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APPLICATION OF COMPLEMENTARY AND ALTERNATIVE MEDICINE THERAPY ON PATIENT WITH POSTOPERATIVE PAIN AFTER CARDIAC SURGERY: A LITERATURE REVIEW

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ABSTRACT

Pain is a devastating outcome following cardiac surgery due to routine procedures, including chest tube removal, deep breathing, and coughing exercise. Pharmacological treatment requires complementary interventions in addressing the post-acute pain phase. This study aimed to identify the application of complementary and alternative medicine (CAM) to reduce postoperative pain after cardiac surgery. A literature search was conducted by exploring original studies on the Google Scholar, PubMed NCBI, ProQuest, and ScienceDirect database that published in the last five years (2016-2021), enrolled adult participants who were undergoing cardiac surgery, and evaluated the outcome of CAM therapy on the postoperative pain after the cardiac surgery. Eighteen original studies were analyzed and synthesized. Thirteen studies employed randomized controlled trial, four studies applied quasi-experimental, and one study used one group pre-post-test design. Among these studies, ten studies focused on the manipulative and body-based practices domain (cryotherapy and massage). The application of relaxation exercise, music therapy, and distraction technique from the mind-body intervention domain was discussed in six studies. Only three studies reported the utilization of therapy from the alternative medical system, biologically-based therapy, and energy therapy domain. The majority of the CAM interventions provided significant effects in postoperative pain relief after cardiac surgery. Nurses should be able to assign appropriate CAM therapies for each patient, although all domains of CAM consider as an effective modality for postoperative pain relief after cardiac surgery. Hence, the CAM therapy would be a proper complement for the pharmacological therapies, effective in reducing the pain, and provides a chance for the patient to manage their pain independently.

Keywords:
Cardiac surgery, Complementary and alternative medicine, Postoperative pain

BACKGROUND

Cardiovascular diseases are the leading cause of the global mortality rate. World Health Organization (2017) had revealed that 17.9 million deaths attributed to cardiovascular disease in 2016 were represented 31% of death around the world. Cardiac surgery procedure as an optimal medical therapy provides a pivotal part in treating heart function. Coronary artery bypass grafting (CABG) is a common cardiac surgery procedure performed today (65.6%) (Pishkarmofrad et al., 2016; Taherian et al., 2020). CABG forms new pathways for high-concentration oxygen blood to flow to the heart muscles. In the end, it would improve patient's quality of life (Hany et al., 2019; Kyavar et al., 2016). Despite its beneficial effects, surgery procedures also present several adverse effects.

Postoperative pain is a devastating outcome after cardiac surgery. Persistent pain potentially occurred on 28%-56% of postoperative cardiac surgery patients (El-Naggar et al., 2020). Furthermore, sternum pain was found as a common complaint following the CABG procedure. Fifty to sixty percent of postoperative cardiac surgery patients reported moderate to severe pain, 24 to 72 hours after the procedure (Pishkarmofrad et al., 2016). Pain initially stimulates by tissue damages. Inflammatory mediators such as bradykinin, serotonin, histamine, cytokines, dan leukotriene are released into the bloodstream by the injured tissues (El-Naggar et al., 2020; Zubrzycki et al., 2018). Adequate postoperative pain management is necessary to reduce the risk of pain complications.

Acute postoperative pain management is an essential component of perioperative nursing care. Clinical pain management favors the conventional approach (multimodal regimen) to reduce the side effect of pain, avoid sedation and respiratory distress, improve patient satisfaction, and decrease morbidity (Cogan, 2010; Hany et al., 2019). This conventional management might need complementary therapies after the acute phase. The integration with complementary and alternative medicine (CAM) potentially supports the pain relief process.

CAM has been widely implemented to manage pain, nausea, and fatigue. A study reported sufficient effect of CAM therapies on 46.2% of its application. Specifically, 42.3%, 34.6%, 23.1%, and 23.1% of those therapies employed food supplements/vitamins/minerals, massage therapy, homeopathy, and herbal therapy, respectively (Kessel et al., 2016). Acupuncture therapy, guided imagery, and hypnosis have potential benefits in reducing postoperative pain (Bakker et al., 2020). Although its versatile application in pain cases, nurses were often deal with confusion because of the limited scientific resources and inadequate policies in the application of CAM (Micah et al., 2019). There were two studies assessing the effect of CAM on cardiovascular disease and postoperative cardiac surgery patients. However, they did not fully concentrate on postoperative pain after cardiac surgery (Chandrababu et al., 2017; Wahyuningsih and Pandin, 2021). This study aimed to explore the application of CAM on postoperative pain after cardiac surgery.

METHODS

The literature search conducted on several databases such as Google Scholar, PubMed NCBI, ProQuest, and ScienceDirect. This search was filtered by the publication year of 2016-2020, English-language publication, and the availability of the full-text article.

The search strategy used English keywords that consisted of "complementary and alternative medicine", "mind-body interventions", "biofield", "herbs", "manipulative and body-based practices", "energy therapies", "curcuma", "ginger", "pain", "cardiac surgery", "post-cardiac surgery", "CABG", and applied Boolean logic such as "AND" and "OR" to limit and expand the scope of the journal article search.

This study used Population, Intervention, Comparison, Outcome, and Time (PICOT) method to fit the inclusion criteria. The inclusion criteria for the literature review were as follows: 1) original research with experimental, quasi-experimental, pre-experimental, and cross-sectional design 2) enrolled >=18 years old participant who was undergoing cardiac surgery, 3) evaluating CAM therapy, 4) evaluating pain intensity and/or pain quality. While the exclusion criteria included the following: 1) study with the review, commentary, and study protocol design, 2) discussed the impact of postoperative pain after cardiac surgery (anxiety, sleep disturbance, fatigue, nauseous feeling, and quality), and 3) enrolled children as the study participant. PRISMA flow chart used to screen and select the journal. Of 3,476 articles, only 27 articles passed the screening. However, 9 articles excluded the criteria due to some reasons, such as an article only discussed the pharmacology aspect, five articles did not address the aim of this review, an article did not relate to CAM therapies, and two articles did not meet the participant criteria. Finally, 18 articles were eligible to review based on inclusion criteria. Data extracted from each study consisted of author, year, country, design, sample (number, gender, and health

status), procedure, and result. Data synthesis employed to classify the category and type of the CAM.

RESULTS

The search initially found 3,476 articles from four databases. However, only a total of 18 studies met the eligibility criteria. The flow of literature search dan selection is shown in Figure 1.

Characteristic of Study

Among these studies, randomized controlled trial (RCT) was the most common design applied (13 studies), followed by quasi-experimental design (four studies), and pre-experiment design, one group pre-test post-test (one study). The majority of study were conducted in Iran (66.7%). The rest of them was performed in Mesir (11.1%), India (11.1%), Indonesia (5.6%), and Thailand (5.6%). These studies were dominated by male participants and CABG procedures (Table 1.)

The Application of CAM on Post-Operative Pain After Cardiac Surgery

All domains of CAM that composed of alternative medical systems, mind-body interventions, biologically based therapies, manipulative and body-based practices, and energy therapies (biofield) were recognized in 18 reviewed studies. There were ten manipulative and body-based practice (50%), six mind-body (30%), two alternative medical system (10%), one biologically based therapy (5%), and one energy therapy (5%) domain documented in this study (Table 2).

In the manipulative and body-based practice domain, we identified the application of cryotherapy and massage therapy. Eight studies were exploring the effect of cryotherapy to reduce postoperative pain after cardiac surgery. Media of cold gel packs or ice packs applied on cryotherapy. It was placed over the sternotomy incision site and the sterile dressing covering the chest tube. The majority of these studies revealed significant postoperative pain reduction after the cryotherapy procedures. However, a study by Bastani et al., (2016) presented a contrary result. There were two studies investigating the effect of massage therapy on postoperative pain after cardiac surgery. The procedures applied were different, but both studies found significant effects. A study by Taherian et al. (2020) performed massage therapy on the Hegu point, while Rosy (2016) conducted foot massage in her study.

Six studies discussed the effect of the mind-body intervention domain on postoperative pain after cardiac surgery. Relaxation technique, music therapy, and distraction therapy documented in this domain. Two studies proposed similar relaxation techniques. The participant was asked to lie in a bed and instructed to inhale and exhale slowly. Two studies applied music therapy in a similar duration, 30 minutes. Distraction therapy delivered by playing the recorded voice of the participant's loved ones. Relaxation technique, music therapy, and distraction identified as an effective therapy for postoperative pain after cardiac surgery.

The alternative medical system domain of CAM in this study is represented by acupressure therapy. Two studies performed acupressure at the LI4 point, but Bastani et al (2016) also used ST36 and P6 point in the acupressure procedure. Both studies showed a significant reduction in postoperative pain after its application. Reiki therapy and herb supplement (ginger capsule) that classified into energy therapy dan biologically based therapy, respectively, were also reviewed in this study. Reiki therapy was administered by a therapist by channeling energy to the patient's body (Shaybak et al., 2017). The administration of ginger capsule (250 mg) was done since ten days prior to the angioplasty procedure (Hasanvand et al., 2019). Reiki and ginger capsule was statistically proven effective in reducing postoperative pain after the cardiac surgery.

DISCUSSION

Manipulative and Body-Based Practices Domain

Cryotherapy and massage therapy from the manipulative and body-based practice domain were spotted as the dominant therapy in this review. These therapies are popular, also linked to ancient methods since the Hippocrates era. Its outcome is well documented throughout history in decreasing the traumatic effect (Pishkarmofrad et al., 2016). The majority of studies mentioned the temperature of the ice packs or cold gel packs used in the range of -50C to 150C with the procedure duration of 10 to 20 minutes. Cold gel packs that placed in the targeted area for 9-12 minutes had decreased the temperature of the skin to <13.60C.

This temperature produces analgesic effects for the patients (Ebrahimi-Rigi et al., 2016; Lokesh et al., 2015). Patients were put into semi-fowler to fowler positions. Their heads and shoulders were also supported by a pillow to maintain the stroke volume, avoid tachycardia, and prevent orthostatic stress (Kubota

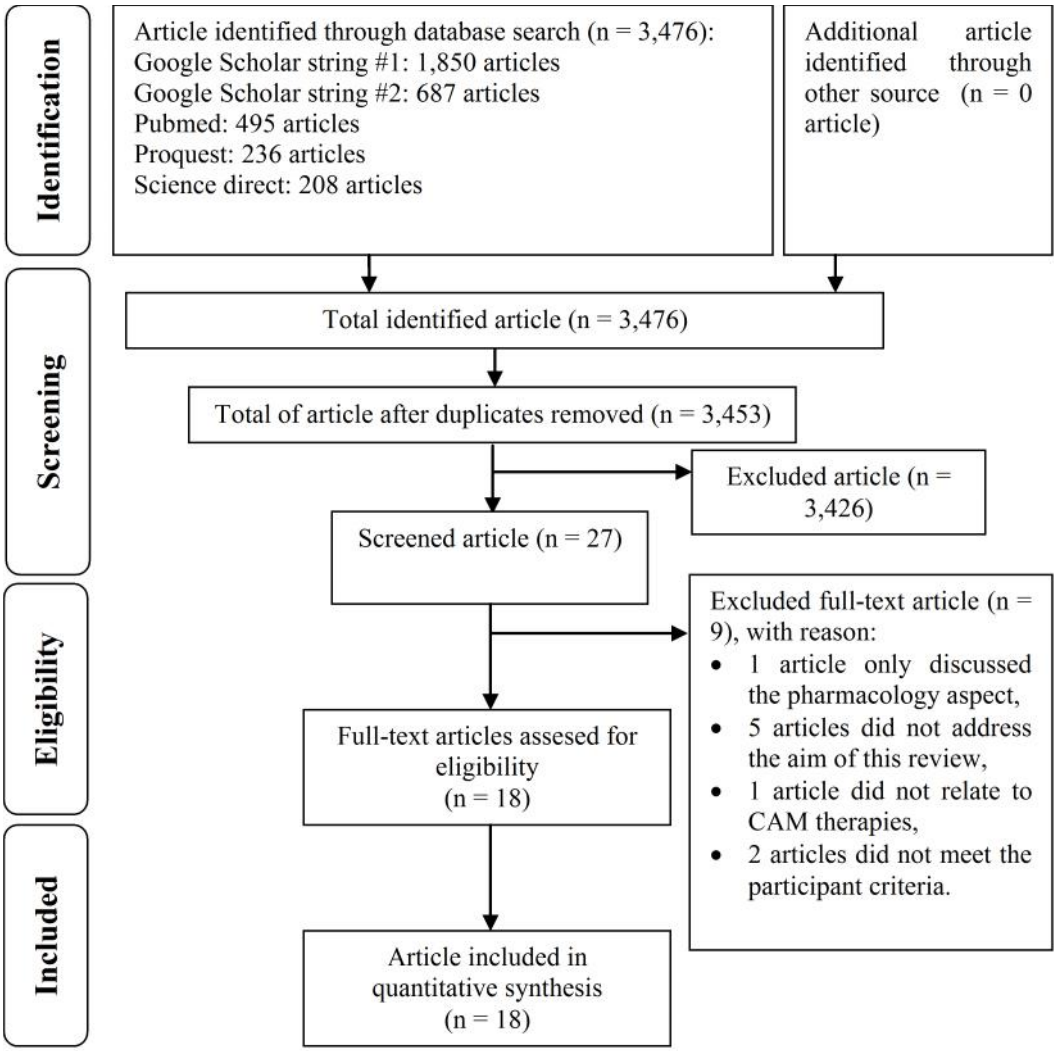

Figure 1. Flow Diagram of Literature Search and Selection

et al., 2017).

Cryotherapy was effective in reducing postoperative pain after cardiac surgery. Cold therapy activates the inhibitor nerves to restrict the nerves that originate from the posterior horn of the gray matter on the spinal cord. This mechanism produces lower pain transmission activities. Cold therapy also decreases the nerve conduction velocity, local blood circulation, and cellular metabolism (Ebrahimi-Rigi et al., 2016). It blocks the pain impulses by activating the descending inhibitory neurons that inhibit ascending nociceptive nerves from the substantial gelatinosa and decreases the production of inflammatory mediators (Keawnantawat et al., 2018; Yan et al., 2019).

Massage therapy applied lotion to facilitate the movements (Micozzi, 2014). Hegu point stimulates the secretion of ?-endorphin, dynorphin, and met-enkephalin to relieve the pain (Taherian et al., 2020). Massage therapy discovered as an effective modality for alleviating postoperative pain after cardiac surgery. Beta-endorphin activates the opioid mu (a?-opioid) receptors which provide an essential role in inhibiting glutamate secretion (Subadi and Laswati, 2014). Hence it will block the pain sensation transmission from C neurons and A?. The ?-opioid receptor situated in pre-synaptic of primary afferent neurons in dorsal cornu medulla spinalis. Pressure stimulation affects the endogen endorphin activation for the pain relief process.

Mind-Body Intervention Domain

Relaxation technique for pain reduction was identified in three studies. Patients were seated with a straight back or placed in a high-fowler position in a bed. They were asked to relax and take slow-deep breathing and exhale slowly. While they were sitting, they instructed to say "A" (A-kara). These techniques improve the vital capacity, forced expiration volume in one second, and peak expiratory flow up to 25-75%. Intra-abdominal pressures that lower above the diaphragm produced the highest lung volume (Pal et al., 2017) (Mooventhan and Khode, 2014). These

Table 1. Description of Study Analyzed

Author/ Location	Design	Patient Number/ Gender/Condition	Intervention	Result
Pishkarmofrad et al (2016) Iran	RCT	50 patients M: 50% F: 50% Post-CABG surgery	Localized Cryotherapy Media: ice packs Temperature: 0^0C Duration: 5-10 minutes Location: sternotomy wound	Comparison between the control and intervention group revealed that localized cryotherapy was effective in reducing postoperative pain 15 minutes after the cryotherapy application.
El-Naggar et al (2020) Egypt	Quasi-experimental	60 patients L: 46.7% P: 53.3% Post-operative cardiac surgery	Ice gel packs Media: cold gel packs Temperature: 0-5^0C Duration: 15 minutes Location: sternotomy wound	Cold therapy was significantly reduced the pain level on the the first to the fourth session, especially on the first and second session, before ($p>0.05$) and after the intervention ($p<0.05$).
Narimani et al (2018) Iran	RCT	70 patients No gender data available Post-CABG surgery	Acupressure Acupoint: LI4 (bilateral pressure) Duration: 20 minutes (10 seconds of pressure and 2 seconds of rest). Pressure applied equal to 3-5 kg (warmth, numbness).	Acupressure was significantly reduced the pain level in the experimental group. It also provided effective outcome in pain relief before the measurement, soon after the intervention, and 20 minutes after the intervention in comparison with the control group.
Yarahmadi et al (2018)	RCT	180 patients M: 67.8% F: 32.2%	**Cold Therapy** Media: ice packs Temperature: -5^0C Duration: 20 minutes	Cold therapy and music therapy was effective in reducing postoperative pain soon after the chest tube removal ($p<0.0001$). A

relaxation techniques induce the artery vasoconstriction tone that will suppress the total peripheral resistance. The artery vasoconstriction also influences the blood flow rate to arteries and capillary vessels that deliver oxygen and nutrition to the tissues, especially the brain and heart. This process presents better cell metabolism due to the higher production of adenosine triphosphate (ATP). It also produces a lower level of pain and a mind-relaxing effect (Rini, 2018).

Music therapy was also reported as an effective modality to alleviate postoperative pain after cardiac surgery. A study elaborated the utilization of music therapy with a 60 dB sound intensity. It was claimed that the sound intensity of 60 dB provides the best therapeutic effect (Roshita, 2018). Music has a sedative effect, it distracts pain by the mechanism of pain perception inhibition and stimulates the release of endorphin to the bloodstream. Music therapy also reported being capable of regulating opioid circulation that improves the dopamine pathways in the central nervous system (Lin et al., 2020).

A study reported the effect of distraction technique with a loved one's voice for distraction in postoperative pain after cardiac surgery. Distraction therapy was also declared as an effective therapy in reducing postoperative pain after cardiac surgery. Distraction transforms the pain perception by changing nociceptive responses and triggering the internal pain suppression system. This mechanism decreases the activation of a set of brain regions, such as the thalamus, that contributes a consistent and significant role in pain perception. The gate control theory also explained this situation (Ibitoye et al., 2019). Some examples of distraction method that serves a pleasant stimulation are music, imagination, watching TV, hypnosis, massage, hydrotherapy, singing, rhythmic breathing, and playing a video game (Ibitoye et al., 2019; Sheykhasadi et al., 2019).

Alternative Medical System Domain

This CAM domain is represented by acupressure. Two studies identified the utilization of LI4 and ST36

A A Firoozabadi et al (2016) Iran	RCT	60 patients NA Post-CABG surgery	Relaxation Exercise Duration: one day prior the surgery and continued until the next 72 hours, conducted every 15 minutes	Findings showed that the relaxation exercise was not effective in reducing postoperative pain after the CABG procedure between the control and experimental group on the 24, 48, and 72 hours.
Kyavar et al (2016) Iran	RCT	60 patients M: 78.3% F: 21.7% Post-CABG surgery	Music Therapy Type: participant's favorite music Duration: 30 minutes Media: - Sound Intensity: - dB	Music therapy was effective in reducing postoperative pain after the CABG procedures in the experimental group in comparison with the control group ($p<0.0001$).
Rofi'ah et al (2020) Indonesia	Quasi-experimental	60 patients M: 61.7% F: 38.3% Post-operative cardiac surgery	Cold Therapy Media: ice gel packs Temperature: 10-15^{0}C Duration: 20 minutes Location: sternotomy incision site	Cold therapy effective in reducing pain and pain disorder in the intervention group, compared to the control group ($p<0.001$).
Rosy (2016) India	One group pretest - postest	30 patients M: 73% F: 27% Post-operative cardio-thoracic surgery	Foot Massage Technique: moderate pressure. Location: foot Duration: 5 minutes on each foot	Foot massage was an effective method in alleviating postoperative pain after the cardio-thoracic surgery ($p<0.05$). It had reported that 75% of severe pain occurred before the foot massage. While, after the application of the foot massage, there was 57% of mild pain identified among the participants.
Mohamm	RCT	90 patients	Cold Therapy	Cold therapy was effective in

acupuncture points, while Bastani et al. (2016) only applied pressure on the P6 acupoint. Acupressure is the application of pressure on the acupuncture point (acupoint) according to the meridian system or channel that embodies art and asian medical philosophy (Micozzi, 2014). These studies explained the application of pressure on the LI4, ST36, and P6 acupoints had relieved headache, chest pain, and abdominal pain, respectively (Lown et al., 2019). The pressure applied is approximately equal to 3-5 kg which induce the sensation of pain, numbness, heaviness, distension, and warmth and assure the accuracy for each acupuncture point (Chen and Wang, 2014). Findings showed that acupuncture is effective in reducing postoperative pain after cardiac surgery. Stimulation on these acupoints sends impulses to the type I and II fibers of the afferent nerves or A? in the muscles that would forward these impulses to the anterolateral tracts in the spinal cord. Then enkephalin and dynorphin were released and blocked the sensation of pain. The other mechanism that occurs was the release of beta-endorphin that known for its analgesic property (Panggabean and Asiah, 2019).

Energy Therapy/Biofield Domain

In CAM, reiki belongs to the energy therapy domain. Reiki requires a specialized practitioner or therapist to heal the spirit and physical body due to the involvement of therapeutic touch in the therapy (Bardia et al., 2006). Reiki reported as an effective CAM therapy for postoperative pain relief after cardiac surgery. According to the Qi theory, the obstruction of energy flow, poor energy circulation, and energy imbalance on the body organs manifests into pain or diseases. Another mechanism identified was parasympathetic activity stimulation, reduction of the need for opium administration, improvement of endorphin and enkephalins released, and pain inhibition (Shaybak et al., 2017). Reiki therapists believe that reiki energy is not limited by time and space. It directs energy to reduce pain(vanderVaart et al., 2011).

Biologically-Based Therapy Domain

Ginger capsule (250 mg) administrated since ten

Jose (2020) India	RCT	60 patients M: 81.7% F: 13.7% Post-CABG surgery	Quick relaxation technique Technique: patients were instructed to close eyes and breathe in and out deeply and slowly in 7 cycles, also chant the "A" sound Duration: 5-10 minutes	Significant difference of pain level was 15 minutes after the chest tube removal in the intervention group ($p<0.001$).
Shaybak et al (2017) Iran	RCT	40 patients M: 60% F: 40% Post-CABG surgery	*Reiki* Duration: 9 minutes (6 minutes on auras and 3 minutes on chakra Position: supination, closed eyes	There was a significicant reduction in sensory pain level between the control and reiki group ($p = 0.019$). No diffirence on the affective pain noticed after the intervention in both groups.
Hany et al (2019) Egypt	Quasi-experimental	60 patients M: 65% F: 35% Post-CABG surgery	Deep Breathing Exercise Technique: 5 cycles of deep breathing in a high fowler position, patient was asked to relax.	There was a significant reduction on the pain level on the first and second day after the deep breathing exercise in the experimental group, in comparison with the control group.
Ebrahimi-Rigi et al (2016) Iran	RCT	46 patients F: 73.9% M: 26.1% Post-CABG surgery	Cold Therapy Media: cold gel packs Temperature: -^{0}C. Duration: 15 minutes Location: chest insicion site. Procedure: Head of the bed raised to 45-90 degrees	There was a significant reduction in sensory pain between the both group before and after the application of the cold therapy. However, no affective pain change noted in the both groups.
Hasanvan Keawnan tawat et al (2018) Thailand	RCT	34 patients 70 patients M: 60% F: 40% Post-operative cardiac surgery	*Zingiber officinale* Cold Therapy Media: cold gel pack Temperature: 10-15^{0}C Duration: 20 minutes Location: sternum incision site Position: perpendicular/upright	Pain level was significantly The pain intensity and pain complaint was reduced significantly after the application of the cold therapy on the first and second day, in comparison to the control group ($p = 0.000$).

Abbreviation: M: Male; F: Female; PTCA: *percutaneous transluminal coronary angioplasty*

days before the angioplasty procedures. Ginger (Zingiber officinale) capsule was an effective pain relief modality for postoperative pain after cardiac surgery. Its anti-inflammatory effect and 6-gingerol and 6-shogaol property that inhibited cyclooxygenase-1 (COX-1) and COX-2 enzymes, leukotriene synthesis, and proinflamation cytokine provide a potential therapeutic effect for pain relief. Gingerol, shogaols, and zingerone are agonist receptors of the transient receptor potential vaniloid (TRPV) 1. TRPV1 receptor released in peripheral (dorsal root ganglion) and central nervous system was associated with nociception and pain control. Numerous properties on ginger were also proven sufficient in inhibiting lipopolysaccharide (LPS) that induce the prostaglandin E2 production (Black et al., 2010; Hasanvand et al., 2019; Lantz et al., 2007).

The majority of studies did not discuss the effect of analgesics that administered during the study. Hence, there was no thorough explanation related to the effect of analgesics elaborated in this study. Analgesics might contribute an essential role in pain level or intensity during the CAM application. We also did not carefully evaluate the influence of culture and belief systems in a particular country (Iran, Mesir, India, and Thailand) on the CAM therapies in this

study. In addition, the articles of this study retrieved from limited international database, so the review process only focused on 18 articles. Moreover, this study did not explain detail about level of evidence of each article. However, dominant of these articles were RCT design.

CONCLUSION

Four domains of CAM were described in this study. Cryotherapy and massage therapy from manipulative and body-based practice domain recognized as prominent therapy for postoperative pain after cardiac surgery. The utilization of relatively simple procedures and tools have been introduced them as familiar CAM therapies in the medical field. We suggested complementing the pharmacological approach of postoperative pain after cardiac surgery with CAM therapies. Future nursing studies also required to examine further effect of CAM therapy on perioperative nursing care, mainly in the alternative medical system, energy therapy, and biologically based therapy domain.

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