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Review Article

The role of gabapentin in reducing postoperative pain and opioid consumption

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ABSTRACT

Effective postoperative pain management is essential for improving patient comfort, preventing complications like chronic pain, and reducing recovery times and hospital stays. Gabapentin, originally developed as an anticonvulsant, has gained attention for its potential role in managing postoperative pain and reducing opioid consumption. This literature review explores the effectiveness of gabapentin in various surgical contexts, focusing on its mechanism of action, safety profile, and impact on postoperative pain and opioid usage. Key findings from detailed trials indicate that gabapentin can effectively reduce pain scores and opioid consumption, particularly within the first 24 hours post-surgery. Studies in breast cancer surgery, spinal surgery, laparoscopic cholecystectomy, and arthroscopic procedures highlight its varying degrees of efficacy. While gabapentin consistently demonstrates opioid-sparing benefits and a favorable safety profile, its impact on pain reduction can differ based on the type of surgery. The review underscores the importance of tailoring gabapentin use to specific surgical and patient contexts for optimal outcomes. Continued research is recommended to refine dosage strategies and expand its application in multimodal pain management protocols.

Keywords: Gabapentin, Opioid, Surgery, Pain

INTRODUCTION

Postoperative pain management remains a crucial aspect of modern surgical care due to its impact on patient outcomes, recovery times, and overall quality of life. Pain control not only aids in patient comfort but is also instrumental in reducing complications such as chronic pain development and prolonged hospital stays.[1] Traditionally, opioids have been the mainstay for managing moderate to severe postoperative pain. However, the reliance on opioids has significant drawbacks, including the potential for tolerance,

dependence, adverse side effects like respiratory depression, and an increased risk of developing long-term opioid use disorders. The opioid crisis has underscored the urgent need for more balanced pain management strategies that can effectively control pain while minimizing opioid consumption.[2]

Gabapentin, originally developed as an anticonvulsant for treating epilepsy, has been explored for its off-label use in managing various pain conditions, including neuropathic and postoperative pain. It is structurally similar to gamma-aminobutyric acid (GABA) but does not act through GABAergic pathways. Instead, gabapentin binds to the alpha-2-delta subunit of voltage-gated calcium channels in the central nervous system, inhibiting excitatory neurotransmitter release. This mechanism helps reduce neuronal excitability and central sensitization, which are crucial components in the amplification of pain perception. Due to its distinct mechanism of action, gabapentin has been considered an effective adjunct to multimodal analgesic regimens aimed at minimizing opioid use and improving overall pain control.[3]

In recent years, clinical research has expanded to include gabapentin as part of perioperative protocols to better manage postoperative pain and reduce the need for opioids.[4] Studies and meta-analyses have shown varying degrees of success, with some trials highlighting significant benefits in pain reduction and opioid sparing, while others report more modest or inconclusive results. This variability emphasizes the importance of understanding gabapentin's potential benefits and limitations within the broader context of postoperative care.[5]

This literature review aims to delve into the role of gabapentin in the perioperative setting by examining its mechanisms of action, safety and tolerability profile, efficacy in reducing postoperative pain, and impact on postoperative opioid consumption. By analyzing current research and findings from clinical trials, we seek to determine gabapentin's value as part of multimodal pain management strategies. Understanding its application and impact can provide insights into how surgical teams can better tailor analgesic plans to reduce reliance on opioids and mitigate their associated risks, ultimately leading to improved patient outcomes and satisfaction. This review will contribute to a more comprehensive understanding of whether gabapentin should be a routine component of postoperative pain management protocols and under what conditions it offers the most benefit.

LITERATURE SEARCH

This study is based on a comprehensive literature search conducted on 7 November 2024 in the Medline, PubMed, Scopus and Cochrane databases. Utilizing medical subject headings (MeSH) and relevant keywords, the search aimed to identify pertinent studies on the role of gabapentin in reducing postoperative pain and opioid consumption. To ensure thoroughness, a manual search was also performed through Google Scholar, examining the reference lists of identified papers to find additional relevant studies. We focused on articles discussing the mechanisms of action, clinical efficacy, safety, and tolerability of gabapentin, as well as its impact on postoperative pain management and opioid consumption. No restrictions were applied regarding publication date, language, participant age, or type of publication, enabling a comprehensive review of the existing literature.

DISCUSSION

Gabapentin, initially developed as an anticonvulsant, has been repurposed for managing postoperative pain due to its mechanism of action involving the modulation of calcium channels, which reduces the release of excitatory neurotransmitters. This results in decreased central sensitization and improved pain control. Its role as part of multimodal pain management strategies aims to reduce both acute pain and opioid consumption post-surgery, addressing the risks associated with high opioid use, such as dependency and adverse side effects.[6]

Mechanism of action of gabapentin

Gabapentin, as highlighted in several studies, exerts its effects by binding to the alpha-2-delta subunit of voltage-gated calcium channels. This binding reduces calcium influx into neurons, limiting the release of excitatory neurotransmitters like glutamate, which plays a key role in pain perception. This mechanism is particularly relevant in surgeries that involve significant nerve involvement or inflammation, where central sensitization is a factor.[7] The study by Mardani-Kivi et al noted that gabapentin's modulation of neurotransmitter release contributes to its pain-relieving properties, making it effective in pre-emptive analgesia for shoulder surgeries. Additionally, gabapentin may enhance the effects of other analgesics, thereby providing a multimodal approach to pain management.[2]

Gabapentin efficacy in postoperative pain management

Numerous studies have investigated the role of gabapentin in postoperative pain relief. In the context of breast cancer surgery, a meta-analysis by Jiang et al involved nine randomized controlled trials (RCTs). The findings indicated that gabapentin significantly reduced pain scores, particularly in the first 24 hours post-surgery. Pain reduction was measured using visual analog scale (VAS) scores, with the analysis showing immediate and prolonged benefits. This outcome was notable for contributing to a decrease in the incidence of chronic pain, emphasizing gabapentin's dual role in managing acute and persistent postoperative pain.[8]

For spinal surgery, a systematic review by Söğüt et al highlighted gabapentin's impact across 13 RCTs encompassing 843 participants. The study found that

preoperative administration of gabapentin led to significant reductions in both VAS pain scores and opioid consumption within the first 24 hours after surgery. This substantial reduction underlines gabapentin's efficacy in highly innervated surgical areas, where managing acute pain is often more challenging.[9]

In laparoscopic cholecystectomy, Froehlich et al conducted an analysis of 19 trials with a combined total of 2,068 patients. Their findings demonstrated a notable mean reduction in pain scores during the initial 24 hours post-surgery when gabapentin was administered preoperatively. This approach also extended the time to the first analgesic requirement and effectively reduced cumulative opioid use. The study underscores gabapentin's role in enhancing multimodal pain management, particularly in minimally invasive surgical procedures.[10]

In knee arthroscopy, Mardani-Kivi et al. conducted a triple-blinded RCT on 114 patients who received a 600 mg dose of gabapentin preoperatively. The patients were assessed using the VAS for pain, and the study found that gabapentin helped manage pain effectively within a 10-hour postoperative window. The intervention was given under general anesthesia, which supports its role as an adjunct in multimodal analgesia.[11] Similarly, Menigaux et al.'s trial with 40 patients used a higher dose of 1200 mg of gabapentin and evaluated pain over 100 hours using VAS. This study confirmed gabapentin's role in reducing immediate postoperative pain, showing a longer duration of effectiveness due to the higher dose.[12]

Gabapentin's utility in hysterectomy procedures was explored by multiple studies. Ajori et al involved 138 patients undergoing open hysterectomies with a single 600 mg dose of gabapentin administered under general anesthesia. Pain was assessed using the VAS for 10 hours post-surgery, revealing a significant reduction in pain and lower opioid requirements.[13] Durmus et al. expanded on these findings with 50 patients receiving a higher 1200 mg dose and monitored pain using the VAS over a 100-hour period. This higher dose maintained reduced pain scores over an extended duration, reinforcing gabapentin's effectiveness in managing more intensive postoperative pain scenarios.[14]

Gabapentin's role in cardiac and thoracic surgeries was highlighted by Ucak et al and Huot et al who focused on coronary artery bypass grafting (CABG) and thoracotomies. Ucak et al. administered 1200 mg of gabapentin to 40 patients undergoing open CABG, with pain assessed using the VAS up to 10 hours postoperatively. The results showed significant pain reduction and delayed time to the first analgesic use, indicating gabapentin's efficacy in complex cardiac procedures.[15] Huot et al.'s study included thoracotomy patients who received gabapentin with both general and epidural anesthesia. The outcomes demonstrated moderate reductions in pain and a clear decrease in opioid consumption, underlining the adjunctive value of gabapentin in high-pain thoracic surgeries.[16,17]

Gabapentin impact on opioid consumption

The opioid-sparing effects of gabapentin are particularly emphasized across the reviewed studies. General findings from Verret et al and Kang et al demonstrated that incorporating gabapentin into pain management protocols consistently reduced cumulative opioid consumption. Although the exact mean differences varied across studies, the overall trend confirmed that gabapentin effectively lowered the morphine-equivalent doses required postoperatively. This indicates its reliable role in minimizing opioid reliance in diverse surgical contexts.[18,19]

Hah et al provided valuable insights by examining perioperative gabapentin use in 410 patients from a mixed surgical cohort, using post-hoc analysis. Their findings showed a significant association between gabapentin administration and earlier opioid cessation, with a hazard ratio of 1.37 ($p=0.016$). This supports gabapentin's role in promoting faster recovery and reducing the risks associated with prolonged opioid dependency.[20]

Jiang et al highlighted that preoperative gabapentin administration led to a decrease in total morphine consumption in patients who underwent breast cancer surgery. This further supports gabapentin's role as an effective component of multimodal pain strategies, enhancing postoperative recovery while mitigating opioid use.[21]

Factors affecting the efficacy of gabapentin

Patient-specific factors such as age and comorbidities significantly impact the efficacy and safety profile of gabapentin. For instance, Hah et al noted that preoperative characteristics, including pre-existing pain at the surgical site and anxiety levels, influenced the success of gabapentin in reducing postoperative opioid use and pain duration. Patients with a history of chronic pain or those using opioids preoperatively were less likely to achieve pain resolution and opioid cessation without tailored interventions.[20] Similarly, age-related metabolic differences may affect gabapentin's pharmacokinetics and overall effectiveness, particularly in elderly patients who are more prone to side effects like dizziness and sedation.[22,23]

The type and invasiveness of surgery also play a crucial role in determining gabapentin's effectiveness. Studies included in this review, such as Mardani-Kivi et al and Adam et al revealed that more invasive procedures, like total knee arthroplasty or complex shoulder surgeries, often required higher doses or repeated administration to achieve significant pain relief and reduced opioid use.[2,24] Conversely, less invasive surgeries, like arthroscopic procedures, showed varying results, suggesting that

gabapentin may be more effective in cases involving significant nerve pain or inflammation.

The timing and dosing of gabapentin are critical for optimizing its analgesic and opioid-sparing effects. Trials such as those conducted by Jiang et al and Durmus et al demonstrated that preoperative administration of gabapentin was associated with greater pain reduction and decreased opioid consumption. The effectiveness was noted to peak within the first 24 hours post-surgery. Doses varied widely across studies, ranging from 300 mg to 1200 mg, with higher doses generally producing more prolonged analgesic effects but also potentially increasing side effects such as dizziness.[8,25]

Gabapentin's role is often evaluated within the context of multimodal pain management strategies. For example, studies involving hysterectomies and thoracic surgeries highlighted its use alongside non-opioid analgesics and nerve blocks. These regimens improved patient outcomes by leveraging gabapentin's mechanism to reduce excitatory neurotransmitter release and complement the actions of other analgesics. Such combinations can amplify pain control and minimize opioid-related side effects, proving crucial for enhanced recovery protocols.[26]

Safety and tolerability of gabapentin

The safety profile of gabapentin was consistently analyzed across the studies, with a focus on both mild and significant side effects.[27] The systematic review by Verret et al encompassed 281 randomized trials involving 24,682 participants. This extensive analysis confirmed that while gabapentin reduces postoperative nausea and vomiting, it does so at the cost of increased dizziness and visual disturbances.[28] Additionally, Kang et al reported no significant differences in the incidence of severe side effects such as sedation or respiratory depression when comparing gabapentin to placebos in total knee and hip arthroplasty patients.[29]

CONCLUSION

Gabapentin has demonstrated significant potential as an adjunct in postoperative pain management, with particular strength in reducing opioid consumption and improving pain control in the immediate postoperative period. While its efficacy varies among different types of surgeries, its consistent opioid-sparing effects contribute to better pain management practices and reduced opioid-related side effects. The findings support the integration of gabapentin into multimodal analgesia strategies, especially in surgeries where pain management is complex. However, despite strong evidence of gabapentin's benefits, gaps remain regarding its variable effectiveness across different surgeries and patient demographics. Further studies are recommended to standardize dosing and refine protocols tailored to specific surgical and patient characteristics, as well as to investigate long-term outcomes.

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REFERENCES

1. Moore L, Norwood C, Stackhouse R, Nguyen K, Brown W, Sevak RJ. Gabapentin reduces postoperative pain and opioid consumption in patients who underwent lumbar laminectomy. J Am Pharmac Assoc. 2021;61(5):e78-83.
2. Mardani-Kivi M, Karimi Mobarakeh M, Keyhani S, Haghighi M, Hashemi-Motlagh K, Saheb-Ekhtiari K. Arthroscopic bankart surgery: Does gabapentin reduce postoperative pain and opioid consumption? A triple-blinded randomized clinical trial. Orthopaed Traumatol Surg Res. 2016;102(5):549-53.
3. Fukada C, Kohler JC, Boon H, Austin Z, Krahn M. Prescribing gabapentin off label: Perspectives from psychiatry, pain and neurology specialists. Canad Pharmacists J. 2012;145(6):280-4.
4. Keskinbora K, Pekel AF, Aydinli I. Gabapentin and an Opioid Combination Versus Opioid Alone for the Management of Neuropathic Cancer Pain: A Randomized Open Trial. J Pain Symptom Management. 2007;34(2):183-9.
5. Hurley RW, Cohen SP, Williams KA, Rowlingson AJ, Wu CL. The Analgesic Effects of Perioperative Gabapentin on Postoperative Pain: A Meta-Analysis. Regional Anesthesia Pain Med. 2006;31(3):237.
6. Moore RA, Wiffen PJ, Derry S, Toelle T, Rice AS. Gabapentin for chronic neuropathic pain and fibromyalgia in adults. Cochrane Database Syst Rev. 2014;2014(4):CD007938.
7. Cheng J-K, Chiou L-C. Mechanisms of the Antinociceptive Action of Gabapentin. J Pharmacol Sci. 2006;100(5):471-86.
8. Jiang Y, Li J, Lin H, et al. The efficacy of gabapentin in reducing pain intensity and morphine consumption after breast cancer surgery: A meta-analysis. Medicine. 2018;97(38):10.
9. Söğüt MS. Effects of Gabapentin on Postoperative Pain Management After Spinal Surgery: A Systematic Review and Meta-analysis. Comprehensive Med. 2024:198-212.
10. Froehlich KA, Deleon ZG, Tubog TD. Effects of Gabapentin on Postoperative Pain and Opioid Consumption Following Laparoscopic Cholecystectomy: A Systematic Review and Meta-analysis. J PeriAnesthesia Nursing. 2024;39(1):132-41.
11. Mardani-Kivi M, Mobarakeh MK, Keyhani S, Motlagh KH, Ekhtiari KS. Is gabapentin effective on pain management after arthroscopic anterior cruciate ligament reconstruction? A triple blinded randomized controlled trial. Arch Bone Joint Surg. 2013;1(1):18-22.
12. Ménigaux C, Adam F, Guignard B, Sessler DI, Chauvin M. Preoperative gabapentin decreases anxiety and improves early functional recovery from

knee surgery. Anesthesia Analgesia. 2005;100(5):1394-9.
13. Ajori L, Nazari L, Mazloomfard MM, Amiri Z. Effects of gabapentin on postoperative pain, nausea and vomiting after abdominal hysterectomy: a double blind randomized clinical trial. Arch Gynecol Obstet. 2012;285(3):677-682.
14. Durmus M, Kadir But A, Saricicek V, Ilksen Toprak H, Ozcan Ersoy M. The post-operative analgesic effects of a combination of gabapentin and paracetamol in patients undergoing abdominal hysterectomy: a randomized clinical trial. Acta Anaesthesiol Scand. 2007;51(3):299-304.
15. Soltanzadeh MA, Ebad A, Pipelzadeh MR. Gabapentin May Relieve Post-Coronary Artery Bypass Graft Pain: A Double Blind Randomized Clinical Trial. Iran Cardiovas Res J. 2012;5:79-82.
16. Huot M-P, Chouinard P, Girard F, Ruel M, Lafontaine ER, Ferraro P. Gabapentin does not reduce post-thoracotomy shoulder pain: a randomized, double-blind placebo-controlled study. Canad J Anest. 2008;55(6):337-43.
17. Huot MP, Chouinard P, Girard F, Ruel M, Lafontaine ER, Ferraro P. Gabapentin does not reduce post-thoracotomy shoulder pain: a randomized, double-blind placebo-controlled study. Canad J Anaest. 2008;55(6):337-43.
18. Verret M, Lauzier F, Zarychanski R, Caroline P, Xavier S, Anne-Marie P, et al. Perioperative Use of Gabapentinoids for the Management of Postoperative Acute Pain: A Systematic Review and Meta-analysis. Anesthesiology. 2020;133(2):265-79.
19. Kang J, Zhao Z, Lv J, Lei S, Bin L, Benchao D, et al. The efficacy of perioperative gabapentin for the treatment of postoperative pain following total knee and hip arthroplasty: a meta-analysis. J Orthopaed Surg Res. 2020;15(1):332.
20. Hah JM, Hilmoe H, Schmidt P, Rebecca McC, Jodie T, Debra C, et al. Preoperative Factors Associated with Remote Postoperative Pain Resolution and Opioid Cessation in a Mixed Surgical Cohort: Post Hoc Analysis of a Perioperative Gabapentin Trial. J Pain Res. 2020;13:2959-70.
21. Hu J, Huang D, Li M, Wu C, Zhang J. Effects of a single dose of preoperative pregabalin and gabapentin for acute postoperative pain: a network meta-analysis of randomized controlled trials. Journal of pain research. 2018;11:2633-43.
22. Boyd RA, Turck D, Abel RB, Sedman AJ, Bockbrader HN. Effects of age and gender on single-dose pharmacokinetics of gabapentin. Epilepsia. 1999;40(4):474-9.
23. Gronich N. Central Nervous System Medications: Pharmacokinetic and Pharmacodynamic Considerations for Older Adults. Drugs Aging. 2024;41(6):507-19.
24. Adam F, Bordenave L, Sessler DI, Chauvin M. Effects of a single 1200-mg preoperative dose of gabapentin on anxiety and memory. Ann Françaises Anesthésie Réanimation. 2012;31(10):e223-7.
25. Modak S, Magar J, Kakad V. Pre-emptive gabapentin for postoperative pain relief in abdominal hysterectomy. Int J Res Med Sci. 2016:3755-9.
26. Senderovich H, Jeyapragasan G. Is there a role for combined use of gabapentin and pregabalin in pain control? Too good to be true? Curr Med Res Opin. 2018;34(4):677-82.
27. Moore RA, Wiffen PJ, Derry S, McQuay HJ. Gabapentin for chronic neuropathic pain and fibromyalgia in adults. Cochrane Database Syst Rev. 2011(3):CD007938.
28. Viderman D, Aubakirova M, Salamat A, Dastan K, Nurzhamal S, Ramil T, et al. The Impact of Gabapentinoids on Pain-Related Outcomes after Knee and Hip Surgery: A Systematic Review with Meta-Analysis of Randomized Controlled Trials. J Clin Med. 2024;13(14):4205.
29. Kang J, Zhao Z, Lv J, Lei S, Bin L, Benchao D, et al. The efficacy of perioperative gabapentin for the treatment of postoperative pain following total knee and hip arthroplasty: a meta-analysis. J Orthop Surg Res. 2020;15(1):332.

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