

Review

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Heat Therapy to Reduce Chest-Pain Among Patients with Acute Coronary Syndromes (ACS): A Literature Review**Aan Nur'aeni¹, Yanny Trisyani¹, Donny Nurhamsyah¹, Oman Hendi¹, Rahmalia Amni¹, Vanny Leutualy¹, Gita Maya Sari¹, Nurlaeci², Rika Winarni²**¹Faculty of Nursing, Universitas Padjadjaran²Hasan Sadikin General Hospital**ARTICLE INFO****Article history:**

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ABSTRACT

The main clinical manifestations of patients with Acute Coronary Syndrome (ACS) during the acute period is chest pain. Handling complaints of pain patients with ACS definitively done with medication; however, it is possible to do additional nonpharmacological therapies to optimize the results. Nonpharmacological treatment can be performed in various ways, one of them with heat therapy. This literature review aimed to determine the use of heat therapy as an additional nonpharmacological intervention in reducing the intensity of chest pain in patients with ACS. Four electronic databases were used to carry out systematic searches on articles, namely Proquest, Science Direct, Pubmed, and CINAHL-Ebsco. The combination of keywords was "heat therapy" AND "chest pain" AND "acute coronary syndrome" NOT "Literature review" OR "Literature review" OR "Overview" OR "Systematic Review" OR "Meta-analysis." The inclusion criteria used were experimental study articles, peer-reviewed articles, and research articles written in English and performed in the period between 2014-2019. The search results obtained three articles that met the inclusion criteria and analyzed. The results of the study found that heat therapy effective in reducing the intensity of chest pain, the use of analgesic opioids, and improving the patient's hemodynamics. In conclusion, the therapy can be considered used as adjunctive therapy to reduce chest pain in patients with ACS with certain criteria. In addition, further research is also needed to see the effectiveness of this therapy if it is implemented with more frequent frequencies and compare its effectiveness in reducing chest pain if the application is given to the anterior or posterior of the chest.

Introduction

Acute coronary syndrome (ACS) is a part of acute coronary arterial disease (CAD). The prevalence of coronary artery disease in Indonesia in the last few years is quite high. Data Riset kesehatan dasar (Basic Health Research) (2018) showed that the incidence of coronary artery disease in Indonesia amounted to 1.01729 million people. The provinces with the highest prevalence of ACS today are the province of West Java. A total of 186 thousand people diagnosed with coronary artery disease in 2018 in West Java (Ministry of Health of the Republic of Indonesia, 2018).

Acute coronary syndrome occurs due to rupture of atherosclerotic plaques in the coronary arteries resulting in decreased oxygen supply to the heart muscle (myocardium). The imbalance of oxygen in the heart muscle will cause the activation of anaerobic metabolism, so it will be an increase in lactic acid. The situation will cause chest pain and if untreated will lead to injury and infarction of the heart muscle (AHA, 2015 & 2016; Kelly & Kontos, 2014; PERKI, 2018).

Chest pain is the main clinical manifestations that occur in patients with ACS in acute conditions. Chest pain felt by patients with ACS can be like pressure or burning and radiating to the left arm, neck, jaw and back. In addition to chest pain, clinical manifestations that also appear in ACS patients are dyspnea, tachycardia, nausea, vomiting, anxiety or anxiety, and sweating (Godarzi, Khodai & Razaghi, 2012; Lewis et al., 2017). ACS patients will receive intensive care treatment, for continuous monitoring and administration of therapy (PERKI, 2018). Management of chest pain is very important in the treatment of ACS, because chest pain that occurs constantly or uncontrollably cause physiological and psychological problems in patients, such as discomfort, anxiety, respiratory problems, hypertension, and heart rate variability problems (Hala et al., 2018).

The above conditions will increase the workload and oxygen demand in the heart muscle, which will result in the expansion of infarction. Controlling chest pain needs to be done

pharmacologically or with additional non-pharmacological therapy. Pharmacological pain management is done through the administration of medicines, whereas nonpharmacologic pain management that has been studied is heat therapy (Hala et al., 2018; Mohammadian, Mohammadpur, Nematollahi, & Jamiyati, 2017).

Heat therapy reduces pain by increasing blood circulation to injured tissue, resulting in increased perfusion and oxygenation in the tissue. Previous studies also suggested that the use of pharmacological action with a combination of nonpharmacologic have a more positive effect in reducing the level of chest pain in patients with ACS (Hala et al., 2018; Neumar, Shuster & Callaway, 2015). Nonetheless, the effectiveness of the procedures and the extent of heat therapy as an adjunctive therapy to decrease chest pain in ACS patients in intensive care units still need to be explored further.

Method

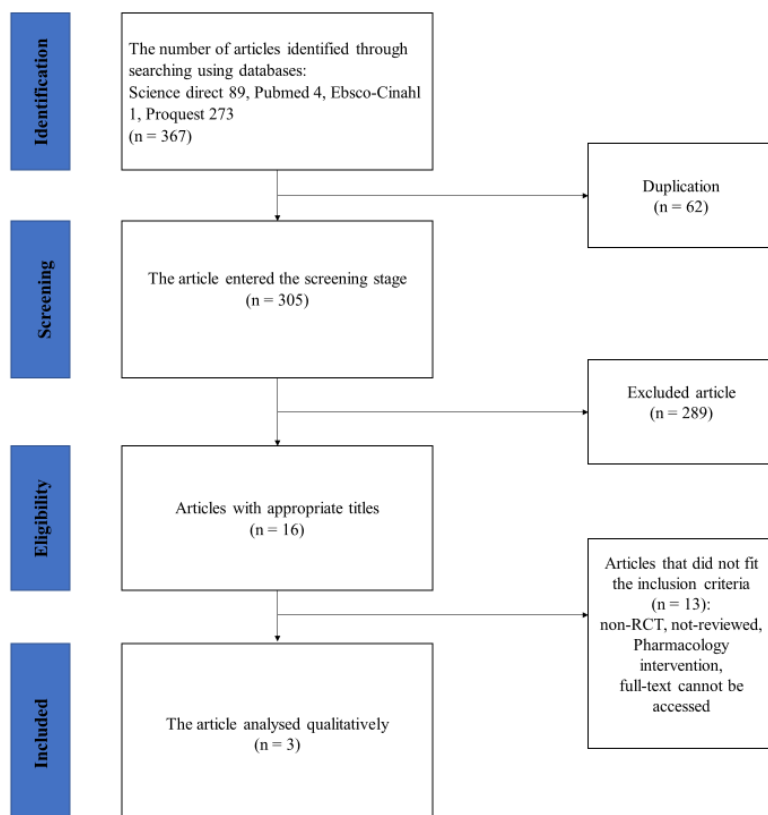
This research method was a literature review. Four electronic data base used to perform a systematic search in the articles that Proquest, Science Direct, Pubmed and CINAHL Ebsco. The combination of keywords was "heat therapy" AND "chest pain" AND "acute coronary syndrome" NOT "Literature review" OR "Literature review" OR "Overview" OR "Systematic Review" OR "Meta analysis". The inclusion criteria used include articles with experimental study, peer-reviewed, English language and research conducted in the period between 2014-2019. Exclusion criteria: 1) articles which do not have the structure of a complete article; 2) and article review.

Results

Based on the search results by entering keywords, the articles obtained from Ebsco CINAHL 1 article, Science Direct 89 articles, Pubmed 4 articles, and Proquest 273 articles. After the selection of articles using the inclusion criteria the number of articles remaining was 39. There were 4 articles which were similar and 30 articles that were excluded, so the number of articles

analyzed was 5 articles, but only 3 articles had the structure of an article and discuss heat therapy and its effect on pain in acute phase patients with ACS.

Figure 1. Flow chart of article selection results



In the following table (table 1) a summary of the articles is presented.

Table 1. A summary of the articles analyzed

No	Articles	Purposes	Method design	Sample	Results
1	Effects of Local Thermotherapy on Chest Pain in Patients with Acute Coronary Syndrome: A Clinical Trial (Moradkhani et al., 2018).	To find out the effects of local thermotherapy on chest pain in patients with Acute Coronary Syndrom	<i>Randomized Controlled Trial</i>	The study was conducted on 78 acute coronary syndrome patients in ICU. Each patient was divided into randomized intervention and control groups, each group consisting of 39 patients. Inclusion criteria: patients over 30 years old; without a history of psychological, muscle and gastrointestinal disorders; without decreasing the level of consciousness; and without a chest wound. During the implementation of local thermotherapy, patients in the intervention group received thermotherapy using a hot pack heated to temperatures reaching 50 degrees Celsius one hour after the patient entered the treatment room. Implementation was carried out for 20 minutes and continued every 12 hours for five days. Hot pack was placed on the posterior chest. While the control group only received routine care.	The severity of pain in the intervention group before the treatment averaged 3.22 ± 0.86 ; and after the intervention, it was reduced to 2.61 ± 0.7 , meaning that the local thermotherapy action had an impact. But statistically, these results do not show significant differences. Besides, there was no significant difference between age, sex, diabetes, hypertension, and hyperlipidemia, with the severity of pain ($P > 0.05$).
2	Effect of Local Heat Application on Physiological Status and Pain Intensity among	To discover the effects of local heat therapy caused by physiological status and pain intensity of	<i>Quasi experimental study</i>	A total of 60 patients were taken by purposive sampling, then randomly selected into two groups of 30 respondents each.	The results show that the mean age between the intervention and control groups was 54.60 ± 4.29 years; 54.40 ± 4.29 years. Most were men (intervention group 63.3, control

Patients with Acute Coronary Syndrome (Hala et al., 2018).	patients with acute coronary syndromes.	<p>Inclusion criteria: age 21 to 60 years, male and female sex, compos mentis, and willing to participate in the study, as well as patients diagnosed with ACS.</p> <p>While the exclusion criteria: patients with other chronic diseases such as diabetes, or digestive diseases, psychological disorders and inflammation, sores, blisters, and redness of the anterior chest.</p> <p>In the intervention group, the hot pack was filled with water heated to 50°C and then wrapped in a towel and placed on the front of the chest for 20 minutes, carried out every 12 hours for 24 hours, and given routine therapy. The control group was given regular hospital care (rest, oxygen therapy, and pharmacological therapy).</p>	<p>group 66.7%). The physiological parameters measured are pulse frequency, blood pressure, respiratory rate, and oxygen saturation. Physiological parameters differed significantly between the control and intervention groups after 24 hours of intervention, with the positive effect of these parameters being more dominant in the intervention group. Likewise, the level of intensity of chest pain that was reduced was higher in the intervention group. Hot compresses can significantly reduce chest pain levels in the intervention group than in the control group after 24 hours of intervention ($P < 0.01$).</p>
<p>3 The effects of topical heat therapy on chest pain in patients with acute coronary syndrome: A randomised double-blind placebo-controlled clinical trial. (Mohammadpour et al., 2014)</p>	<p>To determine the effect of local heat therapy on chest pain in patients with ACS and the need for opioid treatment for pain reduction.</p>	<p><i>Randomized double-blind placebo-controlled clinical trial</i></p>	<p>The study sample was 66 patients with the acute coronary syndrome. Patients were randomly selected for the experimental group or placebo, each of 33 respondents. Patients in the intervention and placebo groups received local heat therapy using heat packs heated to 50 degrees Celsius each for the experimental group and 37 degrees Celsius for the placebo group. The researcher assessed the intensity, duration, and</p> <p>Statistical test results show that local heat therapy is an effective intervention to prevent and relieve chest pain in patients with the acute coronary syndrome. Compared with the control group, pain intensity, duration, and frequency in the experimental group decreased significantly after the study ($P < 0.001$). Local heat therapy effectively reduces the intensity, duration, and frequency of chest pain episodes in ACS patients. In addition, before and after the intervention,</p>

frequency of chest pain, and the need for opioid therapy before and after the study. The first 2 hours, the respondent is given routine care, the intensity, duration, and frequency of pain, and opioid therapy must be measured. Local heat therapy was given 2 hours after patients entered the treatment room in both groups. The hot pack is first heated to 75 degrees Celsius and then wrapped in a towel and placed over the patient's chest, the temperature the respondent receives immediately is 50 degrees Celsius. Therapy is given every 12 hours for two consecutive days (4x) each for 23 minutes. Patients in the placebo group received the same therapy but with a hot pack temperature of 37 degrees Celsius.

opioid analgesic needs were significantly different between the intervention group and the control group.

Effect of heat therapy on acute attack phase patients with ACS

The entire article research results showed a decrease in chest-pain in the control group, but there is an article that shows a statistically insignificant results, the article is the first article written by Moradkhani et al (2018). Based on these three literatures the provision of heat therapy both directly applied to the anterior and posterior parts of the chest has a positive effect on pain relief. Pain reduction in the study of Moradkhani et al., (2018) comparing pain at the beginning of the intervention and after 24 hours of intervention showed a mean value of 0.61. While research Hala et al., (2018) showed a decrease in pain by category. Pain reduction from the category of severe to mild pain and no pain was more in the intervention group compared to the control group. In the intervention group, severe pain was felt initially by 25 respondents, while in the control group by 22 respondents, and at the end of the measurement the number of respondents who experienced severe pain became absent, while in the non-pain category in the intervention and control groups were 18 and 7, respectively. Likewise with Mohammadpour et al., (2014), which measures the chest pain by its duration and severity. The duration of chest pain in the intervention and control groups at the beginning of the measurement was no difference in mean score of 25.66, however, at the end of the intervention, duration of chest pain in the intervention group was significantly reduced to 3.48, whereas the control group did not change. For term pain severity, at the beginning of the measurement obtained a mean score of 44.8 in both groups, and at the end of the measurement after the intervention, the mean score of 7.51 obtained for the intervention group, whereas, for the control group only reduced to 37.88. In addition to chest pain, this study also produced data on a significantly lower need for analgesic opioids in the intervention group compared to the control group (Mohammadpour et al., 2014). This heat therapy also had a positive influence on pulse frequency and oxygen saturation in the

intervention group compared to the control group (Hala et al., 2018).

Heat therapy procedure

Based on these studies, there are several criteria that need to be considered prior to treatment, these criteria are: an adult patient, diagnosed definitively SKA, conscious, status hemodynamic normal, no dependency on drugs and alcohol, did not have a history of gastrointestinal disease or musculoskeletal chest, or psychological abnormalities, no swelling, redness, edema, and injuries to the chest and had a body mass index (BMI) of 18.5 to 25 (Hala et al., 2018; Mohammadpour et al., 2014; Moradkhani et al., 2018).

Heat therapy which is based on two articles of research, carried out by heating the hot pack to 50° C which was then wrapped in a towel (Hala et al., 2018; Moradkhani et al., 2018), whereas in the study Mohammadpour et al., (2014), hot packs used for heat therapy preheated up to 75° C and then wrapped in a towel, to keep the temperature is maintained and to protect the patient's skin from burns. Next the hot pack was applied to the patient's chest, two studies placed the hot pack on the patient's anterior chest (Hala et al., 2018; Mohammadpour et al., 2014) while Moradkhani et al., (2018), placed it in the patient's posterior chest. The duration of heat therapy on three studies was relatively the same that lasts 20-23 minutes, one study conducted once every 12 hours for 24 hours (Hala et al., 2018), and on other research carried out for 2 days (Mohammadpour et al., 2014). Meanwhile, the other studies made only one treatment a day, for five consecutive days (Moradkhani et al., 2018).

Discussion

Pain management in ACS patients can be done with pharmacological and non-pharmacological therapy. Pharmacological therapies that are usually given are morphine, oxygen, nitrate and aspirin (MONA). However, not all patients get these therapies simultaneously. For patients with ACS, peripheral oxygen saturation is recommended, and aspirin 160-320

mg is given to all patients, whereas patients with chest pain that still persist when arriving at the emergency department are also given sublingual nitroglycerin (NTG) tablets. except patients with systolic blood pressure <90mmHg or heart rate <50bpm or> 100bpm. If the pain does not disappear in one time administration, it can be repeated every 5 minutes to a maximum of 3 times. For patients who are unresponsive to 3-dose sublingual NTG therapy, morphine sulfate is given 1-5 mg IV, it can be repeated every 10-30 minutes (HIPERKI, 2018).

Non-pharmacological therapy heat therapy is one of the non-pharmacological measures to relieve pain because it is given specifically at the location of chest pain which can improve symptoms by increasing tissue perfusion, increasing tissue oxygenation supply and eliminating inflammatory mediators (bradykinin, serotonin, histamine, prostaglandin) in myocardial injury area so that the pain decreases. On the other hand, heat therapy reduces the contraction of smooth muscles in the walls of blood vessels by stimulating the heat receptor and cause dilation of blood vessels. Besides heat therapy also reduces the action of the nervous system that can eliminate other symptoms (Gale, Rothbart & Ye, 2006).

Another study conducted by Mohammadpour et al (2014), supporting the results of previous studies. Local heat therapy is effective in reducing the intensity, duration and frequency of chest pain episodes in ACS patients. Local heat therapy can prevent and reduce chest pain because by giving heat therapy to the chest of patients who experience chest pain will trigger coronary artery dilatation, accelerate the process of angiogenesis thereby increasing myocardial perfusion. Myocardial perfusion increases myocardial oxygenation and facilitates the release of inflammatory mediators such as bradykinin and histamine from myocardial injury. In addition, local heat therapy can also stimulate the secretion of endorphins such as endogenous morphine compounds that can help reduce pain. Statistical analysis showed local heat therapy is an effective intervention to prevent and relieve chest pain in patients with acute coronary syndromes. When compared with the control group, pain intensity,

duration, and frequency in the experimental group decreased significantly after the study ($P < 0.001$). These results are consistent with research conducted by Mohammadian, et al., (2017) showed that after intervention, systolic blood pressure ($p < 0/001$) and respiratory rate ($p = 0/027$) decreases and oxygen saturation increased significantly ($p = 0/003$) in the experimental group compared with those in the control group. Systolic blood pressure, oxygen saturation and respiratory rate are physiological parameters of patients with ACS.

Local heat therapy can prevent and reduce chest pain because of the heat treatment given to the patient's chest, will trigger a coronary artery dilatation, accelerate the process of angiogenesis thus improving myocardial perfusion. Myocardial perfusion increases myocardial oxygenation and facilitates the release of inflammatory mediators such as bradykinin and histamine from myocardial injury. Besides local heat therapy can also stimulate the secretion of endorphins as endogenous morphine compound that can help reduce pain.

According to the gate control theory, pain impulses can be regulated or inhibited through defense mechanisms throughout the central nervous system, regulated by sensory neuron activity and descending control fibers. Delta-A and C neurons release substance-P to transmit implants through defense mechanisms. Mechanoreceptors, beta-A neurons which more quickly release inhibitory neurotransmitters. When the A-beta fibers more dominant then it will shut down a defense mechanism. The closure mechanism can be done with a heat therapy that stimulates the nerves descending to release endogenous opiates like; endorphins to eliminate natural pain that comes from the body. (Lewis et al., 2017).

The results of these three articles showed the effectiveness of heat therapy in reducing pain in ACS patients. However, some of the things explained in the study still leave some questions including what is the actual temperature effective in this therapy. These two studies mentioned that the hot pack used for this therapy was heated to 50° C and wrapped in a towel before being applied

on top or behind the patient's chest. Whereas one study stated that the hot pack was previously heated to 75° C and wrapped in a towel to protect the chest from burns and reduce heat release from the hot pack. In addition, which one is more effective in reducing pain when a hot pack is applied whether on the anterior or posterior chest, and what if the therapy is done more frequently, for example repeated less than 12 hours. Meanwhile, in the aspect of duration, heat therapy done relatively similar with an average of 20 minutes. The duration of the extended application period can reduce the temperature of hot pack so it is feared may decrease the effectiveness of these therapies, such as those delivered Knight et al., (2012) that the temperature at 45 ° C under local thermotherapy will decrease after the application is done within 23 minutes.

Conclusions and Recommendation

Pain response experienced by ACS can also be optimized by using heat therapy. Heat therapy has a significant effect on decreasing chest pain, as well as affecting a decrease in heart rate, respiratory rate and increasing oxygen saturation. This reduction in chest pain occurs due to decreased activity of the sympathetic nervous system, which can reduce heart rate, and increase coronary perfusion. In addition, heat therapy was able to enhance and accelerate the dilation of coronary angiogenesis so that oxygenation to the coroner becomes more effective. Based on the three articles, the researchers recommends the need for further research related to the most effective temperature of heat therapy to reduce chest pain, hot pack placement when applied whether on the anterior or posterior part of the chest, as well as the effectiveness of the frequency of heat therapy to reduce chest pain if given more than two times (less than 12 hours) within 24 hours.

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