim to incorporate objective measures of postoperative complications, such as the Clavien-Dindo classification, and ensure robust blinding protocols to reduce bias in subjective outcomes like pain and nausea.

Author Contributions

Yohannis Derbew Molla: conceptualization, data curation, formal analysis, writing – original draft. **Hirut Tesfahun Alemu:** software, writing – original draft, writing – review and editing.

Ethics Statement

The authors have nothing to report.

Consent

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The authors confirm that the data supporting the findings of this study are available within the article.

Transparency Statement

The lead author Yohannis Derbew Molla affirms that this manuscript is an honest, accurate, and transparent account of the study being reported; that no important aspects of the study have been omitted; and that any discrepancies from the study as planned (and, if relevant, registered) have been explained.

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