Chest Tube Removal: Efficacy of Cold Application and Breathing Exercise on Pain and Anxiety Level

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ABSTRACT

***Context*:** Post-cardiothoracic surgical chest tube removal (CTR) is considered a painful technique and one of the most painful patients' experiences in the intensive care unit. Painkillers are the most prevalent method to relieve the pain, but the patient may not respond well and achieved complete relaxation. Regardless of scientific advances, no efficient action is possessed to decrease pain and anxiety because of it.

Aim: This study aimed to investigate the efficacy of cold application and breathing exercises on pain and anxiety levels following chest tube removal.

Methods: A quasi-experimental design (one group pre/post-test) was utilized to achieve the aim. This study was conducted in the Intensive Care Unit at the Cardio-Thoracic Academy Affiliated to Ain Shams University Hospital, Cairo. A Purposive sample included 60 patients undergoing cardiothoracic surgical procedures and having at least two chest tubes in place. Data were collected using three tools; a structured interviewing questionnaire, pain intensity assessment visual numeric scale, short-form McGill pain assessment questionnaire, modified comfort scale, and breathing exercise checklist.

Results: This study revealed that patients suffer from severe pain before CTR without cold application and breathing exercise (61.7%), or with the application of them (66.7%), the pain level improved during removal as 80% of patients display no pain when using the cold application and breathing exercise that increased to 95% after 10-15 minute of removal compared to 8.3% when cold application and breathing exercise not used. Otherwise, the anxiety level decreased during CTR as 58.3% had mild anxiety level with cold application and breathing exercises compared to 38.3% had a very severe anxiety level. Mild anxiety level increased to 91.7% after 10-15 minutes of CTR compared to 16.7 % when CTR without application.

Conclusion: Cold application and breathing exercises are useful for reducing patients' pain and anxiety levels associated with chest tube removal after cardiothoracic surgery. Encouraging critical care nurses to use cold application and breathing exercises as a non-pharmacological pain relief technique during chest tube removal was highly recommended.

Keywords: Chest tube removal, pain, anxiety, cold application, breathing exercise

1. Introduction

According to the American Heart Association, annually, more than 448,000 patients underwent cardiothoracic surgery, including coronary artery bypass grafting (CABG), valve replacement, or repair of structural defects *(Islam et al., 2020).* Many cardiothoracic patients need a chest tube insertion in either emergency or non-emergency situations with eventual removal. These chest tubes are inserted to drain accumulated air, blood, and fluid from the chest cavity *(Mohammadi et al., 2018).* By stopping these accumulations, severe complications can be avoided to the heart and the lung. Nurses should be routinely assessing the tube function and document how much drainage is coming from the tube *(Hsieh et al., 2017).*

It is vital to put in a chest tube in all types of cardiothoracic surgeries to maintain the heart and lungs' function and prevent pneumothorax, hemothorax, and pleural effusion *(Chawla et al., 2020).* The chest tube is generally removed within 24 to 48 hours after surgery when the excess air, blood, or fluid has been adequately drained, and respiratory sounds are normal *(Dave, 2016).* Chest tube removal (CTR) is a painful and frightening experience for patients who have moderate to severe pain, and unfortunately, their pain was managed very poorly. Chest tube considering obstinacy to the surrounding tissues, its separation from the adjoined tissues is painful *(Payami et al., 2014).*

This pain resulting from chest endothelial tissue adhered to the tip of the tube, and at the time of removal, the withdrawal force will mow this adhesion resulting in severe pain. Numerous researches indicated that the patients always described CTR as one of the worst experiences that can face. The patients described their pain after cardiothoracic surgeries with expressions as burning, distressing, tender, exhausting, and disturbing more often on postoperative days two and three. Anxiety and inconvenience are unfavorable feelings resulting from the pain associated with chest tube removal *(Naseri, 2015).*

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Pain management is considering the highest nursing priority, and there is no consensus about controlling pain following CTR. At the same time, the usual method to control pain is the prescription of analgesics. Research has revealed that CTR is painful despite using analgesics and anesthetics *(Jafari et al., 2017; Kunter & Gezer, 2019)*. Besides, pharmacological ways are expensive and may lead to complications. The nurse plays a vital role in pain management by administering painkillers, which is the most popular intervention used in a diverse situation for pain management. Although analgesics are considered the most effective intervention for relieving pain during chest tube removal, the critical care nurse can manage pain during chest tube removal using non-pharmacological methods. Pain-relieving manners such as cold application and breathing exercises were substituting for the administration of analgesics or pain-relieving medications as Opioids and Non-Steroidal Anti-Inflammatory Drugs (NSAID), which is the most common. Administration of analgesics is associated with side effects such as respiratory distress, nausea, itching, and gastrointestinal bleeding *(Chen et al., 2017; Sheykhasadi et al., 2019).*

Anxiety, fear, and other unpleasant emotional experiences are common among patients after cardiovascular interventional procedures are primarily related to CTR. Patients describe the procedure using words as "distressing" and" fearful" *(Chandrababu et al., 2019).* Anxiety is a feeling distinguished by stimulation of the sympathetic nervous system that increased general response to tachycardia, blood pressure, respiration, reduced chest dilatation, respiratory dysfunction with hypoxemia, and muscle tone resulted from the pain associated with CTR *(Aktaş & Karabulut, 2019).* No suspicion of poorly managed procedural pain results in significant stress for many patients. The higher anxiety may affect the prognosis and recovery of patients *(Yarahmadi et al., 2018).*

Cold applications are commonly used as alternative or adjacent. It has been accepted for decades as an effective non-pharmacological method for pain control by slowing down tissue metabolism and nerve conduction velocity locally and has vasoconstrictive, anti-inflammatory, antispasmodic, and analgesic effects *(Bastani et al., 2016).* The main effect of cold during recovery is the cold-related vasoconstriction that may decrease vessel permeability. Thus, ice is believed to help pain control by inducing local anesthesia around the treatment area and decreases edema *(Çevik et al., 2020)*. Studies have displayed that the implementation of cold can lead to pain management and increase the pain threshold. So, it is advised that cold application be implemented for 20 minutes at two-hour intervals *(Hasanzadeh et al., 2016; Shin et al., 2018).*

Deep breathing exercise is another non-pharmacological method in pain management *(Kunter & Gezer, 2019).* Keeping in mind that anxiety can cause pain and pain also can cause anxiety. Breathing exercise is a component of various relaxation techniques reported as complementary approaches in the management of pain, makes a state of relaxation associated with the absence of physical, mental, emotional stress, and can help manage pain both physiologically and psychologically. Physiologically, relaxation leads to a decrease in or reversal of the sympathetic response to pain leading to a reduction in oxygen consumption, blood pressure, heart rate, and respiration. Pain influences respiration by increasing its flow, frequency, and volume. Furthermore, paced, slow breathing is associated with pain reduction *(Aktaş & Karabulut, 2019).* Psychologically, relaxation leads to reducing stress, anger, misunderstood, and anxiety in patients who provide psychological resources to cope with their physical condition *(Khalkhali et al., 2014; Ayyasi et al., 2019).*

2. Significance of The Study

Inserting chest tubes after cardiac surgery aimed to maintain heart and lung functioning *Kunter & Gezer, 2019; Chawla et al., 2020)*. Keeping CTs in place, however, is associated with increased pain and discomfort for the patient, mechanical irritation of the heart and pericardium, and an increased incidence of infection *(Mazloum et al., 2018).* However, in Egypt, there are no national statistics available about cardiothoracic surgery. Meanwhile, the cardiothoracic academy's medical records at Ain Shams University hospital revealed that the number of patients who had undergone cardiothoracic surgery (2018/ 2019) was 2160 patients.

Patients who have undergone cardiothoracic surgery reported moderate to severe pain during chest tube removal. This pain significantly affects a patient's life, leading to a prolonged hospital stay and increasing the patient's anxiety level, leading to hemodynamic instability. All these leads to excessive abuse of painkillers, which have many side effects. Our study aimed to explore the effect of cold application and breathing exercises as non-pharmacological methods to decrease pain and anxiety levels without harming the patient.

3. Aim of The Study

The current study aimed to investigate the efficacy of cold application and breathing exercises on pain and anxiety levels following chest tube removal.

3.1. Research Hypotheses

H1. Patients who applied cold application and performed breathing exercises will have significantly less pain intensity during and after CTR than the time without cold application and breathing exercise.

H 2. Patients who applied cold application and performed breathing exercises will have significantly less anxiety during CTR than time without cold application and breathing exercises.

4. Subjects and Methods

4.1. Research design

A quasi-experimental design pre/post-test one-group design was used in this study. The researchers took the same patient, and no control group was taken because pain is subjective, and the pain threshold differs from person to another, so pre/post-test one group was chosen.

It is used to guess the effect of an intervention in the absence of randomization. In the pre-test/post-test research design, the research involves measuring salient outcomes both before displaying the sample to a stimulant of some kind and after exposure to the stimulant. By constructing an experiment in this direction, a researcher can appraise alteration in targeted outcomes to be exposed to the stimulant *(Braddock, 2019).* The post-test permits the researchers to decide the immediate effects of the treatment on the outcome variable(s). In addition to the pre-test and immediate post-test, a delayed post-test or post-test is often included to examine the longer-term treatment effects *(Rogers & Révész, 2020).*

4.2. Research Setting

The study was conducted at the postoperative Intensive Care Unit at the Cardiothoracic Academy affiliated to Ain Shams University Hospital, Cairo. Post open heart surgery ICU contains 17 beds, 11 beds with 11 ventilators and monitors distributed in one room, and intermediate ICU contains six beds with six monitors and four ventilators, located on the hospital's 8th floor.

4.3. Subjects

A purposive non-probability/nonrandomized sample of sixty patients undergoing cardiothoracic surgical procedures and having at least two chest tubes in place. They fulfill the following inclusion and exclusion criteria.

Inclusion criteria

- Both gender
- Oriented to place and time
- Able to verbally report Pain
- First-time insertion of the chest tube having at least two chest tubes.
- The interval between two chest tube removal at least one hour.

Exclusion criteria

- Patients on mechanical ventilation support.
- Patients with communication problems.
- Unconscious patient
- Oversensitivity to cold
- Any psychiatric disease or mental disabilities prevent patients from notifying pain and anxiety during chest tube removal.

The sample size was specified statistically by power analysis considering the total number of patients after cardiothoracic surgery (2018/2019).

Type I error with significant level α= 99%

Type II error by power test β= 95%

4.4. Tools of data collection

4.4.1. Structured Interviewing Questionnaire

It was designed by the researcher to collect demographic data from the patients' medical records regarding age, gender, educational level, occupation, and clinical data, which include BMI, type of surgery, previous surgeries, duration of chest tube placement, history of chronic pain, type of chest tube, vital signs and receiving cold application before.

4.4.2. Visual Numeric Scale (VNS)

It was used to assess pain intensity. It was developed by *Ritter et al. (2006)* to obtain the advantage of numeric scales' lineaments whereas supplying diverse visual signs. The VNS seemed to be a valid measure was reliable at 0.85. It was as effective as the VAS in measuring the underlying pain variable. It was easier to administer and sign than the VAS and was sensitive to alteration in pain. It is self-completed by the respondent who was asked to circle the number below VNS grade to clarify their pain intensity. It is a 10-points rating scale (0= no pain, 10= worst pain imaginable). The ranges include 0 =no pain, 1-3 mild pain, 4-6 moderate pain, and 7-10 severe pain. VNS was assessed three times during our study (before CTR, during CTR, and 10-15 min. after CTR.

4.4.3. The Short-Form McGill Pain Questionnaire

The short-form McGill Pain Questionnaire (SF-MPQ) is a shorter, less time-consuming version of the original MPQ *(Melzack, 1975),* was modified later in 1987 and evaluated for its reliability by *Grafton et al. (2005)* to measure the different qualities of the subjective complaints of pain experience and to control the effects of pain relief.

It contains 15 descriptors (sensory with 11 words, and affective with four words). The researchers omitted some items to suit the study (seven descriptors from sensory dimension as shooting, cramping, gnawing, hot-burning, tender, splitting and aching, and two descriptors from the affective dimension sickening and punishing-cruel).

The scale consists of 6 words describing the pain instead of 15 words, four sensory descriptors as throbbing, stabbing, sharp, heavy, and two affective descriptors as tiring-exhausting and fearful, and which are rated on an intensity scale as 0 =none, 1 = mild, 2 = moderate or 3 = severe for each, with a total score range from 0– 18, where 0 no pain, 1-6 indicates discomforting, 7-12 distressing, and 13-18 horrible. SF-MPQ was assessed three times during our study (before CTR, during CTR, and 10-15 min. after CTR).

The measurement is by aggregating the mark values for six responses. They are six words, four words for the sensory dimension of pain (i.e., the quality of the pain) and two words for the affective dimension of pain (i.e., how the pain affects you)

. The total score of SF-MPQ calculated based on the score from Visual Numeric Scale 0/10 added to sensory and affective dimensions. Higher scores generally indicated to a worsened subjective experience of pain. The inference was made:

4.4.4. Modified Comfort Scale

It was adapted from the *National Institute of Health (2003)* to measure anxiety level severity. It was assessed three times during our study (before CTR, during CTR, and 10-15 min. after CTR). The researcher omitted some items to suit our study's aim and test it for content validity and reliability. The scale consists of 6 items: calmness,

cardiovascular symptoms, autonomic symptoms, respiratory symptoms, blood pressure, and heart rate. Each item was rated on a 5-point scale, ranging from 1 (not present) to 5 (severe), with a total score range from 6-30, where ≤6 no anxiety, 7-12 indicates mild anxiety level, 13-18 moderate anxiety level, 19-24 severe anxiety level, and 25-30 very severe anxiety level. The scale's consistency was examined in a study of two hundred fifty-seven adults, and alpha Cronbach's was 0.95 in their study *(Houston & Jesurum, 1999).*

4.4.5. Breathing Exercise Checklist

The observational checklist included deep breathing exercises (9 steps), developed by researchers after reviewing the relevant literature *(Khalkhali et al., 2014; Ayyasi et al., 2019).* One grade was given to the step done correctly and zero grade to the step, which was done incorrectly or not done. The satisfactory level started from ≥ 90% (≥8 grades).

4.5. Procedures

The researcher assessed the tool face and content validity of the suggested tools through a jury of seven experts. They were two assistant professors and three professors of Medical-Surgical Nursing, and two professors of cardiothoracic surgery. They reviewed the instrument for clarity, relevance, comprehensiveness, understanding, and easiness for administration. Minor modifications were required.

Alpha Cronbach test was used to measure the internal consistency of the study tools. The Short-Form McGill Pain Questionnaire was reliable at 0.85, VNS was reliable at 0.85, Modified Comfort Scale was reliable at 0.91, and the breathing exercise checklist was reliable at 0.95.

Preparatory phase: The pivotal authorized consents were gained from the directors of the Cardiothoracic Intensive Care Unit (ICU). Letters of the request were publicized to them from the Faculty of Nursing at Ain Shams University, clarifying the study's objective and its expected outcomes.

Ethical considerations: An official permission was taken from the hospital administrators. The researchers clarified the objectives and aim of the study to patients included in the study. To protect patients' rights in the study's scope, before the initial interview, oral consent was secured from each patient after being aware of the nature, objective, and benefits of the study. Patients were acquainted that sharing is willing and could withdraw at any time without giving reasons. Confidentiality was assured by declaring that the personal information protected private after being shared with the researchers and assured patients that the information would be utilized only for the research purpose. Moreover, the intervention used in the current study is safe and not causing any harm to participants.

Once authorization was awarded for going ahead with the suggested study, a pilot study was executed before starting data collection on six targeted patients (10% of the total number of the study sample) from the previously mentioned setting according to the inclusion criteria. They were excluded from the main sample to evaluate the feasibility of fieldwork, the clarity, applicability of the tools, and appreciate the time needed to collect data to detect any possible obstacles that might face the researchers and interfere with data collection.

The study analysis of feasibility revealed that the patient's pain experience before CTR of each tube was not different. A pilot study also revealed that half an hour duration of ice pack gel application was convenient for the patients as verbalized that the tube site is anesthetized to touch.

Implementation phase: Fieldwork was carried out from the beginning of August 2019 until February 2020, including developing the tools. It was based on reviewing recent and relevant literature regarding pain, anxiety, and chest tube. The researchers were visiting the cardiothoracic ICU in the morning shift for 2-days/week. Data collection was done by the researchers using the same tools for the same patient as one CTR done without any intervention, only routine ICU care during CTR and the another CTR with the intervention (applying cold application and breathing exercise), the interval between the first CTR and the second at least one hour. The researchers apply intervention for the same patient, and the three measurements were done for the same patient because the pain threshold differs from one patient to another, and many factors affect the sensitivity of pain such as age, gender, and deposit of fat.

The first interview: The first time the researcher converged, the participants deemed the baseline measure. Data collection included filling the demographic questionnaire and clinical data. During the first interview, the researchers elucidated how to utilize the Visual Numeric Scale for Pain to assess pain intensity during CTR. The researcher also clarified to the participants that the pain intensity and anxiety level would be assessed three times. The first time for measurement during the first CTR without any intervention (1st measurement).

Another CTR with the intervention was done by applying cold application with a cooling gel pack by researchers. Cold gel packs were preserved in the freezer for at least 2 hours. Then were covered with a single layer of sterile gauze and were applied to the area surrounding the chest tube for 15-20 minutes before the CT withdrawal.

Deep Breathing Exercise Technique: The researchers trained the participants through demonstration and re-demonstration techniques using deep breathing exercises observation checklist. Participants were commanded to inhale judiciously and deeply via their nose and exhale bit by bit through semi-closed lips, all with closed eyes for 5 minutes. In the last 5 minutes of cold application, the researchers asked the participants to do breathing exercises, and then the chest tube was removed.

Evaluation phase: The researchers asked the patients to rate the pain intensity and anxiety level they were felt in the chest tube during removal with cold application and breathing exercise. Pain intensity and anxiety level were measured immediately (2nd measurement), and 10-15 minutes after chest tube removal (3rd measurement).

4.6. Data analysis

The data was organized and tabulated using a personal computer. Statistical Package for Social Science (SPSS) version 20 was utilized. Data were presented using descriptive statistics in the form of frequencies and percentages. T-test was utilized as an inferential statistic was used to investigate the effects of cold application and breathing exercise on the changes in pain intensity and anxiety level at three times: before, immediately after, and 10-15minutes after the chest tube was removed. The chi-square test was used to identify the relationship between qualitative variables, and Mean±SD also was used. Statistical significance was considered at p-value ≤ 0.05, and < 0.001 was considered highly significant.

5. Results

Table 1 shows that 40 % of the study group had age 50 years or more with a mean age of 37.85±6.12. Regarding patients' gender, it was found that 61.7% of patients were males. 51.7% cannot read or write; 53.4% of them their work needs physical effort. Mean and standard deviation of body mass index was 26.27±4.31, 68.3% of them had undergone CABG, 81.7% had no previous surgeries, 78.3% had a duration of chest tube placement between 24 -> <36 hours, 85.0% had no history of chronic pain and 83.4% of the study group had not received the cold application before.

Figure 1 illustrates that 88.3% of the studied patients had pleural chest tube, 68.3% had retrocardial, and 55.0% had a retrosternal type of chest tube.

Table 2 demonstrates the mean pain scores at the three-time points (before, during, and 10-15 minutes) after chest tube removal. There was no statistically significant difference in the baseline pain intensity among the studied patients before CTR with and without cold application and breathing exercises (p>0.05). Simultaneously, there were highly statistically significant differences in the mean pain scores during and 10-15 minutes after chest tube removal between the cold application and breathing exercises and without applying them (p<0.001).

Table 3 reveals no statistically significant difference in the mean anxiety scores of the study group before CTR with and without cold application and breathing exercises at (p>0.05). In comparison, there were highly statistically significant differences in the mean anxiety scores during and 10-15 minutes after chest tube removal with and without the cold application and breathing exercises at (p<0.001).

Figure 2 illustrates the percentage distribution of pain levels during the three measurements. It was noted that patients suffer from severe pain before CTR either without cold application and breathing exercise (61.7%) or applying them (66.7%). The pain level improved during removal as 80% of patients display no pain when using the application of cold and breathing exercises that increased to 95% after 10-15 minutes of removal compared to 8.3% when cold application and breathing exercise were not used.

Figure 3 shows the percentage distribution of anxiety levels during the three measurements. It was noted that patients suffer from very severe anxiety levels before CTR either without cold application and breathing exercise (33.3%) or with their application (36.7 %). The anxiety level decreased during CTR as 58.3% had mild anxiety level with the application of cold and breathing exercise increased to 91.7% after 10-15 minutes of CTR compared to 16.7 % when CTR without application.

Table 4 reveals a non-statistically significant difference in the hemodynamic parameters among the studied patients with and without cold application and breathing exercises before CTR (P>0.05). In contrast, there were highly statistically significant differences in the hemodynamic parameters during and 10-15 minutes after chest tube removal with the cold application and breathing exercises at (P<0.001). It was noted that patients suffer from elevation BP, the elevation of HR, tachypnea, and shortness of breath during CTR without application was 61.7%, 56.7%, 60%, and 40%, during CTR respectively. Meanwhile, the hemodynamic parameters improved during CTR by applying the cold packs and breathing exercises as 11.7%, 13.3%, 16.7%, and 8.3%, respectively.

Additionally, patients suffer from elevated BP, elevated HR, tachypnea, and shortness of breath 10-15 min after CTR without application was 46.7%, 48.3%, 48.3%, and 28.3%, respectively. The hemodynamic parameters improved 10-15 min after CTR with application were 3.3%, 3.3%, 3.3% and 0.0% respectively.

Table 5 represents the relation between the level of pain and selected demographic characteristics. It is noticed that there is a high statistical significant association between the level of pain, pleural type of chest tube, history of previous surgeries, and duration of chest tubes placement at (p<0.001), and there is no significant association in the level of pain with age, gender, and BMI.

Table (1): Number and percentage distribution of the study sample demographic characteristics (n=60).

Characteristics	N	%
Age		
20- < 30	9	15.0
30- <40	11	18.3
40- <50	16	26.7
50 or more	24	40.0
Mean±SD	37.85±6.12	
Gender		
Male	37	61.7
Female	23	38.3
Education Level		
Cannot read or write	31	51.7
Read & write	19	31.7
High education	10	16.7
Occupation		
Unemployed	17	28.3
Need physical effort	32	53.4
Need mental effort	11	18.3
BMI		
<18.5	4	6.7
18.5- 24.9	31	51.7
25- 29.9	25	41.7
Mean±SD	26.27±4.31	
Type of surgery		
CABG	41	68.3
Valve surgeries	19	31.7
Previous surgeries		
Yes	11	18.3
No	49	81.7
Duration of chest tube placement		
24 -> <36 hours	47	78.3
36 -48 hours	13	21.7
History of chronic Pain		
Yes	9	15.0
No	51	85.0
Received Cold Application Before		
Received	10	16.6
Not received	50	83.4

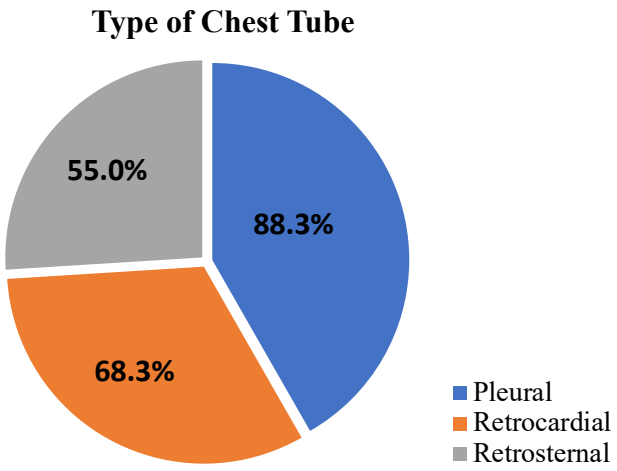

Figure (1): Percentage distribution of types of chest tube among the study group.

Table (2): Comparison of pain mean score with and without CTR cold application and breathing exercise at the three measurements (n=60).

Pain intensity	CTR without Cold Application and Breathing Exercise	CTR with Cold Application and Breathing Exercises	T-test	
	Mean±SD	Mean±SD	t	P-value
Before CTR	3.50±0.75	3.60±0.62	0.799	0.426
During CTR	3.60±0.56	1.23±0.50	24.463	<0.001
10-15 min after CTR	3.17±0.96	1.05±0.22	16.654	<0.001

Table (3): Comparison of anxiety mean score with and without CTR cold application and breathing exercise at the three measurements (n=60).

Anxiety level	CTR without Cold Application and Breathing Exercises	CTR with Cold Application and Breathing Exercises	T-test	
	Mean±SD	Mean±SD	t	P-value
Before CTR	4.03±0.86	4.03±0.94	0.000	1.000
During CTR	4.22±0.72	2.50±0.65	13.749	<0.001
10-15 min after CTR	3.53±1.05	2.08±0.28	10.347	<0.001

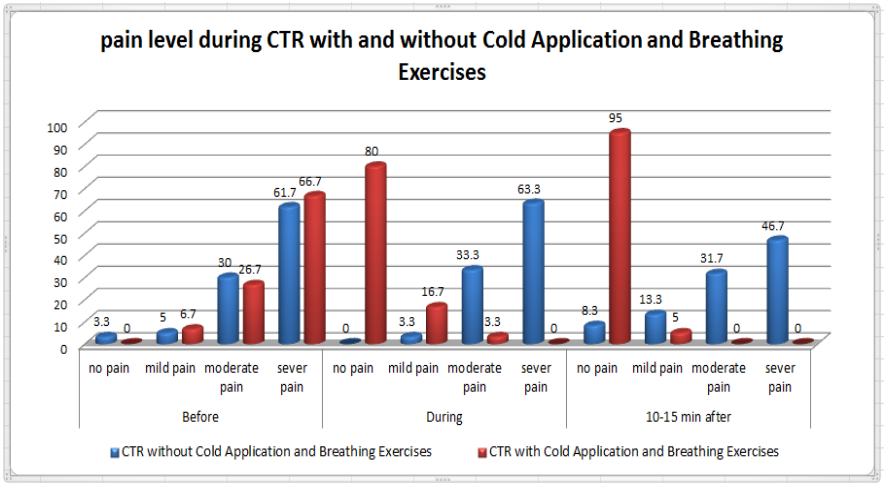

Figure (2): Percentage distribution of pain level before, during, and after CTR with and without cold application and breathing exercises.

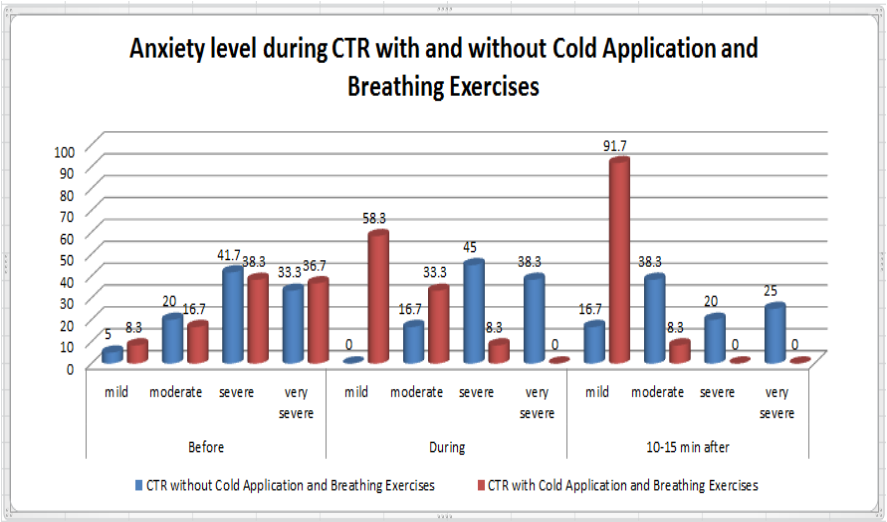

Figure (3): Percentage distribution of anxiety level before, during, and after CTR with and without cold application and breathing exercises.

Table (4): Comparison of hemodynamic parameters before and after CTR with and without cold application and breathing exercises (n=60).

Hemodynamic parameters		CTR without Cold Application and Breathing Exercises		CTR with Cold Application and Breathing Exercises		Chi-square	
		N	%	N	%	X^2	P-value
Before CTR							
Blood Pressure	BP below baseline	20	33.3	22	36.7	0.311	0.856
	BP at baseline	6	10.0	7	11.7		
	Elevation of BP	34	56.7	31	51.7		
pulse rate	HR Below baseline	19	31.7	20	33.3	1.303	0.521
	HR at baseline	9	15.0	5	8.3		
	Elevation of HR	32	53.3	35	58.3		
Respiration Rate	Normal	0	0.0	0	0.0	1.292	0.256
	Tachypnea	41	68.3	35	58.3		
	Shortness of Breath	19	31.7	25	41.7		
During CTR							
Blood Pressure	BP below baseline	23	38.3	9	15.0	70.580	<0.001
	BP at baseline	0	0.0	44	73.3		
	Elevation of BP	37	61.7	7	11.7		
pulse rate	HR Below baseline	24	40.0	12	20.0	54.476	<0.001
	HR at baseline	2	3.3	40	66.7		
	Elevation of HR	34	56.7	8	13.3		
Respiration Rate	Normal	0	0.0	45	75.0	72.144	<0.001
	Tachypnea	36	60.0	10	16.7		
	Shortness of Breath	24	40.0	5	8.3		
10-15 min after CTR							
Blood Pressure	BP below baseline	18	30.0	4	6.7	54.972	<0.001
	BP at baseline	14	23.3	54	90.0		
	Elevation of BP	28	46.7	2	3.3		
pulse rate	HR Below baseline	17	28.3	3	5.0	57.678	<0.001
	HR at baseline	14	23.3	55	91.7		
	Elevation of HR	29	48.3	2	3.3		
Respiration Rate	Normal	14	23.3	58	96.7	67.405	<0.001
	Tachypnea	29	48.3	2	3.3		
	Shortness of Breath	17	28.3	0	0.0		

6. Discussion

Chest tube insertion following cardiac surgery is considered a frequent practice. Patients who undergo CTR experienced moderate to severe pain. Patients incessantly characterize chest tube removal as a distressing and fearful experience (Sinha et al., 2016; Ay, 2018). Cold application and deep breathing exercises are efficient non-medicinal manners to reduce pain and anxiety during chest tube removal (El Mokadem & Ibraheem, 2017). The current study hypothesized that patients exposed to cold application and performed breathing exercises would have significantly less pain intensity and less anxiety during and after CTR compared to CTR time without cold application and breathing exercise. The finding of this study supports the research hypotheses.

Concerning the demographic characteristics, the present study's findings elucidated that two-fifth of the study sample was more than 50 years. The increased incidence of cardiac diseases could be explained as normal physiological changes of aging, and the morphological changes occur inside blood vessels. This finding is contradicted with Keawnantawat et al. (2018), who reported in their study that the mean (SD) of age was 54.74 (14.20). Concerning gender, more than half of them were males. This finding may be due to more stress from heavy physical activities in males than females with limited ways to express emotional stress. This finding is following Mohammadi et al. (2018), who reported that more than half of the studied patients were males.

Besides, more than half of the sample could not read or write. This finding might be due to decreased social standards for patients attending Ain Shams University hospital for medical treatment. This result is following Mazloum et al. (2018), who reported that more than three-quarters of the study sample could not read or write and contradicted with El Mokadem and Ibraheem (2017), who reported that two-thirds of the study sample was highly educated.

Regarding BMI, more than half of the studied sample was between 18.5-24.9 with a mean (SD) of 26.27±4.31 kg/cm2. This finding due to extra fat deposition, which leads to increased liability to atherosclerotic changes. This finding agreed with Gorji et al. (2014), who reported that the body mass index (BMI) mean score of 26.16 ± 2.61 kg/cm2. Regarding the type of surgery, more than two-thirds of them performed CABG.

Table (5): Relation between pain level and selected patients' demographic characteristics during CTR with the cold application and breathing exercises (n=60).

Demographic Variables	Pain intensity						Chi-square	
	No pain		Mild		Moderate			
	N	%	41	%	N	%	X^2	P-value
Age								
20- < 30	8	88.9	1	11.1	0	0.0	6.244	0.396
30- <40	9	81.8	2	18.2	0	0.0		
40- <50	12	75.0	2	12.5	2	12.5		
50 or more	19	79.2	5	20.8	0	0.0		
Gender								
Male	28	75.7	7	18.9	2	5.4	1.763	0.414
Female	20	87.0	3	13.0	0	0.0		
BMI								
18.5>	4	100	0	0.0	0	0.0	4.097	0.393
18.8-24.9	26	83.9	5	16.1	0	0.0		
25-29.9	18	72	5	20	2	8		
Type of Chest Tube								
Pleural								
Yes	44	83.0	9	17.0	0	0.0	15.687	<0.001**
No	4	57.1	1	14.3	2	28.6		
Retrosternal								
Yes	30	73.2	9	22.0	2	4.9	3.851	0.146
No	18	94.7	1	5.3	0	0.0		
Retrocardial								
Yes	27	81.8	4	12.1	2	6.1	2.576	0.276
No	21	77.8	6	22.2	0	0.0		
Previous surgeries								
Yes	5	45.5	4	36.4	2	18.2	14.054	<0.001**
No	43	87.8	6	12.2	0	0.0		
duration of chest tube placement								
24 -<36 hours	43	91.5	4	8.5	0	0.0	19.468	<0.001**
36 -48 hours	5	38.5	6	46.2	2	15.4		

This result was congruent with Kunter & Gezer (2019), who reported that nearly two-thirds of the study sample were performed CABG. Concerning previous surgery, more than four-fifths of them had no previous surgery. This finding contradicted Aktaş and Karabulut (2019). They reported that two-thirds of the study sample had experienced previous surgery in their study about using cold therapy, music therapy, and lidocaine spray to reduce pain and anxiety following chest tube removal.

Simultaneously, more than three-quarters of the current study sample removed the chest tube after 24->36 hours. This finding is due to early ambulation for the patients post cardiothoracic surgery, which accelerates drainage and enhances their early removal. This finding was contradicted by *Keawnantawat et al. (2018),* who reported that chest tube duration ranges from one to three days for more than half of the study sample. Regarding the history of chronic pain, more than four-fifths of them had no history of chronic pain. *Mohammadi et al. (2018)* support this finding.

Concerning the type of chest tube, the majority of the patients had pleural chest tube. Due to the technique of cardiothoracic surgery requiring plural opening and plural CT to maintain full lung expansion, this finding was in the same line with *El Mokadem and Ibraheem (2017),* who reported that more than three-quarters of the study sample had pleural chest tube. Regarding receiving cold application before, more than four-fifths of the study sample has not received the cold application before.

The present study's finding had implicated a non-statistically significant difference in the baseline pain intensity for CTR among the study participants with and without cold application and breathing exercises before CTR. Simultaneously, there was a highly statistically significant difference in the mean pain scores during and 10-15 minutes after chest tube removal with cold application and breathing exercises. This finding may be because cold gel packs used in our study were elastic to cover around tubes readily and lead to effective cooling around the tissue. This finding is the same line as what was reported by *El Mokadem and Ibraheem (2017); Ayyasi et al. (2019); Kunter and Gezer (2019)* that using of cold application combined with breathing exercises technique was effective in reducing pain intensity. This finding is different from *Hsieh et al. (2017),* who reported that cold application is not a more effective treatment in decreasing pain during CTR. Although statistically non-significant, clinically essential differences of decreased pain scores were observed with cold application among women.

The current study's finding depicts a non-statistically significant difference in the study participants' mean anxiety

scores before CTR with and without cold application and breathing exercises. Also, the anxiety level decreased during CTR; more than half of the sample had mild anxiety level with the application of cold and breathing compared to nearly fifth of them had moderate anxiety when CTR without application. This finding is due to decreased pain intensity level, which positively affected the anxiety level.

This finding is congruent with *Al-Otaibi et al. (2013),* who reported that patients experienced high anxiety levels before CTR. This finding may be due to anxiety might have been increased by the information received about the procedure. Moreover, the mean anxiety scores decreased during and 10-15 minutes after chest tube removal with the cold application and breathing exercises. This finding is comparable to what is reported by *Jeevaneson (2017)*; *Hatami et al. (2018)***,** who studied the cold application and breathing exercises to reduce pain and anxiety during chest tube removal and disclosed that the correlation between anxiety and pain before and during chest tube removal was insignificant. In contrast, it was significantly correlated immediately and 15 to 30 minutes after chest tube removal in the studied groups contrasted to the control group.

On the same scope, patients' hemodynamic parameters before, during, and after CTR with and without cold application and breathing exercise shows a non-statistically significant difference in the hemodynamic parameters of the study participants with and without cold application and breathing exercise before CTR. Simultaneously, there is a highly statistically significant difference in the hemodynamic parameters during and 10-15 minutes after chest tube removal with the cold application and breathing exercise. This finding is consistent with what was reported by *Ebrahimi Rigi et al. (2016)*; *Sandhya (2019).* In opinion, pain control is vital to maintain the patient's comfort and respiratory system efficiency after chest surgery, which directly reflects patients' stable vital data when felt more comfortable due to decreased pain and anxiety levels. Thus, the relaxation and cold application methods showed relatively similar effects on anxiety level and hemodynamic stability.

The current study's finding evidenced a highly statistically significant relationship between the level of pain intensity and the studied patients' history of previous surgeries. This finding may be because patients with a previous surgery history responded well to the ice pack application because of better pain tolerance and postoperative management awareness. A significant relationship was also found between the pleural type of chest tube, the duration of chest tubes placement, and pain intensity. This finding may be due to the tube's adherence to the adherent tissue is induce pain with prolonged placement.

This finding was not following *Jeevaneson (2017)* in the study to estimate the effectiveness of cold application in reducing pain during chest drain removal among patients following Coronary Artery Bypass Graft Surgery (CABG), who stated that VAS and McGill's score was significantly depressed in experimental group contrasted to the control group at $P<0.05$. There is no significant correlation ($P> 0.05$) of any demographic items to pain among CABG patients. Also, *Bastani et al. (2016),* whom research conducted to compare the effect of acupressure and cryotherapy on the pain relating to the removal of chest drain tube in the elderly patients undergoing open-heart surgery, concluded that applying cryotherapy is effective in decreasing the severity of pain caused by the removal of drain tube from the chest.

7. Conclusion

Patients who received the cold application and breathing exercises had significantly less pain intensity and anxiety during and after CTR than time without cold application and breathing exercise. Cold application combined with breathing exercise is convenient and has low risk of pain intensity and anxiety level reduction during chest tube removal.

8. Recommendations

The researchers recommended that:

- Increase the critical care nurses' awareness about the effectiveness of using cold application combined with breathing exercise as a non-pharmacologic therapeutic intervention for reducing pain and anxiety levels during chest tube removal.
- Applying cold application combined with breathing exercise as a care protocol before CTR for patients post cardiothoracic surgery is a safe, inexpensive, and effective pain management technique.

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