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Effect of Local Heat Application on Physiological Status and Pain Intensity among Patients with Acute Coronary Syndrome

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Abstract: *Acute coronary syndrome (ACS) is a main problem of coronary heart disease. In patients with this disease, there are many pharmacological and non-pharmacological methods used for symptom management. One of these non-pharmacological methods is local heat application. Symptom management is the most important component of comprehensive nursing care. Nursing role should be emphasized on assessment and management of symptom inflicted by acute coronary syndrome.*
Aim: *study the effect of local heat application on physiological status and pain intensity among patients with acute coronary syndrome.*
Subjects and Method: design: *quasi experimental research design was utilized to achieve the aim of this study.*
Setting: *the study was conducted at cardiac care unit and emergency intensive care unit at Menoufia University Hospital.*
Sample: - *A purposive sample of 60 patients were assigned randomly and divided into two groups 30 patients for each group.* ***Tools:*** *three tools were utilized to collect the data.*
Tool I*:* ***An interviewing questionnaire*** *to assess demographic and medical data,*
Tool II: physiological parameters measurement tool *to identify patients' physiological problems and its extent.*
Tool III: visual analogue pain scale *to assess the patient,s subjectiv pain intensity .*
Result*: illustrated that, the mean age of studied group 54.60 ± 4.29 years; 54.40 ±4.29 years in study and control group respectively. More than half of them were male (63.3, 66.7%) in study and control group respectively. Physiological parameters of patients with acute coronary syndrome(Heart rate, Blood pressure, Respiratory rate,& Oxygen saturation) were significantly different among study group &control group after 24 hrs from local heat application. Level of chest pain decreased in study group rather than control group after 24 hrs from local heat application.*
Conclusions*: local heat application had positive effect on improving physiological parameters and decreased intensity of chest pain among patients with acute coronary syndrome.*
Recommendations*: Application of local heat should be carried out routinely for managing symptom among patients with acute coronary syndrome.*
Key words: *Local heat application, Physiological status, Pain intensity and Acute coronary syndrome*

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I. Introduction

Cardiovascular disease is a major health problem and a major cause of death worldwide with a mortality rate of 35%. The mortality rate of the disease in high- and low-income countries is 40 and 28%, respectively [(1)] .One of the most type of cardiac disease is coronary artery disease which leads to approximately 1.1million death in the United States (US) [(2)]. Acute coronary syndrome (ACS) is a main problem of coronary heart disease and above 2.5 million hospitalized patients worldwide each year [(3)]

Acute coronary syndrome (ACS) refers to a group of conditions that result from impairment of blood supply to coronary arteries which affect on heart muscle and unable it to function properly or die [(4)]. The main cause of these condition is atherosclerosis in addition to many risk factors which classified into modified and non modified risk factors such as heredity, gender ,while the main modifiable risk include; atherosclerosis, smoking, hypertension and diabetes mellitus. Complications from them lead to increase of vascular injury and finally coronary syndrome [(5)].

Clinical manifestations in these patients include; chest pain, sweating, dyspnea and a feeling of choking, tachycardia, vomiting, hypertension, anxiety and feeling of being on the border of death due to imbalance between myocardial oxygen supply and demand, and leads to intensifies ischemia process. [(6,2)]

Chest pain is the most indicator of coronary artery syndrome which often radiate to the left arm, neck, jaw & back. The quality of cardiac chest pain like as heaviness, tightness, squeezing, or a choking sensation pressure-like in character, and it may be associated with nausea, vomiting and sweating. Acute coronary syndrome is connected with three clinical manifestations: ST elevation myocardial infarction (STEMI, 30%), non ST elevation myocardial infarction (NSTEMI, 25%), or unstable angina (38%) [(7)] . The percentage of patients with acute coronary syndrome (ACS) who have STEMI is around 38% in the US. About 15% of patients in the US who have an acute MI will die of it, half within 1 hour of the onset of symptoms [(8)].

Constant or uncontrolled chest pain can cause different physiological and psychological problems such as general discomfort, anxiety, respiratory distress, hypertension and abnormal heart rate and rhythm may occur. These conditions increase cardiac workload and myocardial oxygen demand, resulting in the exacerbation of myocardial ischemia and injury and the aggravation of chest distress [(1)]

There are different types of examination that should be done to patients has chest pain. The electrocardiogram is the most diagnostic test that distinguishes between various causes. It should be done as soon as possible even in the ambulance to detect any change as acute heart damage (elevation in the ST segment, new left bundle branch block),in addition to another investigation and diagnostic tests such as a chest X-ray, cardiac enzyme and telemetry should be performed for accurate diagnosis [(9)]

Controlling chest pain takes the uppermost importance in providing care to patients with ACS. Aim from quick management is to alleviate chest pain, enhance blood flow, return and improve heart function probably .Using pharmacological plus non pharmacological measures has the positive effect in reducing level of pain.[(1&9)]

Heat therapy is one of non pharmacological measures that relieve pain and improve symptoms by increasing perfusion to injured and inflamed tissues. Enhancing blood supply to tissue, improving tissue oxygenation and removing the inflammatory mediators from the injured tissues lead to decrease level of pain. From the other side, heat therapy decreases contraction of smooth muscle in the vessels wall by stimulating heat receptors and as the result enlarges the vessels wall and improves the symptoms in this way. In addition heat therapy acts to reduce action of nervous system, so disappear other symptoms ([(10)]. Moreover, according to the gate control theory, heat decreases level of pain by enhancing non pain receptors in the skin and thereby closing pain pathways [(11-2)]

There are different methods for administrating heat therapy as local heat therapy, sauna therapy and bathing. Hot pack is one of the many techniques for applying local heat to the body surface .Hot pack is a silicate gel bag that is warmed using an electric water heater and then is applied directly to skin to provide humid heat to the body [(12-13)] . Yaghobi*et al*. found that local heat therapy applied to lumbar area using hot pack significantly decreased the intensity and the duration of herniated disc-related pain [(14)]. Also Yildrim ,Ulusoy, Bodur found that heat application every other day decreased pain and disability of the patients with knee osteoarthritis[(15)] .

Miyata et al. stated that; sauna and heat therapy improves hemodynamic situation, heart performance, ventricular arrhythmias, hormonal and neural factors and symptoms of the patients with CHF [(16)]. In addition to that, Kuwahata et al. found that; sauna decreases sympathetic nervous activity and activates parasympathetic nervous [(17)] .

Nurse play a significant role for monitoring and relieving symptom, so the nurse must be ready to use nonpharmacolocical methods as heat therapy which is available to use, safe, and effective. Nurses traditionally apply heat and cold applications and some forms of massages; thus, they should be informed on the strength of the evidence for the efficiency of these applications [(18-19)].

Aim of the study: The aim of this study is to study the effect of local heat application on physiological status and pain intensity among patients with acute coronary syndrome

Operational definitions:

- **Physiological status** is systolic and diastolic blood pressure, heart and respiratory rate and arterial oxygen saturation.
- **Local heat application**: tap water was heated by heater to 50 C and then poured in the heating pad, wrapped in a cotton towel and put on anterior part of the chest for 20 minutes every 12 hours for 24 hours.

Research Hypothesis

The following research hypotheses were formulated to achieve the aim of the study:

1. Patients who receive local heat application "study group" will report decreased intensity of chest pain than the control group exposed to routine care.

2. Patients who receive local heat application "study group" will report better improvement of the systolic and diastolic blood pressure, heart and respiratory rate and arterial oxygen saturation than control group exposed to routine care.

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II. Subjects and method

Research design: quasi experimental research design was utilized to achieve the aim of this study.
Research Setting: the study was conducted at cardiac care unit and emergency intensive care unit at Menoufia University Hospital.

Subjects:
Sampling technique: The subjects of our study were selected from cardiac care and emergency care units at Menoufia University Hospital. The sample size was determined and calculated using EPI info program and it was 55 patients at CI (coefficient interval) 99%. The researcher increase sample size up to 60 patients in order to increase power of the study and allow for dropping-out.
Sample: - A purposive sample of 60 adult patients were assigned randomly and divided into two groups 30 patients for each group.

Inclusion criteria included Age range from 21 to 60 years old, both sexes, conscious and willing to participate in the study, definite diagnosis of ACS by a specialist. **While exclusion criteria** were patients with other chronic diseases such as diabetes, or digestive disease, psychological disorders and inflammation ,wounds ,abrasions and redness on anterior chest.

Tools:
In order to acheive the aim of the study, three tools were utilized for data collection. These tools are as follow:

Tool I: An interviewing questionnaire: It was constructed by the researchers to assess patients' demographic and medical data. It included two parts:
Part one demographic Data. It included information about : patients' age, sex, and occupation.
Part two: Medical data such as: medical diagnosis, length of hospital stay and medication.

Tool II: Physiological parameters measurement tool
This tool was developed by the researcher based on the reviewing of the relevant literature [(20)] to identify patients' physiological problems and its extent. It was composed of: measurement of systolic and diastolic blood pressure, heart and respiratory rate and arterial oxygen saturation.

Tool III: Visual analogue pain scale (VAS): It was developed by Bain ,Kuwahata,Raymod and Foster [(21)] to rate the patient,s level of pain intenisity . The measurement was from zero to ten in which: 0 = no pain, 1-3 = mild pain , 4-6 = moderate pain , 7- 10 = sever pain

Method:
1-Administration and ethical consideration: Official letter from the Faculty of Nursing was delivered to the responsible authorities of hospitals and approval to conduct this study was obtained after explanation of the aim of study.

3- **Validity of the tools:** All tools were tested for face and content validity by a jury five academic staff of various departments. Two experts in Cardiology, Faculty of Medicine, Menoufia University. Three experts in Medical Surgical Nursing, Faculty of Nursing, Menoufia University. Modifications were done to ascertain relevance and completeness.

3- Reliability of the tools: reliability was tested using a test retest method and a person correlation coefficient formula was used. The period between each test was two weeks. It was 0.97 for tool I, and 99 for tool II. Boonstra et al., tested the reliability of tool III and found that the test retest reliability was 0.84[(22)].

4- Pilot study: - A pilot study was conducted prior to data collection on 10% of the study sample (6 patients). This was performed in order to test the clarity and applicability of the tools. Necessary modifications were done. These patients were excluded from the sample.

5- Ethical consideration: Patient's signed ethical written consent to participate in this study after explanation of the purpose of study. Each patient was reassured that any information obtained would be confidential and would

only be used for the study purpose. The researcher emphasized that participation in the study was entirely voluntary and anonymity of the patients were assured through coding data. Patients were also informed that refusal to participate wouldn't affect their care.

6- Data collection:

- Data collection extended from the beginning of June 2016 to the end of December 2016.
- Patients who agreed to participate in the study were assigned randomly and alternatively into two equal groups study group I (30 patients) and control group (30 patients).
- All Patients of both group were interviewed individually to collect demographic and medical data using tool I , physiological status were assessed by using tool (II) and assessment of pain intensity by using tool (III) prior to intervention. For 5-10 minutes within 30 minutes of admission.

Study group (I): exposed to local application of hot pack filled with water heated by heater to 50 C then wrapped in cotton towel and it was put on anterior part of the chest for 20 minutes every 12 hours for 24 hours. Beside routine hospital care (rest, oxygen therapy, pharmacological management).

Control group (II): exposed only to routine hospital care (rest, oxygen therapy, pharmacological management)

- All patients in study group 1 and control group II were reassessed using tool II and III after 30 min, and after 24 hours from the beginning of intervention to evaluate the physiological status and pain intensity.

Statistical methodology

The data collected were tabulated & analyzed by SPSS (statistical package for the social science software) statistical package version 20 on IBM compatible computer.

Two types of statistics were done:

1) **Descriptive statistics:** were expressed as mean and standard deviation (X+SD) for quantitative data or number and percentage (No & %) for qualitative data.
2) **Analytic statistics:**

- Chi-square test (χ^2): It is the test of significance used to study association between two qualitative variables.
- Mann-Whitney test (non-parametric test): is a test of significance used for comparison between two groups not normally distributed having quantitative variables.
- t- test: is a test of significance used for comparison between two groups of normally distributed quantitative variables.
- ANOVA: is a test of significance used for comparison between more than two groups of normally distributed quantitative variables.
- Repeated-Measures ANOVA: is a test of significance used when we had a single line of data for each participant, with the repeated measures entered as separate variables on that same line
- Spearman correlation was used for quantitative variables that were not normally distributed or when one of the variables is qualitative.

P-value at 0.05 was used to determine significance regarding:

- P-value > 0.05 to be statistically insignificant (NS).
- P-value ≤ 0.05 to be statistically significant (S).
- P-value ≤ 0.001 to be highly statistically significant.

III. Results

Table (1): Distributions of demographic characteristics of the study and control groups (No 60)

demographic characteristics	Studied groups				Test of significance	P value
	Study group (n=30)		Control group (n=30)			
	No.	%	No.	%		
Age (years):						
Mean±SD	54.60 ± 4.29		54.40 ±4.29		**t- test =**	0.85
Range	45.0 – 60.0		44.0 – 59.0		0.18	NS
Gender:						
Male	19	63.3	20	66.7	χ^2	0.78
Female	11	36.7	10	33.3	=0.07	NS

Occupation:					χ^2	
Hard work	24	80.0	16	53.3	=4.80	0.02
Office work	6	20.0	14	46.7		S
Marital status:						
Single	2	6.7	1	3.3	χ^2	0.94
Married	22	73.3	23	76.7	=0.35	NS
Divorced	4	13.2	4	13.2		
Widowed	2	6.7	2	6.7		

t= student's t test χ^2= Chi square test

Table (1): illustrated that, the mean age of both groups was 54.60 ± 4.29; 54.40 ±4.29 in study and control group respectively. More than half of them were male (63.3, 66.7% in study and control group respectively), in addition more than two thirds (73.3%, 76.7 %) of the study and control group respectively were married. Regarding occupation, the majority of study group (80%) and more than half of control group (53.3%) had hard work. There were no statistical significant differences between both groups regarding demographic data except for occupation.

Table (II): Distributions of Medical Data of the study and control groups (No 60).

Medical History	Studied groups				Test of sig.	P value
	Study group (n=30)		Control group (n=30)			
	No.	%	No.	%		
Medical diagnosis:						
• Angina	7	23.3	8	26.7	χ^2	0.76
• Myocardial infarction	23	76.7	22	73.3	=0.08	NS
Type of medication used:						
• Nitrates, diuretic, antiplatelet, statins, Beta Blockers "BB	6	20.0	6	20.0		
• Nitrate, diuretic, antiplatelet, statins, BB, Angiotensin Converting Enzyme Inhibitors "ACEIs), anticoagulants	10	33.3	9	30.0	χ^2 =0.11	1.0 NS
• Nitrates, antiplatelet, statins, anticoagulants, antiarrhythmic	3	10.0	3	10.0		
• Nitrate, antiplatelet, statins, anticoagulants, antiarrhythmic, diuretics	2	6.7	2	6.7		
• Nitrate, antiplatelet, anticoagulants, diuretics, inotropes	2	6.7	2	6.7		
• Nitrate, antiplatelet, anticoagulants, diuretics, ACEIs, cardiac glycosides	7	23.3	8	26.7		
Length of hospital stay (days):						
• Mean±SD	4.23 ± 1.65		3.83 ±1.64		**U=**	0.33
• Range	2.0 – 7.0		2.0 – 7.0		0.97	NS

U= Mann-Whitney

Table (II): Clarified medical data; about three fourth of studied groups (study &control groups) had Myocardial infarction (76.7%, 73.3%) respectively. About one third of them took Nitrate, Diuretic, Antiplatelet, Statins, Beta Blockers (BB),, Angiotensin Converting Enzyme Inhibitors (ACEIs), Anticoagulants (33.3%,30%) in study & control group respectively. The mean length of hospital stay was 4.23 ± 1.65 days and 3.83 ±1.64 days respectively.

Table (III): Comparisons between patients of both groups regarding to physiological parameters at three different intervals (before and after 30 min and 24 hours of local heat application) (No 60).

Physiological parameters of Patients with acute Coronary Syndrome	Studied groups: Study group (n=30) Mean±SD	Studied groups: Control group (n=30) Mean±SD	Test of significance	P Value
1) Heart rate First measure (before)	92.27 ± 8.26	91.20 ± 6.91	**t=** 0.54	0.59 NS
Second measure (after 30 min)	86.83 ± 7.39	90.70 ± 7.04	**t=** 2.07	0.04 S
Third measure (after 24 hour)	83.63 ± 5.79	87.27 ± 7.98	**t=**2.01	0.04 S
Repeated-measures analyses of variance	**F=**14.16	**F=**4.30		
P value	<0.001 HS	0.01 S		
Post hoc test	P1=0.002 P2=≤0.001 P3=0.07	P1=0.70 P2=0.01 P3=0.03		
2) Systolic blood pressure First measure (before)	128.33 ± 9.85	127.33 ± 9.80	**t=** 0.39	0.69 NS
Second measure (after 30 min)	120.83 ± 9.29	125.17 ± 9.86	**t=**1.75	0.08 NS
Third measure (after 24 hour)	107.90 ± 10.20	119.83 ± 13.92	**t=**2.72	0.009 S
Repeated-measures analyses of variance	**F=**62.23	**F=**7.12		
P value	<0.001 HS	0.007 S		
Post hoc test	P1=≤0.001 P2=≤0.001 P3=≤0.001	P1=0.06 P2=0.006 P3=0.02		
3) Diastolic blood pressure First measure (before)	84.50 ± 6.74	84.33 ± 7.27	**t=** 0.09	0.92 NS
Second measure (after 30 min)	80.23 ± 5.59	83.23 ± 7.50	**t=**1.75	0.08 NS
Third measure (after 24 hour)	73.73 ± 5.45	78.43 ± 7.78	**t=**2.70	0.009 S
Repeated-measures analyses of variance	**F=**72.83	**F=**30.80		
P value	<0.001 HS	<0.001 HS		
Post hoc test	P1=≤0.001 P2=≤0.001 P3=≤0.001	P1=0.06 P2=≤0.001 P3=≤0.001		

Continuous table (III): Comparisons between patients of both groups regarding to physiological parameters at three different intervals (before and after 30 min and 24 hours of local heat application) (No 60)

Physiological parameters of Patients with acute Coronary Syndrome	Studied groups: Study group (n=30) Mean±SD	Studied groups: Control group (n=30) Mean±SD	Test of significance	P Value
4) Respiratory rate First measure (before)	20.80 ± 2.14	20.13 ± 2.77	**t=** 1.04	0.30 NS
Second measure (after 30 min)	17.77 ± 1.54	19.60 ± 2.15	**t=** 3.78	<0.001 HS
Third measure (after 24 hour)	15.67 ± 1.12	17.70 ± 1.93	**t=** 4.98	<0.001 HS
Repeated-measures analyses of variance	**F=**174.59	**F=**33.15		
P value	<0.001 HS	<0.001 HS		
Post hoc test	P1=≤0.001 P2=≤0.001 P3=≤0.001	P1=0.009 P2=≤0.001 P3=≤0.001		
5) Oxygen saturation First measure (before)	73.13 ± 9.63	75.03 ± 6.85	**t=** 0.88	0.38 NS
Second measure (after 30 min)	86.13 ± 4.51	78.10 ± 6.05	**t=**5.82	<0.001 HS
Third measure (after 24 hour)	94.30 ± 3.07	90.30 ± 5.49	**t=**3.47	0.001 HS
Repeated-measures analyses of variance	**F=**125.59	**F=**100.58		
P value	<0.001 HS	<0.001 HS		
Post hoc test	P1=≤0.001 P2=≤0.001	P1=≤0.001 P2=≤0.001		

	P3=≤0.001	P3=≤0.001	
P value	<0.001 HS	<0.001 HS	
Post hoc test	P1=≤0.001 P2=≤0.001 P3=≤0.001	P1=0.001 P2=≤0.001 P3=≤0.001	

P1: comparison between first measure & second measure
P2: comparison between first measure & third measure
P3: comparison between second measure & third measure

Table III showed the measured physiological parameters of both groups at three different intervals (before and after 30 min and 24 hours of local heat application)

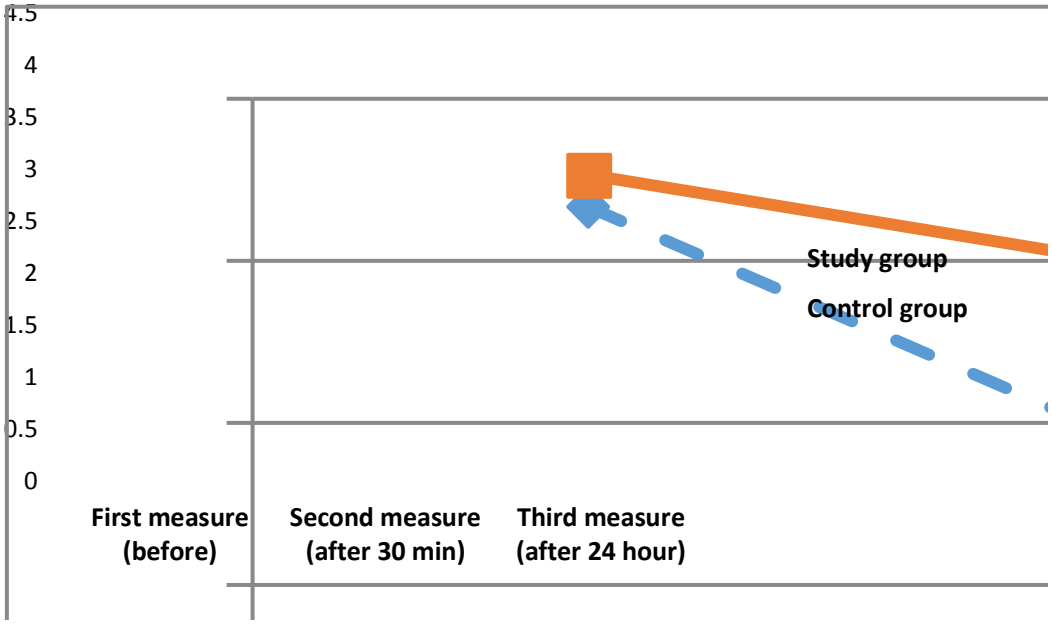
In relation to heart rate "HR", the highest HR means in both study and control groups were before local heat application with percentages 92.27 ± 8.26 and 91.20 ± 6.91respectively and lowest means were after 24 hrs of with percentages 83.63 ± 5.79 and 87.27 ± 7.98 respectively. There was no statistical significant difference between both groups HR before local heat application p=0.59 while there were statistical significant differences between both groups after 30 min and after 24 hrs of local heat application p= .04.

Regarding to systolic and diastolic blood pressure, there was no significant difference between both group before and after 30 minute from local heat application. While there was statistically significant difference after 24 hrs from local heat application (P = .009).

In relation to respiratory rate "RR" the highest means in both study and control groups were before local heat application with 20.80 ± 2.14 and 20.13 ± 2.77 Respectively with no statistical significant difference between the two groups p= 0.30 and lowest means were after 24 hrs of local heat application with 15.67 ± 1.12 and 17.70 ± 1.93 respectively while there was highly statistical significant difference between both groups p <0.001

In relation to oxygen saturation "Sao2" the lowest means in both study and control groups were before local heat application with 73.13 ± 9.63 and 75.03 ± 6.85 respectively with no statistical significant difference between the two groups p= .38 and highest means were after 24 hrs of local heat application with 94.30 ± 3.07 and 90.30 ± 5.49 respectively but with highly statistical significant difference between both groups after 24 hrs p<0.001

Figure I: Comparisons between patients of both groups regarding to chest pain at three different intervals (before and after 30 min and 24 hours of local heat application)(No60).



- **Figure I** showed that there were statistical significant negative correlation between chest pain and time from start of local heat application either in study and control groups but the lowest chest pain mean was detected in study group after 24 hours from start of local heat application with mean±SD =1.40 ± 0.49

Table (IV) Comparisons between patients of both groups regarding intensity of chest pain at three different intervals (before and after 30 min and 24 hours of local heat application)((No 60).

Chest pain intensity	Studied groups				χ^2	P value
	Study group (n=30)		Control group (n=30)			
	NO.	%	NO.	%		
First measure (before)						
Severe	25	83.3	22	73.3	0.88	0.34 NS
Worst	5	16.7	8	26.7		
Second measure (after 30min)						
Moderate	22	73.3	2	6.7	27.77	<0.001 HS
Severe	8	26.7	28	93.3		
Third measure (after 24 hour)						<0.001 HS
No pain	18	60.0	7	23.3	18.02	
Mild pain	12	40.0	10	33.3		
Moderate pain	0	0.0	13	43.3		

Table (IV) illustrated that about three fourth of studied sample had severe pain before local heat application (83.3% &73.3%) in study &control group respectively. While 73.3 % in study group had moderate chest pain post 30 minute from application of local heat while most of control group had severe pain (93.3%) .Furthermore more than half of sample in study group had no pain after 24 hrs from application of local heat.

Additionally there were highly statistically significant difference between intensity of chest pain among studied groups (study &control groups) after 30 min and 24 hours of local heat application p(<0.001 HS, <0.001 HS) respectively

Table (V): Relationship between chest pain & demographic data among studied groups at three different intervals (before and after 30 min and 24 hours of local heat application)(No60).

Demographic characteristics	Studied groups	
	Study group (n=30)	Control group (n=30)
Age (years):	Spearman`s Rho	Spearman`s Rho
Test of sig.	r= - 0.28	r= 0.26
P1	0.13 NS	0.15 NS
P2	0.24 NS	0.12 NS
P3	0.15 NS	0.22 NS
Gender:		
Male	4.11±0.31	4.25±0.44
Female	4.27±0.46	4.30±0.48
Test of sig.	t=1.05	t=0.28
P1	0.30 NS	0.78 NS
P2	0.09 NS	0.72 NS
P3	0.12 NS	0.23 NS
Occupation:		
Hard work	4.13±0.33	4.31±0.47
Office work	4.33±0.51	4.21±0.42
Test of sig.	t=1.21	t=0.59
P1	0.23 NS	0.56 NS
P2	0.15 NS	0.34 NS
P3	0.22 NS	0.23 NS

F=ANOVA

P1- relation before treatment p2- relation after 30 min p3- relation after 24 hrs

Table V: showed that there was no statistical significant relation between chest pain and demographic characteristic of the studied groups either before, after 30minutes and after 24 hours of local heat application.

Table (VI): Relationship between pain & medical data among studied groups post- local heat application (second measure)(No 60)

Medical history	Studied groups	
	Study group (n=30)	**Control group (n=30)**
Length of hospital stay (days):	Spearman`s Rho	Spearman`s Rho
Test of sig.	r= 0.009	r= 0.12
P value	0.96 NS	0.50 NS
Medical diagnosis:		
Angina	3.14±0.37	3.91±0.0
Myocardial infarction	3.30±0.47	4.0±0.29
Test of sig.	t=0.82	t=0.86
P value	0.14 NS	0.39 NS
Type of medication used:		
• Nitrate, diuretic, antiplatelet, statins, BB	3.0±0.0	3.83±0.40
• Nitrate, diuretic, antiplatelet, statins, BB, ACEIs, anticoagulants	3.30±0.48	3.89±0.33
• Nitrate, antiplatelet, statins, anticoagulants, antiarrhythmic	3.33±0.57	4.0±0.0
• Nitrate, antiplatelet, statins, anticoagulants, antiarrhythmic, diuretics		
• Nitrate, antiplatelet, anticoagulants, diuretics, inotropics	3.50±0.70	4.0±0.0
• Nitrate, antiplatelet, anticoagulants, diuretics, ACEIs, cardiac glycosides	3.50±0.70	4.0±0.0
	3.29±0.48	4.0±0.0
Test of sig.	F=0.62	F=0.40
P value	0.68 NS	0.84 NS

Table (VI) showed that there were no statistically significant relation between chest pain and medical data in both groups post local heat application (second measure)

IV. Discussion

The present study illustrated that, the mean age of both groups were above fifty years old. More than half of them were male. This result was in the same line with Jani and Rajkumar who reported that aging process is accompanied with alterations in the mechanical and structural properties of the vascular wall, which decrease elasticity of blood vessel and decrease arterial compliance then causes coronary artery disease ,additionally male are at danger from heart disease than women before menopause[(23)]. Also Jarvis and Saman stated that ACS is more common in men and older people [(5)].

The present study found that the mean length of hospital stay was 4.23 ± 1.65 days and 3.83 ±1.64 days for study and control group respectively .National Association for Healthcare quality reported that the length of hospital stay for patients with ACS in 2012 was 3.9 days [(24)]. Also Tickoo etal., reported that the mean length of hospital stay for patients with ACS was 5.5 days with a median of 4 days[(25)].

Sobajima et al., who clarified that sauna after MI increases vascular endothelial growth factor and improves vascular endothelial cell performance and subsequently increases release of Nitric oxides and prostacyclins by endothelial cells and as the result increases angiogenesis and improves myocardial perfusion and prevents heart failure [(26)]. This was in accordance with the result of the present study which showed that local heat application decreased the blood pressure in the study group compared to control group .This result was supported by Kihara et al., who found that daily sauna therapy for two weeks significantly decreased systolic blood pressure, plasma BNP concentrations and the number of premature ventricular contractions in patients with chronic heart failure [(27)]. Also this results was supported by Mohammadpour et al., who found that systolic blood pressure in heat therapy group was significantly decreased [(20)]. The researcher in the present study explained this result that local heat application can decrease blood pressure by dilate vessels thus increase blood flow in the area of heat application decreases vascular resistance which decrease blood pressure.

The present study stated that there was a significant decrease of heart rate after local heat application in study group than control group. The researcher rationalized that when local heat applied on chest causes vasodilatation of blood vessels and lead to relieve symptom companied with chest pain. This result was in the same line with Ala who clarified that once blood vessels dilate, vascular resistance decreased, and the dilation of arteries indicated reduction in blood pressure and pulse [(28)].

The present study illustrated that respiratory rate increase during pain for both group compared to post intervention specially study group. This result was the same consistent with Wren et al., who stated that during pain, the respiration increase [(29)]. This may be duo to fear of death among patients with chest pain that increase level of anxiety and may lead to increase pulse and respiratory rate due to stimulation of sympathetic nervous system but when the pain relived the condition improved.

In the present study, oxygen saturation percentage were improved remarkably after local heat application, this result was in the same line with Sobajima et al., who stated that heat therapy has the positive effect on decreasing vascular and pulmonary resistance which lead to improve oxygenation[(26)]. Also Mohammad pour et al. found that patients' respiratory rate and oxygen saturation percentage were improved remarkably after chest local heat therapy [(20)].

The study findings revealed that local heat application decreased the intensity of chest pain episodes in patients with ACS. This result was supported by Mohammad pour et al., who stated that local heat therapy is an effective intervention for preventing and relieving chest pain in patients with ACS [(30)]. The researcher in the present study explained that, local heat therapy seems to prevent and relieve chest pain through dilating the coronary arteries, accelerating the angiogenesis process and hence increasing myocardial perfusion. Increased perfusion, in turn, promotes myocardial oxygenation and facilitates the removal of inflammatory mediators from the injured myocardium. Moreover, local heat therapy may also stimulate the secretion of endorphins – endogenous morphine-like compounds – that help relieve pain. On the other hand, the humid heat provided by hot pack alleviates patients' anxiety and hence decreases sympathetic activity, reduces cardiac workload, prevents the progression of ischaemia and finally relieves chest pain. Moreover, humid heat stimulates nonpain receptors and relieves pain through the gate control mechanism.

On the other hand Miyata and Tei noted that sauna therapy in patients with chronic heart failure prevents cardiac dysrhythmias and improves cardiac function through decreasing sympathetic activity [(31)]. Also Tei *et al*. found that sauna therapy in patients with peripheral arterial disease significantly decrease pain, increases ankle-brachial pressure index, increase the blood levels of nitric oxide and stimulates angiogenesis and blood flow in the involved extremity [(32)].

V. Conclusion

Local heat application is effective in reducing intensity of pain scores and improving physiological parameters among patients with acute coronary syndrome.

Recommendation

1- local heat application should be applied routinely for reducing intensity of pain scores and improving physiological parameters for patients with acute coronary syndrome
2- Replication of the study using a large probability sample from different geographical areas must be considered in the development of future research to allow greater generalization of the results.

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