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Pharmacological and Non-Pharmacological Preoperative Pain Management: A Narrative Review

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Abstract

Background:

Effective postoperative pain management improves recovery, maintains haemodynamic stability, and reduces opioid-related risks. While pharmacological interventions such as pregabalin and dexmedetomidine remain widely used, non-pharmacological strategies including music therapy, relaxation techniques, and patient education are increasingly valued for their safety and holistic benefits. However, comparative evaluations of these approaches remain limited.

Methods: A narrative review was conducted using literature published between 2008 and 2024. Relevant studies were retrieved from PubMed, ScienceDirect, Google Scholar, and Consensus. Inclusion criteria were studies examining preoperative pharmacological and non-pharmacological pain management strategies and their effects on postoperative haemodynamics, recovery, and analgesic use.

Results: Thirty-four studies met the eligibility criteria. Pharmacological interventions provided rapid analgesia and supported haemodynamic stability, though concerns regarding drug tolerance and opioid dependence were noted. Non-pharmacological approaches reduced anxiety, improved patient satisfaction, and lowered opioid requirements without notable side effects. Combined multimodal strategies yielded the most consistent improvements in pain control, haemodynamic outcomes, and recovery trajectories.

Conclusion: Both pharmacological and non-pharmacological strategies enhance postoperative outcomes, though their mechanisms and benefits differ. Multimodal integration of these interventions appears most effective in reducing opioid reliance and promoting recovery. Standardized protocols and long-term trials are required to establish optimal combinations tailored to patient and surgical contexts.

Keywords: Pain management, haemodynamics, pharmacological, non-pharmacological, preoperative, and postoperative.

Introduction:

Effective pain management is a cornerstone of perioperative care, with direct implications for recovery, opioid dependency, and physiological stability [1-3]. Both pharmacological and non-pharmacological interventions are employed to achieve these goals, though their roles and benefits differ [5-8].

Pharmacological approaches, including agents such as pregabalin and dexmedetomidine, have demonstrated efficacy in reducing postoperative pain, lowering opioid consumption, and improving intraoperative haemodynamic stability. Similarly, preoperative analgesia has been shown to decrease stress responses and accelerate recovery [12-14].

Non-pharmacological strategies, including music therapy, foot massage, virtual reality, and patient education, are increasingly recognized for their capacity to reduce pain, anxiety, and opioid use while avoiding drug-related risks [19]. Physical measures, such as preoperative exercise, further support recovery and resilience [22].

Importantly, the integration of these interventions has the potential to enhance postoperative haemodynamics by modulating pain perception, lowering anxiety, and improving cardiovascular function. However, while many studies have investigated pharmacological and non-pharmacological approaches individually, few have directly compared them, and even fewer have examined their combined application as a multimodal strategy [5,15].

This narrative review addresses these gaps by synthesizing existing evidence on both approaches, with a particular focus on their comparative and integrated efficacy [2,13]. The aim is to guide clinicians toward safer, more individualized, and outcome-oriented strategies in perioperative pain management [7,25,28].

Method:

This narrative review was conducted to understand how non-pharmacological and pharmacological therapeutic techniques affect postoperative haemodynamics in patients when administrated preoperatively. Articles published in Science direct, Google Scholar, PubMed and Consensus databases from 2008 40 2024. The following keywords were used to search the articles in the English language: “Pain management”, “haemodynamics”, “pharmacological”, non-pharmacological”, preoperative”, “postoperative”, along with the Boolean operators “AND” and “OR”. The most approximately relevant articles totaled 98.

A total of 567 records were identified through database searching. After removing duplicates, 222 records were screened, and 53 were excluded for being related to pediatric or geriatric populations. Of the 45 full-text articles assessed, 11 were excluded due to pregnancy or neurological conditions. Finally, 34 articles met the inclusion criteria and were included in the review. The inclusion criteria included studies involving preoperative pharmacological and non-pharmacological pain management methods and their impact on patient outcomes post-surgery. Pregnancy and neurological conditions-based studies were excluded.

The results of the studied literature revealed that pharmacological interventions were effective in relieving pain promptly but at the cost of drug tolerance in the long run. Non-pharmacological interventions were also effective promptly with no significant side effects in the postoperative setting.

Search Strategy:

A total of five hundred and sixty-seven articles were gathered from database up to December 2024, ninety-eight of which were found to be relevant to this study and thirty-four articles were selected for critical synthesis from the forty-five that were assessed for eligibility.

Results:

The reviewed research offers a thorough grasp of how postoperative pain and hemodynamic stability are affected by pharmacological and non-pharmacological pain management techniques. Significant improvements in postoperative outcomes, such as pain management, recuperation, and hemodynamic control, have been demonstrated by both strategies.

Non-Pharmacological Pain Relief Methods:

- **Music Therapy:** Among the most popular non-pharmacological approaches studied were educational interventions, music therapy, and relaxation techniques. These treatments improved patient satisfaction and overall recovery by successfully lowering postoperative pain and opioid use. Specifically, music therapy was often linked to improved hemodynamic stability, which improved heart rate variability and blood pressure control in the postoperative phase.

- **Relaxation Methods:** It has also been discovered that relaxation techniques like breathing exercises and foot massages can lessen anxiety, lessen pain, and enhance the patient experience. These methods were especially helpful in lowering the need for pharmaceutical pain relief, which in turn decreased the use of opioids.

- **Other Intervention:** Other cutting-edge non-pharmacological treatments, such as patient education and virtual reality glasses, have been demonstrated to offer extra advantages by lowering pain and enhancing recovery, particularly in more invasive procedures.

Pharmacological Pain Relief Methods:

- **Pre-emptive Analgesia and multimodal pain management:** Multimodal pain management and pre-emptive analgesia were popular techniques that showed notable decreases in postoperative pain and accelerated recovery. Pregabalin and other analgesics administered prior to surgery successfully decreased postoperative pain and decreased the need for opioids.

- **Dexmedetomidine:** Dexmedetomidine use, especially during surgery, demonstrated encouraging outcomes in stabilizing hemodynamic parameters like heart rate and blood pressure while effectively reducing postoperative pain. This was especially noticeable during general anaesthesia-required surgeries.

- **Opioid-Sparing Strategies:** Opioid-sparing techniques, like NSAIDs in combination with other local anaesthetics, also helped to improve pain management and lessen adverse effects associated with opioids.

Combined Pharmacological & Non – Pharmacological Approaches:

i. The greatest advantages seemed to be provided by combining pharmacological pain management with non-pharmacological therapies. For instance, combining music therapy with opioids reduced opioid use and pain scores while improving hemodynamic stability.

ii. Pharmacological treatments in conjunction with patient education and preoperative relaxation techniques improved patients' psychological health and pain management, indicating that a more comprehensive approach to pain management enhances overall surgical outcomes.

Impact on Haemodynamics:

i. Research has consistently shown that both pharmacological and non-pharmacological approaches have an impact on haemodynamic stability. In particular, multimodal analgesia and dexmedetomidine helped keep heart rate and blood pressure steady while lowering the need for drastic medication.

ii. It was also discovered that non-pharmacological techniques, in particular music therapy, had a positive effect on blood pressure and heart rate variability, two factors that are essential for the best possible recovery, particularly following high-risk surgeries.

Postoperative Recovery & Pain Control:

i. Non-pharmacological techniques and preoperative interventions (like physical activity and education) both made a substantial contribution to a quicker recovery, less severe pain, and a decrease in the use of opioids. These methods worked especially well for orthopaedic, cardiac, and breast cancer surgeries.

ii. When pharmacological and non-pharmacological approaches were combined, patient satisfaction was consistently higher. These techniques improved overall recovery by addressing psychological and emotional issues in addition to pain management.

iii. Lastly, research has shown that in order to achieve the best outcomes in terms of pain management and hemodynamic stability, customized pain management strategies that take into consideration patient preferences and the type of surgery are essential.

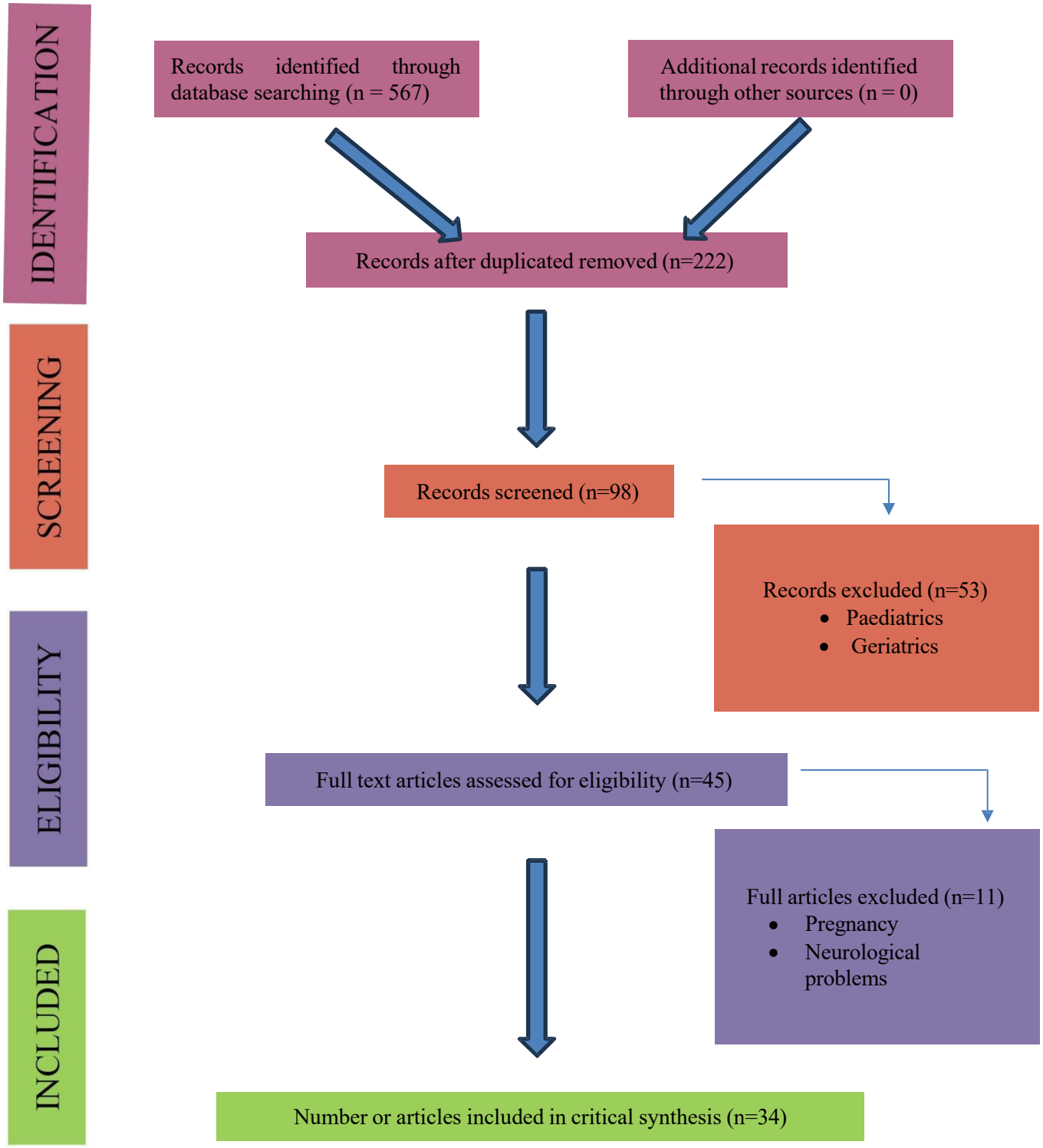

Figure 1 – Detailed flow diagram for study selection

Discussions:

Recovery and overall patient outcomes are significantly impacted by postoperative pain and hemodynamic stability [8,9,26]. In addition to preventing discomfort, proper pain management helps prevent the complications that can result from poorly managed pain, such as cardiovascular changes brought on by stress and slowed recovery [8,17,25,31].

By improving pain management and promoting hemodynamic stability in the postoperative phase, research on preoperative pain management techniques indicates that both pharmaceutical and non-pharmacological interventions can enhance patient outcomes [1-6,12-14,18-23,27-30,33]. By combining the two strategies, a comprehensive postoperative recovery strategy is provided, minimizing the need for opioids, speeding up recovery, and enhancing cardiovascular function [5,6,15,20,23,24,29,32].

Efficacy of Non-Pharmacological Interventions in Postoperative Pain Management:

The past ten years have seen a significant increase in interest in non-pharmacological pain management techniques, such as music therapy and mind-body therapies [2,3,5,18,20,23,24,29,33]. These techniques are becoming more and more recognized as crucial supplements to pharmaceutical treatm ents, particularly when trying to lower opioid use and enhance recovery results [5,6,15,19,20,23,24,29]. Particularly, music therapy has been extensively researched and consistently proven to be beneficial in the management of postoperative pain [6,15,19,20].

According to research, music can significantly reduce pain by diverting the patient's attention, lowering anxiety, and adjusting perceived pain levels. It is also a non-invasive, inexpensive intervention. Research has shown that listening to relaxing music helps patients feel less pain, which is associated with a decrease in heart rate and blood pressure [6,15,19]. By promoting hemodynamic stability and reducing the need for pharmaceutical pain management, these effects reduce the likelihood of negative side effects like opioid dependence and respiratory depression [5,6,15,20,24,26,29].

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In order to manage postoperative pain and preserve hemodynamic stability, relaxation techniques like progressive muscle relaxation, deep breathing exercises, and guided imagery are essential [3,11,18,27,33]. These methods are especially helpful in lowering surgical patients' levels of stress and anxiety, which lowers the activation of the sympathetic nervous system. By doing this, they aid in regulating heart rate and blood pressure, avoiding postoperative variations that may make recovery more difficult, especially in heart and brain surgeries [8,9,11,17,27]. Additionally, it has been discovered that foot massage and other similar interventions improve circulation, reduce pain, and enhance patient comfort in the postoperative period [19,27,29].

Patient education is another important non-pharmacological intervention that is frequently underappreciated for its ability to influence postoperative results [22,23]. Preoperative anxiety is a major contributor to postoperative pain perception, and it can be considerably decreased by teaching patients coping mechanisms, realistic expectations, and pain management techniques [18,23,33].. According to studies, patients who are well-informed have less pain after surgery because they are psychologically ready for the healing process [23, 33]. Additionally, patient education has been linked to decreased stress-induced hemodynamic instability, increased satisfaction, and better adherence to recovery protocols [23, 26, 33].

Pharmacological Interventions and Haemodynamic Control:

The mainstay of postoperative pain management continues to be pharmacological methods. Despite their effectiveness in reducing pain, opioids carry a number of serious risks, such as the possibility of dependence and overuse, respiratory depression, nausea, and constipation. Multimodal analgesia has therefore gained popularity as a tactic. This strategy targets various pain pathways by combining various drug classes, including NSAIDs, acetaminophen, local anaesthetics, and opioids [25,28,30,31]. It has been demonstrated that multimodal analgesia lowers overall opioid consumption, which in turn lowers opioid-related side effects [24,25,28,29,31]. Furthermore, because it eliminates the need for high-dose opioids, which are known to cause fluctuations in heart rate and blood pressure during the postoperative period, this method has been linked to improved hemodynamic control [8,9,25,28,31].

Another crucial pharmacological tactic is the application of pre-emptive analgesia. Preventing hyperalgesia and wind-up pain, which both contribute to the exacerbation of postoperative pain and central sensitization can be achieved by administering analgesics prior to the start of surgery [22,28,31]. For example, pregabalin's potential to prevent postoperative pain, especially after laparoscopic procedures, has been extensively researched. Pregabalin administration prior to surgery has been shown to improve hemodynamic stability and decrease the need for postoperative opioids. Pregabalin helps prevent cytokine release and inflammatory reactions that usually raise blood pressure and heart rate after surgery by preventing acute pain responses prior to surgery [28].

Dexmedetomidine, a sedative analgesic that has been demonstrated to offer both pain relief and hemodynamic stability, is a promising pharmacological intervention in pain management. As an α2-adrenergic agonist, this medication lowers sympathetic nervous system activity, which lowers heart rate and blood pressure during surgery and the first few days after surgery. Dexmedetomidine is especially useful for high-risk patients, such as those having heart surgery, because it can provide sedation and analgesia without significantly depressing breathing. Dexmedetomidine is a flexible perioperative care agent that has also been demonstrated to decrease opioid use and speed up recovery [12-14].

Combined Pharmacological and Non-Pharmacological Approaches:

For a thorough approach to pain management and hemodynamic control, recent research highlights the significance of combining pharmacological and non-pharmacological strategies [5,6,15,18,20,23,27,29,30,33]. Patient outcomes are greatly improved when multimodal pharmacological interventions are combined with preoperative education [23,29,33] . Preoperative anxiety can be decreased by teaching patients about pain management expectations and techniques [18,23,33].

This can enhance the patient's pain tolerance and lessen the intensity of postoperative pain. It has been discovered that pre-emptive analgesia combined with non-pharmacological methods such as music therapy and relaxation exercises improve hemodynamic stability and pain scores [6,15,18,22,25,33].

Specifically, multimodal analgesia in conjunction with non-pharmacological techniques like music therapy has shown great promise in controlling pain levels while reducing the need for opioids [5,6,15,19,20,29]. Because it tackles the psychological, emotional, and physiological facets of recovery, this synergistic approach is crucial [5,6,15,19,20,33].

For example, it has been demonstrated that music therapy improves hemodynamic parameters like heart rate and blood pressure, lowers the perception of pain, and increases patient satisfaction [6,15,19,20]. Music therapy lessens the activation of the sympathetic nervous system, which is frequently made worse by extreme pain and emotional distress, by lowering stress and anxiety [6,15,19,20,27,33].

Impact of Haemodynamics Management on Postoperative Recovery:

Hemodynamic stability is essential for the best possible recovery after surgery, especially in neurological and cardiovascular procedures where changes in heart rate and blood pressure can impair wound healing and organ perfusion [8,9,17,27,29]. Stable haemodynamics have been linked in studies to better wound healing, quicker recovery, and fewer postoperative complications [8,9,17,27,29,31].

Stable haemodynamics depend on both non-pharmacological and pharmaceutical therapies that reduce sympathetic hyperactivity [6,11-14,19,27,33]. Preoperative education and dexmedetomidine are particularly helpful in avoiding hemodynamic instability following surgery [12-14,23,33].

Studies have shown that non-pharmacological treatments, such as breathing techniques and foot massage, can considerably improve cardiovascular function after surgery, resulting in a quicker and less problematic recovery for patients [11,18,19,27,33]. By enhancing psychological well-being, which in turn lessens stress-induced hemodynamic fluctuations, these techniques complement pharmaceutical treatments [18,19,23,27,33].

Limitations and Future Research Directions:

Future research must address a number of issues and constraints, even in light of the encouraging outcomes of both pharmacological and non-pharmacological interventions. There is ongoing discussion regarding these interventions' duration, dosage, and timing. To ensure the best possible pain relief and hemodynamic control, more research is needed to develop standardized protocols that incorporate both pharmaceutical and non-pharmacological approaches. Further studies on the long-term consequences of these interventions are also required, particularly with regard to their influence on the development of chronic pain and opioid dependence.

Furthermore, personalized care is still essential even though there is mounting evidence that non-pharmacological approaches are effective. Depending on the patient's age, mental health, and surgery type, the efficacy of breathing techniques, music therapy, and patient education may differ. As a result, a customized strategy that takes into consideration the preferences of the patient and particular surgical circumstances should be used.

Conclusion:

Pharmacological approaches ensure effective pain relief and hemodynamic stability but pose risks such as opioid dependence, whereas non-pharmacological methods support psychological recovery and patient satisfaction, though with variable efficacy. Integrating both provides the most comprehensive benefit, reinforcing the importance of individualized care, standardized guidelines, and robust long-term research.

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