

▪ **Basic Research**

The Effect of Applying Superficial Cold Gel Packs on Incisional Pain during Different Patients Activities post Coronary Artery Bypass Graft

Soheir M. Weheida⁽¹⁾, Wafaa Wahdan Abd El-Aziz⁽²⁾, Rasha Elsayed Ahmed⁽³⁾, Heba A. Al-Metyazidy⁽⁴⁾, Mohamed Badr⁽⁵⁾, *Rasha Awad A'Elamgied Salime⁽⁶⁾

¹Prof of Medical Surgical Nursing, Faculty of Nursing, Alexandria University, Egypt

²Lecturer of Critical Care and Emergency Nursing Department, Faculty of Nursing, Mansoura University, Egypt

³Lecturer of Adult Health Care Nursing, Faculty of Nursing, Helwan University, Egypt

⁴Assistant Prof of Critical Care Nursing, Faculty of Nursing, Tanta University, Egypt

⁵Lecturer of critical care and emergency medicine, Faculty of medicine, Helwan University, Egypt

⁶Lecturer of Adult Health Care Nursing, Faculty of Nursing, Helwan University, Egypt*

*Corresponding author: rasha_awad@nursing.helwan.edu.eg OR drashasalime@gmail.com

Abstract

Introduction: The most hurting activities during the days post cardiothoracic surgery are coughing and deep breathing exercises, using incentive spirometry, and mobilization. Hence, superficial cold gel therapy is an effective nonpharmacological method that control the pain during coughing, deep breathing, using incentive spirometry, and mobilization. **Aim:** To evaluate the effect of applying superficial cold gel packs on incisional pain during different patients activities post coronary artery bypass graft. **Setting:** The study was carried out at the cardiothoracic care unit affiliated to Al-Hussein University Hospital in Cairo. **Design:** A quasi-experimental research design was utilized to conduct this study using a pretest-posttest approach. **Subject:** A purposive sample of 60 adult fully conscious postoperative cardiopulmonary bypass graft patients newly admitted to the open-heart surgery intensive care unit were included in the current study. **Tools:** three tools were utilized to collect data:(I) subjective pain assessment, (II) pain intensity score, and (III) objective pain assessment. **Results** revealed that there were highly statistically significant differences regarding total mean pain scores and physiological indicators pre post superficial cold gel application. Also, there was an improvement in the total mean scores of the patients' physiological indicators in post-cardiac surgery. **Conclusion:** Based on the findings of the present study, it can be concluded that: superficial cold gel pack application had been proven to be effective in declining pain intensity levels as illustrated from total pain mean scores and physiological parameters post coronary artery bypass graft during different patients activities. **Recommendation:** It was recommended that superficial cold gel application have to be exhilarated as a non-pharmacological management approach pre coughing and deep breathing exercises, using incentive spirometry and mobilization. Additionally, applying cold gel pack therapy is effective, cheap, and can decline the need for pharmacological interventions and its side effect post coronary artery bypass graft. finally, replication of the study on large non- probability sampling from different geographical location. **Keywords:** Coronary artery bypass graft, pain severity, superficial cold gel packs therapy

1. Introduction

Heart bypass surgery, likewise, termed coronary bypass surgery or coronary artery bypass graft (CABG), is a technique that is completed to sidetrack the blood flow in the heart around a tightened or obstructed artery. Open heart surgery with medium sternotomy is greatest frequently done on patients with obstructed heart vessels. Sternal incision pain is the greatest corporate patient grievance post operations. It can inhibit normal breathing, active coughing, using incentive spirometry and sputum clearance, and might be caused respiratory dysfunction, hypoxemia, atelectasis, and pneumonia. Therefore, actual pain control mains to fasting recovery diminishes the postoperative problems and length of hospital stay and elevates patient satisfaction ⁽¹⁾.

Cardiovascular surgical patients may be particularly vulnerable to the physiological effects due to severe pain postoperatively and several pharmacologic and non-pharmacologic treatments that have been prescribed for pain management ⁽²⁾. Although analgesic drugs are the most effective tool available to nurses plus many other ways to relieve pain. Analgesics have some side effects and there are individual differences in their effects, so non-pharmacological methods that may attract some attention such as superficial cold gel application therapy which is a non-pharmacological pain-relieving method. It has been utilized for years as one of the most naive and inexpensive non-pharmacologic methods to release pain post-CABG ⁽³⁾.

Moreover, unbearable pain can produce distress, absence of breath sound, suffering, diminished chest extension, high resonance on the site of operation, decreased breathing concert creating hypoxemia, bigger sympathetic reaction aggravating myocardial ischemia, and stimulation of a widespread tension response which is able to initiate tachycardia increased cardiac output, and vasoconstriction ⁽⁴⁻⁷⁾.

Nowadays, numerous determinations are presently ready to decrease pain severity and the number of narcotic drugs by using non-pharmacological methods ⁽⁸⁾. Pain decrease approaches, such as music cure, touch therapy, diathermy, cold gel application therapy, and acupuncture, are approximate of the nonpharmacological methodologies to pain decrease. These approaches encourage the patient's independence and remain able to apply with simple implements. Furthermore, the patients display calm approval and worthy assistance through treatment. Mostly, these approaches are not attended by the undesirable significances or contrary things of therapeutic interventions ⁽⁹⁾.

Superficial cold gel application therapy is an effective method for pain release. This method decreases the quickness of nervous conductance and pain. Correspondingly, founded on the gate control theory of pain, motivation of thick fibers over methods such as icing could nearby the gate and decrease pain⁽¹⁰⁾. Cold gel application may be used to decrease or opposite pain instincts through triggering descending inhibitory neurons, which chunk rising nociceptive nerves creating from the substantial gelatinosa⁽¹¹⁾.

Acute pain post CABG is a very complex sensation and characterized by a set of three domains: physiological behavioral, and psychological indicators. physical indicators include assessment of intensity, location and duration, physical examination, changes in vital signs, history, knowledge of certain behaviors and use of different pain scales as pain intensity scale and Critical Care Pain Observation. Additionally, behavioral domain of pain includes smoking, changes in the physical activity and Changes in appetite which can reflect on total body mass index. Finally anxiety, stress, withdrawal and fear are the main markers of psychological domain^(1,5,10).

Meanwhile, the unpleasant prevalence of coronary artery disease (CAD) is valued to be 6.9% in men and 6.0% in women, it is significant for nurses to come to be aware of the various types of coronary artery conditions before and after the surgeries and the approaches for evaluating, stopping, and handling these disorders therapeutically and surgically and how to alleviate the patients' pain postoperatively⁽¹²⁾.

Significance of the study:

During clinical observation of patients post cardiothoracic surgery, it was found that the patients experienced acute and severe pain post operatively and the pharmacological management alone was not effective to alleviate or control this pain.

However, in Egypt, there are no national statistics evidence available about CABG and there is limited evidence in Cairo hospitals that investigated the effect of the application cold gel packs on incisional pain associated with deep breathing and coughing exercises, use of incentive spirometry, and early ambulation among post-CABG patients. So, the current study was designed to study the effect of applying superficial cold gel packs on incisional pain post-CABG essential to control the patient pain intensity level during deep breathing, coughing exercises, using incentive spirometry, and early mobilization.

The present study aims to:

Evaluate the effect of applying superficial cold gel packs on incisional pain during different patients' activities post coronary artery bypass graft.

Research hypotheses:

1: Patients post cardiothoracic surgery exhibit a lower degree of pain severity after applying superficial cold gel packs during deep breathing, coughing exercises, using incentive spirometry, and early mobilization than before.

2: Patients post cardiothoracic surgery had the stability of physiological indicators of pain such as pulse rate, blood pressure, respiratory rate, and oxygen saturation after applying superficial cold gel pack application therapy than before.

Operational definition:

Different patients' activities: Means activities which induced severe incisional pain post-CABG such as deep breathing and coughing exercises, use incentive spirometry, and early mobilization. During these activities superficial cold gel packs was applied to assess pre post pain intensity level.

Subjects and methods:

Study Design: A quasi-experimental research design was applied to conduct this study using a pre posttest approach.

Setting of the study: This study was conducted in the cardiothoracic surgery intensive care unit (ICU) at Al-Hussein University Hospital in Cairo. The cardiothoracic surgery intensive care unit includes 5 beds, and it is well equipped with advanced technology and manpower needed for patients' care. This unit provides postoperative care for a patient who has undergone cardiothoracic surgeries involving CABG and valvular surgeries which are the most common operations performed in this unit. The nurse-patient ratio is nearly 1:1.

Subjects: A purposive sample of 60 adults fully conscious post-operative CABG patients newly admitted to open-heart surgery ICU were included in the current study in 6 months according to the inclusion and exclusion criteria.

-The inclusion criteria included adult patients planned to have CABG surgery as evidenced from patients' files and willing to participate in the study.

- Exclusion criteria for patients included:

- Mechanically ventilated patients, patients with diseases that affect pain measurement (delirium, dementia, or major depression, and severe visual, hearing, and verbal impairment)
- Patients who are contraindicated to cold therapy such as Reynaud's disease, cryoglobulinemia, sickle cell anemia, cold allergic conditions, and in areas with impaired sensation, diabetic patients, patients experienced postoperative complications such as infection, bleeding, uncontrolled atrial fibrillation, and wound complications.

Tools for data collection:

Three tools were used for data collection after comprehensively reviewing the related literature⁽¹³⁻²¹⁾.

I): Subjective pain assessment:

this tool developed by the researcher after reviewing the relevant literature⁽¹⁶⁻¹⁸⁾ to assess the patients' sociodemographic characteristics and pain features. It divided into 3 parts as following:

part (1): patient's sociodemographic characteristics: such as age, gender, marital status, social support system, and occupation, level of education,

Part (2): Behavioral features of pain as smoking, physical activity, and overweight)

Part (3): Psychological features of pain as depression, anxiety, isolation, and life stressors.

II): Pain intensity scale:

this tool was developed by Mc Caffery in 1994(16) to evaluate pain intensity levels in conscious patients after CABG. This scale consisted of 10 points ranged from 0 to 10. Zero referred to no pain and 10 referred to worst pain. The patient is asked to mark the pain level on the line between the 0 and 10. The distance between no pain and worst pain defined the patient's intensity level of pain.

Scoring system.

Numerical scale with (0) referred to no pain, (1-3) included mild pain, (4-6) represented moderate pain, (7-9) demonstrated severe pain (10) included worst possible pain.

III): Objective assessment of pain:

it was divided into 2 parts as following:

part (1) Physiological indicators of pain assessment: It was developed by the researcher after reviewing the relevant literature ⁽¹⁷⁻²⁰⁾. It contains pulse rate, mean arterial pressure, respiratory rate, and oxygen saturation (SpO₂).

Part (2): "Critical Care Pain Observation Tool (CPOT)"; It was adopted by G'elinas et al in 2006 ⁽²¹⁾ to evaluate and measure objective behavioral indicators of pain. It included four domains: facial expression, body movement vocalization, and muscle tension.

Scoring system; Each of the four domains was scored as zero and 1, or 2 points, giving a total score ranging from zero (no pain) to 8 (maximum pain). Accounts were assumed to clarify the predictable behaviors for each increase, allowing reliable scoring in each domain.

Method: An official permission was obtained before conducting the current study from Al-Hussein University Hospital administrator.

Ethical Considerations:

- Informed consent was obtained from the studied patients after clarification of the current study aim.
- Patients' privacies were respected.
- Data confidentiality was assured to all studied patients.
- The studied patients were secure that everyone had the right to withdraw from the present study at any time of the research process with no penalty.
- Were assured that the superficial cold gel pack application therapy used in the current study is safe for the studied patients.

Tools development: Tool I was developed by the researchers after a strong review of the relevant literature. Tool II was developed by Mc Caffery in 1994⁽¹⁶⁾ and tool III part one was developed by the researchers and part two was developed by G'elinas et al in 2006⁽²¹⁾.

Content validity: The content validity of the tools was tested by five experts in the field of critical care nursing, medical surgical nursing, and medical biostatistics, and necessary modifications were made based on their feedback.

Reliability of the tools: All tools of the study were tested for reliability using Cronbach alpha. It was 0.802 for tool I and 0.715 for tool II, which denotes the good reliability of these tools.

Pilot study: A pilot study was carried out before starting data collection on 10% of studied patients (6 postoperative CABG patients) these patients were excluded from the study sample to value the clarity, feasibility, and applicability of the tools as well as estimation the time needed to fill out.

Data collection:

Data collection was extended from the period of the beginning of January till the end of June 2021.

The current study was carried out in four phases including the assessment, planning, intervention, and evaluation phases.

Assessment phase:

- Subjective pain assessment such as patient's sociodemographic characteristics, behavioral features of pain, psychological features of pain should be done pre superficial cold gel application using tool I.
- Pain scores and physiological parameters should be assessed pre post superficial cold gel packs during patients' different activities as deep breathing, coughing exercises, using incentive spirometry, and early mobilization using too II and III

Planning phase:

- During this phase, the researcher prepared the patients for deep breathing and coughing exercises and how to use the spirometry before CABG and to gain patient cooperation in the same manner during gel pack sessions.
- Gel packs that were used as the cold source weighted 320 g and measured 25 cm height by 10 cm width. They were kept in the freezer in the patient service unit and the temperature of the frozen was adjusted between 0°C and -5°C, then gel packs were removed from the freezer and placed in a cotton bag. The timer was activated for 15 min and a gel pack was used straight above the sternal wound dressing. In the texts, debate happens concerning the suggested interval of use time which ranges from 5 to 60 min ⁽²²⁾, to achieve the therapeutic effect of cold therapy, it is required to cool down tissues for at least 12 min ⁽²³⁾. Therefore, the 15-min use time was nominated in this study to attain the wanted result.

- Goals and expected outcome criteria were being formulated based on priorities of superficial cold gel pack application therapy as the following:
 - Improving patient's total pain intensity mean score post-CABG surgery.
 - Improving physiological parameter mean score post-CABG surgery.

Implementation phase:

During this phase, a superficial cold gel pack application therapy was applied to all studied patients during sessions.

- Firstly, on the first day post CABG, this was the zero day for the researcher.
- During the first- and second-days post CABG the severity of pain was assessed before coughing and breathing exercise, using incentive spirometer and during early ambulation without application of cold gel pack by using the tool I and tool II (pre-test) for the two consecutive days including the second using two episodes of measuring pain as follows:
 - Patient's pain intensity level was assessed, and the patients asked to mark the intensity of their pain during which the pain level was numbered from 0 (absence of pain) to 10 (the most intense pain possible).
 - Critical care pain observation level was used to assess patients' facial expression, body movement vocalization, and muscle tension.
- The gel pack application was applied for 20 min on the median sternotomy and the researchers waited beside the patient to observe any changes. After 20 minutes, the patients were asked to describe the sensation sensed throughout gel pack use. Then, the gel pack was selected up detached and the head of the bed was elevated between 45°C and 90°C. A pillow or folded sheet was given to the patients for splinting purposes and deep breaths and coughing were started for the patients. The previous technique of cold gel application was carried out three consecutive times on the same day to take the total mean pain scores. In each session, three

cycles of three deep breaths were performed followed by an episode of coughing. The patient was asked to rate his/her pain from 0 to 10.

Evaluation phase: Evaluation of applying superficial cold gel packs on incisional pain during deep breathing and coughing exercises, use incentive spirometry, and early mobilization post coronary artery bypass graft were done using tool II part two and tool III. This was done three times daily in the morning shift during the 1st and 2nd days post-surgery. The mean of two evaluation of both pain intensity and critical care pain observation scores were obtained separately for the same 60 studied patients.

Statistical analysis:

The analysis was done using statistical software SPSS for quantitative data; mean and standard deviation were calculated. Frequency and percentages, significance test t-test, and correlation test. A significance was adopted at $p < 0.05$ for interpretation of the results of tests of significance.

Results:**Table (1): Percentage distribution of the studied patients according to sociodemographic characteristics.**

Patients' personal characteristics	(n=60)	
	n	%
Age (year)		
21- < 40	21	35
40- 60	39	65.0
\bar{x} & SD	45.95±6.94	
Gender		
Male	34	56.7
Female	26	43.3
Educational Level		
Literate	29	48.3
Illiterate	31	51.7
Occupation		
Working	40	66.7
Not working	20	33.3
Marital Status		
Married	52	86.7
Divorced	3	5
Widow	5	8.3
Social support system		
Yes	16	26.7
No	44	73.3

Table (1) reveals the percentage distribution of the studied patients according to personal characteristics and clinical data. It was found that more than half (65.0% and 56.7%) of the studied patients were in the age group of 40- 60 years old and male. The mean age of the studied patients was 45.95±6.94. Also, more than half (51.7%, 66.7%, 86.7%, 73.3%) of the studied patients were illiterate, working, married, had no social support system respectively.

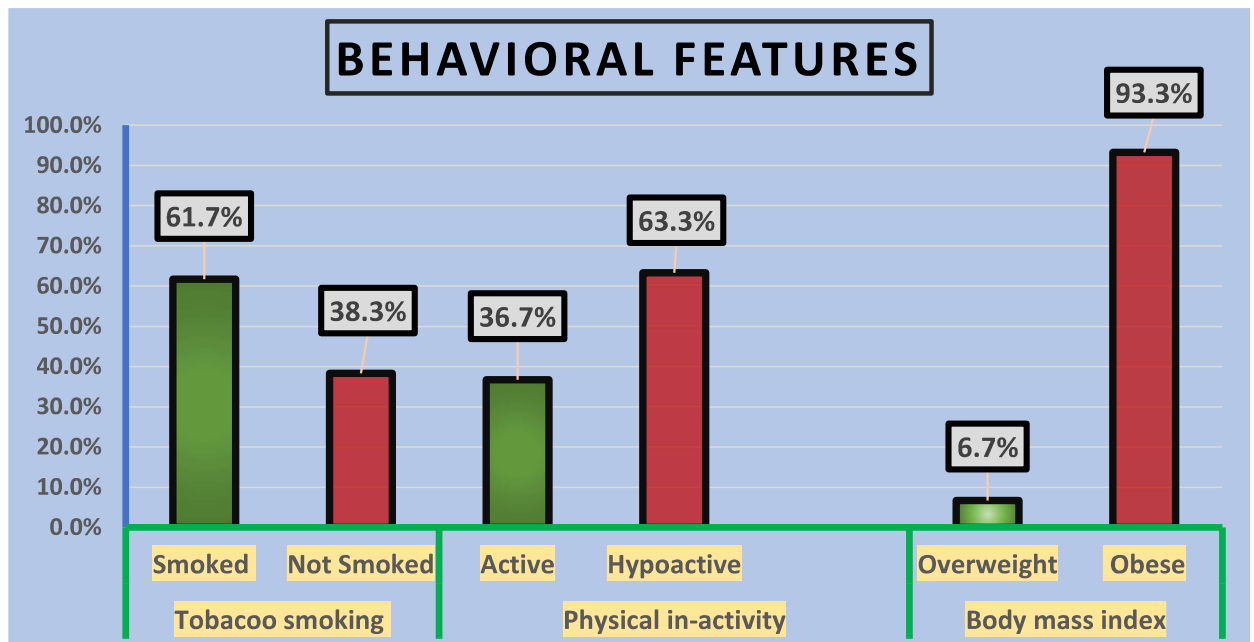


Figure (1) reveals the percentage distribution of the studied patients according to behavioral features. It was observed that nearly two-thirds (61.7%, and 63.3%) of the studied patients were smokers, and hypoactive. Regarding total body mass index, it was found that the vast majority (93.3%) of the studied patients were obese.

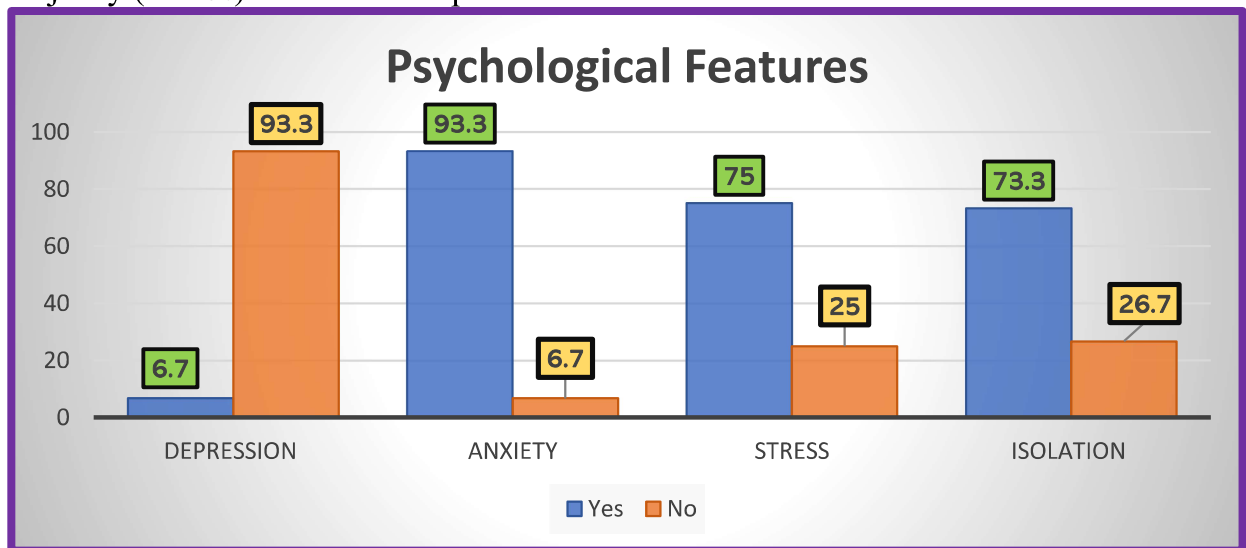


Figure (2) illustrates the percentage distribution of the studied patients according to psychological features. The vast majority (93.3%) of the studied patients suffered from anxiety while more than two-thirds (75% and 73.3) of them suffered from stress, and isolation respectively.

Table (2): Percentage distribution of the studied patients according to pain intensity level at different activity pre post cold gel pack applications throughout the study period.

Different patients' activity	Pain Intensity Level during (n=60)													
	The 1 st day						$\bar{x} \pm SD$	The 2 nd day						$\bar{x} \pm SD$
	Mild		Moderate		Severe			Mild		Moderate		Severe		
	n	%	n	%	n	%		N	%	n	%	n	%	
Cough activity:	2	3.3	28	46.7	30	50	6.47±1.78	10	16.7	30	50	20	33.3	5.47±1.78
-Pre CGPA	16	26.7	30	50	14	23.3	4.87±1.83	26	43.3	30	50	4	6.7	3.87±1.83
-Post CGPA														
χ^2, P	32.82, <0.01**							17.77, <0.01**						
Mobility activity:	4	6.7	28	46.7	28	46.7	6.25±1.80	12	20	30	50	18	30	5.25±1.80
-Pre CGPA	18	30	31	51.7	11	18.3	4.63±1.76	28	46.7	31	51.7	1	1.6	3.63±1.76
-Post CGPA														
χ^2, P	36.57, <0.01**							21.62, <0.01**						
Breathing activity:	8	13.3	29	48.3	23	38.3	5.77±1.77	17	28.3	30	50	13	21.7	4.77±1.77
-Pre CGPA	25	41.7	31	51.7	4	6.7	4.08±1.62	35	58.3	25	41.7	0	0.0	3.08±1.62
-Post CGPA														
χ^2, P	33.54, <0.01**							19.68, <0.01**						
Using of spirometry:	7	11.7	28	46.7	25	41.7	5.95±1.82	15	25	30	50	15	25	4.95±1.81
-Pre CGPA	23	38.3	32	53.3	5	8.3	4.20±1.64	33	55	27	45	0	0.0	3.20±1.64
-Post CGPA														
χ^2, P	33.75, <0.01**							21.90, <0.01**						

Worst possible pain level = 0 CGPA: Cold Gel Pack Applications **highly significant $p < 0.01$

Table (2) shows the percentage distribution of the studied patients according to pain intensity level at different activity pre post cold gel pack applications throughout the study period. It was observed that there was a highly statistically significant decline regarding pain intensity level in relation to different patient activity; activity of cough, mobility, breathing and using of spirometer before and after cold gel pack applications during the 1st and 2nd day $P < 0.01$ **.

Table (3): Mean and standard deviation of critical care pain observational scores among the studied patients in relation to different activities pre post cold gel pack applications throughout the study period.

Critical Care Pain Observational Scores during different activities:	$\bar{x} \pm SD$ Pre CGPA	$\bar{x} \pm SD$ Post CGPA	T test & P Value	$\bar{x} \pm SD$ Pre CGPA	$\bar{x} \pm SD$ Post CGPA	T test & P Value
	1 st Day			2 nd Day		
Cough activity	5.50±1.26	4.18±1.18	19.01 <0.01**	4.50±1.26	3.18±1.18	19.00 <0.01**
Mobility activity	5.07±1.58	3.75±1.36	21.71 <0.01**	4.07±1.58	2.75±1.36	21.74 <0.01**
Breathing activity	4.82±1.61	3.37±1.41	22.38 <0.01**	3.82±1.61	2.43±1.32	19.30 <0.01**
Using of spirometry	4.93±1.56	3.43±1.30	23.04 <0.01**	3.93±1.56	2.43±1.30	23.01 <0.01**

CGPA: Cold Gel Pack Applications

**highly significant $p < 0.01$

Table (3) illustrates the mean and standard deviation of critical care pain observational scores among the studied patients in relation to different activities pre post cold gel pack applications throughout the study period. It was observed that there was highly statistically significant decrease regarding mean and standard deviation of critical care pain observational score among the studied in relation different patient activity; activity of cough, mobility, breathing and using of spirometer pre post cold gel pack applications during the 1st and 2nd day $P < 0.01^{**}$.

Table (4): Percentage distribution of the studied patients according to critical care pain observational scale at different activity pre post cold gel pack applications during the 1st and 2nd day.

Different patients' activity	Critical care pain observational level during (n=60)							
	The 1 st day				The 2 nd day			
	Mild	Moderate	Severe	Un-bearable	Mild	Moderate	Severe	Un-bearable
	%	%	%	%	%	%	%	%
Cough activity:								
-Pre CGPA	0.0	33.3	33.3	33.3	0.0	50	50	0.0
-Post CGPA	0.0	60	36.7	3.3	40	45	15	0.0
χ^2, P	21.07, < 0.01**				35.46, < 0.01**			
Mobility activity								
-Pre CGPA	0.0	41.7	30	28.3	25	30	45	0.0
-Post CGPA	30	28.3	41.7	0.0	41.7	53.3	5	0.0
χ^2, P	37.66, < 0.01**				25.62, < 0.01**			
Breathing activity								
-Pre CGPA	3.3	43.3	31.7	21.7	30	30	40	0.0
-Post CGPA	36.7	33.3	30	0.0	53.3	43.3	3.3	0.0
χ^2, P	30.47, < 0.01**				23.99, < 0.01**			
Using of spirometry								
-Pre CGPA	0.0	46.7	30	23.3	26.7	30	43.3	0.0
-Post CGPA	36.7	31.7	31.7	0.0	53.3	45	1.7	0.0
χ^2, P	37.75, < 0.01**				30.28, < 0.01**			

CGPA: Cold Gel Pack Applications

0.01

**highly significant p <

Table (4) clarifies the percentage distribution of the studied patients according to critical care pain observational scale at different activity pre post cold gel pack applications during the 1st and 2nd day. It was observed that there were highly statistically significant improvements regarding critical care pain observational scale in relation to different patient activity; activity of cough, mobility, breathing and using of spirometer pre post cold gel pack applications during the 1st and 2nd day p < 0.01**.

Table (5): Mean and standard deviation of physiological parameters among the studied patients during different activities pre post cold gel pack applications during the 1st and 2nd day.

Physiological parameters during different activities:	1 st Day (n=60)		T test & P Value	2 nd Day (n=60)		T test & P Value
	$\bar{x} \pm SD$ Pre CGPA	$\bar{x} \pm SD$ Post CGPA		$\bar{x} \pm SD$ Pre CGPA	$\bar{x} \pm SD$ Post CGPA	
Pulse	92.68±7.23	87.80±7.56	16.89 <0.01**	90.25±7.51	85.57±7.59	29.49 <0.01**
Systolic blood pressure	120.5±6.3	115.9±4.1	8.9 <0.01**	118.7±5.9	114.1±4.5	7.6 <0.01**
Diastolic blood pressure	66.9±2.90	65.64±2.59	5.76 <0.01**	66.70±3.01	65.19±24.8	6.23 <0.01**
Respiratory rate	20.8±1.97	18.63±1.4	17.25 <0.01**	20.4±2.31	17.9±1.28	11.76 <0.01**
Oxygen saturation	98.10±1.2	99.3±1.1	9.20 <0.01**	98±1.2	99.6±1.0	10.61 <0.01**

CGPA: Cold Gel Pack Applications

**highly significant $p < 0.01$

Table (5) clarifies the mean and standard deviation of physiological parameters among the studied patients during different activities pre post+ cold gel pack applications during the 1st and 2nd day. It was observed that there were statistically significant differences regarding pulse, systolic blood pressure, diastolic blood pressure, respiratory rate, and oxygen saturation pre post cold gel pack applications during the 1st and 2nd day $p < 0.01$ **.

Table (6): Correlation between sociodemographic characteristics and total mean of pain scores among the studied patients (n=60).

Bio-sociodemographic status	Total mean of pain intensity scores		Total mean of critical care pain observational scores	
	Correlation Coefficient (r)	P- Value	Correlation Coefficient (r)	P- Value
Age	0.500	<0.01**	0.510	<0.01**
Gender	0.857	<0.01**	0.903	<0.01**
Level of education	0.613	<0.01**	0.571	<0.01**
Tobacco smoking	0.830	<0.01**	0.858	<0.01**
Body mass index	0.735	<0.01**	0.635	<0.01**

**highly significant $p < 0.01$

Table (6) shows correlation between sociodemographic characteristics and total mean of pain scores among the studied patients. It can be seen that there were highly significant statistical positive correlation between total mean pain intensity score and total mean of critical care pain observational scores regarding patients' age, gender, level of education, tobacco smoking and total body mass index ($r = 0.500$ & 0.510 , 0.857 & 0.903 , 0.613 & 0.571 , 0.830 & 0.858 , and 0.735 & 0.635 respectively at $p = < 0.01$).

Table (7): Correlation between total mean scores of the physiological parameters and total mean of pain among the studied patients (n=60)

The total mean of the physiological parameters during different activities:	The total mean of pain intensity scores		The total mean of critical care pain observational scores	
	Correlation Coefficient (r)	P- Value	Correlation Coefficient (r)	P- Value
Pulse	0.993	<0.01**	0.981	<0.01**
Systolic blood pressure	0.941	<0.01**	0.946	<0.01**
Diastolic blood pressure	0.953	<0.01**	0.982	<0.01**
Respiratory rate	0.978	<0.01**	0.969	<0.01**
Oxygen saturation	0.973	<0.01**	0.943	<0.01**

**highly significant $p < 0.01$

Table (7) shows the correlation between the total mean scores of the physiological parameters and the total mean of pain among the studied patients. There were statistically significant positive correlation between total mean pain scores and total mean physiological parameters; pulse, systolic blood pressure, diastolic blood pressure, respiratory rate, and oxygen saturation ($r = 0.993$ & 0.981 , 0.941 & 0.946 , 0.953 & 0.982 , 0.978 & 0.969 , and 0.973 & 0.943 respectively at $p < 0.01$).

Discussion:

Pain may be allied with different changes during several activities such as cough activity, mobility, breathing, and use of spirometer among patients undergoing cardiothoracic surgery. Hence, application of superficial cold gel therapy is used to decrease pain intensity during these activities and improves patients' physiological parameters as a response of the autonomic nervous system to pain sensation. Therefore, the present study focused on evaluating the effect of implementing superficial cold gel packs therapy on pain severity among patients post coronary artery bypass graft.

Regarding patients' sociodemographic characteristics, it was found that more than half of the studied patients were in the age group from forty to sixty years old and male. This result was matched with **Khalkhali et al (2014)**⁽²⁴⁾ and **Sweid et al (2021)**⁽¹⁴⁾, who emphasized that the majority of the studied patients were aged between 50 and 60 years old and male.

Regarding psychological features, it can be seen that the vast majority of the studied patients suffered from anxiety while more than two-thirds of them suffered from stress, and isolation respectively. It may be related to anxiety is a normal patients' reaction to a painful situation especially post coronary artery bypass graft. This result was agreed with **Demir and Khorshid (2010)**⁽²⁵⁾, who reported that most studied patients had high anxiety levels before cold applications.

It was observed also that there were highly statistically significant differences regarding pain intensity level in relation to different patient activities such as coughing activity, mobility, breathing, and using of spirometer before and after cold gel pack applications during the 1st and 2nd day. It may be related to the use of pharmacologic interventions as nonsteroidal anti-inflammatory drugs and opioids alone were not effective but when used in a combination with cold gel application therapy pain was controlled. Moreover, applying cold gel packs made the patients' chest more comfortable, relax, and they could take a deep breathing

and coughing easily. Furthermore, cold therapy declined the pain intensity level which enables them to mobile and use spirometers effectively.

This finding was in accordance with **Çevik et al (2020)**⁽²⁶⁾, who investigated that there was a highly statistical and clinically significant reduction in pain scores post-cold gel application. In addition, **Manapunsopée et al (2020)**⁽²⁷⁾, concluded that patients in the study group who were exposed to cold gel application therapy had statistically significantly better recovery of inspiratory muscle strength and decline in pain intensity level post coronary artery bypass graft than patients in the control group. Additionally, **Zencir and Eser (2016)**⁽²⁸⁾, reported that the application of cold gel packs on the sternum wound was effective in eliminating pain during the episodes of deep breathing and coughing exercise.

On the other hand, the findings of this study were contradicted with **Payami et al (2014)**⁽²⁹⁾, who revealed that cold application therapy had no effects on declining pain severity at 15 minutes after cryotherapy. Also, **Mello et al (2014)**⁽³⁰⁾, stated that coughing is the most frequent and common activity accompanied by pain. Additionally, **Naggar et al (2020)**⁽³¹⁾, concluded that there was no statistically significant difference between spirometric volume values and cold gel application therapy during the 1st and 2nd postoperative days.

It was observed that there were highly statistically significant differences regarding the critical care pain observational scale in relation to different patient activities; cough activity, mobility, breathing, and using of spirometer before and after cold gel pack applications during the 1st and 2nd day. It may be attributed to cold gel packs application caused diminished patients' skin temperature and the feeling of coldness and numbness. This finding was supported by **Swid et al (2021)**⁽¹⁴⁾, who found that there was a significant reduction in pain scores on pain intensity and pain distress, as well as the critical care pain observation post the cold gel application therapy in patients undergoing coronary artery bypass grafting.

Concerning total mean scores of physiological parameters before and after cold gel pack applications among the studied patients, it was observed that there were statistically significant regarding pulse, systolic blood pressure, diastolic blood pressure, respiratory rate, and oxygen saturation before and after cold gel pack applications during the 1st and 2nd day. It may be related to the cold application made vasoconstriction which affects the pulse, systolic blood pressure, diastolic blood pressure, respiratory rate, and oxygen saturation and increases the oxygen demand during the 2nd day. These findings were

contradicted **El-Naggar et al (2020)**⁽³¹⁾ and **Sweid et al (2021)**⁽¹⁴⁾, they found that there was no significant difference between pre- and post-intervention regarding respiratory rate and oxygen saturation.

In relation to the correlation between the total mean of pain scores and the total mean of the physiological parameters, the result illustrated that there was a statistically significant positive correlation between total mean pain scores and total mean physiological parameters. The result of the present study was supported by **Mello et al (2014)**⁽³⁰⁾, who clarified that there was an association and positive correlation between total pain mean scores and the presence of physiological changes.

Regarding the correlation between bio-sociodemographic characteristics and total mean pain scores among the studied patients, it was found that there was a highly significant statistical positive correlation between total mean pain intensity score and total mean of critical care pain observational scores regarding patients' age, gender, level of education, tobacco smoking and total body mass index. These findings were in the same line with **Sweid et al (2021)**⁽¹⁴⁾, who concluded that there was a highly significant statistical positive correlation between pain intensity level and patients' age because the patients' pain levels increase with the age. Conversely, **Bjørnnes et al (2018)**⁽³²⁾, reported that there was a negative statistical correlation between total mean pain intensity scores and age and women's marital status

The current study confirmed the hypothesis that superficial cold application supports post coronary artery bypass graft patients during the deep breathing and coughing exercises, using the incentive spirometry and during early ambulation with less incisional pain.

Conclusion:

Based on the findings of the present study, it can be concluded that:

Superficial cold gel pack application had been proven to be effective in declining pain intensity levels as illustrated from total pain mean scores and physiological parameters post coronary artery bypass graft during different patients activities.

Recommendations:

In the light of the findings of the current study the following recommendations are suggested:

- Superficial cold gel pack application has to be exhilarated as a non-pharmacological approach before a painful activity such as coughing and

deep breathing exercises, using incentive spirometry and mobilization post coronary artery bypass graft.

- Application of superficial cold gel pack is effective, cheap, and can decline the need for pharmacological interventions and its side effect.
- Replication of the study on large non probability sampling from different geographical location.

References:

1. Bédard D, Purden MA, Sauvé-Larose N, Certosini C, Schein C. The pain experience of post-surgical patients following the implementation of an evidence-based approach. *Pain Manag Nurs* 2019; 7:80-92.
2. Chailler M, Ellis J, Stolarik A, Woodend K. Cold therapy for the management of pain associated with deep breathing and coughing post cardiac surgery. *Can J Cardiovasc Nurs* 2020; 20:18-24.
3. Edzard E, Veronika F. Ice freezes pain? A review of the clinical effectiveness of analgesic cold therapy. *J Pain Symp Manage* 2018; 9:56-9.
4. Mazzeffi M, Khelemsky Y. Poststernotomy pain: a clinical review. *J Cardiothorac Vasc Anesth.* 2019;25(6):1163-78.
5. Steegers MA, Snik DM, Verhagen AF, van der Drift MA, WilderSmith OH. Only half of the chronic pain after thoracic surgery shows a neuropathic component. *J Pain.* 2018;9(10):955-61.
6. Cogan J. Pain management after cardiac surgery. *Semin Cardiothorac Vasc Anesth.* 2019;14(3):201-4.
7. Apfelbaum JL, Chen C, Mehta SS, Gan TJ. Postoperative pain experience: results from a national survey suggest postoperative pain continues to be undermanaged. *Anesth Analg.* 2013;97(2):534-40.
8. Imani FA, Hasani V, Bazargani B, Entezari SR, Mirdehghan MH. Evaluation of oral gabapentin premedication on postoperative pain after thoracotomy. *Razi Journal of Medical Sciences.* 2019; 16(62):73-9.
9. Shaban MA, Rasoolzadeh N, Mehran AB, Moradalizadeh F. Study of two non-pharmacological methods, progressive muscle relaxation and music, on pain relief of cancerous patients. *Journal of hayat.* 2016; 12(3):63-72.
10. Mazloun SR, Abbasi Teshnizi M, Kianinejad A, Gandomkar F. Effect of applying Ice bag on pain intensity associated with chest tube removal after cardiac surgery. *The Horizon of Medical Sciences.* 2020; 18(3):109-14.
11. Hasanzadeh F, Kashouk NM, Amini S, Asili J, Emami SA, Vashani HB, et al. The effect of cold application and lavender oil inhalation in cardiac surgery patients undergoing chest tube removal. *EXCLI J* 2016; 15:64-74.

12. Nabila E. Saboula, Amal A. Hussein , Abeer G. A. Habouh. Effect of Home-based-Nursing Intervention on Knowledge, Daily Living Activities and pain for Patients after Coronary Artery Bypass Graft. *Tanta Scientific Nursing Journal*. 2020; 18(1):134-59
13. World Health Organization (WHO). Cardiovascular diseases, fact sheet 2019. Retrieved on <http://www.who.int/mediacentre/factsheets/fs317/en/>. Available at August 2021.
14. Sweid M, Taha N, Adel B, Refaat F. International Journal of Africa Nursing Sciences Effect of cold application on incisional pain associated with incentive spirometry after coronary artery bypass graft surgery. *Int J Africa Nurs Sci*. 2021; 15:100315.
15. Marek Zubrzycki, Andreas Liebold1 Christian Skrabal, Helmut Reinelt, Mechthild Ziegler, Ewelina Perdas, Maria Zubrzycka. Assessment and pathophysiology of pain in cardiac surgery. *Journal of Pain Research*,2018; 8:11 1599-611.
16. McCaffery, M., Beebe, A., Latham, J., & Ball, D. *Pain Clinical Manual of Nursing Practice*. London, Mosby.1994.
17. Lister S, Hofland J Grafton H Wilson C. *The Royal Marsden Manual of Clinical Nursing Procedures*. UK, John Wiley & Sons. 2021.
18. Peate I, Wild K. *Nursing Practice: Knowledge and Care*. UK, John Wiley & Sons.2018.
19. Rijkenberg S, Stilma W, Bosman RJ, Meer NJ, Voort PHJ. Pain measurement in mechanically ventilated patients after cardiac surgery: comparison of the behavioral pain scale (BPS) and the critical-care pain observation tool (CPOT). *Journal of Cardiothoracic and Vascular Anesthesia*. 2017; 31(4), 1227-34.
20. Zaccagnino MP, Nedeljkovic SS. *Pain Assessment Tools in Pain Medicine*. Cham, Springer.2017,77-81
21. G'elinas C, Fillion L, Puntillo KA, Viens C, Fortier M. Validation of the critical-care pain observation tool in adult patients. *American Journal of Critical Care*.2006;15(4), 420-7.
22. Koc M, Tez M, Yolds O, Dizen H, Gocmen E. Cooling forthe reduction of postoperative pain: prospective randomized study. *Hernia* 2016; 10:184-6.
23. Ivey M, Johnston RV, Uchida T. Cryotherapy for postoperative pain relief following knee arthroplasty. *J Arthroplasty* 2014; 9:285-90.
24. Khalkhali HR, Tanha ZR, Feizi R, Salehi S. 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*. 2014; 19(6):545-9.
25. Demir Y, Khorshid L. The effect of cold application in combination with standard analgesic administration on pain and anxiety during chest tube removal:

- A single-blinded, randomized, double-controlled study. *Pain Manag Nurs.* 2010; 11:186-96.
26. Çevik K, Serpil IN, Çetin SP, Tetik Ö. 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.* 2020;7(1):76-80.
 27. Manapunsopée S, Thanakiatpinyo T, Wongkornrat W, Chuaychoo B, Thirapatarapong W. Effectiveness of incentive spirometry on inspiratory muscle strength after coronary artery bypass graft surgery. *Heart, Lung and Circulation.* 2020; 29(8):1180-6.
 28. Zencir G, Eser I. Effects of cold therapy on pain and breathing exercises among median sterno-tomy patients. *Pain Management Nursing.* 2016;17(6),401-10.
 29. Payami MB, Daryei N, Mousavinasab N, Nourizade E. Effect of cold application in combination with Indomethacin suppository on chest tube removal pain in patients undergoing open heart surgery. *Iran J Nurs Midwifery Res* 2014;19(1):77-81.
 30. Mello LC, Rosatti SF, Hortense P. Assessment of pain during rest and during activities in the postoperative period of cardiac surgery. *Rev Lat Am Enfermagem.*2014;22(1):136-43.
 31. El-Naggar MR, Zahra AI, Kanona AA, El-Sheikh AA. Effect of cold gel pack on controlling pain intensity associated with deep breathing and coughing exercise after cardiac surgery. *IOSR Journal of Nursing and Health Science (IOSR-JNHS).* 2020;6(1):22-50.
 32. Bjørnnes AK, Lie I, Parry M, Falk R, Leegaard M, Rustøen T, Valeberg BT. Association between self-perceived pain sensitivity and pain intensity after cardiac surgery. *Journal of pain research.* 2018; 11:1425-32.

الملخص العربي

تأثير وضع عبوات الهلام البارد السطحي على الألم الجراحي خلال أنشطة المرضى المختلفة بعد عملية تغيير مسار الشريان التاجي

المقدمة: أكثر الأنشطة المؤذية خلال الأيام التي تلي جراحة القلب هي السعال وتمارين التنفس العميق ، واستخدام قياس التنفس التحفيزي ، والتعبئة. ومن ثم ، فإن العلاج بالهلام البارد السطحي هو طريقة غير دوائية فعالة تتحكم في الألم أثناء السعال ، والتنفس العميق ، واستخدام قياس التنفس التحفيزي ، والتعبئة. الهدف: تقييم تأثير تطبيق عبوات الهلام الباردة السطحية على الألم الجراحي أثناء أنشطة المرضى المختلفة بعد عملية تغيير مسار الشريان التاجي.

مكان الدراسة: أجريت الدراسة في وحدة رعاية القلب والصدر التابعة لمستشفى الحسين الجامعي بالقاهرة. التصميم: تم استخدام تصميم بحث شبه تجريبي لإجراء هذه الدراسة باستخدام نهج الاختبار القبلي والبعدى. **العينة:** تم تضمين عينة هادفة من 60 شخصًا بالغًا واعين تمامًا بعد الجراحة بالقلب والرنين تم قبولهم حديثًا في وحدة العناية المركزة لجراحة القلب المفتوح في الدراسة الحالية. **الأدوات:** تم استخدام ثلاث أدوات لجمع البيانات (الأداة الأولى) التقييم الذاتي للألم ، (الأداة الثانية) درجة شدة الألم ، (الأداة الثالثة) وتقييم الألم الموضوعي.

النتائج : أوضحت وجود فروق ذات دلالة إحصائية عالية فيما يتعلق بدرجات الألم الكلية والمؤشرات الفسيولوجية قبل وضع الجل البارد السطحي بعد ذلك. كما كان هناك تحسن في متوسط الدرجات الإجمالية للمؤشرات الفسيولوجية للمرضى في جراحة ما بعد القلب.

الخلاصة: ثبت أن استخدام عبوات الهلام البارد السطحي فعال في خفض مستويات شدة الألم كما هو موضح من مجموع متوسطات الألم والمعايير الفسيولوجية بعد الكسب غير المشروع لتجاوز الشريان التاجي أثناء مختلف أنشطة المرضى.

التوصيات: يوصي باستخدام الجل البارد السطحي ليكون مبهجًا كنهج إدارة غير دوائية قبل السعال وتمارين التنفس العميق ، باستخدام قياس التنفس التحفيزي والتعبئة. بالإضافة إلى ذلك ، فإن تطبيق العلاج بالهلام البارد فعال ورخيص ويمكن أن يقلل الحاجة إلى التدخلات الدوائية وأثاره الجانبية بعد عملية تغيير مسار الشريان التاجي. وأخيرًا ، تكرار الدراسة على عينات غير احتمالية كبيرة من مواقع جغرافية مختلفة.