



Transcutaneous electrical nerve stimulation and music pain manage after surgery- Literature review

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Abstract

Most of the time patient suffer from serious pain after surgery, usually patient take painkiller relieve pain. But some pain last for a long time after surgery. If patient take painkiller relieve pain for a long time that will lead to tolerance, patient must take more dose of painkiller to achieve the same degree of pain relief. And long-term use of opioids medicines also leads to dependence or addiction. Moreover, painkiller have some side effects, that cause nausea, sedation, drowsiness, slowed breathing, those uncomfortable experiences are one of the reasons make some people don't want take painkiller. Therefore, exploring other non-pharmacological pain management ways are necessary and significant.

This purpose of this study is to recognize transcutaneous electrical nerve stimulation (TENS) and music pain management after surgery and explore transcutaneous electrical nerve stimulation (TENS) and music roles in postoperative pain management. The aim is to use of transcutaneous electrical nerve stimulation (TENS) and music methods manage postoperative pain, therefore patient decrease analgesics consumption and depending, improve the care of postoperative pain management, promote health of the patient.

The method of this study is a literature review. Articles were obtained from school electronic library databases, school paper library, Google Scholar. The relevant content was finally screened to select, organize, and summarize for including studies.

The studies found that transcutaneous electrical nerve stimulation (TENS) and music can relieve pain after surgery. Transcutaneous electrical nerve stimulation (TENS) or music also can combine with drugs to decrease drugs use and reduced risk of side effects. The advantage of transcutaneous electrical nerve stimulation (TENS) and music pain management include, noninvasive, inexpensive, safe, and easy to operate.

Keywords: TENS, music, pain management, after surgery.

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1 Introduction

Pain is a private and subjective experience, which can only be felt and understood by the person experiencing it. In 1979, the International Association defines pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage”. Pain mechanism is very complex. Scientists explore pain mechanism from neurophysiology, such as a sharp object cut skin, pain receptors perceive stimulation, the neural transmission of nociceptive impulses or pain chemicals transmission of pain, then the brain felt pain. In this case, the skin is the pain receptors, but if there are no pain receptors, but people feel pain, such as phantom limb pain, how to explain this pain by neurophysiology? Therefore, there are also some theories explain pain mechanism by psychological aspects. In conclusion, Pain can be viewed as a multidimensional experience with a sensory, cognitive, and emotional component (Mann, E. & Carr, E. 2006). Pain is a bad sensory experience. Pain causes a complex physiological effect, pain stimulate hypothalamic activation and increase sympathetic-adrenergic system activity, secret of hormones, then affects cardiovascular and all the body. when people suffer from pain, they maybe change behavior and emotion, such as sleeplessness, reduce food and water intake, less physically active, became easily irritable, which leads to a decline quality of life and healthy.

In a 2017 study, up to 80% of surgical patients reported inadequate postoperative pain control. The poor postoperative pain control can cause multiple complications, impair breath and movement, increase morbidity, decreased quality of life, longer recovery times. Persistent inadequate postoperative pain control or untreated pain may lead to neurologic disturbances, such as chronic pain syndromes or sensitization. Recent advances in pain management suggest that the optimal treatment requires interfering with multiple targets on pain pathways, known as multimodal analgesia. This approach utilizes a combination of interventions, each working on a different mechanism of pain to reach maximal pain relief and using minimal doses of medications, which lower risk side effects, dependency, and polypharmacy (Cardinali, A. et al. 2021).

Transcutaneous electrical nerve stimulation (TENS) and music have many advantages as non-pharmaceutical postoperative pain management methods, obviously advantages include noninvasive, easy operate, relief of many types of pain, cost-efficient. Because of these advantages, transcutaneous electrical nerve stimulation (TENS) and music intervention are widely used various kinds of postoperative management, or combine with medicine to enhance postoperative pain management, minimize the consume of opioid and nonopioid analgesics, as a part of a multimodal approach control pain, improving postoperative patient recovery.

1.1 Transcutaneous electrical nerve stimulation (TENS)

Transcutaneous electrical nerve stimulation (TENS) is anything that delivers electricity across the intact surface of the skin to activate underlying nerves (Watson 2008,256). Transcutaneous electrical nerve stimulation (TENS) is still widely used for all type of pain (Mann, E. & Carr, E. 2006). There are many theories about How might the transcutaneous electrical nerve stimulation (TENS) work. The most common theory is the gate control theory of pain. According to this theory, the stimulation of large diameter afferent nerves by transcutaneous electrical nerve stimulation (TENS) inhibits central nociceptive transmission with a resultant decrease in pain perception (Gibson et al. 2019, cited in Melzack 1965). Transcutaneous electrical nerve stimulation (TENS) is thought to have additional spinal segmental effects, decreased inflammation-induced dorsal horn neuron sensitization (Gibson et al. 2019, cited in Sabino 2008), altered levels of neurotransmitters such as gamma-aminobutyric acid (GABA) and glycine, which are thought to be involved in inhibition of nociceptive traffic (Gibson et al. 2019, cited in Maeda 2007, Somers 2009). Transcutaneous electrical nerve stimulation (TENS) also appears to influence endogenous analgesia mediated by higher centers of the nervous system. Descending inhibitory activity, relayed via the midbrain periaqueductal grey (PAG) and the rostral ventral medulla (RVM) in the brainstem, has anti-nociceptive effects (Gibson et al. 2019, cited in Gebhart 2004).

1.2 Music therapy

Music therapy is well established as an evidence-based treatment modality all over the world. There is solid knowledge base documenting how and why music can help people with physiological, psychological, existential, spiritual, and social problems and pathologies (Bonde, L. & Theorell, T. 2018). Music therapists are specifically trained to use the unique qualities of music, known as musical components (e.g., melody, rhythm, tempo, dynamics, pitch) in the therapeutic relationship to work on the patient's treatment goals. During music therapy sessions, music therapists attune to the patient by adjusting the way of music-making as an immediate response to the client's needs. The music therapist and the patient interact simultaneously and are regulated through time, yielding a similar expression in movement, matching pulse, rhythm, dynamics and/or melody (De Witte et al. 2022). Music therapy is a reflexive process wherein the therapist helps the client to optimize the client's health, using various facets of music experience and the relationships formed through them as the impetus for change (Bruscia 2014). The purpose of music therapy is improving or supporting patient health and wellbeing. However, music therapy has no international standards, and there are variety of definitions and apply intervention about music therapy. In 2015, the American Music Therapy Association defines music therapy as "music interventions" that are both clinically and evidence- based (Liu, Y. & Petrini, M. 2015).

2 Purpose and aim

This purpose of this study is to recognize transcutaneous electrical nerve stimulation (TENS) and music pain management after surgery and explore transcutaneous electrical nerve stimulation (TENS) and music roles in postoperative pain management. The aim is to use of transcutaneous electrical nerve stimulation (TENS) and music methods manage postoperative pain, therefore patient decrease analgesics consumption and depending, improve the care of postoperative pain management, promote health of the patient.

The research questions are:

1. Can transcutaneous electrical nerve stimulation (TENS) and music effectively manage postoperative pain?
2. Can transcutaneous electrical nerve stimulation (TENS) and music pain management replace analgesics?

3 Methodology

The research method of this literature review is a descriptive study by collecting literature reviews. Literature review method. Literature review is the comprehensive study and interpretation of literature that relates to a particular topic. Literature review is important and useful, because of increasing amount of literature available to health and social care professionals, who can't be expected to read and assimilate all the information on any one topic. Researchers undertake a literature review, then seek to answer this question by searching relevant literature, the review leads to development of new insights that are only possible when each piece of relevant information is seen in the context of other information. Researchers collect individual studies results, analysis and combine the vary results from different studies and summarized into one study, so that the reader does not have to assess each individual research report. (Aveyard 2010,5-6).

3.1 Data sources and search strategy

A comprehensive search was developed, and four electronic databases were searched in Dec 2021 and Jan 2022. These databases include EBSCO (CINAHL, MEDLINE), PROQUEST, ELSEVIER (SCIENCE DIRECT) databases and GOOGLE SCHOLAR. The search terms used are as follows, Transcutaneous electrical nerve stimulation pain management AND after surgery or postoperative. Music pain management AND after surgery or postoperative.

I have limited to full-text reports in English, other language was excluded, studies were published from 2010 to now, I also limited academic articles and scholarly journals, Non-

academic articles were excluded, the Studies included pain management after surgery, pain management before surgery, during surgery or no surgery were excluded, Studies included TENS, music, and multiple pain management, only use pharmacological pain management were excluded. There is no limitation on gender, but the participant's age under 16 years were excluded. Studied were screened by titles or reading abstracts. Table1 is the inclusion and exclusion criteria.

Inclusion	Exclusion
Pain management after surgery	Pain management before surgery, no surgery,
TENS and music	pharmacological
Adult	children
Full text	Reviews
From 2010 to now	Before 2010
Languages: English	Other languages
Academic articles and scholarly journals	Non-academic articles

(Table 1: Inclusion and Exclusion criteria)

3.2 Study selection

One researcher searched library electronic databases: EBSCO (CINAHL, MEDLINE), PROQUEST, ELSEVIER (SCIENCE DIRECT) and GOOGLE SCHOLAR. Then independently assessed the search results according to the inclusion and exclusion criteria, but RCT studies were preferred. Finally, six articles were accepted, three articles are about transcutaneous electrical nerve stimulation pain management after surgery, three articles are about music pain management after surgery.

3.3 Data extraction

One study come from EBSCO (CINAHL, MEDLINE) databases. One study come from PROQUEST databases. Four studies come from ELSEVIER (SCIENCE DIRECT) databases. Four studies are randomized clinical trial. Two studies are randomized, Double-Blind, Placebo-Controlled Trial methods. All the accepted articles were extracted by a preprepared checklist. The checklist consisted of author name, publication year, country, purpose of the study, participants, data collection method, data analysis method, main results (appendix 1).

4 Result

4.1 Transcutaneous electrical nerve stimulation (TENS)

Three studies on Transcutaneous electrical nerve stimulation (TENS) were selected. Three studies are about transcutaneous electrical nerve stimulation pain management for the patients who undergoing inguinal hernia repair. Two selected studies used a randomized, Double-Blind, Placebo-Controlled Trial methods and one study used a randomized controlled. Studies involved of 199 participants, The TENS device was set at a constant stimulation frequency of 100 Hz and a pulse duration of 200 ms. The intensity of amplitude was adjusted individually based on patient tolerance between 10-30 mA. The transcutaneous electrical nerve stimulation intervention last 30mins every time. Outcome measures included the Visual analogue scale (VAS), algometer, Vital signs, Venous blood samples.

Study come from Turkey showed that transcutaneous electrical nerve stimulation increased patients' satisfaction with nursing care and reduced postoperative pain without a negative impact on vital signs (Yılmaz et al. 2019). Study come from Lithuania suggested that TENS could be used in daily practice as part of a multimodal postoperative pain treatment, especially for patients suffering from hyperalgesia (Parseliunas et al. 2021). Study come from IR Iran indicated that transcutaneous electrical nerve stimulation (TENS) is beneficial for postoperative pain relief following inguinal hernia repair, no side effects were observed, and recommended for its short-and long-term effectiveness for decreasing pain and analgesic requirement (AHMED, M. T 2010). Three studies showed that transcutaneous electrical nerve stimulation (TENS) could reduce postoperative pain after inguinal hernia repair. Recently, systematic reviews and meta-analyses have investigated the role of transcutaneous electrical nerve stimulation (TENS) in the treatment of postpartum pain, post-multiple sclerosis pain, and trigeminal neuralgia. Several clinical studies have reported that appropriate stimulation parameters are important to relieve central cerebrovascular accidents and peripheral diabetic peripheral neuropathy and cancer pain. (Yang et al. 2022).

4.2 Music

Three randomized controlled trial studies about music therapy were selected. The studies were about music pain management after surgery include patients who undergoing arthroplasty, cardiac, thoracic surgical. Studies involved of 262 participants. Participants were randomly assigned to two groups, music group received 20-30 minutes music intervention, 1-3 times per day, the intervention last 2-4 days after surgery. Outcome measures included faces pain scale, pain scores, numeric rating scale (NRS; 0-10), state-trait anxiety inventory (STAI), Vital signs (blood pressure, heart rate and respiratory rate).

Study come from China found that music intervention can reduce postoperative pain and anxiety, and lower systolic blood pressure and heart rate in patients after thoracic surgery (Liu, Y. & Petrini, M. 2015). Studies come from American reported music intervention significantly lower pain intensity and distress in hospital and post discharge at home, thought that music listening is an effective adjuvant pain management strategy, it is easy to administer, accessible, and affordable, and encouraged patients continue to use music to reduce pain at home during the postoperative recovery period (Laframboise-Otto et al. 2021). Other one study showed music intervention lower anxiety and increased satisfaction overall, indicated that recorded music and nature sounds can be integrated into the postoperative care of cardiovascular surgery, because recorded music may provide an additional means for addressing common symptoms of pain and anxiety while providing a means of relaxation for patients (Bauer et al. 2011). Three Studies found that music intervention can reduce postoperative pain. Two studies showed music intervention combined with analgesics is an effective pain management strategy. Moreover, Music can be useful for people with depression. A worldwide study on music therapy practice status revealed that 31% of music therapists treat patients with depression. Music is related to pleasure and can support the expression and modulation of affect. Music can support the strengthening and development of identity, promote self-confidence. Music as a complementary treatment supporting patient with depression to improve subjective wellbeing. Several systematic reviews conclude that music therapy as well as other music-based interventions help to reduce depressive symptoms, improving quality of life (Geipel, J et al. 2022).

5 Discussion

5.1 Transcutaneous electrical nerve stimulation (TENS)

This review was conducted to evaluate the efficacy of transcutaneous electrical nerve stimulation (TENS) on inguinal hernia postoperative pain management. Three included studies showed that transcutaneous electrical nerve stimulation (TENS) could reduce postoperative pain after inguinal hernia repair. There are many other studies about transcutaneous electrical nerve stimulation (TENS) relive postoperative pain in other surgeries, transcutaneous electrical nerve stimulation (TENS) has been shown to be effective in no cardiothoracic procedures, and has been implemented following abdominal, hip, knee and shoulder surgeries, amputations. And transcutaneous electrical nerve stimulation can be as effective adjunctive option in multimodal pain management, improve pain control, enhance recovery, decrease analgesia consumption and minimization of side effects (Eidy et al. 2016). Transcutaneous electrical nerve stimulation (TENS) can be used with two or four electrodes, depending on the size of the area to be treated. Electrodes may be applied directly to the painful are or over the course of the relevant nerve trunks or nerve roots, but never directly

on damaged or broken skin. The devices are usually used two to three times a day for no more than about one hour in order limit the risk of skin irritation (Mann, E. & Carr, E. 2006). The anti-hyperalgesia effects of transcutaneous electrical nerve stimulation (TENS) are maintained for 8 - 24 hours after stimulation (Eidy et al. 2016 cited in Kerai 2014). Transcutaneous electrical nerve stimulation (TENS) has been shown to be effective in the multimodal analgesia approach. However, transcutaneous electrical nerve stimulation (TENS) manufactures list cardiac pacemakers, pregnancy, and epilepsy as contraindication, therapy prescribe transcutaneous electrical nerve stimulation (TENS) to patient are taken according to healthcare professional (Watson 2008,264). Therefore, in clinical practice, patients should be evaluated when use transcutaneous electrical nerve stimulation (TENS) relieve postoperative pain, also patients should be trained to properly use the devices while recovering discharged to home or rehabilitation (Cardinali et al. 2021).

5.2 Music

The selected of three studies indicated that music therapy can reduce postoperative pain and anxiety. Music therapy is a psychosocial treatment that can address the varied needs of adults in medical settings such as reducing anxiety and pain, increasing relaxation, and improving affective states. In 2020, more than 1.8 million new cancer cases be diagnosed in the United States, the American Cancer Society recommended that cancer treatments should maintain quality of life and emotional well-being during and after treatment (Merry, M et al. 2021, cited in American Cancer Society, 2019). For improving emotional wellbeing for people with cancer, researchers found that music therapy have beneficial effects on anxiety, pain, mood, and quality of life, music therapy can have positive effects on cancer patients recovering from surgery (Merry, M et al. 2021).

The music therapy has advantages of convenient use, it can be performed anywhere, it doesn't require costly equipment, noninvasiveness. Music therapy is the safest non-pharmacological pain management method. No adverse events were reported. People can almost listen to music anywhere, anytime. Anyone gets benefits from music. Music can meaningfully improve mood, reduce perceived intensity of pain and anxiety. Many studies showed that music can benefit our physical and mental health in numerous ways. There's lots of evidence that listening to music can help calm down when we are in situations where we might feel anxious. Music therapy can assist in pain management, medication combine music manage pain better than medication alone (Kievisiene et al. 2020). Music therapy is feasible in nursing. Nurses are the front-line workers delivering care to patients around the clock. It is important for nursing staff have proper tools to provide symptom relief in nursing intervention, music can timely relief patient's pain and anxiety with no harm adverse effects and risks of misuse, no need worry about drug overdose, improving patient satisfaction. Music is easily put into practice for nursers. Music can be provided in multiple forms such as radio,

MP3 player, CD player. Patients can freedom to decide when to listen music and what kind of music. Study recommended that music should be of a calming nature with rhythms played at 60 to 80 beats per minute to best synchronize with preferred heart rates. Music should be played at least 15 to 30 minutes and at least two times a day (Poulsen et al. 2019)).

6 Conclusion

Result of this review indicate that transcutaneous electrical nerve stimulation (TENS) and music therapy can reduce postoperative pain. Transcutaneous electrical nerve stimulation (TENS) or music therapy combined with analgesics can decrease analgesics consumption. Transcutaneous electrical nerve stimulation (TENS) and music therapy are safety and effective non-pharmaceutical pain management methods without have any side effects. Studies suggested that transcutaneous electrical nerve stimulation (TENS) and music therapy can be part of multimodal postoperative pain management. Non-pharmaceutical pain management methods combined with analgesics can decrease analgesics consumption, therefore, minimization of risk of drug dependence, addiction, and side effects, at the same time, maximize pain relief, promoting wellbeing. It is significant for elderly, because of polypharmacy very common in elderly people, also lots of elderly people suffer from painful, multimodal pain management is effective pain management strategy for elderly people. Especially, music has the power to make people comfort and relax. Much of research have demonstrated that music supports people physical, mental, and emotional health. Music can be put into general nursing routine, music not only relieve people pain, but also help to reduce depressive symptoms, improving health and quality of life. Music is a great way to relieve stress and pressure, making people feeling energetic and happy.

7 Ethical consideration and Reliability

This is a literature review thesis about transcutaneous electrical nerve stimulation (TENS) and music pain management after surgery. It based on the analysis of relevant research results. The author had no direct contact participants, author checked the selected studies follow the ethics rules, all the researchers obtain consent from participants, all the participants have right to withdraw at any time (Turjamaa, R 2014). Ethics as the rules and moral standards that guide researcher decision-making and behaviors. Different country has different ethical principles, ethical research consent and permission set up by ethics committees. Ethical research consent and permission will aim in protecting participants and researchers from inappropriate research (Ingham Broomfield, R 2017).

All selected studies confirmed that the authors allowed the articles to be used properly cited. The author respect other researcher's results, and author adhere citation according to Laurea's criteria principles. The studies selected for the study are reliable because only high-level studies are selected. The use of high-quality papers ensures greater reliability of literature reviews. To Improve reliability and effectiveness, this study uses variety of reliable school online databases, online book, school paper library.

As with any research, there are limitations to this review as well. Some limitations should be considered and caution. First, only English publications were included, therefore language bias should be acknowledged. And due to only one author, all the selected studies by author subjective choices, personal bias should be considered. Because of pain is a subjective feeling, the placebo and Hawthorne effects may not be avoided in the studies, measurement bias could be.

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9 Appendices

Table (transcutaneous electrical nerve stimulation)

Author, year, country	Purpose of the study	Participants (n)	Data collection method	Data analysis method	Main results
Audrius Parseliunas, Saulius Paskauskas, Egle Kubiliute, Jovydas Vaitekunas, and Donatas Venskutonis. 2021 Lithuania.	We evaluated the role of transcutaneous electrical nerve stimulation (TENS) in the multimodal treatment of postoperative pain following open inguinal hernia repair	80 participants	A Randomized, Double-Blind, Placebo-Controlled Trial.	SPSS version 22 software (SPSS, Inc. Chicago, IL) was used for statistical analysis.	TENS could be used in daily practice as part of a multimodal postoperative pain treatment, especially for patients suffering from hyperalgesia.
Emel Yilmaz, Ebru Karakaya, Hakan Baydur, Idil Tekin. 2019. Turkey.	This study was conducted to investigate the effect of transcutaneous electrical nerve stimulation on postoperative pain, changes in patients' vital signs, and patient satisfaction after inguinal herniorrhaphy	52 participants	A randomized clinical trial.	A satisfaction scale was administered before discharge to assess patient satisfaction with nursing care.	Transcutaneous electrical nerve stimulation reduced postoperative pain without a negative impact on vital signs and increased patient satisfaction

Transkuta nöz Elektriksel Sinir Uyarmnn nguinal Herni Onarm Sonrasnda Postoperat if ArÜzerind eki Etkisi: Randomize Plasebo Kontrollü Çal flma Egypt 2010.	This study was investigated the effect of TENS on postoperative pain, analgesic requirements, and serum cortisol level (SCL) after inguinal hernia repair.	67 participants	A Randomized double-blind, placebo-controlled trial.	The data were expressed as mean and standard deviation (Mean±SD). For normally distributed data, t-test was used to identify the differences between the 2 groups.	TENS is beneficial for postoperative pain relief following inguinal hernia repair.
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Table (Music)

Author, year, country	Purpose of the study	Participants (n)	Data collection method	Data analysis method	Main results
Joanne M. Laframboise-Otto, MaryBeth Horodyski, Hari K. Parvatane ni, Ann L. Horgas, 2020 American.	This pilot study evaluated music as an adjuvant therapy with prescribed analgesics to reduce acute pain and analgesic use	50 participants	A Randomized Controlled Trial	Statistical Package for the Social Sciences Software (SPSS, Version 24, Chicago, IL) was used to analyze the data.	Music listening is an effective adjuvant pain management strategy. It is easy to administer, accessible, and affordable.

	among patients undergoing arthroplasty surgery			Descriptive statistics were used to describe the sample characteristics.	
Yang Liu, Marcia A. Petrini 2015 China	To examine the effectiveness of music listening on pain, anxiety, and vital signs among patients after thoracic surgery in China	112 participants	A randomized controlled clinical trial	Data was analyzed using SPSS (version 21.0 for Windows). Participant characteristics and the survey results were analyzed with descriptive statistics.	The findings provide further evidence to support the practice of music therapy to reduce postoperative pain and anxiety, and lower systolic blood pressure and heart rate in patients.
Susanne M. Cutshall, Patricia G. Anderson, Sharon K. Prinsen, Laura J. Wentworth, Tammy L. Olney; Penny K. Messner, et al, 2011 American.	This study focused on the efficacy and feasibility of special music, which included nature sounds, for pain and anxiety.	100 participants	A randomized controlled trial.	Data were analyzed with descriptive statistics. Continuous variables were summarized as mean (standard deviation) and median.	Recorded music and nature sounds can reduce patient's pain and anxiety. The recordings may provide an additional means for these patients.