Effect of Cold Gel Pack Intervention on Controlling Pain Associated with Incentive Spirometry Post Open-Heart Surgery

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Abstract

Background: Sternal incision pain is the most common patient complaint after open heart surgery. It can impede normal respiration, deep breathing, effective coughing, and sputum clearance, and may result in respiratory dysfunction **Aim:** This study aimed to evaluate effect of cold gel pack intervention on controlling pain associated with incentive spirometry post open heart surgery. **Design:** A Quasi experimental design was utilized. **Setting:** The study was conducted in cardiothoracic intensive care unit and cardiothoracic department of Benha University Hospital. **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 Subjective pain assessment sheet, Tool III Objective pain assessment sheet. **Results:** This study revealed that 36.7% of control group had severe pain and 33.3% of intervention group had a moderate pain during first day post intervention , while during the second day 63.3% had moderate pain and 53.3% had mild pain, respectively to be post one week moderate level among 50.0% of control group and mild level among 73.3% of intervention group, with a significant overall change in pain score within the control group (p=0.040*) and highly significant (p=<0.001**) within the intervention group throughout post intervention phases. **Conclusions:** Application of cold gel pack intervention was effective for reducing incisional pain and improving physiological parameters associated with incentive spirometry in patients post coronary artery bypass graft. **Recommendations:** Cold gel pack application should be applied as a non-pharmacological treatment option before incentive spirometry for post-operative CABG patients.

Keywords: Cold Gel Pack, Incentive Spirometry, Open Heart Surgery, Pain

Introduction

Open heart surgery (OHS) is one of the treatment options for cardiovascular diseases. OHSs mainly include coronary artery bypass graft surgery (CABG), valvular heart surgery (VHS), heart transplantation, and congenital heart surgery. The number of patients undergoing OHS has gradually increased with the prolonged life expectancy and increasing medical developments **(Yeşiler et al.,2022).**

Open heart surgery presents a lifesaving and life enhancing opportunity to thousands of patients. Many patients face significant challenges during the postoperative period including pain, anxiety and tension which can impair immune function and slow wound healing **(Jensen et-al., 2020).**

Sternal incision pain is the most common complaint after open heart surgeries. Since the sternum is cut open for the surgery, the movement of the rib cage during spirometry

typically increases pain, creating breakthrough pain after cardiac surgery and patients need to perform these activities to optimize their recovery such as deep breathing and coughing exercises and spirometry **(Joseph& Garasiya.,2021).**

One of these activities that can create incident pain is spirometry. Patients who underwent these surgeries report having most severe pain during chest physio therapy procedure especially spirometry. using spirometer is very important in the prevention of respiratory complications such as hypoxemia, atelectasis, pneumonia. But, patient not likely to do this exercise if they are uncomfortable, or do not have strategies to control the break through pain **(Feixiang et-al., 2023).**

Control of pain in patients after heart surgery is one of the common problems in ICUs. Failure to treat the pain would deeply affect the quality of life and can have physical, psychological, social, and economic consequences. **(Jensen et-al.,2020).** Pain management requires a multidisciplinary approach (physician, nurse, pharmacist, physiotherapist, anesthesiologist). A nurse is a member who is facing the patient with pain and who often suffers from being unable to fully relieve their pain **(El-Nagaret-al., 2020).**

Cold therapy is an effective and safe method with limited complications. cold therapy leads to pain control and increases pain threshold. Cold Gel Packs are an economical treatment option that can be reused for multiple forms of therapeutic relief. it is made of high quality, durable materials that are intended to last through many uses and contrasting temperatures. The pack is filled with large, moldable gel beads that remain flexible even when frozen. This provides cooling relief of pain and swelling to all body contours **(Chen et-al., 2023).**

Many hospitals have postoperative standards of care that encourage patients to using incentive spirometry for deep breathing after open heart surgery at least every two hours while they are awake using incentive spirometry for deep breathing is typically associated with incisional pain because most cardiac surgical patients undergo a sternotomy (**El-Nagaret-al., 2020).**

Significance of the study:

Post open heart surgery patients frequently experience postoperative pulmonary problems (Decreased oxyhemoglobin saturation level, atelectasis, and pneumonia, etc.) which can occur in up to one-fifth of cases and are caused by general anesthesia, ischemia with consequences for the extracorporeal circulation, sternotomy, and extended hypothermia **(Tanner & Colvin 2020).**

Application of superficial cold gel packs is an efficient technique for pain relief because it slows down the speed of nerve conduction, which in turn lessens pain. However, **Çelik, & Özer., (2021)** who conducted a study about "Effect of Cold Application on Chest Incision Pain Due to Deep Breathing and Cough Exercises and they recommended that there is a need for future studies to evaluate Effect of Cold Application on Chest Incision Pain Due to using incentive spirometry Therefore, the purpose of the current study was to evaluate the effect of cold gel pack intervention on controlling pain associated with incentive spirometry post open heart surgery.

Aim of the study:

The aim of this study was to evaluate the effect of cold gel pack intervention on controlling pain associated with incentive spirometry post open heart surgery.

Research hypotheses:

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

H1: patient who will apply cold gel pack (intervention group) will have decreased intensity of pain associated with incentive spirometry 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 cardiothoracic intensive care unit and cardiothoracic department will be divided into two equal groups, control group and intervention group according to inclusion and exclusion criteria and available at the time of the study.

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 **Khalkhali 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, Gender, marital status, educational level, nature of work and the place of residence.

Part two: patient's medical health history: about assessment of the Present medical history which included (3item), patients' life style (6 items) and past medical history (4 item).

Tool II: Subjective pain assessment sheet: It compromised two parts:

Part one: "Pain Intensity Scale": it was adopted from **(McCaffery et al., 1994)**. for adults who had undergone postoperative coronary artery bypass graft surgery and were completely aware and oriented, it was utilized to measure pain intensity (5 item).

Scoring system: This scale consists of a 10-point numeric scale, where **"0"** denotes no pain, "**1-3**" mild pain, "**4-6**" moderate pain, **"7-9"** severe pain, and **"10"** representing unbearable pain. With a total score between **0 (no pain)**, and **10 (worst possible pain).**

part two: Patient self- report of pain (Pain characteristics): It was developed by the researchers after extensive reviewing the relevant literature such as **(Jancy, 2019; Harris, 2022; Zaccagnino & Nedeljkovic, 2017).** It was used to assess the quality of pain which was self-reported by patient. It consists of different characteristics of pain **such as** Onset, Radiation, Location, Quality, Frequency, duration and associated symptoms

Tool III: Patients' behavioral pain scale it was adopted from **G´elinas et al. (2006).** It is used to assess and measure objective behavioral indicators of pain. It includes four domains, facial expression, body movement, vocalization and muscle tension.

Scoring system: Each of the four domains is scored as **0, 1, or 2** points, giving an overall score ranging from **0 (no pain) to 8**

(maximum pain). Descriptions are consistent scoring within each domain.

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 (1 professor, 3 assistant professors and one lecture 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 was testing statistically to assure that the tools were reliable before data collection and it 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 considerations:

Official permissions for data collection were generated from Hospital directors and head managers of the cardiothoracic surgery intensive care unit (ICU) and cardiothoracic department of Benha University Hospital. by the submission of a formal letter from the dean of Faculty of Nursing at Benha University. Also, the study approval was obtained from the Ethical Committee of Faculty of Nursing before initiating the study work. Oral and written approval was taken from patients after explanation the aim of the study, they were also informed that their participation is optionally, and that they have the right to withdraw at any time without any consequences. The researcher was assured maintaining anonymity and confidentiality of data and information gathered used only for patients benefit and for the purpose of the study.

Pilot Study:

Pilot study was conducted on 10% (6 patients) before data collection of all patients in ICU department at Benha University Hospital to test the clarity and applicability of the study tools and the guidelines, to estimate time needed for each tool to be filled in as well as to identify any possible obstacles that may hinder data collection.

Field work:

The implementation of the incentive spirometer procedure included the following steps:

Control group: (the group without cold gel pack intervention) The researcher assessed the patients' standard levels of pain before procedure. then providing them description about the incentive spirometry, then 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 researcher makes a pain assessment immediately upon completion.

Intervention group: the group with application of a cold gel pack intervention, baseline pain assessment was performed by the researcher (pre intervention assessment), then patients were elevated to stay in the

upright position and skin sensitivity was tested at the sternotomy wound area.

- The cold gel pack was left for 20 minutes on place until it was time to remove it, and the researcher 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 researcher then used data collection tools II and III to evaluate pain post intervention.

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

Results:

Table (1): Displays the sociodemographic 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, 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 hour among 60.0% and 66.6%, respectively. Moreover (70.0% & 73.3%, respectively) were residing urban area.

Table (2): This table reveals the comparison of pain intensity between control and intervention groups, pointing out that there was a significant statistical difference post each intervention period. Where 36.7% of control group had severe pain and 33.3% of intervention group had a moderate pain during first day post intervention , while during the second day 63.3% had moderate pain and 53.3% had mild pain, respectively to be post one week moderate level among 50.0% of control group and mild level among 73.3% of intervention group, with a significant overall change in pain score within the control group p=0.040*) and highly significant p=<0.001**) within the intervention group throughout post intervention phases.

Figure (1): This figure illustrates that, there was no significant changes among control and intervention groups regarding their nature of pain (p value = 0.0327 n.s), where (46.7% & 53.3%, respectively) reported a burning sensation.

Table (3): Reveals the comparison of behavioral indicators between control and intervention groups, pointing out that there was a significant statistical difference post

each intervention period. Where 70.0% and73.4%, of control group assume protection position during first- and second-day post intervention, while regarding the intervention group 63.3% and 83.3, respectively, had been relaxed during first day post intervention and talking in normal tone or no sound, during the second day. Moreover, post one-week intervention, about 63.3% of control group were sighing, and moaning, whereas 80.0% of intervention group, were talking in normal tone or no sound with a significant overall change in pain score within the control group ($p=0.530^{n.s}$) and highly significant ($p=0.001^{**}$) within the intervention group throughout post intervention phases.

Table (4): Reveals the relationship between total pain score of intervention group and their sociodemographic characteristics. Where there was significant statistical relation age and gender during first, second day and post one week, also with educational level during first and second day post intervention (p= 0.010* & 0.002*, respectively).

Table (1): Frequency distribution of studied patients (control & intervention groups) according to their demographic characteristics (n=60)

Patients' sociodemographic characteristics	Variables	Control group N=30		Intervention group N=30		Test	
		No.	%	No.	%	X^2	P value
Age (year)	20-<30	5	16.7	6	20.0	0.310	0.857 n.s
	30-<40	12	40.0	10	33.3		
	40-60	13	43.3	14	46.7		
	Mean ± SD	**40.27±0.74**		**39.27±0.78**		t= 0.335	0.739 n.s
Gender	Male	22	73.3	21	70.0	0.082	0.774 n.s
	Female	8	26.7	9	30.0		
Marital status	Single	4	13.3	3	10.0	0.430	0.934 n.s
	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 n.s
	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 n.s
	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 n.s
	6-<8 hrs	18	60.0	20	66.6		
	8-<10 hrs	9	30.0	8	26.7		
	10-12 hrs	2	6.7	2	6.7		
	Mean ± SD	**6.43±0.747**		**6.50±0.77**		t= 0.333	0.740 n.s
Residence	Urban	21	70.0	22	73.3	0.082	0.774 n.s
	Rural	9	30.0	8	26.7		

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

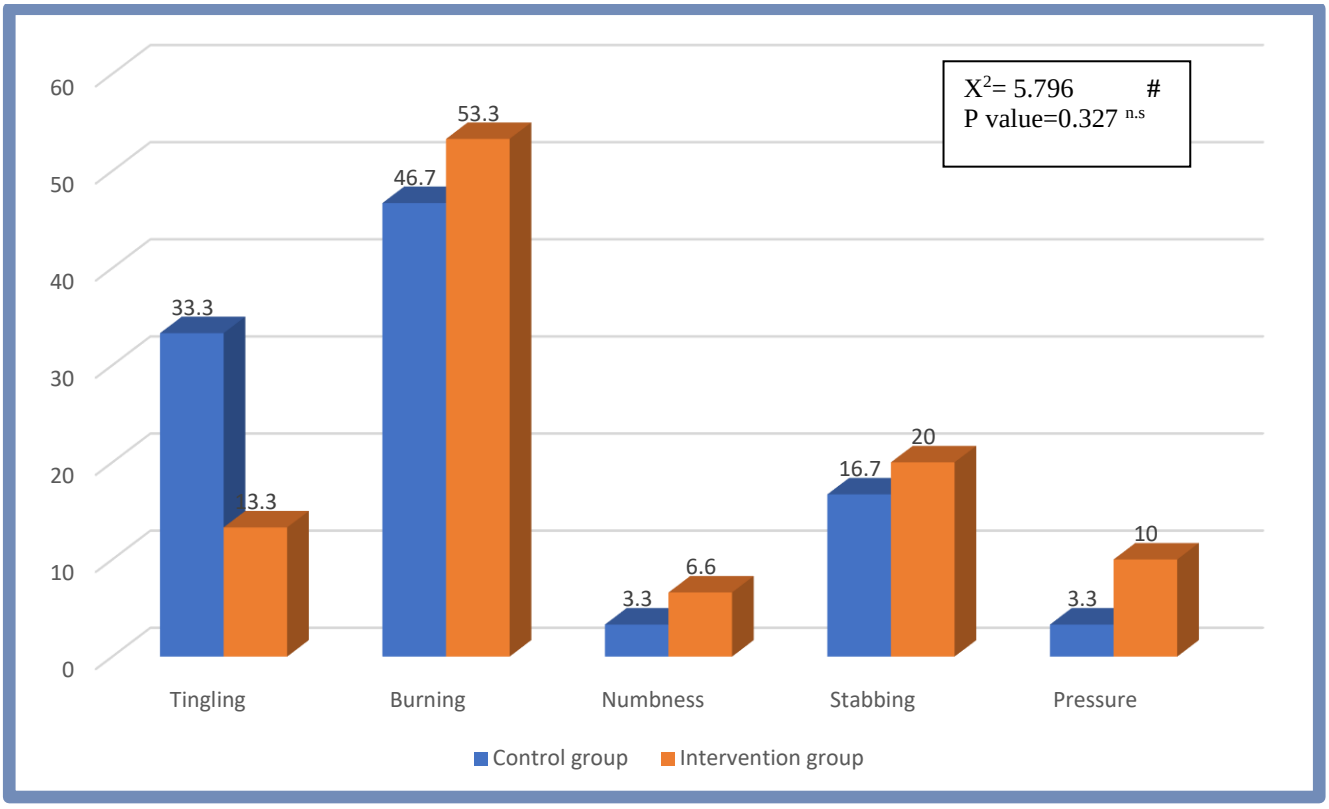

Figure 1: Frequency distribution of nature of pain among studied patients (control & intervention groups) (n=60)

Table (2): Comparison of patients' pain intensity between control and intervention groups throughout post intervention phases (n=60).

Pain intensity	Control group (n=30)						Intervention group (n=30)						X^{2} test P value (1)	X^{2} test P value (2)	X^{2} 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			
No pain (0)	2(6.7)	0(0.0)	0(0.0)	0(0.0)	1(3.3)	1(3.3)	0(0.0)	5(16.7)	0(0.0)	3(10.0)	0(0.0)	8(26.7)	17.275 0.002*	30.238 <0.001**	56.444 <0.001**
Mild pain (1-3)	5(16.7)	0(0.0)	9(30.0)	0(0.0)	15(50.0)	0(0.0)	5(16.7)	6(20.0)	5(16.7)	16(53.3)	14(46.7)	22(73.3)			
Moderate pain (4-6)	13(43.3)	9(30.0)	18(60.0)	19(63.3)	14(46.7)	15(50.0)	8(26.7)	10(33.3)	15(50.0)	10(33.3)	16(53.3)	0(0.0)			
Severe pain (7-9)	10(33.3)	11(36.7)	3(10.0)	8(26.7)	0(0.0)	14(46.7)	13(43.3)	7(23.3)	10(33.3)	1(3.3)	0(0.0)	0(0.0)			
Unbearable pain (10)	0(0.0)	10(33.3)	0(0.0)	3(10.0)	0(0.0)	0(0.0)	4(13.3)	2(6.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)			
Mean ± SD	8.03±0.89	9.03±0.80	4.80±0.61	6.47±0.68	4.43±0.57	5.40±0.68	8.53±0.94	6.83±1.17	5.17±0.69	4.30±0.70	2.53±0.51	0.73±0.45	U1= 703.500 <0.001**	U2= 782.000 <0.001**	U3= -874.000 <0.001**
Fr test P value (4)	6.424 0.040*						22.978 < 0.001**								

(Fr) Friedman test (U) Mann witney test Not significant ($p > 0.05$) (*) Statistically Significant at ≤0.05 ** Highly significant ($p \leq 0.001$)

(1) P1: p value for comparing post intervention pain scores between control and intervention groups post first day
(2) P2: p value for comparing post intervention pain scores between control and intervention groups post second day
(3) P3: p value for comparing post intervention pain scores between control and intervention groups post one week
(4) P4: p value for comparing pain scores within each group throughout post intervention phase

Table (3): Comparison of patients' behavioral indicators of pain (Control & intervention) groups throughout intervention phases. (N=60).)

Behavioral indicators	Response	Control group (n=30)						Intervention group (n=30)						X^2 test P value (1)	X^2 test P value (2)	X^2 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			
Facial expressions (0-2)	Relaxed, neutral	3(10.0)	2(6.7)	0(0.0)	8(26.7)	10(33.3	9(30.0)	0(0.0)	13(43.3)	5(16.7)	10(33.3)	17(56.7)	20(66.7)	8.583 0.014*	12.222 0.002*	10.557 0.005*
	Tense	20(66.7)	19(63.3)	24(80.0)	12(40.0	16(53.3	16(53.3)	16(53.3)	12(40.0)	22(73.3)	20(66.7)	13(43.3)	10(33.3)			
	Grimacing	7(23.3)	9(30.0)	6(20.0)	10(33.3	4(13.4)	5(16.7)	14(46.7)	5(16.7)	3(10.0)	0(0.0)	0(0.0)	0(0.0)			
Body movements (0-2)	Absence of movement or normal position	10(33.3)	5(16.7)	4(13.4)	7(23.3)	10(33.3	10(33.3)	8(26.7)	15(50.0)	13(43.3)	20(66.7)	17(56.7)	20(66.7)	7.597 0.022*	11.759 0.003*	8.148 0.017*
	Protection	17(56.7)	21(70.0)	22(73.3)	22(73.4	18(60.0	17(56.7)	14(46.7)	12(40.0)	16(53.3)	10(33.3)	13(43.3)	10(33.3)			
	Restlessness	3(10.0)	4(13.3)	4(13.3)	1(3.3)	2(6.7)	3(10.0)	8(26.7)	3(10.0)	1(3.3)	0(0.0)	0(0.0)	0(0.0)			
Muscle tension (0-2)	Relaxed	8(26.7)	3(10.0)	8(26.6)	8(26.7)	19(63.3	14(46.7)	4(13.3)	19(63.3)	19(63.3)	19(63.3)	11(36.7)	22(73.3)	19.036 <0.001**	8.606 0.014*	6.578 0.037*
	Tense, rigid	16(53.3)	21(70.0)	17(56.7)	21(70.0	9(30.0)	12(40.0)	17(56.7)	7(23.3)	9(30.0)	11(36.7)	19(63.3)	8(26.7)			
	Very tense or rigid	6(20.0)	6(20.0)	5(16.7)	1(3.3)	2(6.7)	4(13.3)	9(30.0)	4(13.3)	2(6.7)	0(0.0)	0(0.0)	0(0.0)			
Compliance with ventilator (intubated patient) Or Vocalization (extubated patient)(0-2)	Talking in normal tone or no sound	12(40.0)	10(33.3)	12(40.0)	11(36.7)	7(23.3)	9(30.0)	17(56.7)	18(60.0)	19(63.3)	25(83.3)	22(73.3)	24(80.0)	4.286 0.038*	14.444 0.001**	15.578 <0.001**
	Sighing, moaning	16(53.3)	20(66.7)	18(60.0)	15(50.0	20(66.7	19(63.3)	13(43.3)	12(40.0)	11(36.7)	5(16.7)	8(26.7)	6(20.0)			
	Crying out, sobbing	2(6.7)	0(0.0)	0(0.0)	4(13.3)	3(10.0)	2(6.7)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)	0(0.0)			
Total		3.60±1.71	3.60±1.07	2.33±1.06	3.40±1.75	2.17±0.94	3.07±1.82	4.07±1.23	2.50±1.19	3.70±1.49	1.53±0.82	2.90±1.03	1.13±0.86	U1= 229.500 <0.001**	U2= 169.000 <0.001**	U3= 163.000 <0.001**
Fr test P value (4)		1.271 0.530 n.s						14.935 0.001**								

(Fr) Friedman test (U) Mann witney test (n.s) Not Statistically Significant at >0.05 (*) Statistically Significant at ≤0.05 ** Highly significant (p ≤ 0.001)

(1) **P1: p value for comparing post intervention behavioral indicators between control and intervention groups post first day**
(2) **P2: p value for comparing post intervention behavioral indicators between control and intervention groups post second day**
(3) **P3: p value for comparing post intervention behavioral indicators between control and intervention groups post one week**
(4) **P4: p value for comparing behavioral indicators scores within each group throughout post intervention phase**

Table (4). Relation between socio demographic characteristics among intervention group with total score of pain intensity, throughout intervention phases (n=30).

Socio demographic characteristics	Total Pain intensity of intervention group (n=30)					
	First day Post intervention	Test P value	Second day Post intervention	Test P value	Post first week Post intervention	Test P value
Age /year	$\bar{\chi}$ ± SD		$\bar{\chi}$ ± SD		$\bar{\chi}$ ± SD	
20-<30	**0.67 ± 0.81**	H=10.200 0.0.006*	**1.00 ± 0.00**	H=13.609 0.001**	**0.00 ± 0.00**	H=21.091 <0.001**
30-<40	**1.70± 1.16**		**0.80± 0.63**		**0.90± 0.31**	
40-60	**2.43± 0.93**		**1.79± 0.57**		**0.93± 0.26**	
Gender						
Male	**1.43 ± 1.12**	U=30.000 0.003*	**1.00 ± 0.54**	U=21.000 <0.001**	**0.62 ± 0.49**	U=58.500 0.034 *
Female	**2.78± 0.66**		**2.00± 0.50**		**1.00± 0.00**	
Marital status						
Single	**0.33± 0.57**	H=5.196 0.074 n.s	**0.33± 0.57**	H=5.647 0.059 n.s	**0.67± 0.57**	H=0.158 0.924 n.s
Married	**2.08 ± 1.38**		**1.54 ± 0.77**		**0.77 ± 0.43**	
Divorced	**2.00± 0.70**		**1.44± 0.52**		**0.78± 0.44**	
Widowed	**1.80± 1.09**		**1.00± 0.00**		**0.60± 0.54**	
Educational Level						
Illiterate	**1.33 ± 1.36**	H=11.425 0.010*	**1.33 ± 0.81**	H= 15.133 0.0.002*	**0.50 ± 0.54**	H=2.104 0.551 n.s
Read and write	**1.00± 0.70**		**0.60± 0.54**		**0.80± 0.44**	
Intermediate qualification	**1.77 ± 0.92**		**1.15 ± 0.37**		**0.77 ± 0.43**	
University qualification	**3.17± 0.75**		**2.17± 0.40**		**0.83± 0.40**	
Natur of Work						
Manual work	**1.20 ± 0.83**	H=3.016 0.389 n.s	**1.00 ± 0.70**	H=1.232 0.745 n.s	**0.40 ± 0.54**	H=5.221 0.156 n.s
Sedentary work	**2.18± 1.47**		**1.36± 0.92**		**0.73± 0.46**	
House wife	**2.00± 0.81**		**1.43± 0.53**		**0.71± 0.48**	
No work	**1.57 ± 1.13**		**1.29 ± 0.48**		**1.00 ± 0.00**	
Residence						
Rural	**1.74 ± 1.28**	U=68.500 0.896 n.s	**1.26 ± 0.73**	U=58.500 0.360 n.s	**0.74 ± 0.45**	U=65.500 0.585 n.s
Urban	**2.00± 1.19**		**1.50± 0.75**		**0.88± 0.35**	

Discussion:

Regarding age: the current study presented that there was no statistically significant difference between the two groups. Clarifying that near to half of both control and intervention group had 40-60 years old with a mean age of **(40.27±0.74&39.27±0.78SD)** respectively, this might be this is the most affected age with coronary artery disease and this disease is common in middle and old age than young age as a result of aging process and the related physiological changes in the vascular system.

This result was agreed with the study conducted in turkey. **by Cevik et al., (2020)** who examined Effect of "Applying Cold Gel Pack to the Sternum Region on the Postoperative Pain after Open- Heart Surgery" and emphasized that the half of studied patients were aged between 50 and 60 years old.

In contradiction with this study **Tanha et al., 2022,** whose study 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 old

As regard to gender, the present study revealed that more than two third of the control and study group patients were males. From the researcher point of view, this result might be because of stressors they face and unhealthy life style behavior they followed. This finding agreed with **Khan et al.,(2020**) who studied " Global Epidemiology of Ischemic Heart Disease", and reported that more than two third of studied patients were males. also this finding in the line with **Hallman et al., (2021).** who studied " Objective postoperative pain assessment using incentive spirometry values: a prospective observational study.", and reported that nearly three quarter of studied patients were males.

Concerning to marital status, the present study finding revealed that more than one third of studied patients were married. From the researcher's 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, (2019).** who studied "Effects of cold therapy on pain and breathing exercises among median sternotomy patients". and reported that married patients who have ischemic heart disease represented the higher percentage of their study subject than single and widow patients.

Owing to 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 is in the same line with **Girgin, et al., (2021)**, in a study about "The Effect of pulmonary rehabilitation on respiratory functions, and the quality of life, following coronary artery bypass grafting" and revealed that the majority of heart failure patients attained an intermediate education

As regard to residence, the finding of the current study represented that about three quarters of both groups were living in urban areas, this Results were similar also to 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.

On the other hand, this finding is disagree with **Bakitas et al., (2020)** in the study entitled "Effect of an early palliative

care telehealth intervention vs usual care on patients with coronary artery disease, in New York", who showed that more than half of patients lived in rural areas

Regarding comparison of pain intensity between control and intervention groups, The results of the current study revealed that 36.7% of control group had severe pain and 33.3% of intervention group had a moderate pain during first day post intervention , while during the second day 63.3% had moderate pain and 53.3% had mild pain, respectively to be post one week moderate level among 50.0% of control group and mild level among 73.3% of intervention group, with a statistically significant differences in pain score among intervention group (p=<0.001**) compared by control group (p=0.040*) throughout post intervention phases. from the researcher point of view, the incentive spirometry increase pain in control group due to chest expansion and pressure fall on chest cage during usage and cold gel pack more effective in reducing incisional pain.

These results were in agreement with **Chailler et al., (2022)** whose study entitled "Cold therapy for the management of pain associated with deep breathing and coughing post-cardiac surgery". and founded that there was a significant reduction in pain scores between pre-and post-application of the gel pack

Also, this result agreed with the study results by **Chauhan et al., (2021):** about effectiveness of cold application versus breathing exercises to reduce pain and anxiety during chest tube removal among postoperative cardiac surgery adult patient who stated that mean scores of pain intensity in cold application group was significantly decreased compared to breathing exercises group.

Regarding patients' behavioral indicators of pain, the results of the current study revealed that there was a significant statistical difference post each intervention period between control group and intervention group. from the researcher point of view, pain aggravating has negative effect on facial expression, body movement and muscle contraction these results could be related to that decreasing pain caused by cold gel pack leads to muscle relaxation and decrease muscle spasm.

These results are supported by **Seweid et al., (2021)** who found that there was significant reduction in pain scores in pain intensity and pain distress as well as critical care pain observation post cold gel application therapy in patient undergoing coronary artery bypass grafting

on the other hand, these results are controverted by **El-Nagar et al., (2020)** who revealed that localized cryotherapy effective in reducing pain intensity but not change behavioral indicators because it is related to patient tolerance.

Regarding relation between socio demographic characteristics among intervention group with total score of pain intensity, throughout intervention phases

The result of the present study revealed that there was significant statistically relationship between pain intensity and age, gender during first, second day and post one week, this result may be related to pain threshold differ from person to another person, male person may pear pain more than women one and pain intensity doesn't associate with residence. the result of the present study agree with the result of study conducted by **Weheida et al., (2021**) entitled "The Effect of Applying Superficial Cold Gel Packs on Incisional Pain during Different Patients Activities post Coronary Artery

Bypass Graft in Egypt" who concluded that there were highly statistically significant relationship between pain intensity and patient age .

but on the other hand, this result was disagreeing with **Milgrom et al., (2022)** who stated that there was statistically significant relationship between pain intensity and marital status.

Finally, the current study affirmed the hypotheses that post coronary artery bypass graft surgery patients who received cold gel pack intervention would experience reduced incisional pain related to the use of incentive spirometry.

Conclusion:

Cold application is one of the non-pharmacological strategies that can be used beside pharmacological management by critical care nurses to alleviate incisional pain associated with the use of incentive spirometry in an easy, effective, and costless way.

Recommendations:

❖ Cold gel pack should be used as an alternative non-pharmacological pain management method for open heart surgery patients as it is cheap, readily available and saves high costs of medication that used for pain relief and control.

❖ The study should be performed on a sizable, non-probability sample and in a different hospital setting from diverse geographical regions in order to generalize the study's finding.

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تأثير كمادات الجل المجمدة على التحكم في الألم المرتبط بمقياس التنفس التحفيزي بعد جراحة القلب المفتوح

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تعتبر جراحة القلب المفتوح هي أحد الجراحات الكبري التي يتم فيها فتح الصدر وذلك لإجراء الجراحة على عضلات القلب أو الصمامات أو الشرايين المتصلة بة. وتعتبر عملية تغير مسار الشرايين التاجية هي الأكثر شيوعًا من جراحات القلب االمفتوح .ويعتبر تخفيف الالم بعد جراحة القلب المفتوح من أهم إستراتيجيات الرعاية التمريضية ولذلك يتم تطبيق طرق مختلفة للتقليل أو السيطرة على الألم الجراحي بشكل فعال ، والتي يتم تصنيفها إلى طريقتين وهما الدوائية وغير الدوائية .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 حديثًا 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. وأظهرت النتائج أنة كان هناك فرق إحصائي كبير بعد كل فترة من إستخدام العلاج بكمادات الجل حيث كان 36.7% من مجموعة التحكم يعانون من ألم شديد بعد استخدام مقياس التنفس التحفيزي في حين أن 33.3% من مجموعة التدخل يعانون من ألم متوسط خلال اليوم الأول بعد إستخدام كمادات الجل ، بينما خلال اليوم الثاني يعاني 63.3% من ألم متوسط و53.3% يعانون من ألم خفيف، ليكونوا بعد أسبوع بمستوى متوسط بين 50.0% من مجموعة التحكم والم خفيف بين 73.3% من مجموعة الدراسة مع تغير إجمالي كبير في درجة الألم طوال فترة مراحل ما بعد التدخل. ولخصت الدراسة إن العلاج بالتبريد هو أحد الاستراتيجيات غير الدوائية التي يمكن استخدامها بجانب الادوية من قبل مقدمي الرعاية الحرجة لتخفيف الألم الجراحي المرتبط باستخدام مقياس التنفس التحفيزي بطريقة سهلة وفعالة وغير مكلفة. وأوصت الدراسة بانة يوجد احتياج إلى مزيد من الدراسات لتقييم تأثير استخدام طرق غير دوائية مختلفة على تحسين نتائج المرضى في فترة ما بعد تحويل مسار الشريان التاجي.