Systematic Review/Meta-analysis

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Evidence-based guideline on chronic postsurgical pain management in adult patients in resource-restricted setting, 2023: systematic review and guideline

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Background: Chronic postsurgical pain (CPSP) after tissue trauma is frequent and may have a long-lasting impact on the functioning and quality of life. The development of CPSP increases the burden on both the patient and the community. This review aims to systematically review articles and, lastly, pull an evidence-based guideline for CPSP management in adult patients in resource-limited areas.

Methodology: The review was reported based on preferred reporting items for the systemic review and meta-analysis (PRISMA) protocol. A literature search was conducted from the Cochrane, PubMed/Medline, and Google Scholar databases, and other gray literature from 2010 to 2022. The conclusion was made based on the level of evidence.

Results: A total of 3521 articles were identified through the database by searching strategies. Finally, by filtering duplicates unrelated to the topics, 22 articles (9 meta-analyses and systematic reviews, 12 systematic reviews, and one cohort study) were selected on the management of CPSP in adult patients. Filtering was made based on the intervention, outcome data of the population, and methodological quality.

Conclusion: Given the complexity and multidimensional nature of chronic postsurgical pain, effective assessment, and management require a comprehensive, multiaxial approach. Adequate preoperative preparation and counseling, potential risk identification and optimization, and use of a multimodal approach, and noninvasive surgical techniques are crucial in reducing the development of chronic postsurgical pain.

Keywords: adult, chronic postsurgical pain, management, quality of life

Introduction

Background

Pain is defined as an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage[1]. While chronic postsurgical pain (CPSP) is defined as pain that persists past normal healing time and hence lacks the acute warning function of physiological nociception. CPSP is usually regarded as chronic when it lasts at least 3 months[2–6]. The development of CPSP increases the burden on both the patient and the community. To take an effective measure against this debilitating condition, it is crucial to identify those at risk[7].

Risk factors for developing CPSP comprise patient (demographic, psychosocial, and, genetic) and periprocedural or perioperative factors (duration and type of surgery, extent of intraoperative nerve damage, preoperative pain, and intensity and duration of postoperative pain)[8].

CPSP is a principal public health problem with a significant economic and social burden. Besides, this condition not only affects the patient but also the members and social circles[9,10].

HIGHLIGHTS

- Chronic postsurgical pain (CPSP) is a principal public health problem with a significant economic and social burden. Besides, this condition affects the patient and all the family members and social circles.
- Comprehensive assessment, classification, and evidence-based approaches are crucial while managing patients with CPSP.
- The combination of pharmacologic and nonpharmacologic management modalities for CPSP can be safely applied in these patients with fewer adverse effects.

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CPSP has a prevalence rate ranging from 10 to 50% depending upon the type of surgery. For instance, common surgical procedures such as thoracotomy (30–40%), mastectomy (20–30%), cardiac surgery (30–50%), amputation (50–80%), hernia repair (5–10%), back surgery, and also other minor procedures[11–13].

CPSP is one of the most common motives for adults to pursue medical care and has been linked to restrictions in mobility and daily activities, sleep disturbances, dependence on opioids, social withdrawal, increased suicidal risk, reduced quality of life, and increased healthcare costs and further, CPSP is frequently accompanied by psychiatric disorders such as pain medication addiction and depression that make treatment complicated[6,14–17].

Comprehensive assessment, classification, and evidence-based approaches are crucial while managing patients with CPSP. Moreover, the assessment has several additional roles, including documenting the severity of the pain condition, tracking the longitudinal course of pain, and providing mechanistic information. The assessment should also encompass multiple domains of pain, including the sensory and affective qualities of pain, the temporal dimensions of pain, and the location, and also incorporate methods to identify pathophysiological mechanisms underlying the pain[18].

Our missed perception of CPSP needs to be changed. For clinicians, a strong therapeutic coalition is critical to aid patients to understand their pain, shift their expectations, and set realistic, individualized goals that prioritize function and quality of life, rather than complete pain relief. A detailed discussion with the patient on therapeutic options and the risk-benefit ratio and psychological reassurance is also crucial[19].

Managing CPSP effectively is challenging and it requires physicians who are knowledgeable in both pharmacologic and nonpharmacological treatment. Because CPSP management interventions are individualized to each patient, physicians must have a clear understanding of the realm of interventions to best manage pain[20]. The combination of pharmacologic and nonpharmacologic management modalities for CPSP can be safely applied in these patients with fewer adverse effects.

Therefore, it is important to develop a guideline that helps professionals to prevent and manage CPSP among the adult population using a combination of pharmacologic and nonpharmacologic management modalities. Generally, this review and guideline aim to provide evidence-based practice for CPSP management in adult patients and to use it in resource-limited areas.

Objectives and research question

Objectives

The objective of this review and guideline was to provide evidence on the management of CPSP in adult patients.

Research question

Do we have high-quality evidence on the management of CPSP in adult patients?

Is pharmacologic management of CPSP more effective than nonpharmacologic management of chronic postsurgical pain?

Methodology and materials

Eligibility criteria

Types of study

Systematic reviews, meta-analyses, randomized clinical trials, and cohort studies that fulfill inclusion criteria were included in this review and evidence-based practice guidelines.

Types of participants

All studies incorporating obstetric, orthopedic, and surgical patients with CPSP and managed with pharmacologic and nonpharmacologic versus control were considered in this review and evidence-based guidelines.

Intervention

The intervention was pharmacologic and nonpharmacologic interventions administered to patients with chronic postsurgical pain.

Comparator

The control was patients who took a placebo or other form of treatment to compare it with pharmacologic and nonpharmacologic management.

Types of outcomes

The primary outcomes were the severity of chronic postsurgical pain. The secondary outcomes were quality of life, duration of hospital stay, and related adverse effects including the incidence of infection.

Inclusion and exclusion criteria

This review included studies, including both pharmacologic and nonpharmacologic management modalities comparing their effectiveness in the management of CPSP in adult patients.

The excluded studies were those studies assessing the effectiveness of pharmacologic and nonpharmacologic management of CPSP in pediatrics and cancer patients.

Search strategy

The search strategy was aimed at exploring all accessible published and unpublished studies on pharmacologic and nonpharmacologic prevention and management of CPSP from 2010 to 2022. A three-phase search strategy was employed in this evidence-based guideline. An initial search was conducted on PubMed/Medline, Cochrane Library, and African Online Journal, followed by an examination of the text words contained in the Title/Abstract and indexed terms. A second search was undertaken by combining free-text words and indexed terms with Boolean operators. The third search was conducted with reference lists of all identified reports and articles for additional studies. Finally, an additional and gray literature search was conducted on Google Scholar for up to saturation, and articles written in languages other than English were excluded. The result of the search strategy was presented with the PRISMA flowchart (Fig. 1). The search strategy conducted in PubMed was presented in (Annex 1, Supplemental Digital Content 1, http://links.lww.com/MS9/A227).

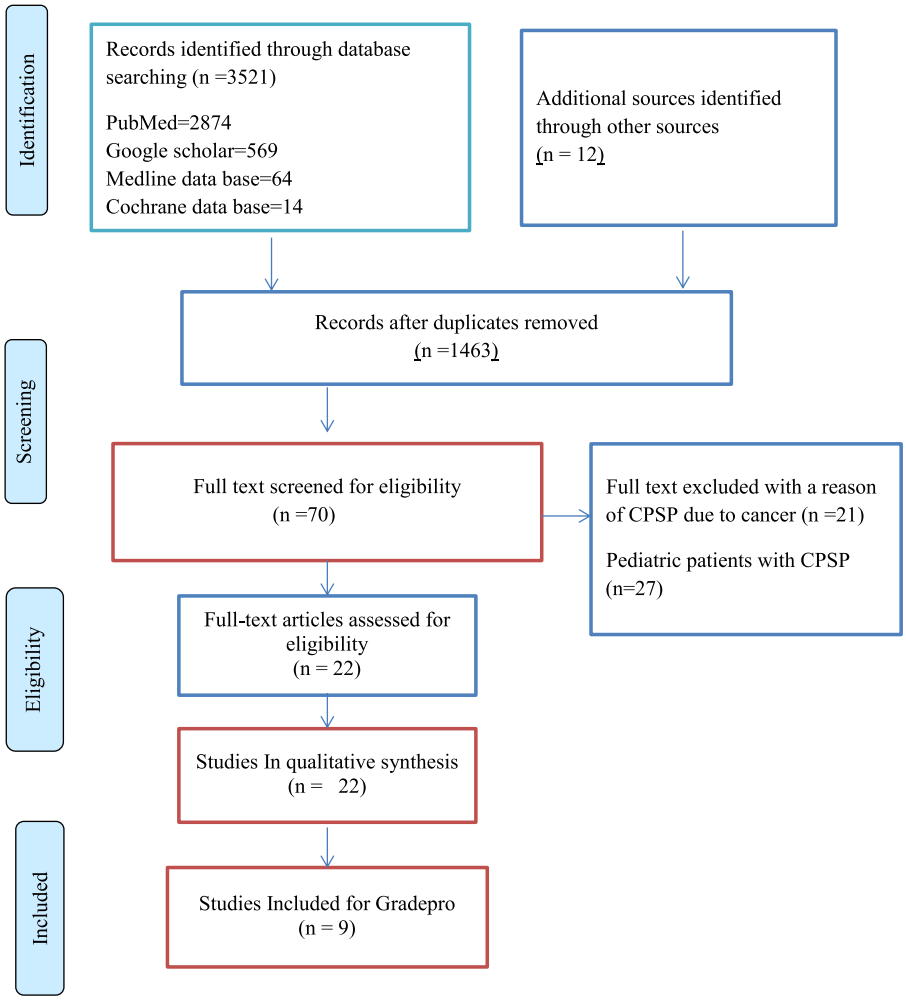

Figure 1. PRISMA flowchart. Moher *et al*.[21].

Data extraction

The data from each systemic review and meta-analysis was pulled out with two independent authors for the narration of the included studies and the grading of the overall quality of the evidence of each systemic review and meta-analysis. The data extracted included author, year of publication, number of RCTs included, number of participants, methodological quality, the outcome of interest, total events in treatment and control, and effect sizes (odds ratio, relative risk, mean difference, and 95% CI). The overall quality of evidence was graded with online GRADEpro GDT software (Tables 1 and 2) and Oxford level of evidence (Table 3). The review was presented based on the Preferred Reporting Items for Systemic Reviews and Meta-Analysis (PRISMA, Supplemental Digital Content 2, http://links.lww.com/MS9/A228)[28].

Grading the quality of evidence

Generally, the quality of evidence for the studied outcome was evaluated using the GRADE system (Grading of Recommendations Assessment, Development, and Evaluation). The system incorporates study quality (risk of bias), inconsistency (comparison of effect estimates across studies), indirectness (applicability of the population, intervention, comparator, and outcomes to the clinical decision), imprecision (certainty of confidence interval), and a high probability of publication bias. The overall quality of evidence was categorized as follows by evaluating and combing the five parameters for the management of CPSP, duration of hospital stay, and incidence of infection.

(1) Effective interventions: indicated that the review found high-quality evidence of effectiveness for an intervention.
(2) Possibly effective interventions: indicated that the review found moderate-quality evidence of effectiveness for an intervention, but more evidence is needed.
(3) Ineffective interventions: indicated that the review discovered high-quality evidence of an intervention's lack of effectiveness (or harm).
(4) Probably ineffective interventions: indicated that the review found moderate-quality evidence indicating a lack of efficacy (or harm) for an intervention, but more evidence is required.
(5) No conclusions were possible: indicated that the review found low or very low-quality evidence or insufficient evidence to comment on the effectiveness or safety of an intervention.

Table 1

GRADE pro evidence summary table for the effectiveness of nonpharmacologic management of chronic postsurgical pain.

Certainty assessment								No. of participants		Effect			
Author	No. of studies	Study design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other consideration	Intervention	Control	Relative (95% CI)	Absolute (95% CI)	Certainty	Importance
Edwardo et al.[22]	14	RCT	Not serious	serious	not serious	Not serious	none	Music 654/1178 (55.5%)	Control 524/1178 (44.5%)	–	MD 0.62 higher (0.43 higher to 0.9 higher)	⊕⊕⊕◯ MODERATE	CRITICAL
Tirza Z. Taemin[23]	2	RCT	not serious	not serious	not serious	Not serious	none	Exercise 34/273 (12.5%)	Control 45/273 (16.5%)	OR 1.50 (0.30–5.94)	–	⊕⊕⊕⊕ HIGH	CRITICAL
Yuan et al.[24]	6	RCT	not serious	not serious	not serious	not serious	none	Acupuncture 213/413 (51.5%)	Control 200/413 (48.4%)	–	Mean-0.42 (– 0.62, – 0.22)	⊕⊕⊕⊕ HIGH	CRITICAL

Table 2

GRADE evidence summary table for the effectiveness of pharmacologic management of chronic postsurgical pain.

Certainty assessment								No. of participants		Effect			
Author	No. of studies	Study design	Risk of bias	Inconsistency	Indirectness	imprecision	Other consideration	intervention	control	Relative (95% CI)	Absolute (95% CI)	Certainty	Importance
Andreae and Andreae[25]	3	RCT	not serious	not serious	not serious	not serious	none	Regional 60/121 (49.6%)	conventional 61/121 (50.4%)			⊕⊕⊕⊕ HIGH	CRITICAL
Wang Jiang Mei et al.[26]	4	RCT	not serious	not serious	serious	not serious	none	treatment 297/604 (49.9%)	Control 307/604 (50.1%)	OR 3.10 (2.44–3.96)		⊕⊕⊕◯ MODERATE	CRITICAL

Table 3

Oxford Level of evidence and grade of recommendation.

Level of evidence	Grading criteria	Grade of recommendations
1a	A systemic review of RCT including meta-analysis	A
1b	Individual RCT with a narrow CI	A
1c	All or nonrandomized control trial	B
2a	A systemic review of cohort study individual cohort including low-quality RCT	B
2b	Individual cohorts including low-quality study	C
3b	Individual case–control study	C
4	Case series poor-quality cohort and case–control study	C
5	Expert opinion without explicit critical appraisal	D

Oxford Level of evidence and grade of recommendation[27].

Results

Description of included studies

A total of 3521 articles were identified through the database by searching strategies. Finally, by filtering duplicates unrelated to the topics, 22 articles (9 meta-analyses and systematic reviews, 12 systematic reviews, and one cohort study) on the management of CPSP in adult patients were selected. Filtering was made based on the intervention, outcome data of the population, and methodological quality (Table 4). Articles dealing with the management of pediatric and nonsurgical cancer patients (cancer surgery) with CPSP were excluded from this evidence-based guideline. The severity of pain was assessed with the visual analog scale[45], brief pain inventory[46], and leeds assessment of neuropathic signs and symptoms[47](Annex 2, Supplemental Digital Content 1, http://links.lww.com/MS9/A227).

The majority of systemic reviews show the efficacy of nonpharmacologic management of CPSP and all included systematic reviews have high-quality and a moderate level of evidence, while few studies reveal the effectiveness of pharmacologic management of chronic postsurgical pain. CPSP management was the primary outcome in eight meta-analyses out of nine meta-analyses, while one meta-analysis was on physical function and quality of life.

The methodological quality of each included systemic review was evaluated with the AMSTAR (Assessing the Methodological Quality of Systemic Reviews) tool (Supplemental Digital Content 3, http://links.lww.com/MS9/A229) by two independent advisors[48]. A score was given for each included systemic review from the sum of all positive points to the checklist items and the inconvenience between the two advisors was resolved by the third advisor. The included systemic reviews were classified based on the AMSTAR (Supplemental Digital Content 3, http://links.lww.com/MS9/A229) scores as high-quality 8–11, moderate-quality 4–7, and low-quality 0–3 score values (Table 5). And management of chronic post-surgical pain management flow chart is developed based on the level of evidence (Fig. 2)

Data synthesis

The primary objective of this review was to provide quality evidence on the assessment of the severity of CPSP in adult patients. The methodological quality for each systemic review was evaluated with the AMSTAR tool (Supplemental Digital Content 3,

Table 4

Description of included studies.

References	Year	Intervention	Control	Study design	Sample size	Quality score
Wiffen *et al.*[29]	2011	Carbamazepine	Placebo	Systematic review	629	9
Birse *et al.*[30]	2012	Phenytoin	Placebo	Systematic review	783	10
Moore *et al.*[31]	2014	Gabapentin	Placebo	Systematic review	5633	10
Hah *et al.*[32]	2017	Opioids	–	Cohort	200,005	5
McNicol *et al.*[7]	2014	Ketamine	Placebo	Meta-analyses	1015	10
Kurdi, *et al.*[25]	2014	Ketamine	Placebo	Systematic review	1067	6
H. Clarke *et al.*[33]	2015	Preventive analgesia	–	Systematic review	280	8
Montgomery[34]	2020	Opioids	Placebo	Systematic review	654	7
Andreae *et al.*[35]	2012	Local anesthesia and regional anesthesia	Conventional analgesia	Systematic review	1090	9
Levene *et al.*[36]	2019	Local anesthesia and regional anesthesia	Conventional analgesia	Meta-analyses	3027	10
Vickers *et al.*[22]	2012	Acupuncture	Placebo	Meta-analysis	17,922	10
Yin *et al.*[37]	2017	Music-induced analgesia	Placebo	Systematic review	6379	9
Garza *et al.*[38]	2017	Music-induced analgesia	Placebo	Meta-analysis	6132	10
Jin Hyung Lee[23]	2016	The effect of music on pain	Placebo	Meta-analyses	9,184	9
Bernatzky *et al.*[39]	2011	Music as nonpharmacologic management	Placebo	Systematic review	620	8
Tirza Z. Taemin[40]	2018	Exercise	Diet	Meta-analysis	734	10
Geneen *et al.*[5]	2017	Exercise	No exercise	Systematic review	37,143	9
Gibson *et al.*[41]	2019	Transcutaneous Electrical Nerve Stimulation(TENS)	Placebo	Systematic review	2942	10
Zhu et al.[42]	2017	TENS	Placebo	Meta-analysis	529	9
Woodyard[43]	2011	Yoga	Placebo	Systematic review	–	9
Büssing *et al.*[44]	2012	Yoga	Placebo	Meta-analysis	1007	10

Table 5

Assessment of Methodological quality.

References	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	SCORE
Wiffen *et al.*[29]	√	X	√	√	√	√	√	√	√	X	√	9
Birse *et al.*[30]	√	√	√	√	√	√	√	√	√	X	√	10
Moore *et al.*[31]	√	√	√	√	√	√	√	√	√	X	√	10
Kurdi, *et al.*[25]	√	X	√	√	X	√	X	√	√	X	X	6
Clarke *et al.*[33]	√	X	√	√	√	√	X	√	√	X	√	8
Montgomery[34]	√	√	√	√	X	√	X	X	√	X	√	7
Andreae *et al.*[35]	√	√	√	X	√	√	√	√	√	X	√	9
Yin *et al.*[37]	√	√	√	√	X	X	√	√	√	X	√	8
Bernatzky *et al.*[39]	√	X	√	√	X	√	√	√	√	X	√	8
Geneen *et al.*[5]	√	√	√	X	√	√	√	√	√	√	√	10
Gibson *et al.*[49]	√	√	√	√	√	√	√	√	√	X	√	10
Woodyard[43]	√	X	√	√	X	√	√	√	√	X	√	8

The AMSTAR tool (Assessing the Methodological quality of systemic reviews).
Q1: Was an 'a prior' design provided?
Q2: Was there duplicate study selection and data extraction?
Q3: Was a comprehensive literature search performed?
Q4: Was the status of publication (i.e. Gray literature) used as an inclusion criterion?
Q5: Was a list of studies (included and excluded) provided?
Q6: Were the characteristics of the included studies provided?
Q7: Was the scientific quality of the included studies assessed and documented? Q8: Was the scientific quality of the included studies used appropriately in formulating conclusions?
Q9: Were the methods used to combine the findings of studies appropriate?
Q10: Was the likelihood of publication bias assessed?
Q11: Was the conflict of interest included?

http://links.lww.com/MS9/A229) and the overall quality evidence for the outcomes such as quality of life duration of hospital stay, and related adverse effects including the incidence of infection were evaluated with online GRADEpro software (Tables 1 and 2).

Discussion

General management of chronic postsurgical pain

The modern approach to CPSP management is based on the biopsychosocial model. The biologically modifiable factor should be identified and where possible treated. Psychosocial components are similarly, if not more essential in numerous cases, and these components should be recognized and addressed. Without an assessment of the complex components that play a part in the patient's pain experience, a positive outcome is unlikely. Enhancements in function and quality of life aims are more likely to be attainable and should be tracked[52].

The biological component of pain includes any biological pain generators. This includes the extent of tissue trauma at the time of surgery, potential nerve injury, and scarring or adhesions during the healing process, which may contribute to pain. Potentially reversible causes of pain should be considered such as infection, recurrence of the previous pathology, and specific complications from surgery, such as a damaged prosthesis. The patient should be reviewed by an experienced surgeon to rule out these causes. In many cases of CPSP, a clear cause cannot be identified[53].

Pharmacologic management of CPSP

Anticonvulsants

Carbamazepine

Anticonvulsant drugs have been used in pain management since the time of 1960s. The precise mechanisms of action of anticonvulsant drugs concerning the relief of neuropathic pain remain unclear, but they reduce the ability of the neuron to fire at high frequency. The two standard explanations are enhanced gamma-aminobutyric acid inhibition (valproate, clonazepam) or a stabilizing effect on neuronal cell membranes. A third possibility is action via N-methyl-D-aspartate (NMDA) receptor sites. Carbamazepine work by blocking voltage-sensitive sodium channels, meaning that fewer of these channels are available to open, making brain cells less excitable[54] (weak recommendation, moderate-quality).

Phenytoin

Phenytoin is a well-established and extensively used antiepileptic drug that controls seizures by stabilizing voltage-gated sodium channels. It is also well thought-out to have anxiolytic and mood-stabilizing properties. It has been used to treat trigeminal neuralgia and may be advantageous in extra types of neuropathic pain and fibromyalgia. This review could find no evidence of ample quality to support the use of phenytoin in chronic neuropathic pain and fibromyalgia[55] (strong recommendation, low-quality).

Gabapentin

Gabapentin is thought to act by binding to calcium channels and modifying calcium influx. This mode of action convenes antiepileptic, analgesic, and sedative effects. The most latest research shows that gabapentin acts by blocking new synapse formation. Gabapentin treatment can be started at a dose of 300 mg/day for treating neuropathic pain. Depending on individual patient response and tolerability, the dosage may be increased by 300 mg per day until pain relief is experienced or side effects make taking the drug intolerable gabapentin at doses of 1200 mg or more effective for some people with painful neuropathic pain conditions[56] (weak recommendation, moderate-quality).

Hah *et al.*[29] reveal perioperative gabapentin seems to reduce the rate and intensity of postoperative pain up to 6 months after ENT, orthopedic, mastectomy, and abdominal/pelvic operations. Additionally, perioperative gabapentin is often cited as a component of multimodal analgesia, but results have been diverse regarding gabapentin's efficacy to reduce acute pain in the context of multimodal analgesia (weak recommendation, low-quality).

Ketamine

Ketamine, a noncompetitive NMDA receptor antagonist, plays a great role in decreasing the incidence of CPSP when administered perioperatively. Analgesic doses employed clinically vary widely, but intravenous bolus doses in the range of 0.2–0.75 mg/kg and infusions of 2–7 mcg/kg/min have been recommended. Studies suggest that perioperative ketamine is safe; therefore, it may be suitable in patients undergoing painful surgeries or who are expected to require large doses of opioids postoperatively[8] (strong recommendation, moderate-quality).

The study done in the Netherlands shows that long-term treatment of CPSP specifically in pain with a neuropathic component with ketamine will basis protracted pain relief, even though the importance is additional that no effect on functionality. Still, ketamine treatment is linked to a variety of side effects (which include CNS-related symptoms (development of a schizoid-like state, somnolence, dizziness, drug-high, memory

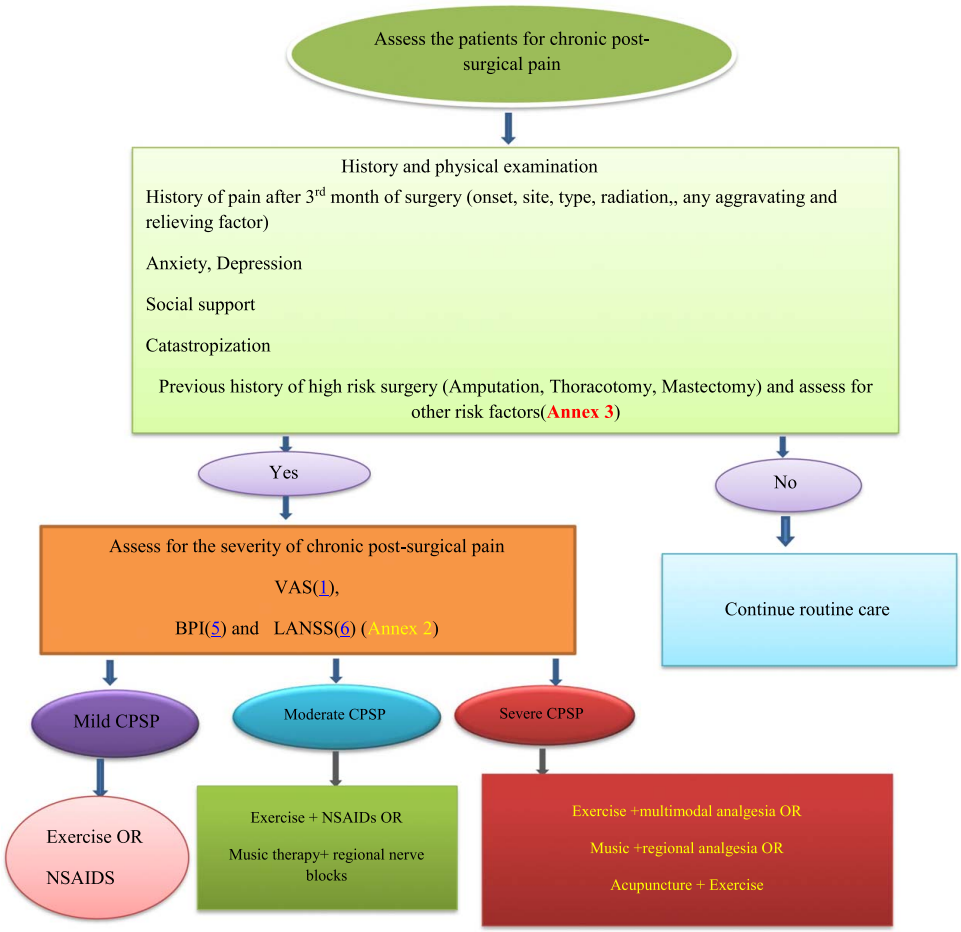

Figure 2. Management of chronic postsurgical pain algorithm. (Adapted from Yousef *et al.*[45], Clarke *et al.*[31], Li *et al.*[35], Weingarten *et al.*[46], Bendinger and Plunkett[47], Vickers *et al.*[36], Yin *et al.*[50], Garza-Villarreal *et al.*[22], Bernatzky *et al.*[51], Tamin *et al.*[23], and Andreae and Andreae[25].)

defects), cardiovascular stimulation, and in a minority of patients liver injury[30] (weak recommendation, low-quality).

Nonsteroidal-anti-inflammatory drugs

The analgesic effects of NSAIDs have been attributed to their anti-inflammatory properties concerning inhibiting the synthesis of prostaglandins. The COX-2 isoform appears to be the enzyme responsible for inflammation and pain. COX-2 inhibitors, such as parecoxib, reduce secondary hyperalgesia and appear to reduce central sensitization in humans. None of the studies conducted on NSAIDs have demonstrated a significant impact of NSAIDs (in isolation) on the reduction in incidence or severity of CPSP[31] (moderate recommendation, low-quality).

Opioids

The role of opioids in chronic pain is smaller and clinical decision-making suffers from poor-quality evidence. Hyperalgesia, tolerance, dependence, and adverse effects including opioid use disorder and respiratory depression all limit the clinical use of opioids at this time. There is an urgent need to address these negative consequences of opioid use, to maximize the therapeutic benefit that opioids can offer[32] (moderate recommendation, low-quality).

Regional nerve blocks

Regional anesthesia (RA) may reduce the rate of chronic pain after surgery, a frequent and debilitating condition. RA for the prevention of CPSP for 6 months after thoracotomy was less, with an OR of 0.33 (95% CI: 0.20–0.56). Epidural anesthesia may reduce the risk of developing chronic pain after thoracotomy in about one patient out of every four patients treated. The paravertebral block may reduce the risk of chronic pain after breast cancer surgery in about one out of every five women treated[25] (strong recommendation, high-quality).

A study conducted in New York reveals that RA reduces the risk of developing persistent pain after surgery. This study suggests that RA can markedly reduce the risk for CPSP. The evidence is strongest and homogenous regarding epidurals for thoracotomy (OR of 0.52; 95% CI: 0.32–0.84, $P = 0.008$) and paravertebral blocks for breast surgery (OR of 0.61; 95% CI: 0.39–0.97, $P = 0.04$). RA may prevent CPSP in approximately one out of every six to seven patients[33] (strong recommendation, moderate-quality).

Multimodal analgesia

A multimodal analgesia technique is ideal for surgical patients. This approach comprises a variety of drugs from different

families, each with its distinctive mechanism of action and side effect profile. In addition, multimodal analgesia should include RA techniques, including neuraxial and peripheral nerve block approaches. With the ongoing opioid crisis and increasing costs of opioid-related morbidity and mortality, it is essential that for any multimodal analgesia pathway, the concept of opioid-sparing is prioritized[34].

Nonpharmacological treatment

One core approach in nonpharmacologic management is self-management support, targeting to increase the individual's capability to manage their pain in daily life. Because today's treatments provide a modest improvement in pain and minimum enhancements in physical and emotional functioning, a large number of people are posed to struggle with chronic postsurgical pain in their daily life.

Acupuncture

Acupuncture, a traditional alternative therapy, has been used to treat pain for many years, and several clinical studies have proved its efficacy for postsurgical pain. Opioids could improve the quality of postoperative analgesia and the quality of life after surgery, but it is accompanied by obvious adverse effects. Many studies have revealed that acupuncture can be useful for CPSP management and reduced opioid use, and it has the advantages of low cost, high tolerance, suitability, and minimal adverse reactions[35](strong recommendation, moderate-quality).

A study done in the UK shows Acupuncture is effective for the treatment of CPSP and it is, therefore, a rational referral option. Major differences between true and sham acupuncture indicate that acupuncture is better than a placebo. However, these differences are relatively modest, signifying that factors in addition to the specific effects of needling are important contributors to the therapeutic effects of acupuncture[36] (moderate recommendation, high-quality).

Another study done by Yin and colleagues reveals Acupuncture is effective, harmless, and cost-effective for treating chronic postsurgical pain conditions when performed by well-trained healthcare professionals. Further studies are instantly needed to explore its effectiveness as an adjunct or alternative to opioids and in perioperative settings[50](strong recommendation, moderate-quality).

Music-induced analgesia

The most accepted hypothesis states that pain perception can be centrally modulated via the descending pain modulatory system (DPMS) by either inhibiting or facilitating nociceptive input at the brainstem and spinal cord levels. Music characteristics such as high familiarity little beats-per-minute, and self-chosen music, have been described to provoke cognitive and emotional mechanisms such as distraction, pleasure, sense of control, and control-like effects that may contribute to the analgesic effect, all of which can affect the DPMS. It is therefore possible that music provides an easily accessible and strong medium for the top-down influence of the DPMS, thus decreasing pain[57].

A study done in Mexico shows music reduces pain in CPSP conditions, and anxiety and depression symptoms and that self-chosen music or music preferred by the patient have a superior analgesic effect; hence, music can be used as an effortlessly administered, effective adjuvant for CPSP and its common comorbidities[22](strong recommendation, high-quality).

A study done in Korea shows music interventions overall have beneficial effects on pain intensity, emotional distress from pain, minimal or no use of anesthetic agents, results in reduced utilization of opioid and nonopioid agents, stable hemodynamics (i.e. heart rate, systolic and diastolic blood pressure, and respiratory rate)[37](strong recommendation, moderate-quality).

A study done by Bernatzky *et al*. shows music therapy gives the impression to be a simple, effective means of endorsing psychosomatic benefits. Such effects need to be better understood, but so far, long-term evaluation of music therapy in pain management has demonstrated improved quality of life parameters along with reduced utilization of analgesics. It has fewer adverse effects and can, therefore, be easily incorporated into a multimodal pain management program[51](strong recommendation, high-quality).

Exercise

Exercise provides numerous benefits for patients including improvements in strength, flexibility, and endurance; decrease in cardiovascular and metabolic syndrome risk; better bone health; improved cognition and mood; and often most importantly for the patient, enhanced pain control[38].

Exercise has a positive effect on CPSP mediators by exerting anti-inflammatory effects, and enhancing muscle coordination caused by muscle imbalance. Aerobic exercise and resistance exercise upsurge in epinephrine and endogenous morphine-like hormone activity that enables the stress adaptive response. Endorphins are endogenous morphine-like chemical in both structure and effect and it also has a similar binding site in brain cells or receptor to reduce pain signals, quiet the brain in stress full situations, and bring euphoria[23] (strong recommendation, high-quality).

A study done by Geneen *et al*.[6] advocates physical activity and exercise as interventions with few adverse events that may improve pain severity and physical function, and the resultant quality of life (moderate recommendation, low-quality).

A study conducted in the USA shows exercise as a harmless, cost-free, nonpharmacologic way of managing pain and has been found to reduce anxiety and depression, improve physical capacity, increase functioning and independence, and reduce morbidity and mortality that are associated with the disease[39](weak recommendation, moderate-quality).

A study conducted in China shows that timely functional exercises of passive and autonomic activities can enhance the postoperative quality of life of patients with lumbar disk herniation and delivers a basis for their presence in postoperative treatment of lumbar disk herniation. Importance should be placed on factors, such as postoperative exercise, that can improve the curative effect of rehabilitation[58](moderate recommendation, low-quality).

Yoga

Yoga is a form of mind-body fitness that involves a combination of muscular activity and an internally directed mindful focus on awareness of the self, the breath, and energy. Yoga interrupts the fluctuations of the mind and by acting consciously; live better and suffer less. Yogic practices enhance muscular strength and body flexibility, promote and enhance respiratory and cardiovascular function, accelerate recovery from and treatment of addiction, reduce stress, anxiety, depression, and chronic postsurgical pain,

improve sleep patterns, and enhance overall well-being and quality of life[40].

The study done in Germany reveals the beneficial effects of yoga can be explained, to some extent, by amplified physical flexibility, coordination, and strength encouraged because yoga may have the potential to be implemented as a safe and beneficial supportive treatment that is relatively inexpensive and needs just the motivation of patient[44](strong recommendation, low-quality).

Cognitive-behavioral therapy

Enthusiastic perioperative psychological intervention, encompassing cognitive-behavioral therapy and relaxation therapy, decreases chronic postsurgical pain, and physical impairment. Even though there are no significant effects of perioperative education or psychological support on CPSP or physical impairment compared with usual care[26](weak recommendation, low-quality).

Physiotherapy

Physiotherapy is frequently a key component in chronic postsurgical pain forming an integral part of the multidisciplinary approach to pain management. Treatment may be given within a hospital, clinic, or community setting. Evidence has shown that physiotherapists can use a wide scope of practice to guide and support people with chronic postsurgical pain toward a better quality of life[43].

Conclusion

Given the complex and multidimensional nature of chronic postsurgical pain, effective assessment, and management requires a comprehensive, multiaxial approach. Adequate preoperative preparation and counseling, potential risk identification and optimization, the use of a multimodal approach, and noninvasive surgical techniques are very crucial in the reduction of the development of chronic postsurgical pain. The combinations of pharmacologic and nonpharmacologic management modalities have to be implemented to achieve effective and efficient management of chronic postsurgical pain.

Controversies and future directives

A large number of studies and evidence-based medicine support the effectiveness of physiotherapy as nonpharmacologic management for chronic postsurgical patients. However, there has been a lack of effectively designed randomized double-blind studies on physiotherapy. There was also no clear evidence on how to provide when it should be started to be effective and the total duration it is needed. Because physiotherapy is simple and easy to apply to large sample sizes, multicenter randomized double-blind studies are needed in the future.

The majority of literature supports the effectiveness of opioids for the management of CPSP and its effect on the reduction of the transition from acute pain to chronic pain despite these advantages opioids have many adverse effects on sustained use, including the risk of abuse and economic issues, especially in developing countries. In addition to this, there is no consensus on which opioids are safe and effective if used for a long period. So it needs further well-designed RCTs that address on safety and efficacies of the prolonged use of these medications.

Recommendation

The recommendation was given based on the combined result of AMSTAR[48] (Supplemental Digital Content 3, http://links.lww.com/MS9/A229) for the Systematic review and online grading was done by using GRADEpro for meta-analysis (Tables 1 and 2).

Recommendation 1: we recommend the perioperative utilization of regional analgesia as part of the management of CPSP (strong recommendation, high-quality).

Recommendation 2: we recommend music-induced analgesia to be widely used in the management of patients with chronic postsurgical pain; hence, they are easy, feasible, and effective (strong recommendation, moderate-quality).

Recommendation 3: we recommend health professionals have to encourage patients to exercise; hence, the exercise is easy to perform, harmless, minimal, or cost-free with multiple benefits (strong recommendation, moderate-quality).

Recommendation 4: we recommend the use of acupuncture for chronic postsurgical pain management and it is associated with reduced opioid use, low cost, high tolerance, convenience, and minimal adverse reactions (strong recommendation, high-quality).

Recommendation 5: we suggest proper and timely management of acute postsurgical pain to minimize the incidence of CPSP; hence, acute postsurgical pain is one of the major risk factors for the development of CPSP (weak recommendation, moderate-quality).

The strengths and limitations of this review

Strength

This review included recent literature focused on the prevention of CPSP in adult patients and the majority of the studies are randomized control trials with decent quality of evidence. Furthermore, this review includes some approaches such as nonpharmacological adjuncts.

Limitations

This review has also various limitations. Some of the studies had reduced methodological quality and small sample sizes. Though the objective of this review is to determine the prevention strategies of CPSP after surgery, there were not enough studies reviewed on the CPSP management strategies for adult patients.

Ethical approval

No ethical approval is needed for this review.

Consent

This evidence is generated from already published papers.

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Author contribution

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Conflicts of interest disclosure

All authors declare that the is no conflicts of interest.

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References

[1] Raja SN, Carr DB, Cohen M, *et al*. The revised international association for the study of pain definition of pain: concepts, challenges, and compromises. Pain 2020;161:1976–82.
[2] Treede R-D, Rief W, Barke A, *et al*. A classification of chronic pain for ICD-11. Pain 2015;156:1003–7.
[3] Hylands-White N, Duarte RV, Raphael JH. An overview of treatment approaches for chronic pain management. Rheumatol Int 2017;37:29–42.
[4] Wylde V, Dennis J, Beswick A, *et al*. Systematic review of management of chronic pain after surgery. J Br Surg 2017;104:1293–306.
[5] Practice guidelines for chronic pain management: an updated report by the American Society of Anesthesiologists Task Force on Chronic Pain Management and the American Society of Regional Anesthesia and Pain Medicine. Anesthesiology 2010;112:810–33.
[6] Geneen LJ, Moore RA, Clarke C, *et al*. Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews. Cochrane Database Syst Rev 2017.
[7] Tawfic Q, Kumar K, Pirani Z, *et al*. Prevention of chronic post-surgical pain: the importance of early identification of risk factors. J Anesth 2017; 31:424–31.
[8] McNicol E, Schumann R, Haroutounian S. A systematic review and meta-analysis of ketamine for the prevention of persistent post-surgical pain. Acta Anaesthesiol Scand 2014;58:1199–213.
[9] Dueñas M, Ojeda B, Salazar A, *et al*. A review of chronic pain impact on patients, their social environment and the health care system. J Pain Res 2016;9:457–67.
[10] Cohen SP, Vase L, Hooten WM. Chronic pain: an update on the burden, best practices, and new advances. Lancet 2021;397:2082–97.
[11] Wylde V, Dennis J, Beswick AD, *et al*. A systematic review of the management of chronic pain after surgery. Br J Surg 2017;104:1293–306.
[12] Shipton E. The transition from acute to chronic post surgical pain. Anaesth Intensive Care 2011;39:824–36.
[13] Humble S, Dalton A, Li L. A systematic review of therapeutic interventions to reduce acute and chronic post-surgical pain after amputation, thoracotomy or mastectomy. Eur J Pain 2015;19:451–65.
[14] Dahlhamer J, Lucas J, Zelaya C, *et al*. Prevalence of chronic pain and high-impact chronic pain among adults - United States, 2016. MMWR Morb Mortal Wkly Rep 2018;67:1001–6.
[15] Turk DC, Fillingim RB, Ohrbach R, *et al*. Assessment of psychosocial and functional impact of chronic pain. J Pain 2016;17(9 Suppl):T21–49.
[16] Hilton L, Hempel S, Ewing BA, *et al*. Mindfulness meditation for chronic pain: systematic review and meta-analysis. Ann Behav Med 2017;51: 199–213.
[17] Gan TJ. Poorly controlled postoperative pain: prevalence, consequences, and prevention. J Pain Res 2017;10:2287–98.
[18] Fillingim RB, Loeser JD, Baron R, *et al*. Assessment of chronic pain: domains, methods, and mechanisms. J Pain 2016;17(9, Supplement): T10–20.
[19] The L. Rethinking chronic pain. Lancet 2021;397:2023.
[20] Eaton LH, Gordon DB, Wyant S, *et al*. Development and implementation of a telehealth-enhanced intervention for pain and symptom management. Contemp Clin Trials 2014;38:213–20.
[21] Moher D, Liberati A, Tetzlaff J, *et al*. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. PLoS Med 2009;6:e1000097.
[22] Garza-Villarreal EA, Pando V, Vuust P, *et al*. Music-induced analgesia in chronic pain conditions: a systematic review and meta-analysis. BioRxiv 2017:105148.
[23] Tamin TZ, Murdana N, Pitoyo Y, *et al*. Exercise intervention for chronic pain management, muscle strengthening, and functional score in obese patients with chronic musculoskeletal pain: a systematic review and meta-analysis. Acta Med Indones 2018;50:299–308.
[24] Yuan QL, Wang P, Liu L, *et al*. Acupuncture for musculoskeletal pain: A meta-analysis and meta-regression of sham-controlled randomized clinical trials. Sci Rep 2016;6:30675.
[25] Andreae MH, Andreae DA. Local anaesthetics and regional anaesthesia for preventing chronic pain after surgery. Cochrane Database Syst Rev 2012;10:CD007105–.
[26] Wang L, Chang Y, Kennedy S, *et al*. Perioperative psychotherapy for persistent post-surgical pain and physical impairment: a meta-analysis of randomised trials. Br J Anaesth 2018;120:1304–4.
[27] Oxford Center for Evidence-Based Medicine: Levels of Evidence. 2009.
[28] Moher D, Shamseer L, Clarke M, *et al*. Preferred reporting items for systematic review and meta-analysis protocols (PRISMA-P) 2015 statement. Syst Rev 2015;4:1.
[29] Hah JM, Bateman BT, Ratliff J, *et al*. Chronic opioid use after surgery: implications for perioperative management in the face of the opioid epidemic. Anesth Analg 2017;125:1733–40.
[30] Kurdi MS, Theerth KA, Deva RS. Ketamine: current applications in anesthesia, pain, and critical care. Anesth Essays Res 2014;8:283–90.
[31] Clarke H, Poon M, Weinrib A, *et al*. Preventive analgesia and novel strategies for the prevention of chronic post-surgical pain. Drugs 2015; 75:339–51.
[32] Montgomery LS. Pain management with opioids in adults. J Neurosci Res 2022;100:10–8.
[33] Levene JL, Weinstein EJ, Cohen MS, *et al*. Local anesthetics and regional anesthesia versus conventional analgesia for preventing persistent postoperative pain in adults and children: a cochrane systematic review and meta-analysis update. J Clin Anesth 2019;55:116–27.
[34] Gabriel RA, Swisher MW, Sztain JF, *et al*. State of the art opioid-sparing strategies for post-operative pain in adult surgical patients. Expert Opin Pharmacother 2019;20:949–61.
[35] Li G, Zhang C, Wang C, *et al*. Acupuncture against chronic postsurgical pain in non-small cell lung cancer patients: a protocol of randomized controlled trial. Medicine (Baltimore) 2021;100:e27461–.
[36] Vickers AJ, Cronin AM, Maschino AC, *et al*. Acupuncture for chronic pain: individual patient data meta-analysis. Arch Intern Med 2012;172:1444–53.
[37] Lee JH. The effects of music on pain: a meta-analysis. J Music Ther 2016; 53:430–77.
[38] Kroll HR. Exercise therapy for chronic pain. Phys Med Rehab Clin 2015; 26:263–81.
[39] Sullivan AB, Scheman J, Venesy D, *et al*. The role of exercise and types of exercise in the rehabilitation of chronic pain: specific or nonspecific benefits. Curr Pain Headache Rep 2012;16:153–61.
[40] Woodyard C. Exploring the therapeutic effects of yoga and its ability to increase quality of life. Int J Yoga 2011;4:49–54.
[41] Gibson W, Wand BM, Meads C, *et al*. Transcutaneous electrical nerve stimulation (TENS) for chronic pain - an overview of Cochrane Reviews. Cochrane Database Syst Rev 2019;4:CD011890–.
[42] Zhu Y, Feng Y, Peng L. Effect of transcutaneous electrical nerve stimulation for pain control after total knee arthroplasty: a systematic review and meta-analysis. J Rehabil Med 2017;49:700–4.

[43] Semmons J. The role of physiotherapy in the management of chronic pain. Anaest Intens Care Med 2016;17:445–7.
[44] Büssing A, Ostermann T, Lüdtke R, *et al*. Effects of yoga interventions on pain and pain-associated disability: a meta-analysis. J Pain 2012;13:1–9.
[45] Yousef E, Ateia I, Mansour N, *et al*. Impact of Ozone gel, PRF & A-PRF on pain and trismus during tissue healing after extraction of mandibular third molars. Egypt Dent J 2021;67:2075–89.
[46] Weingarten T, Moeschler S, Ptaszynski A, *et al*. An assessment of the Association between smoking status, pain intensity, and functional interference in patients with chronic pain. Pain Physician 2008;11: 643–53.
[47] Bendinger T, Plunkett N. Measurement in pain medicine. BJA Educ 2016; 16:310–5.
[48] Shea BJ, Grimshaw JM, Wells GA, *et al*. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. BMC Med Res Methodol 2007;7:10.
[49] Gibson W, Wand BM, Meads C, *et al*. Transcutaneous electrical nerve stimulation (TENS) for chronic pain - an overview of Cochrane Reviews. Cochrane Database Syst Rev 2019;2:CD011890–2.
[50] Yin C, Buchheit TE, Park JJ. Acupuncture for chronic pain: an update and critical overview. Curr Opin Anaesthesiol 2017;30:583–92.
[51] Bernatzky G, Presch M, Anderson M, *et al*. Emotional foundations of music as a non-pharmacological pain management tool in modern medicine. Neurosci Biobehav Rev 2011;35:1989–99.
[52] Roth RS, Geisser ME, Williams DA. Interventional pain medicine: retreat from the biopsychosocial model of pain. Transl Behav Med 2012;2: 106–16.
[53] Koneti KK, Perfitt JS. Chronic pain management after surgery. Surgery (Oxford) 2019;37:467–71.
[54] Wiffen PJ, Derry S, Moore RA, *et al*. Carbamazepine for acute and chronic pain in adults. Cochrane Database Syst Rev 2011:CD005451–.
[55] Birse F, Derry S, Moore RA. Phenytoin for neuropathic pain and fibromyalgia in adults. Cochrane Database Syst Rev 2012;2012:Cd009485.
[56] Moore RA, Wiffen PJ, Derry S, *et al*. Gabapentin for chronic neuropathic pain and fibromyalgia in adults. Cochrane Database Syst Rev 2014.
[57] Garza-Villarreal EA, Pando V, Vuust P, *et al*. Music-induced analgesia in chronic pain conditions: a systematic review and meta-analysis. Pain Physician 2017;20:597–610.
[58] Zhang R, Zhang SJ, Wang XJ. Postoperative functional exercise for patients who underwent percutaneous transforaminal endoscopic discectomy for lumbar disc herniation. Eur Rev Med Pharmacol Sci 2018;22 (1 Suppl):15–22.