Efficacy of nonpharmacological therapies for postoperative pain in cardiac surgery: A systematic review

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Research Article

Keywords: Postoperative pain, Cardiac surgery, Complementary therapies

Posted Date: November 3rd, 2022

DOI: https://doi.org/10.21203/rs.3.rs-2230920/v1

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Abstract

Introduction: Postoperative pain is common and occurs frequently in patients undergoing cardiac surgery, which can lead to adverse events. Therefore, it is critical that assessment and adequate analgesia are performed to avoid compromising the recovery process. It is recommended that multimodal therapy be used for this purpose, as it promotes better analgesia. Therefore, the aim of this study is to search for studies that address the efficacy of nonpharmacological methods for pain relief in these patients.

Methods: This study used a PRISMA-compliant systematic literature review that selected primary randomized clinical trials on the efficacy of nonpharmacological pain relief therapies in patients undergoing cardiac surgery. Searches were conducted in PubMed, LILACS, CINAHL, the Web of Science, Scopus, and the Cochrane Central Register of Controlled Trials, with no time or language restrictions. The Joanna Briggs Institute Critical Appraisal Checklist for Randomized Clinical Trials was used to assess methodological rigor.

Results: After screening, 23 of the 140 studies found in the databases were selected. The studies examined the efficacy of thirteen different nonpharmacological therapies, as well as a combination of therapies, with massage therapy being the most commonly examined, followed by musical intervention and hypnosis.

Conclusions: Some interventions, when combined with pharmacological therapy, were effective in relieving postoperative pain after cardiac surgeries, according to the studies analyzed. However, most studies had significant methodological flaws, and further studies with high methodological quality are needed.

Systematic review registration: The present study is registered in the International Prospective Register of Systematic Reviews (PROSPERO) under number CRD42020168681.

Introduction

Pain is considered the fifth sign of life and is defined by the International Association for the Study of Pain (IASP) as "an unpleasant sensory and emotional experience associated with or resembling actual or potential tissue damage," thus a unique experience influenced by biological, psychological, and social factors [1]. Therefore, it is critical to assess and measure pain using a biopsychosocial model to diagnose the cause and apply appropriate analgesic therapy [2].

In surgery, the intensity of postoperative pain depends on the type and duration of surgery, the type of surgical incision, the anesthetic technique, and patient factors such as gender, age, and previous surgical experience, among others [3].

Cardiac surgeries are usually performed through a median sternotomy, which is directly related to expressive pain and difficult recovery in the postoperative period due to tissue damage to the skin, subcutaneous tissues, cartilage, and bone [4, 5]. In addition to this nociceptive stimulus caused by the trauma, other complex mechanisms are at work. In general, an inflammatory response occurs, leading to sensitization of peripheral and central nerve pathways, resulting in pain [4].

If left untreated, postoperative pain can cause cardiovascular, gastrointestinal, respiratory, metabolic, and immunologic changes associated with delayed and poor healing of the surgical wound, risk of thromboembolism, decreased muscle strength, and decreased immune response, among others [2].
Because postoperative pain is common and has a high incidence [6], which may promote the occurrence of adverse events such as myocardial ischemia, cardiac arrhythmias, and pulmonary complications [4], it is crucial that assessment and appropriate analgesia are performed to avoid compromising the recovery process [6].

According to a study conducted on 24 patients who underwent elective cardiac surgery, the patients did not experience pain in the preoperative period, but only in the postoperative period. Moreover, the level of pain was directly related to a decrease in functional level, which may lead to a decrease in quality of life after discharge [7].

As a result, uncontrolled postoperative pain hinders functional recovery, decreases the patient's quality of life, and becomes a risk factor for persistent postoperative pain, chronic pain, and disability, demonstrating poor quality of care [8].

Because postoperative pain can impact patient recovery, it is critical that it be properly managed using a multimodal approach to improve analgesia and reduce side effects to prevent hemodynamic, metabolic, immunologic, and hemostatic changes that can increase postoperative morbidity and mortality. This may also lead to higher patient satisfaction and a better clinical outcome [2, 4, 5].

Experts strongly advise providing multimodal analgesia to patients postoperatively. This includes the administration of various analgesic drugs and techniques with different mechanisms of action in the central and/or peripheral nervous systems, which must be combined with nonpharmacological interventions [9].

In this context, it is crucial to highlight the scientific evidence of pharmacological and nonpharmacological therapies, because such a therapeutic combination promotes effective pain relief while favoring the reduction of drug doses and side effects, thus optimizing patient recovery and reducing hospital costs [10].

A study that examined 38 scientific articles on pharmacological and nonpharmacological methods of pain management in patients undergoing general surgery found that although several medications are effective in relieving pain in the immediate postoperative period, multimodal therapy is more effective than not using them [10].

Nonpharmacological therapies, which fall under the category of integrative and complementary therapies, rely on traditional knowledge to stimulate natural mechanisms to prevent disease and maintain health [11]. Moreover, they are commonly available techniques that are easy to perform and have a low risk of side effects when performed by trained professionals [10]. In this way, they are alternatives that can support the patient's recovery during hospitalization [12].

Therapeutic massages, music therapy, aromatherapy, and acupressure were among the nonpharmacological therapies mentioned in a scoping review of 17 studies [12]. Transcutaneous electrical nerve stimulation, cognitive-behavioral therapies such as guided imagery, and other relaxation and hypnosis techniques can also be mentioned [9]. Cryotherapy, distraction, and physical activities are mentioned by other authors [13], as are acupuncture, osteopathic manipulation, meditation, yoga, and tai chi [14].

Despite the growing body of research on nonpharmacological interventions for pain relief, they are rarely used in nursing. Thus, in order to promote the evidence-based practice and implementation of such therapies, nurses must embrace the autonomy of care that has been delegated to them [15].

However, to achieve satisfactory outcomes, nurses must understand the benefits of nonpharmacological therapies for acute pain, their mechanisms of action, and their effective implementation. It is crucial that professionals are
prepared to recognize patients' needs and preferences, as well as their own willingness and ability to implement such interventions [13, 16].

With this in mind, this study is justified by the importance of promoting evidence-based practice by collecting accurate data from the literature on the efficacy of nonpharmacological methods for pain relief in patients undergoing cardiac surgery.

Therefore, the aim of this review was to determine the efficacy of nonpharmacological therapies in relieving postoperative pain in adults undergoing cardiac surgeries.

Methods

This is a systematic review of the literature conducted according to PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) (see Additional File 1) [17] and registered in the International Prospective Register of Systematic Reviews (PROSPERO) under the number CRD42020168681.

The following procedures were followed in the preparation of the review: development of the systematic review protocol, review questions, inclusion criteria, and research strategy; screening and selection of studies; critical appraisal; data extraction; and data synthesis [18].

For this review, the mnemonic PICOT (population, intervention, comparison, outcome, and study types) [18] was used: P: adult patients undergoing cardiac surgery; I: nonpharmacological treatments; C: adults undergoing cardiac surgery and not receiving nonpharmacological therapies; O: postoperative pain; T: randomized controlled clinical trial.

Eligibility Criteria

Inclusion criteria

This systematic review included primary randomized clinical trials of patients over 18 years of age who underwent cardiac surgery and experimentally received nonpharmacological therapy at some point during the perioperative period, with results describing the efficacy of the nonpharmacologic therapy for postoperative pain.

Exclusion criteria

Editorials, literature reviews, letters to the editor, experience reports, case reports, case series, dissertations, theses, monographs, and abstracts from conference proceedings were excluded.

Databases and search strategies

The search for primary studies was conducted in May 2022 without time or language restrictions in the following databases: the National Library of Medicine's PubMed, Latin American and Caribbean Health Sciences Literature (LILACS), the Cumulative Index to Nursing and Allied Health Literature (CINAHL), the Web of Science, Scopus, and the Cochrane Central Register of Controlled Trials.

Additional File 2 describes the descriptors, terms, and search strategies used in each database.

Study selection and data extraction
Two researchers independently searched the databases and, after removing duplicate studies, read the titles and abstracts of all articles to decide whether to include or exclude them based on the defined criteria. A third researcher ruled on any discrepancies. Subsequently, the selected articles were read in their entirety and assessed for eligibility in pairs and independently.

Data were extracted from the articles using a survey tool that had already undergone face and content validation. It contained several items related to the identification of the article, the institution where the study was conducted, the type of publication, the methodological characteristics, and the assessment of the methodological rigor of the article [19].

**Methodological quality assessment**

Two independent researchers assessed the methodological quality of the studies included in the review using the Joanna Briggs Institute Critical Appraisal Checklist for Randomized Clinical Trials. This tool consists of 13 items related to the processes of randomization, allocation, blinding, follow-up, outcome evaluation, and statistical analysis, each with four response options (yes, no, unclear, or not applicable) [18].

**Data synthesis**

Data were analyzed and summarized in narrative form and presented in tables indicating objective, population, sample, intervention, measurement tool, outcome, and methodological quality, and a figure was prepared.

**Results**

A total of 140 records were initially found in the databases. After removing 8 duplicate files, 132 titles and abstracts were checked, and 100 articles were excluded. Thirty of the 32 articles were retrieved in full text and checked for eligibility. Because 7 of them did not meet the inclusion criteria, the systematic review sample consisted of 23 studies (Figure 1).

**Characteristics of the studies**

The studies analyzed were published in English from 1974 to 2022 [20-42]. Considering the final samples of each study, a total of 1,999 participants were evaluated, with the smallest sample comprising 22 patients [35] and the largest comprising 252 patients [36]. Regarding the country of origin of the studies, most (8, or 34.8%) were from the United States.

The characteristics of the 23 clinical trials included in this review and their main findings related to the efficacy of nonpharmacological therapies in postoperative pain after cardiac surgery are summarized in Additional File 3.

The studies examined thirteen different nonpharmacological therapies, some of which were analyzed in isolation and/or in combination in the same study, in addition to a set of therapies that combined relaxation with guided imagery, soft touch, or light massage and music.

Therapeutic massage was the most commonly used intervention, analyzed independently in eight studies (34.8%) and in combination with patient education in one (4.3%), followed by an isolated musical intervention in four (17.4%) and in conjunction with chest physiotherapy and oxygen support in one (4.3%), and hypnotherapy alone in two (8.7%) and in conjunction with brief psychotherapy in one (4.3%) and in conjunction with virtual reality in one (4.3%) (Figure 2).
For pain assessment before and after the intervention, the most used scale was the Visual Analogue Scale (VAS), in 17 studies (73.9%), followed by the Numeric Pain Scale in five (21.7%) studies, and the Verbal Pain Scale in one (4.3%) study.

Regarding the efficacy of nonpharmacological therapies, a statistically significant pain reduction in the postoperative period of cardiac surgery was found in six studies (75%) using therapeutic massage as an intervention [22, 25, 28, 30, 32, 33], one study (100%) using therapeutic massage in conjunction with patient education [24], five studies (100.0%) using musical intervention [20, 29, 37, 38, 40], one study (100%) evaluating osteopathic manipulative treatment [26], one study (33.3%) using hypnotherapy [27], one study (100%) using ice pack therapy [31], one study (100%) using electroacupuncture [35], one study (100%) evaluating a set of complementary alternative therapies [39], one study (100%) using scheduled rest [40], one study (100%) using neurolinguistic programming, and one study (100%) using guided imagery [23].

However, in the study evaluating musical intervention with 86 patients, no reduction in the use of analgesics was found, despite the decrease in the level of pain after cardiac surgery [38], and in the study conducted in Sweden with 58 patients, it was found that there were no significant differences between the groups when the outliers were disregarded [37].

Regarding the efficacy of the nonpharmacological therapies analyzed, no statistically significant difference in pain reduction was found between the groups of patients in two studies (25%) in which therapeutic massage was used as an intervention [36, 41], one study (33.3%) using hypnotherapy [21], one study (100%) using brief psychotherapy in conjunction with hypnosis [42], one study (100%) evaluating virtual reality in isolation, one study (100%) using virtual reality in conjunction with hypnosis [21], one study (100%) addressing homeopathic treatment [34], and one study (100%) using guided relaxation [41].

**Methodological quality assessment**

Regarding methodological quality, none of the analyzed studies included all 13 elements recommended in the Joanna Briggs Institute’s critical appraisal checklist to reach the highest level of methodological quality [43].

The number of items of the tool that were completely fulfilled, i.e., answered “yes,” ranged from 5 (38.5%) to 12 (92.3%), with only one study (4.3%) achieving the highest score, as it fulfilled 12 items of the checklist.

The major methodological flaws observed in the articles were blinding of those who performed the treatment (13, or 56.5%), lack of information on blinding of participants (12, or 52.2%), and blinding of examiners (10, or 43.5%). As shown in Table 1, 19 (82.6%) of the studies had between one (7.7%) and six (46.1%) unclear items.

**Table 1.** Methodological quality of studies according to the Joanna Briggs Institute’s critical appraisal checklist for randomized clinical trials.

**Discussion**

Massage therapy, considered a physical modality [9], was the most discussed nonpharmacological therapy for pain relief in the postoperative period of cardiac surgery, followed by musical intervention and hypnotherapy, considered cognitive-behavioral therapies [9].
Massage therapy proved effective in six of the eight studies [22, 25, 28, 30, 32, 33], and it also proved effective when combined with patient education [24]. Massage not only reduced anxiety [24, 25, 28, 32, 33] but also stress [28, 32] and fatigue [24].

The feet received the most attention [22, 25, 41], followed by the area indicated by the patient, which could be the head, neck, shoulders, arms, hands, back, legs, or feet [28, 33]. The duration of massage ranged from 10 to 30 minutes, with 20 minutes being the most common [22, 24, 28, 32, 33, 41].

A meta-analysis that evaluated the effect of massage on reducing perioperative anxiety and postoperative pain recommended that massage sessions should last 10 to 20 minutes in busy clinical settings [44].

A randomized clinical trial of 60 patients undergoing cardiac surgery found that, in addition to standard ICU care, a 20-minute massage session with moderate pressure on the hands could reduce the intensity and unpleasantness of pain and anxiety [45]. However, further research is needed on the optimal frequency, techniques, and duration of massage in the postoperative setting [33].

In a study conducted in Saudi Arabia with 31 patients, it was found that foot massage combined with pharmacological treatment can reduce pain, as there was a reduction of 2 to 3 points on the VAS, as well as a reduction in anxiety levels. In addition, this study addressed the importance of pain control, especially in the first four postoperative days [25].

Similarly, in a study of 152 patients, the authors found that massage therapy, used as an adjunct to standard treatment beginning on the third postoperative day, helped to relieve pain and reduce anxiety [28].

The effectiveness of massage therapy was demonstrated in a study conducted with 53 patients in the United States, which found a significant reduction in the level of pain in intensive care patients, as well as benefits related to the interrelationship between pain, relaxation, sleep, emotions, recovery, and other phases of healing [46].

In addition, massage therapy is considered a safe and inexpensive technique [25] that can be used as an adjunct to standard treatment to relieve discomfort while providing physical and psychological benefits during hospitalization [25, 28].

As health care professionals and patients become more aware of the benefits of massage therapy as an adjunct to conventional therapy, nurses will play an important role during patients' hospitalization by identifying the evidence and benefits of this technique for relieving pain and anxiety [47].

Regarding the efficacy of musical intervention, studies [20, 29, 37, 38, 40] have shown a significant reduction in postoperative pain and anxiety [20, 38, 40].

Background music and sedative music can be used in conjunction with pharmacological therapy to help patients recover after cardiac surgeries by reducing pain and anxiety [20, 29, 40]. In addition, musical intervention is low-risk and can be performed safely [20, 40].

In the studies analyzed, musical intervention was delivered through headphones or a music pillow at 20- to 30-minute intervals, with music preprogrammed by the researcher or chosen from a list by the patient. The music styles used were classical [20, 38, 40], jazz [38, 40], structured music with nature sounds [29], new age-style soft music [37], easy listening ("ambient music") [38], sedative music (synthesizer, harp, piano, orchestra, and flute) [40], and folk and pop [20]. A mixed randomized clinical trial with a quantitative and a qualitative phase conducted on 45 patients
undergoing cardiac surgery found that a 15- or 30-minute session of musical intervention was effective in reducing pain. Pain intensity on the VAS was reduced by approximately two points, and the technique had a positive effect on reducing anxiety [48].

A meta-analysis of systematic reviews found that musical intervention was effective in reducing pain and anxiety in patients undergoing cardiac surgery and was a simple therapy to implement [49].

The effects of musical intervention on the relief of postoperative pain have been studied in a variety of surgical settings. A meta-analysis of 81 randomized clinical trials concluded that listening to music reduced pain and anxiety in adults undergoing surgery. However, it should be noted that the risk of bias in the studies ranged from moderate to high [50].

Further studies are needed on the effects of musical intervention on pain relief, as well as on the optimal duration of each session, the effects of repeated sessions, and the style of music [37, 38, 40].

Hypnosis, on the other hand, is a psychotherapeutic technique in which the hypnotist suggests changes in behavior, cognition, perception, affect, or mood [51, 52], which may help alleviate pain associated with medical procedures [54].

Only one of the four evaluations of hypnotherapy alone or in conjunction with other therapies [27] has demonstrated the effectiveness of the intervention in reducing pain after cardiac surgery. This study examined hypnosis in patients undergoing myocardial revascularization and found that it contributed to both pain relief and reduction of anxiety and stress. However, the authors emphasized that this technique should only be used by trained and certified teams [27].

Hypnotherapy has also been shown to be beneficial in other surgeries [55, 56] and procedures [57], although in some cases no statistically significant results were found [58]. In addition, one study found that hypnotic sedation may reduce the incidence of chronic pain in patients who have undergone mastectomy [53].

Although some studies have failed to demonstrate the efficacy of hypnosis for pain control in the postoperative period of cardiac surgery [21, 42], a meta-analysis of 85 clinical trials found that this therapy was able to significantly reduce pain in healthy patients exposed to a nociceptive stimulus, making it an attractive alternative to analgesics for most people [59]. Another meta-analysis of 50 studies found that pain relief had a positive outcome in surgical patients [60].

However, we emphasize the importance of conducting methodologically rigorous clinical trials with different populations to prove the efficacy and applicability of hypnosis in order to recommend this therapy [59], as well as to analyze the circumstances in which the beneficial effects of this therapy may occur [60].

Osteopathic manipulative treatment is a therapy whose results are well documented in the treatment of musculoskeletal disorders, especially low back pain; however, its application in other pathologies is still limited [61]. Despite the positive results found in an Italian study of 80 patients on the applicability of this therapy in the relief of pain after cardiac surgeries, further studies are needed to support the practice [26].

Although studies using ice packs, electroacupuncture, a set of complementary alternative therapies, scheduled rest, neurolinguistic programming, and guided imagery have shown positive results in reducing postoperative pain,
individual studies are insufficient to recommend the clinical application of these therapies for pain relief after cardiac surgery.

Similarly, studies indicating the ineffectiveness of homeopathic treatment, guided relaxation, brief psychotherapy, and virtual reality in significantly reducing pain are insufficient to rule out their use as adjunctive methods to pharmacological analgesia.

In the absence of sufficient scientific evidence, the North American consensus of pain specialists neither recommends nor discourages the use of physical methods such as therapeutic massage, acupuncture, or cold therapy as adjuncts to the management of postoperative pain. In contrast, cognitive-behavioral therapies such as music intervention, hypnosis, guided imagery, and others have only moderate evidence and are only weakly recommended [9].

Moreover, studies show that these nonpharmacological therapies are safe, low-risk, and well accepted by patients, in addition to being inexpensive and easy to use [25, 26, 31, 39]. However, complementary therapies should be used in conjunction with pharmacological methods and not as a substitute [23].

The lack of meta-analysis is a potential limitation of the present systematic review, as the included studies were quite heterogeneous in evaluating different types of nonpharmacological therapies using different methods.

**Conclusion**

Music intervention, massage therapy, osteopathic manipulative treatment, ice pack therapy, electroacupuncture, a set of complementary alternative therapies, scheduled rest, neurolinguistic programming, and guided imagery proved effective in relieving postoperative pain after cardiac surgery when used in conjunction with pharmacological therapy in the studies analyzed. However, most studies had significant methodological flaws, suggesting that greater rigor is needed in the conduct of clinical trials.

There are still gaps in the use of nonpharmacological therapies after cardiac surgery, especially in terms of efficacy, mode and timing of administration, and number of sessions required. Therefore, more research with high methodological quality is needed to provide more robust results that can support the use of therapies in clinical practice.

Given the small number of randomized clinical trials found in this systematic review, most of which focused on specific therapies, and the significant limitations of the methods used in the studies, it is not possible to accurately determine the efficacy of nonpharmacological interventions for pain management in the context of cardiac surgery or even to claim that one therapy is more effective than the others.

**List Of Abbreviations**

IASP: International Association for the Study of Pain; PRISMA: Preferred Reporting Items for Systematic reviews and Meta-Analyses; PROSPERO: International Prospective Register of Systematic Reviews; LILACS: Latin American and Caribbean Health Sciences Literature; CINAHL: Cumulative Index to Nursing and Allied Health Literature; VAS: Visual Analogue Scale; ICU: Intensive Care Unit.

**Declarations**
Ethical approval and consent to participate
Not applicable.

Consent to publication
Not applicable.

Data and material availability
Not applicable.

Conflicts of interest
The authors declare no conflicts of interest.

Funding
There is no funding for this study.

Author contributions
MHB was the research coordinator. MHB, EVA, and MMSF developed the research protocol. EVA, MMSF, and MBGF participated in the selection and extraction of data from the articles. LMO, EVA, and MFF contributed to data analysis and the writing of the manuscript. LMO and KFNS contributed to the review of the article. All authors read and approved the final manuscript.

Acknowledgements
We thank the National Council for Scientific and Technological Development (CNPq) for the research productivity grant (PQ No. 307468/2021-6) given to the researcher MHB.

References


Tables

Table 1 is available in the Supplementary Files section.

Figures
Figure 1
Flowchart of steps for inclusion of articles in the systematic review according to PRISMA, 2021
Figure 2

Nonpharmacological therapies used in studies assessing pain in the postoperative period after cardiac surgery

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Table1.docx
- Additionalfile1.docx
- Additionalfile2.docx
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