

## Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients

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### Abstract:

**Background:** Incentive spirometry usage reduces the patient's ability to perform important activities after coronary artery bypass surgery. This may be attributed to the fact that incentive spirometry takes a lot of time to be performed and may result in changes in muscle tension, activity in skeletal position and physiological parameters. **Aim:** This study aimed to evaluate efficacy of localized cryotherapy on physiological parameters associated with incentive spirometry among postoperative cardiac patients. **Design:** Quasi experimental design (pre/post) was utilized. **Setting:** The study was conducted in cardiothoracic intensive care unit. **Sample:** A Purposive sample of 60 adult patients were included in the study. **Tools of data collection:** Three tools were used for data collection; Tool I Structured interview questionnaire, Tool II patients' perception about cold gel pack Tool III physiological parameters assessment. **Results:** There were statistically significant improvement in physiological parameters and return to normal after local application of cryotherapy in study group compared to control group where, 90.0% and 86.7%, respectively among intervention group had normal respiratory rate and SPO2 comparing by 63.3% of control group had abnormal pulse rate and mean arterial pressure after one-week post intervention with a total normal parameters among 63.3% of intervention group comparing by total abnormal parameters among 66.7% of control group. **Conclusions:** Application of localized cryotherapy was effective for improving physiological parameters associated with incentive spirometry in patients post coronary artery bypass graft surgery. **Recommendations:** More research is necessary to examine the effectiveness of different types of localized cryotherapy, such as (ice pack, massage, and ice towel) on the incisional discomfort linked to incentive spirometry following CABG surgery.

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**Keywords:** Cardiac Patients, Efficacy, Incentive spirometry, Localized Cryotherapy, Physiological Parameters

### Introduction

Open-heart surgery is any type of surgery where the chest is cut open and surgery is performed on the muscles, valves, or arteries of the heart. According to the National Heart, Lung, and Blood Institute (NHLBI), coronary artery bypass grafting (CABG) is the most common type of heart surgery done on adults. During this surgery, a healthy artery or vein is grafted (attached) to a blocked coronary artery. This allows the grafted artery to

“bypass” the blocked artery and bring fresh blood to the heart (Gunther et al., 2022).

Open-heart surgery is also done to repair or replace heart valves, which allow blood to travel through the heart, repair damaged or abnormal areas of the heart, implant medical devices that help the heart beat properly and replace a damaged heart with a donated heart (heart transplantation) (Ozkan & Cavdar, 2022).

## **Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients**

Maintaining physiological parameters within normal after open heart surgery is considered the foremost postoperative care strategy. Today the strong emphasis is on non-pharmacological pain relief methods including relaxation, touch therapy, music therapy, imagination, and applying heat and cold therapy. (Şermet et al.,2021)

These methods are easy to use and may be acceptable to the patients and nurses also are capable of implementing them independently and some nurses prefer non pharmacological techniques since they are low risk and they also give patients an active role in relieving their own pain. Cold therapy is a non-pharmacological and a cost-effective way of relieving pain (Yarahmadi et al., 2022).

Cold therapy is also known as cryotherapy. It works by reducing blood flow to a particular area, which can significantly reduce inflammation and swelling that causes pain, especially around a joint or a tendon. It can temporarily reduce nerve activity, which can also relieve pain. There are a number of different ways to apply cold therapy to an affected area such as ice packs or frozen gel pack, ice massage and ice bath (Emren et al.,,2023).

The beneficial effects of cold therapy for improving physiological parameters have been widely documented and the side effects are minimal, yet its use remains limited in post-surgical cardiac patients. after open heart surgery, patients recover from anesthesia and they are encouraged to perform activities such as DB & C exercises or use incentive spirometry to maximize their recovery and to prevent pulmonary complications such as atelectasis and infections (Ebrahimi-Rigi et al., 2022)

The incentive spirometry is typically associated with incisional pain. This relates to

the fact that most patients having open heart surgery undergo a procedure termed sternotomy, the sternum is cut open medially to provide access to the heart, At the end of the surgery, the sternum is wired back together and the skin is sutured creating an incision line on the sternum (Gorji et al.,2020).

Unfortunately, the use of incentive spirometry contributes to the patient's pain and reduces the patient's ability to perform important activities after open heart surgery. This may be attributed to the fact that incentive spirometry takes a lot of time to be performed and may result in changes in muscle tension and activity in skeletal position, which may contribute to incisional pain (Sullivan et al.,2021).

Nurses play an important role in controlling and managing post-operative pain through good assessment and applying pharmacological and non-pharmacological methods for controlling the intensity of pain (Ozkan& Cavdar, 2023).

### **Significance of the study:**

The incentive spirometry creates stress and pain on the incision line over the sternum which change patients physiological parameters as the thoracic cage expands and puts pressure on the wound. The discomfort associated with incentive spirometry can prevent patients from performing these activities on postoperative days. (Seweid et al.,2021).

As well as from the clinical experience, observation for actual situations the researchers noticed that there is sever incisional pain and worsen change in physiological parameters during the use of incentive spirometry in post CABG patients at Benha University Hospital. The study of retrospective statistical record revealed that, the number of patient admitted to

cardiothoracic intensive care unit at the last three years (2020, 2021, 2022) were approximately, 110, 130 ,200 patients respectively (**Statistical Office in Benha University Hospital, 2023**). So this study is aimed to evaluate the efficacy of localized cryotherapy on physiological parameters associated with incentive spirometry among post-operative cardiac patients

#### **Aim of the study:**

This study aimed to evaluate the efficacy of localized cryotherapy on physiological parameters associated with incentive spirometry among post-operative cardiac patients

#### **Research hypotheses:**

To achieve the aim of this study the following research hypothesis will be formulated:

**H<sub>1</sub>:** patient who will apply localized cryotherapy (cold gel pack) (intervention group) will have significantly improved in physiological parameters than patients who will receive routine care (control group).

#### **Subjects and Methods**

##### **Research Design:**

Quasi-Experimental research design (pre and posttest) was used to achieve the aim of the study.

##### **Setting:**

The study was conducted in cardiothoracic surgery intensive care unit (ICU) and cardiothoracic department of Benha University Hospital.

##### **Subjects:**

A Purposive sample of (60) post-operative coronary artery patients newly admitted to mentioned setting divided into two equal groups, control group and intervention group within 6 months from the beginning of January till the end of June 2023 will be included in this study according to inclusion and exclusion criteria.

##### **Inclusion criteria:**

- Age from 20 to 60 years.
- Patients scheduled to coronary artery bypass graft surgery. and haven't any complications.

##### **Exclusion criteria**

- Mechanically ventilated patients, as the patient will not be conscious
- patient with Contraindicated to cold therapy such as Reynaud's disease, sickle cell anemia, cold allergic conditions.
- Patients experienced post-operative complications such as infection, bleeding and uncontrolled atrial fibrillation excluded from the study as identified from related literatures such as (**Weheida et-al.,2021**)

##### **Tools of data collection:**

**Three tools used to collect the data of the study:**

**Tool I: structured interviewing questionnaire.**

This tool was developed by the researchers after reviewing related literature such as **Khalkhal et al., (2019)**, **Çevik et-al., (2020)** and **El-Nagar et-al.,(2020)**. It compromised two parts;

**Part one: Demographic characteristics of the studied patients:**

It was concerned with the demographic characteristics of patients which included (6 items) such as patient's age, sex, marital status, educational level, nature of work and the place of residence.

**Part two: patient's medical history:** which include Present medical history which included (3item), and past medical history (4 item).

**Tool II: patients' perception (sensation and preference) about localized cryotherapy (cold gel pack):** It was **developed by (Chailer, 2009& Aminah et al.,2017)** and was used to assess patients' perception (sensation and preference) for cryotherapy

## Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients

(using cold gel pack) which included (8 items)

**scoring system for Perception=10 scores**

Low perception <70% = <7 scores,

High perception  $\geq 70\%$  =  $\geq 7$  score

### **Tool III: Physiological Parameters**

**assessment:** The researchers developed it after considering the relevant articles (Umaz et al ., 2021& Seweid et-al .,2021). It contained pulse rate, oxygen saturation, respiratory rate, and mean arterial pressure.

### **Tools validity:**

The face and content validity of the tools were ascertained for comprehensiveness, relevance, simplicity, clarity and ambiguity through a jury of five experts from medical surgical nursing department, faculty of nursing, Benha University. Based on the opinion of panel of expertise some modifications were done and then the final form was developed based on newest current literature and used for data collection.

### **Tools reliability:**

Reliability of tools was evaluated using test-retest method by the Cronbach's alpha test which is used to measure the internal consistency. It was found that Cronbach's Alpha test for the tool I was 0.906, 0.8 for Tool II, and 0.7 for tool III which reflects reliable tools.

### **Ethical consideration:**

Approval to conduct this study was obtained from Scientific Research Ethical Committee in Faculty of Nursing, Benha University. Once the researcher granted approval, the patients` oral and written approvals were taken after explanation of the aim, requirement, duration and anticipated benefits of the study. The patients were also informed that their participation is optionally, and that they have the right to withdraw at any time.

### **Pilot Study:**

Pilot study was conducted on 10% (6 patients) before data collection of all patients in ICU department at Benha University Hospital in order to test the clarity and applicability of the study tools.

### **Field Work:**

**Data will be collected in the following sequence:**

Data were collected within 6 months from the beginning of January to the end of July 2023. All postoperative coronary artery bypass graft surgery patients admitted to the Cardiothoracic Surgical ICU and Cardiothoracic Surgery Department at Benha University Hospital who met the inclusion criteria were enrolled in this study. The process of data collection was achieved three times first day, second day and after one week after surgery.

### **III-Implementation phase of the procedure:**

**The implementation phase included the following steps:**

**Control group:** (the group without localized cryotherapy) The researchers assessed the patients' baseline levels of physiological parameters before procedure. then providing them with a thorough description of the incentive spirometry, patients were prepared to use it.

The patient was instructed to exhale normally, secure their lips over the mouthpiece, and then take a slow, deep breath without using their nose. or patient can take deep breath from nose and exhale in the incentive spirometry.

To support sternal wound, a folded blanket or pillow was placed over the chest incision. Patients were asked to hold their breath and count to three once they were no longer able to inhale.

Patients were told to conduct three

cycles with the gadget their lips out of the mouthpiece and exhaling properly. The researchers makes a physiological parameters assessment immediately upon completion.

**study group:** the group with localized cryotherapy (application of a cold gel pack intervention) physiological parameters assessment was performed by the researchers (pre intervention assessment), then patients were elevated to stay in the upright position and skin sensitivity was tested at the sternotomy wound area.

A reusable gel pack, size 10.0x26.5 cm was used as the cold source. It is manufactured of a soft, naturally drug-free, nontoxic, biodegradable gel held in a flexible plastic contour. (Kwiecien,& McHugh ., 2021 ,Manapunsopee et-al.,2020 ).

The temperature of the gel pack was tested using the same digital thermometer each time before the cold therapy session started.

The cold gel pack that would be used for localized cryotherapy was placed in the freezer for 30 to 40 minutes. According to advice from other studies (Çevik et-al., 2020) the researchers immediately put the cold gel pack over the median sternotomy incision of the patients for 20 minutes after bringing it from the freezer to their bedside and wrapping it in a washcloth or towel. to achieve the therapeutic effect of cold therapy its required to cool down the tissues for at least 12 minutes, therefore 15-min use time was suitable in this study to attain the wanted results (Awad et-al.,2022)

The cold gel pack was left for 20 minutes on place until it was time to remove it, and the researchers remained beside each patient bed to confirm this and observe any changes on patient. Patients were prepared for the use of incentive spirometry (three cycle). Patients acquired instruction on how to utilize incentive spirometry (three cycle). The

researchers then used data collection tools II and III to evaluate physiological parameters and patient preference to use cold gel pack post intervention.

As soon as the evaluation was done, the cold gel pack was cleaned in accordance with hospital infection control procedures and put back into the freezer for future. usage

#### **Evaluation phase:**

For intervention group the researchers applies cold gel pack on first day, second day and one week post operatively after cold application the patient prepared to use the incentive spirometry, then the researchers assesses patient physiological parameters and using tool III ,For control group the researchers assessed physiological parameters before and after using the incentive spirometry and compare between them.

#### **Statistical Analysis:**

Data analysis was performed for first day, second day and post one week using the SPSS software (version 25). For determining the normal distribution of quantitative variables was used to Kolmogorov-Smirnov test. Chi-square tests were used to compare nominal variables in the two groups and compare between different periods.

Fisher's exact test was applied on smaller sample sizes, alternative to the chi-square test, when the frequency count is < 5 for more than 20% of cells.

For comparing the mean scores in two groups were used to the independent t-tests, Mann Whitney test for non-parametric quantitative data. Friedman test to compare between more than two periods or stages. spearman method was used to test correlation between numerical variables.

Linear regression was used for multivariate analyses on physiological indicators as dependent factor A P value > 0.05 was considered no statistical significant,

## Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients

p-value < 0.05 was considered significant, and <0.001 was considered highly significant.

### **Results:**

**Table (1):** Displays the Demographic distribution of the studied patients (control and intervention groups), where there was no statistically significant difference between the two groups. Clarifying that (43.3% & 53.3%, respectively) had 40-60 years old with a mean age of (40.27±0.74 & 39.33±0.80) years respectively, while (73.3% & 70.0%) of them were males, (46.7 % & 43.3%) were married. In addition, (40.0% & 43.3%) of the studied patients had an intermediate qualification. Moreover, (33.3% & 36.7%) of them had sedentary work, with working hours of 6-<8 hours among 60.0% and 66.6%, respectively. Moreover (70.0% & 73.3%, respectively) were residing urban area.

**Table (2):** Displays patients' perceptions of cryotherapy among intervention group, where there was a highly significant statistical difference between first day with second day and post one-week intervention periods (p=<0.001\*\*), and it was noted that 86.7% of patients in first day had a fear of the treatment's side compared to 30% in second day and 16.7% post week. while 86.7% of studied patient didn't prefer to use cryotherapy in order to decrease pain during first day compared to 13.3% in second day and 6.7% post week. However, it was also perceived that cryotherapy is a preferred method to decrease pain after CABG in second day among 86.7% to be 93.3% post one week of intervention as well as 90.0% reported that cryotherapy can make breathing easier and expectorate more freely.

**Figure (1):** Illustrates that, 93.3% of intervention group had low level of perception about localized cryotherapy (cold gel application) pre intervention while a high level among 90.0% and 83.3%, respectively

during immediate post 1<sup>st</sup> day intervention and post one week of intervention periods.

**Table (3):** Shows the comparison of physiological indicators between control and intervention groups, displaying that there was a significant statistical difference post each intervention period. Where 86.7% of control group had arrhythmic pulse, comparing by 66.7% of intervention group had rhythmic pulse during first day post intervention with p value = <0.001\*\*, also during the second day 73.4% of control group had pulse rate > 100 b/m comparing by 66.7% of intervention group had 60-100 b/m with p value = <0.001\*\*, concerning one-week period post intervention 63.3% of control group had ≥ 95% of O2 saturation, comparing by 86.7% of intervention group with p value = 0.037\*.

**Figure (2):** Illustrates that, 90.0% and 86.7%, respectively among intervention group had normal respiratory rate and SPO2 comparing by 63.3% of control group had abnormal pulse rate and mean arterial pressure after one-week post intervention with a total normal indicator among 63.3% of intervention group comparing by total abnormal indicators among 66.7% of control group.

**Table (4):** Reveals relation between socio demographic characteristics among intervention group with total level of perception about cold gel pack intervention, pre and post one-week intervention. where there was significant statistical relations during pre-intervention period with age, sex, nature of work and residence while during post one-week intervention period was significant with age, marital status, education level and residence.

**Table (1): Frequency distribution of studied patients according to their demographic characteristics (n=60).**

Patients' sociodemographic characteristics	Variables	Control group N=30		Intervention group N=30		Test	
		No.	%	No.	%	X <sup>2</sup>	P value
Age (year)	20-<30	5	16.7	6	20.0	1.201	0.548 <sup>n.s</sup>
	30-<40	12	40.0	8	26.7		
	40-60	13	43.3	16	53.3		
	<b>Mean ± SD</b>	<b>40.27±0.74</b>		<b>39.33±0.80</b>		t= 0.335	0.739 <sup>n.s</sup>
Sex	Male	22	73.3	21	70.0	0.082	0.774 <sup>n.s</sup>
	Female	8	26.7	9	30.0		
Marital status	Single	4	13.3	3	10.0	0.430	0.934 <sup>n.s</sup>
	Married	14	46.7	13	43.3		
	Widowed	7	23.3	9	30.0		
	Divorced	5	16.7	5	16.7		
Educational level	Illiterate	6	20.0	6	20.0	0.437	0.933 <sup>n.s</sup>
	Read and write	4	13.3	5	16.7		
	Intermediate qualification	12	40.0	13	43.3		
	University qualification	8	26.7	6	20.0		
Nature of work	Manual work	6	20.0	5	16.7	0.282	0.963 <sup>n.s</sup>
	Sedentary work	10	33.3	11	36.7		
	House wife	6	20.0	7	23.3		
	Not working	8	26.7	7	23.3		
Working hours	< 6 hrs	1	3.3	0	0.0	1.419	0.841 <sup>n.s</sup>
	6-<10 hrs	21	90.0	28	93.3		
	10-12 hrs	2	6.7	2	6.7		
Residence	Urban	21	70.0	22	73.3	0.082	0.774 <sup>n.s</sup>
	Rural	9	30.0	8	26.7		

(n.s) Not significant (p > 0.05)

**Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients**

**Table (2): Distribution of perception about cold gel pack intervention among intervention group throughout different study phases**

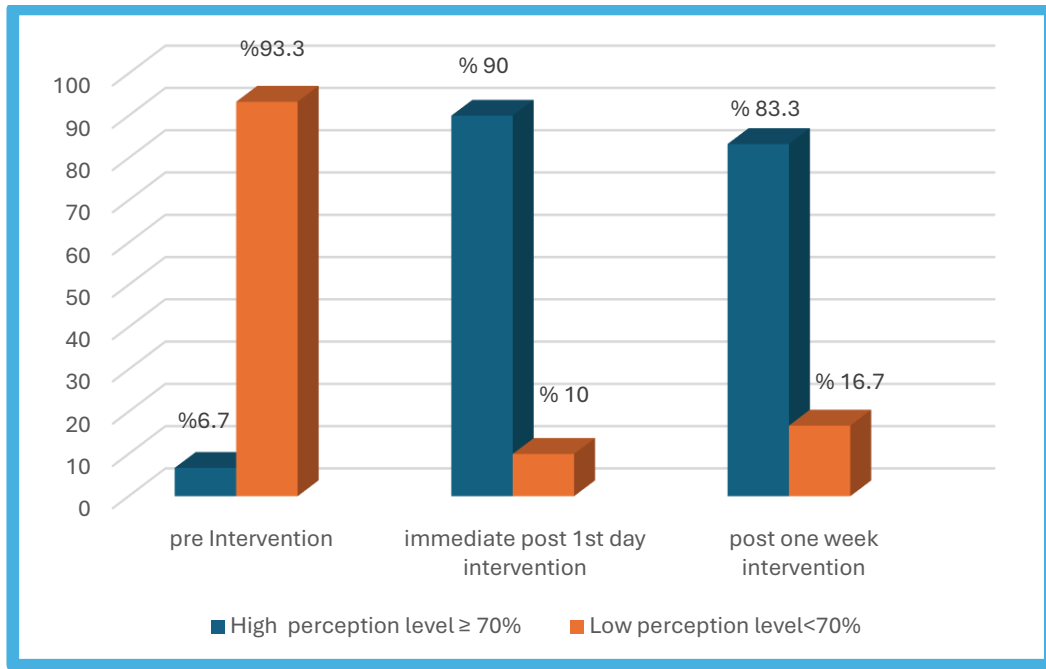
Patients' Perception	Variables	Intervention group (n=30)						X <sup>2</sup> test P value (1)	X <sup>2</sup> test P value (2)
		(pre intervention)		immediate post 1 <sup>st</sup> day intervention		(post one week intervention)			
		No.	%	No.	%	No.	%		
Sensation during cryotherapy	Experience cold	24	80.0	2	6.2	1	5.0	63.29 <0.001 **	23.49 <0.001* *
	feeling slight numbness	1	5.0	15	50.0	7	21.7		
	comfort and less pain	5	15.0	13	43.8	22	73.3		
Fear from side effect	Yes	26	86.7	9	30.0	5	16.7	64.45 <0.001 **	96.3 <0.001* *
	No	4	13.3	21	70.0	25	83.3		
Decrease pain level comparing to analgesics	Yes	9	30.0	23	76.6	26	86.7	42.19 <0.001 **	64.45 <0.001* *
	No	21	70.0	7	23.4	4	13.3		
Changing pain level makes you use analgesics	Yes	6	20.0	25	83.3	26	86.7	78.51 <0.001 **	87.57 <0.001* *
	No	24	80.0	5	16.7	4	13.3		
Cryotherapy can make breathing easier and expectorate more freely	Yes	8	26.7	24	80.0	27	90.0	55.49 <0.001 **	80.63 <0.001* *
	No	22	73.3	6	20.0	3	10.0		
Cryotherapy is the easiest method for pain relief	Yes	6	20.0	21	70.0	25	83.3	48.51 <0.001 **	60.8 <0.001* *
	No	24	80.0	9	30.0	5	16.7		
Prefer using cryotherapy to decrease pain after CABG	Yes	4	12.5	26	86.7	28	93.3	106.46 <0.001 **	128.66 <0.001* *
	No	26	86.7	4	13.3	2	6.7		
Prefer using cryotherapy during incentive spirometry	Yes	4	12.5	24	80.0	25	83.3	89.42 <0.001 **	98.2 <0.001* *
	No	26	86.7	6	20.0	5	16.7		

\*\* Highly significant (p ≤ 0.001)

(1) (pre intervention) vs (immediate post intervention) among intervention group

(2) (pre intervention) vs (post one week of intervention) among intervention group





**Figure (1). Distribution of perception level for cold gel application among intervention group during pre, immediate post first day and post one week of intervention implementation (N=30).**

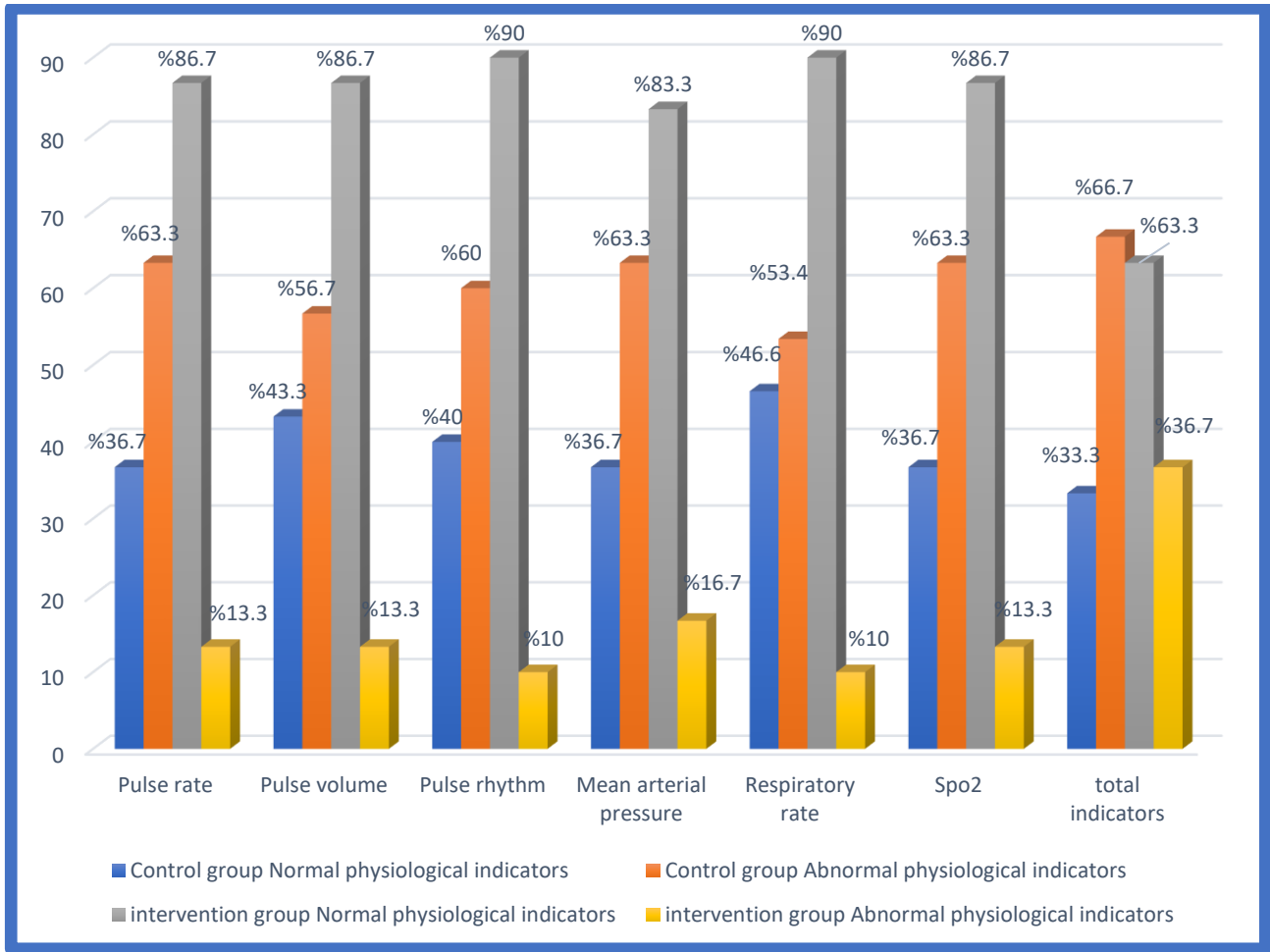
## Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients

**Table (3): Comparison of patients' physiological parameters assessment between control and intervention groups throughout post intervention phases (n=60).**

Physiological indicators	Response	Control group (n=30)						Intervention group (n=30)						X <sup>2</sup> test P value (1)	X <sup>2</sup> test P value (2)	X <sup>2</sup> test P value (3)
		First day		Second day		After One week		First day		Second day		After One week				
		Baseline	After intervention	Baseline	After intervention	Baseline	After intervention	Baseline	After intervention	Baseline	After intervention	Baseline	After intervention			
Pulse rate b/m	< 60b/m	9(30.0)	0(0.0)	10(33.3)	1(3.3)	1(3.3)	7(23.3)	2(6.7)	3(10.0)	2(6.7)	6(20.0)	1(3.3)	1(3.3)	26.268 <0.001*	22.292 <0.001**	15.981 <0.001**
	60-100b/m	10(33.3)	8(26.7)	14(46.7)	7(23.3)	16(53.3)	11(36.7)	5(16.6)	6(20.0)	5(16.6)	20(66.7)	25(83.3)	26(86.7)			
	>100b/m	11(36.7)	22(73.3)	6(20.0)	22(73.4)	13(43.3)	12(40.0)	23(76.7)	21(70.0)	23(76.7)	4(13.3)	4(13.3)	3(10.0)			
Pulse volume	Weak	6(20.0)	3(10.0)	6(20.0)	2(6.7)	3(10.0)	17(56.7)	4(13.3)	2(6.7)	4(13.3)	2(6.7)	3(10.0)	0(0.0)	8.270 0.016*	7.179 0.028*	14.206 0.001**
	Normal	10(33.3)	10(33.3)	12(40.0)	8(26.6)	18(60.0)	13(43.3)	9(30.0)	21(70.0)	15(50.0)	18(60.0)	23(76.7)	26(86.7)			
	Strong	14(46.7)	17(56.7)	12(40.0)	20(66.7)	9(30.0)	0(0.0)	17(56.7)	7(23.3)	11(36.7)	10(33.3)	4(13.3)	4(13.3)			
Pulse rhythm	Rhythmic	14(46.7)	4(13.3)	18(60.0)	11(36.7)	17(56.7)	12(40.0)	8(26.7)	20(66.7)	6(20.0)	22(73.3)	25(83.3)	27(90.0)	17.778 <0.001*	39.65 <0.001**	16.569 <0.001**
	Arrhythmic	16(53.3)	26(86.7)	12(40.0)	19(63.3)	13(43.3)	18(60.0)	21(70.0)	10(33.3)	23(76.7)	8(26.7)	5(16.7)	3(10.0)			
Mean arterial pressure (MmHg)	<70 MmHg	4(13.3)	8(26.7)	6(20.0)	6(20.0)	6(20.0)	4(13.3)	4(13.3)	8(26.7)	3(10.0)	6(20.0)	3(10.0)	3(10.0)	9.091 0.011*	12.084 0.002*	14.509 0.001**
	70-100 MmHg	20(66.7)	6(20.0)	18(60.0)	5(16.7)	5(16.7)	11(36.7)	9(30.0)	16(53.3)	7(23.3)	17(56.7)	22(73.3)	25(83.3)			
	>100 MmHg	6(20.0)	16(53.3)	6(20.0)	19(63.3)	19(63.3)	15(50.0)	17(56.7)	6(20.0)	20(66.7)	7(23.3)	5(16.7)	2(6.7)			
Respiratory rate c/m	<12c/m	7(23.3)	3(10.0)	6(20.0)	2(6.7)	7(23.3)	0(0.0)	4(13.3)	6(20.0)	4(13.3)	4(13.3)	1(3.3)	1(3.3)	6.824 0.033*	8.883 0.012*	17.611 <0.001**
	12-20c/m	18(60.0)	14(46.7)	15(50.0)	12(40.0)	11(36.7)	14(46.6)	8(26.7)	20(66.7)	9(30.0)	21(70.0)	23(76.7)	27(90.0)			
	>20c/m	5(16.7)	13(43.3)	9(30.0)	16(53.3)	12(40.0)	16(53.4)	18(60.0)	4(13.3)	17(56.7)	5(16.7)	6(20.0)	2(6.7)			
SpO2%	<95%	11(36.7)	19(63.3)	9(30.0)	15(50.0)	9(30.0)	11(36.7)	7(23.3)	10(33.3)	6(20.0)	7(23.3)	3(10.0)	4(13.3)	5.406 0.020*	4.593 0.032*	4.356 0.037*
	≥95%	19(63.3)	11(36.7)	21(70.0)	15(50.0)	21(70.0)	19(63.3)	23(76.7)	20(66.7)	24(80.0)	23(76.7)	27(90.0)	26(86.7)			

(FE) p value for Fisher exact for chi square Not significant (p > 0.05) (\*) Statistically Significant at ≤0.05 \*\* Highly significant (p ≤ 0.001)

- (1) P1: p value for comparing post intervention physiological indicators between control and intervention groups post first day
- (2) P2: p value for comparing post intervention physiological indicators between control and intervention groups post second day
- (3) P3: p value for comparing post intervention physiological indicators between control and intervention groups post one week



**Figure (2). Distribution of physiological parameters among control and intervention groups after one week post intervention (n=60)**

**Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients**

**Table (4): Relation between socio demographic characteristics among intervention group with total level of perception about cold gel pack intervention, pre and post one-week intervention (n=30).**

Sociodemographic characteristics	Total perception level of Intervention group (n=30)						
	Variables	Pre intervention		X <sup>2</sup> Test P value	Post one week intervention		X <sup>2</sup> Test P Value
		High ≥ 70% (n=2)	Low < 70% (n=28)		High ≥70% (n=25)	Low < 70% (n=5)	
		No. (%)	No. (%)		No. (%)	No. (%)	
Age (year)	20-<30	0 (0.0)	6 (21.4)	11.95 0.005*	6 (24.0)	0 (0.0)	18.70 <0.001 **
	30-<40	1 (50.0)	7 (25.0)		5 (20.0)	3 (60.0)	
	40-60	1 (50.0)	15 (53.6)		14 (56.0)	2 (40.0)	
Gender	Male	0 (0.0)	21 (75.0)	116.82 <0.001 **	18 (72.0)	3 (60.0)	2.70 0.100 n.s
	Female	2 (100.0)	7 (25.0)		7 (28.0)	2 (40.0)	
Marital status	Single	0 (0.0)	3 (10.7)	0.430 0.512 n.s	3 (12.0)	0 (0.0)	6.41 0.011*
	Married	0 (0.0)	13(46.4)		10 (40.0)	3 (60.0)	
	Divorced	1 (50.0)	8 (28.6)		7 (28.0)	2 (40.0)	
	Widowed	1 (50.0)	4 (14.3)		5 (20.0)	0 (0.0)	
Educational level	Illiterate	0 (0.0)	6 (21.3)	0.560 0.454 n.s	5 (20.0)	2 (40.0)	18.70 <0.001 **
	Read and write	0 (0.0)	5(17.9)		5 (20.0)	0 (0.0)	
	Intermediate qualification	1(50.0)	12(42.9)		8 (40.0)	2 (40.0)	
	University qualification	1(50.0)	5 (17.9)		5 (20.0)	1 (20.0)	
Nature of work	Manual work	0 (0.0)	5 (17.9)	8.750 0.003 *	5 (20.0)	0 (0.0)	1.50 0.220 n.s
	Sedentary work	1 (50.0)	10 (35.7)		10 (40.0)	1 (20.0)	
	House wife	0 (0.0)	7 (25.1)		6 (24.0)	1 (20.0)	
	Not Working	1(50.0)	6 (21.3)		4 (16.0)	3 (60.0)	
Residence	Rural	0 (0.0)	22 (75.0)	116.82 <0.001 **	17 ( 68.0 )	5 (100.0)	35.75 <0.001 **
	Urban	2 (100.0)	6 (25.0)		8 (32.0)	0 (0.0)	

(n.s) not significant (\*) Statistically Significant at ≤0.05 (\*\*) Highly statistically Significant at ≤0.001

**Discussion:**

**Regarding age**, the current study presented that there was no statistically significant difference between the two groups. Clarifying that more than one third of control group and more than half of study group had 40-60 years old with a mean age of (40.27±0.74 & 39.33±0.80) years, this might be because this is the most affected age with coronary artery disease and CAD is common in middle and old age than young age as a result of aging process. this is consistent with **Ebrahimi-Rigi et al., (2016)** in a study entitled "Effect of cold therapy on the pain of deep breathing and coughing in patients after coronary artery bypass grafting in one of the hospital in Iran" and reported that the studied groups didn't differ significantly regarding age.

In contradiction with this study **Tanha et al., (2014)** whose study conducted in Iran entitled " Effect of applying cold gel pack on the pain associated with deep breathing and coughing after open heart surgery. who stated that most of studied sample was young persons whose age ranged between 25-40 years.

**As regard to gender**, the present study revealed that more than two third of the control and study group patients were males. **From the researchers' point of view**, this result might be because of stressors they face and unhealthy life style behavior they followed. This finding agreed with **Hallman et al., (2021)**. who studied " Objective postoperative pain assessment using incentive spirometry values: a prospective observational study.", and reported that more than three quarter of studied patients were males.

In addition to, **Brown et al., (2022)** who studied "Risk Factors for Coronary Artery

Disease ", and showed that the percentage of male is more than female So men had a higher prevalence of CHD than woman.

But this finding was in contradict with study by **Mehta et al., (2020)**, and found that more than three fifths were females and less than two fifth were males.

**Concerning to marital status**, the present study finding revealed that more than one third of studied patients were married. From the researchers' point of view, this result might be due to the physical and social stress in their life and their families' responsibility. This finding was supported by the result of **Zencir, & Eser, (2016)**. who studied Effects of cold therapy on pain and breathing exercises among median sternotomy patients. they reported that married patients who have ischemic heart disease represented the higher percentage of their study subject than single and widow patients.

**In respect to the educational level**, the result of the present study revealed that more than one third of the studied patients had intermediate education this may be due to that the study was conducted in the Governmental Hospital which accommodates great numbers of patients with low socioeconomic levels with low educational level. This result supported by the result of study by **Tsao, et al,(2022)** who conducted a study about "Heart disease and stroke statistics-2022" and stated that most of patients with coronary heart disease had intermediate education level and the minority had university education .

**As regard to residence**, the finding of the current study represented that about three quarters of the studied patients were living in urban areas, these results were similar to

## Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients

findings of study by **Singh et al., (2020)**, who studied "Urban-Rural Differences in Coronary Heart Disease incidence in the United States ". They revealed that more than two third of studied group were living in urban areas. also in the same line.

The finding of the present study showed that there was a highly significant statistical difference between pre, immediately post and after one-week post cold gel pack intervention and the majority of studied patients pre intervention had a fear of the treatment's side effects and didn't prefer to use cryotherapy or using it during incentive spirometry. but after one week of intervention, it was noted that more than two third of studied patients feeling comfort and less pain, from the researchers point of view this result about patient's perception of cold gel pack due to fear from the unknown which has been defined by researchers as a fear caused by a perceived lack of information.

This result agreed with the result of study conducted by **Dardier et al.,(2022)** entitled "Efficacy of localized cryotherapy on incisional pain associated with incentive spirometry post coronary artery bypass graft surgery "show that more than two third of the studied patients experienced comfort and less pain after one week of localized cryotherapy application.

As regard to patient's physiological indicators between control and intervention groups, the present study revealed that there was a significant statistical difference between control group and intervention group regarding arterial pressure, pulse rate, respiratory rate and oxygen saturation and their values have been reduced to normal after cold gel pack intervention application.

where most of control group had arrhythmic pulse, while more than two third

of intervention group had rhythmic pulse during first day post intervention with **p value = <0.001\*\***, also during the second day about three quarters of control group had tachycardia after procedure while more than two third of intervention group had normal range of pulse at **p value= <0.001\*\***

From the researchers point of view, this results mean that cold gel pack more effective in pain management thus there are improvement in physiological parameters in intervention group compared to control group .This result agreed with the result of study by **Seweid et al., (2021)** about "Effect of cold application on incisional pain associated with incentive spirometry after coronary artery bypass graft surgery" who stated that physiological indicators of incisional pain associated with the use of incentive spirometry reduced with the use of cold gel pack application compared to without cold gel pack application.

On the other hand, these results are controverted by **El-Nagar et al., (2020)** who revealed that there was no significant difference in respiratory rate before and after cold application. In addition, the findings of the current study are disproved by **G'elinas &Arbour, (2019)** who revealed that pain reduction during recovery period has a significant effect on respiratory rate in comparison with nociceptive procedure.

Regarding relationship between socio demographic characteristics among intervention group with total level of perception about cold gel pack intervention, pre and post one-week intervention, this study revealed that there was statistically positive relationship between patient's perception and sociodemographic characteristics, where old age, male and married patients has low level of perception regarding cold gel pack pre

intervention but it was high post intervention. this results may due to these patient don't, use this cold gel pack before and doesn't have enough information about alternative and complementary therapy.

This finding agrees with **El-Nagar et al., (2020)** whose results showed that there was positive relationship between patient's perception and sociodemographic characteristics such as age, and occupation. Also **Khalkhali et al., (2019)** who concluded that there was highly statistically difference between pre and post intervention patient perception regarding cold gel pack application.

#### **Conclusion:**

Localized cryotherapy is one of the non-pharmacological strategies that can be used beside pharmacological management by critical care nurses to improve physiological parameters associated with the use of incentive spirometry in an easy, effective, and costless way.

#### **Recommendations:**

❖ Further studies may be needed to assess effect of using different non-pharmacological methods on improvement of Post CABG patients' outcomes.

❖ For post-operative patients who have CABG surgery, localized cryotherapy should be promoted as a non-pharmacological treatment option before painful activity such as incentive spirometry, deep breathing & coughing exercises and early mobilization.

#### **References:**

- Aminah M, Nagar Priya, Singh P. (2017).** Comparison of topical anesthetic gel, pre-cooling, vibration and buffered local anesthesia on the pain perception of pediatric patients during the administration of local anesthesia in routine dental procedures. *Int J Contemp Med Res.* 2017;4(2):400–403.
- Brown, J. C., Gerhardt, T. E., & Kwon, E. (2022).** Risk factors for coronary artery disease. *Journal of Pain Research,* 18,12.
- Çevik, K., Serpil, İ. N. C. E., Çetin, S. P., & Tetik, Ö. (2020).** Effect of Applying Cold Gel Pack to the Sternum Region on the Postoperative Pain after Open- Heart Surgery. *Celal Bayar Üniversitesi Sağlık Bilimleri Enstitüsü Dergisi,* 7(1), 76-80
- Chailer M, Ellis J, Stolarik A, Woodend K(2022).** Cold therapy for the management of pain associated with deep breathing and coughing post cardiac surgery. *Can J Cardiovasc Nurs.;*20:18–24.
- Chailer, M. (2009).** Cold therapy for the management of pain associated with deep breathing and coughing post cardiac surgery. Doctoral dissertation, University of Ottawa (Canada)
- Dardier Hussein Awad, R., Abdel Halim Mostafa Ahmed, F., Nabil El-Sayied Abboud, A., & Fathy Mohamed Gabr, W. (2022).** Efficacy of Localized Cryotherapy on Incisional Pain associated with Incentive Spirometry Post Coronary Artery Bypass Graft Surgery. *Egyptian Journal of Health Care,* 13(4), 1669-1681.
- Ebrahimi-Rigi, H., Feizi, A., Abdollahimohammad, A., Ebrahimi-Rigi, Z., & Salehi-Ardabili, S. (2022).** Effect of cold therapy on the pain of deep-breathing and coughing in patients after coronary artery bypass
- El-Naggar, M. R., Zahra, A. I., Kanona, A. A., & El-Sheikh, A. A. (2020).** Effect of cold gel pack on controlling pain intensity associated with deep breathing and coughing exercise after cardiac surgery. *J Nurs Heal Sci,* 6(1), 22-50.
- Emren, Z. Y., Emren, S. V., Kılıçaslan, B., Solmaz, H., Susam, İ., Sayın, A., ... &**

## Efficacy of Localized Cryotherapy on Physiological Parameters Associated with Incentive Spirometry among Post Operative Cardiac Patients

- Bayturan, Ö. (2023).** Evaluation of the prevalence of coronary artery disease in patients with valvular heart disease. *Journal of Cardiothoracic Surgery*, 9(1), 1-5.
- Gelinas, C., & Arbour, C. (2019).** Behavioral and physiologic indicators during a nociceptive procedure in conscious and unconscious mechanically ventilated adults: Similar or different? *Journal of Critical Care*, 27(4),617-628.
- Gorji, M. H., Nesami, M. B., Ayyasi, M., Ghafari, R., & Yazdani, J. (2020).** Comparison of ice packs application and relaxation therapy in pain reduction during chest tube removal following cardiac surgery. *North American journal of medical sciences*, 6(1), 19.
- Gunther, S., Muller, J. E., Mudge Jr, G. H., & Grossman, W. (2022).** Therapy of coronary vasoconstriction in patients with coronary artery disease. *The American journal of cardiology*, 47(1), 157-162.
- Hallman, M. J., Dorinsky, N., Wang, Y., Li, Q., Isaak, R., Kolarczyk, L., ... & Lobonc, A. J. (2021).** Objective postoperative pain assessment using incentive spirometry values: a prospective observational study. *Pain Management*, 11(3), 315-324.
- Khalkhali, H.R,Tanha ,Z.R ,Feizi,R ,Salehi, S. (2019):**Effect of applying cold gel pack on the pain associated with deep Uymaz, B., Sezer, G., Koksall Coşkun, P., Tarcan, O., Özleme, S., & Aybek, T. (2021). Clinical outcome, pain perception and activities of daily life after minimally invasive coronary artery bypass grafting. *Anadolu Kardiyoloji Dergisi. The Anatolian Journal of Cardiology*, 14, 172-177.
- Kwiecien, S. Y., & McHugh, M. P. (2021).** The cold truth: the role of cryotherapy in the treatment of injury and recovery from exercise. *European journal of applied physiology*, 121(8), 2125-2142.).
- Manapunsopée, S., Thanakiatpinyo, T., Wongkornrat, W., Chuaychoo, B., & Thirapatarapong, W. (2020).** Effectiveness of incentive spirometry on inspiratory muscle strength after coronary artery bypass graft surgery. *Heart, Lung and Circulation*, 29(8), 1180-1186.
- Mehta, P., Wei, J., & Wenger, N., (2020):** Ischemic Heart Disease in Women: A Focus on Risk Factors, Master thesis, university of new York, P 1073.
- Ozkan, B., & Cavdar, I. (2022).** The Effect of Cold Therapy Applied to the Incision Area After Abdominal Surgery on Postoperative Pain and Analgesic Use. *Pain Management Nursing* 5(3)11.
- Şermet, M. B., Özyazıcıoğlu, N., & Ergün, S. (2021).** The effect of cold application on relieving drug infusion-related pain in: A randomized controlled experimental trial in Turkey. *Journal of Nursing*3(1)22.
- Seweid, M., Ahmed, T., Ramadan, A., & Ahmed, R. (2021).** Effect of cold application on incisional pain associated with incentive spirometry after coronary artery bypass graft surgery. *International Journal of Africa Nursing Sciences*, 15, 100315.
- Singh, S. J., Steiner, M. C., Roberts, C. M., Quint, J. K.,. (2020).** Predictors of referral to pulmonary rehabilitation from UK primary care. *International Journal of Chronic Obstructive Pulmonary Disease*, 2941-2952.
- Statistical Office of Benha University Hospital, (2023):** Number of patients admitted to cardio thoracic intensive care unit and department.
- Sullivan, K. A., Churchill, I. F., Hylton, D. A., & Hanna, W. C. (2021).** Use of incentive



spirometry in adults following cardiac, thoracic, and upper abdominal surgery to prevent post-operative pulmonary complications: a systematic review and meta-analysis. *Respiration*, 100(11), 1114-1127.

**Tanha, Z. E. R., Feizi, A., & Ardabili, S. S. (2022).** Effect of applying cold gel pack on the pain associated with deep breathing and coughing after open heart surgery. *Iranian journal of nursing and midwifery research*, 19(6), 545.

**Tsao, C. W., Aday, A. W., Almarzooq, Z. I., Alonso, A., Beaton, A. Z., Bittencourt, M. S., ... & American Heart Association Council on Epidemiology and Prevention Statistics Committee and Stroke Statistics Subcommittee. (2022).** Heart disease and stroke statistics—2022 update: a report from the American Heart Association. *Circulation*, 145(8), e153-e639.

**Yarahmadi, S., Mohammadi, N., Ardalan, A., Najafizadeh, H., & Gholami, M. (2022).** The combined effects of cold therapy and music therapy on pain following chest tube removal among patients with cardiac bypass surgery. *Complementary therapies in clinical practice*, 31, 71-75.

**Zencir, G., & Eser, I. (2016).** Effects of cold therapy on pain and breathing exercises among median sternotomy patients. *Pain Management Nursing*, 17(6), 401-410.

## فاعلية تطبيق العلاج بالتبريد الموضعي علي العلامات الحيوية المرتبطة بمقياس التنفس التحفيزي بين مرضي جراحة القلب المفتوح

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تعتبر جراحة القلب المفتوح من الجراحات الكبرى التي تحتاج الي إقامة المريض في المستشفى والالتزام بالتعليمات الطبية ومن أهم هذه التعليمات للمرضي القيام بتمارين التنفس العميق عن طريق إستخدام مقياس التنفس التحفيزي وقد يصحب هذا التمرين تغيرا ملحوظا في العلامات الحيوية. وهدفت الدراسة الي تقييم فاعلية تطبيق العلاج بالتبريد الموضعي علي العلامات الحيوية المرتبطة بمقياس التنفس التحفيزي بين مرضي جراحة القلب المفتوح تم استخدام تصميم شبه تجريبي لتحقيق هدف هذه الدراسة. أجريت هذه الدراسة في وحدة العناية المركزة لجراحة القلب والصدر وقسم جراحة القلب والصدر بمستشفى بنها الجامعي. اشتملت عينة الدراسة على 60 مريض قلب مفتوح من المرضى البالغين الذين تم دخولهم حديثاً في وحدة العناية المركزة للقلب والصدر من كلا الجنسين وتتراوح أعمارهم بين 20-60 سنة خلال فترة الدراسة ( ستة أشهر) ووافقوا على المشاركة في هذه الدراسة والتي تنطبق عليهم الشروط. أثبتت الدراسة أن مجموعة الدراسة الذين تم إستخدام كمادات الجل كمصدر للتبريد الموضعي لديهم تحسن كبير في العلامات الحيوية المصاحبة لتمارين التنفس عن طريق مقياس التنفس التحفيزي مقارنة بمجموعة التحكم. ولخصت الدراسة إن العلاج بالتبريد الموضعي هو أحد الاستراتيجيات غير الدوائية التي يمكن استخدامها بجانب الادوية من قبل مقدمي الرعاية الحرجة لتخفيف الألم الجراحي وتحسين العلامات الحيوية المرتبطة باستخدام مقياس التنفس التحفيزي بطريقة سهلة وفعالة وغير مكلفة بين مرضي جراحة القلب المفتوح. وأوصت الدراسة بانه يجب إجراء الدراسة على عينة كبيرة وغير احتمالية وفي مستشفيات مختلفة من مناطق جغرافية متنوعة من أجل تعميم نتائج الدراسة.