

Effect of Relaxation Technique on Pain Intensity during Chest Tube Removal following Cardiac Surgery

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Abstract

Background: patients who have chest tubes removal (CTR) following cardiac surgery are often experience a variety of discomfort, so that relaxation technique using slow deep breathing (SDB) exercise may be effective to minimize and alleviate their pain intensity. **Aim of the study:** this study was conducted to assess the effect of relaxation technique on pain intensity during chest tube removal following cardiac surgery through the following;(1) assess medical data and pain intensity of patients with chest tube following cardiac surgery, (2) implement relaxation technique using slow deep-breathing exercise during chest tube removal (3) evaluate the effect of relaxation technique using SDB on pain intensity among the patients during chest tube removal following cardiac surgery. **Design:** A quasi-experimental design (study and control groups) was utilized to achieve the aim. **Setting:** This study was conducted at cardiothoracic surgical intensive care unit at Cardiac Academy affiliated at Ain Shams University. **Sample:** A purposive subject of (136) critical ill adult patients, subdivided into two groups (study and control). **Tools:** Data was collected using three tools 1) Patients' interviewing questionnaire .2) Numeric Rating Scale (NRS). 3) Relaxation Technique observational checklist. **Results:** The present study revealed that pain intensity during CTR was significantly alleviated among the study group compared to the control group. **Conclusion:** The results of this study concluded that, level of patient's performance in the study group improved after the relaxation technique intervention (This supported the first hypothesis). Also, relaxation technique had a positively significant effect regarding alleviating pain intensity for the study group of patients during chest tube removal following cardiac surgery compared with the control group (This supported the second hypothesis). **Recommendations:** The importance of applying slow deep breathing exercise combined with described analgesic for all patients during chest tube removal following cardiac surgery to alleviate their pain.

Key words: Chest Tubes Removal, Pain, Relaxation Technique.

Introduction

Cardiac surgery is one of the treatments for heart disease which results in a reduction in mortality and standing as the most frequently performed surgical interventions worldwide. It is divided into two types; reconstructive, which includes procedures such as coronary artery bypass grafts or cardiac valve repair, and substitutive, which includes procedures such as valve replacement. Cardiac surgery is a complicated procedure that requires routine admission to the intensive care unit (ICU) and complete care for patients after surgery (*Barretta, et al., 2017*).

Following cardiac surgery, chest tubes are an important part of the recovery process. Most patients received two or more chest tubes; either in the mediastinal, pleural cavities, or both, to remove hemothorax, pleural effusion, and pneumothorax after surgery. In addition to, prevent cardiac tamponade and avoid re-exploration. Early removal of the chest tubes is important to reduce complications and enhance patient's ambulation (*Barozzi, et al., 2020*).

Insertions of chest tubes following cardiac surgery are required to maintain hemodynamic stability and cardiopulmonary function and facilitate drainage from the pleural,

pericardial or mediastinal cavity. Chest tubes are usually removed 2-3 days after surgery, when air, fluid and blood have been properly evacuated. The removal of chest tubes is a painful part of a patient's hospital stay and lead to intense pain and has been described as one of the worst experiences for patients with cardiac surgery (*Tareq, et al., 2020*).

Controlling pain during and after chest tubes removal (CTR) is one of important therapy provided following cardiac surgery. Pain has been defined as, a protective response related to any actual or potential tissue injury and the most critical and under-managed symptom that affecting patients with cardiac surgery throughout recovery. Moreover, pain following cardiac surgery is comparable to other types of post-operative pain. However, the pain is caused by damaged intercostal nerves at the incision site, irritation and incitation of pleura during CTR (*Micah, et al., 2019; Soydan & Uğraş, 2021*).

Furthermore, untreated pain can may have a negative physiological and psychological effect and impede post-operative recovery. Pain can be managed with both pharmacologic and non-pharmacologic or combination of both. Pain management is the most critical aspect of care for patients during CTR. The choice of analgesic modalities currently described to alleviate pain during chest tubes removal includes: narcotic, paracetamol, and non-steroidal anti-inflammatory medications are routinely utilized. Many of these drugs have also been restricted due to major side effects such as nausea, vomiting, constipation and tolerance of the analgesic (*Çevik, et al., 2020; Mohamed, et al., 2022*).

Management of pain is of a high priority for nursing care and most common role of nurse is to use non-pharmacological interventions, such as relaxation techniques, listening to music, massage and hot/cold application; have the advantage of relieving pain without introducing chemical agents into patient's body, inexpensive and easy to use by nurses either

employed alone or in combination with pharmacological interventions. It plays an important role in alleviating pain during chest tubes removal (*Kunter & Gezer, 2019; Asman & Maifita, 2019*).

Relaxation technique is a method that controls post-operative pain by alleviate mental and physical tension, and pain by distracting patient's attention and the most effective non-pharmacologic intervention when taught and applied to the patients. Slow deep breathing (SDB) is one of the recommended relaxation techniques (*Yaban, 2019*).

Slow deep breathing plays an important role in pain signalling and autonomic nervous system (ANS) activation, emotional regulation and produced remarkable relief of pain. In addition, such technique, reduce the use of analgesics, reduce the side effects associated with these drugs, and ensure that the patient has the highest level of nursing satisfaction (*Jafari, et al., 2020*).

Significance of the study

The process of removing the chest tubes could produce intense and acute pain, which is usually considered as one of the the most unpleasant sensation for patients after cardiac surgery. The unrelieved pain during chest tubes removal may be associated with physiological and psychological changes, and resulting in an increased morbidity, mortality, and also could lower quality of life. Therefore, combination of pharmacological and non-pharmacologic interventions such as relaxation technique using slow deep breathing exercise during and after the chest tubes removal is effective to alleviate pain level among patients post cardiac surgery (*Sheykhasadi, et al., 2019*).

Aim of the study:

This study was conducted to assess the effect of relaxation technique on pain intensity during chest tube removal following cardiac surgery through the following:

- 1- Assess medical data and pain intensity of patients with chest tube following cardiac surgery.
- 2- Implement relaxation technique using slow deep-breathing (SDB) exercise during chest tube removal.
- 3- Evaluate the effect of relaxation technique using SDB on pain intensity among the patients during chest tube removal following cardiac surgery.

Research hypotheses:

The current study hypothesized that:

- 1- Level of patient's performance in the study group will be improved after the relaxation technique intervention.
- 2- Relaxation technique will have a positively significant effect regarding alleviating pain intensity for the study group of patients during chest tube removal following cardiac surgery compared with the control group.

Operational definition:

Relaxation Technique; is defined as absence of physical, mental and emotional tension. There are a variety of techniques may use to achieve relaxation, but the selected one is the **slow deep breathing (SDB) technique**, it is an active process of taking conscious control of timing as well as volume cycle of respiration.

Patient's performance; it refers to patient's ability to practice slow deep breathing exercise.

Subject and Methods

Research Design:

A quasi-experimental design (study and control group) was utilized to achieve the aim.

Setting: The current study was conducted at cardiothoracic surgical intensive care unit at Cardiac Academy affiliated at Ain Shams University.

Subject: A purposive subject of (136) critical ill adult patients. The sample size was calculated by adjusting the power of the test to 80% and the confidence interval to 95% with

margin of accepted error 5%, so the total population need for the study as a representing sample was 136 patients subdivides into two groups.

Patients who met the study inclusion criteria were divided alternatively and randomly into two equal groups, 68 patients in each group. The control group (I) receives the routine hospital care with the described medications only, while the study group (II) receives the relaxation technique (SDB) with routine described medications.

Inclusion criteria

1. Adult patients from both sex and able to participate in the study.
2. Patients with two or three mediastinal / or pleural chest tubes for the first time following cardiac surgery.
3. Hemodynamic stable at the time of observation (extubated and no inotropes).
4. Free from neoplastic disease or the presence of other disease that could contribute to exercise limitation (as neuromuscular disorders, psychotic confusion, or patients on mechanical ventilation). They were excluded from the previous mentioned setting.

Tools for data collection:

I. Patients' interviewing questionnaire (Appendix 1):

This tool was designed by the investigator, in English language and divided into three parts as following:

• **Part I:** Patients' demographic data; it was concerned with assessing demographic data of patients; such as (age, gender, educational level and occupation).

• **Part II:** Patients' medical data; this part was used to assess medical data of patients which include the present, past, surgical and family history.

• **Part III:** Hemodynamic data; this part was designed by the investigator according to the aim of the current study based on reviewing

recent literature (*Potter, et al., 2017*). It was used to assess patient's hemodynamic stability in both groups (control and study) before and during the chest tubes removal. It was including five items as follows; blood pressure, temperature, heart rate, respiration and oxygen saturation.

II. Numeric Rating Scale (NRS):

It was used to assess pain intensity before, during and after the chest tubes removal in both groups (control and study), it was adopted from (*Linton, 2016*).

❖ Scoring system:

The Numeric Rating Scale (NRS-11) can be classified into (no pain, mild, moderate, and severe levels) based on the NRS score (zero= no pain) (1-3= mild pain, 4-6 = moderate pain and 7- 10 = severe pain).

III. Relaxation technique observational checklist:

This tool was concerned with slow deep breathing (SDB) exercise regarding alleviate pain intensity for patients during chest tubes removal following cardiac surgery. It was developed by (*Sajedi-Monfared, et al., 2021*). The investigator demonstrated and re-demonstrated the technique of SDB for (study group). It consisted of (13) steps divided into:

A- Before SDB exercise (5 steps)

B- Actual steps; the patients perform it in order to alleviating pain intensity (5 steps)

C- After SDB exercise (3 steps).

❖ Scoring system:

One grade was given to the step done correctly and zero grade to the step, which was done incorrectly or not done. All patients were in a satisfactory level because it was mandatory for the study group.

Validity and reliability: Content validity of the suggested tools was done through a jury of seven experts. They were two professors and five assistant professors from the critical care and medical surgical nursing

departments. They reviewed the instrument for clarity, relevancy, comprehensiveness, understanding, and easiness for administration. Minor modifications were required

Reliability was tested statistically for the developed tools using cronbach's coefficient alpha statistical test for internal consistency of the tool items. The data was analyzed; pain scale was (0.822) that refers to satisfactory level of reliability and hemodynamic data (vital signs) was (0.744), so it is accepted reliability level.

Ethical Consideration:

The investigator 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 taken 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 from the study at any time without giving reasons. Confidentiality was assured by declaring that the personal information protected private after being shared with the investigator only and assured patients that the information would be utilized only for the research purposes. Moreover, the intervention used in the current study is safe and not causing any harm to the participants.

Pilot study:

It was conducted on 10% of the study sample (14 patients) divided equally into two groups (control and study) to test the feasibility of fieldwork, the clarity, applicability of the tools, and appreciate the time needed to collect data parallel to detect any possible obstacles that might face the investigator and interfere with data collection. Patients who participated in the pilot study were included in the final analysis of the sample.

Field work:

The current study was carried out (about six months) from September 2021 until February 2022, field work included four phases: assessment, planning, implementation and evaluation phase.

A-Assessment phase:

The investigator visits the cardiothoracic ICU in the morning and afternoon shift for 3-days/week (Sunday, Monday and Tuesday). The patients who fulfill the inclusion criteria were interviewed individually by the investigator in the intensive care units before starting the session of intervention. A total sample of 136 adult patients with two or three chest tubes were assigned into two equal groups, 68 patients in each group.

The Interview: the investigator met the participants after extubated and with stable condition to collect the baseline data. Data collection was done by using the same tools for the both groups, whereas each patient was taken from 30-45 minutes, which filling the demographic questionnaire, medical data, weight and height taken from patient's file then calculate the body mass index by the equation. The investigator explained to the participants how to report the pain by using numeric rating scale to assess pain intensity, and measured at three times (before, during and after 15 minutes of the chest tubes removal CTR), also, assessed hemodynamic data before and during CTR for both groups of patients.

B-Planning phase

The individualized teaching about slow deep breathing exercise was designed for the study group based on their readiness and level of understanding. Meanwhile the control group followed the routine hospital protocol care.

C- Implementation Phase:

The investigator started data collection firstly from all control group and thereafter study group, to avoid contamination of data. Regarding (study group II) the investigator explain relaxation technique (SDB) for patients through individualized teaching session; how to do it and practice at least 15 minutes before CTR. After physician decision to remove the chest tubes, patients who assigned to be in the (control group I) without any intervention, only received hospital analgesic at regular time, while the study group (II) Asked to perform

(SDB) before CTR with receiving the hospital analgesic at regular time.

Procedure:

The patients in the study group II were taught the slow deep breathing exercise (SDB) then asked to continuously do it according to observational checklist and follow the following steps:

1. Slow deep breathing exercises were done by inhaling slowly through the nose with mouth and eye closed.
2. Exhaling through pursed lips two times slower than inhalation with closed eyes until feeling relaxed for about 10-15 mins.
3. Then, the patient was instructed to hold his or her breath during CTR. The chest tubes were removed by the physician and according to the ICU policies.

D-Evaluation phase:

The investigator asked the participants to rate the pain intensity they felt during the chest tubes removal. Pain intensity was measured twice during the chest tubes removal and 15 minutes after the chest tube removal for the both groups and compared with baseline (first measurement).

Statistical analysis:

Data collected from the studied sample was revised, coded and entered using personal computer (PC). Computerized data entry and statistical analysis were fulfilled using (SPSS) version 22. Data were presented using descriptive statistic in the form of frequencies, percentage and mean SD. Chi square test statistic is commonly used for testing relations between categorical variables. A t test compared the mean of two groups and correlation coefficient (r) test was used to test the relation between two quantitative variables.

Significance of the results:

- Non-significant with p-value ≥ 0.05
- Statistical significance with p-value < 0.05 .

- High significant with p-value <0.01.

Results:

Table (1): Concerning demographic data of study and control group, demonstrated, the highest percentage of patients among the study and control groups were (60.3%, 63.2%) respectively their age was 40+ years old with the mean age 47.80 and 45.91 for the study group and the control group. Concerning the gender (63.2%, 60.3%) respectively of the study and control groups were males, as well as (52.9%, 51.5%) among the study and control groups respectively can read and write, as regard to the occupation (57.4%, 60.3%) respectively had work.

Table (2): Regarding to chest tubes, illustrated that, (67.7%, 70.6%) respectively among the study and control groups had three chest tubes. While (42.6%, 44.1%) respectively among the study and control groups removed the chest tubes from 24-36 hours following cardiac surgery. Concerning location of the

chest tubes insertion (67.7%, 70.6%) respectively among the study and control group had mediastinal and pleural chest tubes. While (60.3%, 61.8%) respectively among the study and control groups had hemothorax.

Figure (1): showed, the total mean of hemodynamic data of the studied patients in the study and control groups during the chest tubes removal (n=136).

Figure (2): revealed, percentage distribution of the studied patients in the study and control groups regarding to pain intensity during the chest tubes removal (n=136).

Table (3): showed that, there was a statistically significant relation between pain intensity, number of chest tubes with ($X^2=5.808$ and $P=.020^*$), duration of chest tubes and pain intensity among the study group with ($X^2=6.001$ and $P=.011^*$). Also, there was a highly statistically significant relation between location of chest tubes and pain intensity with ($X^2=12.66$ and $P=.000^{**}$).

Table (1): Number and percentage distribution of the study and control groups of patients' according to demographic data (n=136).

Demographic data	Study group N=68		Control group N=68		Test	P value
	N	%	N	%		
Age					T Test	
20- < 30 years	9	13.2	6	8.9	1.046	0.091
30- <40 years	18	26.5	19	27.9		
40+ years	41	60.3	43	63.2		
Mean S.D	47.80 ±6.42		45.91±5.98			
Gender					X²	
Male	43	63.2	41	60.3	2.907	0.052
Female	25	36.8	27	39.7		
Level of education						
Can not read and write	15	22.1	13	19.1	1.756	0.062
Read and write	36	52.9	35	51.5		
High education	17	25.0	20	29.4		
Occupation						
Not work	29	42.6	27	39.7	1.334	0.083
Work	39	57.4	41	60.3		

*Significant at p <0.05. **Highly significant at p <0.01. Not significant at p >0.05.

Table (2): Number and percentage distribution of the study and control groups of patients' according to chest tubes (n=136).

Items	Study group N=68		Control group N=68		X ²	P value
	N	%	N	%		
Number of the chest tubes						
Two	22	32.3	20	29.4	0.138	0.710
Three	46	67.7	48	70.6		
Duration of the chest tubes						
<24 hours	0	0	0	0	0.136	0.934
24 to 36 hours	29	42.6	30	44.1		
48 hours	29	42.6	27	39.7		
>48 to 72 hours	10	14.8	11	16.2		
Location of the chest tubes						
Mediastinal	22	32.3	20	29.4	0.138	0.710
Mediastinal and pleural	46	67.7	48	70.6		
Indications of the chest tubes						
Hemothorax	41	60.3	42	61.8	0.317	0.957
Pneumothorax	8	11.8	6	8.8		
Pleural effusion	11	16.2	10	14.8		
Hemopneumothorax	37	54.4	35	51.5		

*Significant at p <0.05. **Highly significant at p <0.01. Not significant at p>0.05.

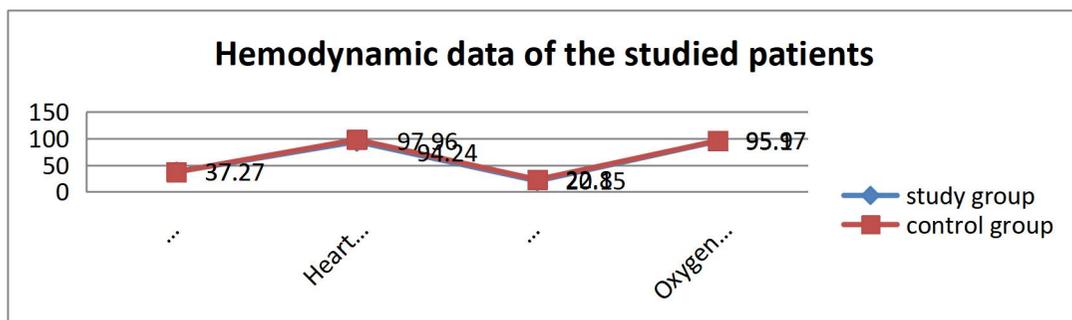


Figure (1): the total mean of hemodynamic data of the studied patients in the study and control groups during the chest tubes removal (n=136).

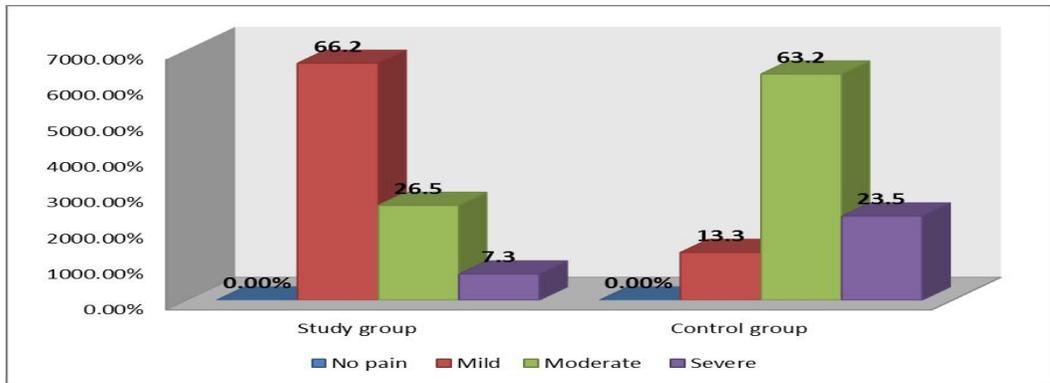


Figure (2): percentage distribution of the studied patients in the study and control groups regarding to pain intensity during the chest tubes removal (n=136).

Table (3): Relation between the chest tubes characteristics and pain intensity among the study group during the chest tubes removal after application of the relaxation technique (n=68).

Items		Pain intensity								X ²	P-Value
		No n=0		Mild n=45		Moderate n=18		Severe n=5			
		N	%	N	%	N	%	N	%		
Number of chest tube	Two	0	0	18	40	3	16.7	1	20	5.808	.020*
	More than two	0	0	27	60	15	83.3	4	80	6.001	.011*
Duration of chest tube	24 to 36 hours	0	0	24	53.3	4	22.2	1	20		
	48 hours	0	0	20	44.5	8	44.5	1	20		
Location of chest tube	>48 to 72 hours	0	0	1	2.2	6	33.3	3	60		
	Mediastinal	0	0	16	35.6	6	33.3	0	0	12.66	.000**
	Mediastinal and pleural	0	0	29	64.4	12	66.7	5	100		

Discussion:

Concerning patient's **demographic data**, the present study result revealed that, about two third of studied patients' age from each group was 40 years old and more, with the mean age 47.80 ± 6.42 for the study group and 45.91 ± 5.98 for the control group. From the investigator's point of view, increase daily stress of lifetime among younger adults in which their age group represents the working-age population that leads to stress induced cardiac diseases.

This finding agreed with *Hsieh, et al., (2017)*, who carried out study entitled: "Efficacy of Cold Application on Pain during Chest Tube Removal: A Randomized Controlled Trial", and stated that, the mean age

of studied sample was between (43-45) years old.

On the other hand, this finding was not matching with *Aktaş & Karabulut, (2019)*, in the study entitled: "The Use of Cold Therapy, Music Therapy and Lidocaine Spray for Reducing Pain and Anxiety following Chest

Tube Removal", who mentioned that, the mean age of the studied sample was between 65.80 and 64.13 years old.

Regarding to **gender**, the present study result revealed that, about two third of the studied patient were male; it's noted that male's exposure to more stress and smoking effect than females, furthermore estrogen hormone protect

women from cardiac disease. This finding was similar to *Mohammadi, et al., (2018)*, in study entitled: "Effects of Cold Application on Chest Tube Removal Pain in Heart Surgery Patients", who reported that, more than half of the studied patients were males.

Concerning **level of education**, the present study result revealed that, about half of the studied patients among the study and control groups can read and write; that might be because most of them attended Ain shams university hospital from rural area and from low socioeconomic level. This finding was on the same line with *Mazloun, et al., (2018)*, in study entitled: "The Impact of Using Ice on Quality of Pain Associated with Chest Drain Removal in Post Cardiac Surgery Patients: An Evidence-Based Care", who mentioned that, more than three quarters of the study sample could not read or write.

Moreover, this result disagreed with *Jeevaneson, (2017)*, who examined in study entitled: "A Study to Assess the Effectiveness of Cold Application in Reducing Pain during Chest Drain Removal among Patients following Coronary Artery Bypass Graft Surgery (CABG) in Selected Hospital", who confirmed that, most of the studied sample was well educated.

Concerning **occupation**, the present study result revealed that, more than half of the studied patients were working; that might be considered predisposing factor for daily stress in working-age population. This finding was congruent with *Yarahmadi, et al., (2018)*, who conducted study entitled: " The Combined Effects of Cold Therapy and Music Therapy on Pain following Chest Tube Removal among Patients with Cardiac Bypass Surgery", and reported that, about half of the groups of patients were working.

According to **number** of the chest tubes, the present study result revealed that, more than two third of patients in the both groups had three chest tubes; one tube in the left pleural these due to technique of surgeon in operation who preferred to drain all fluids and

air from the pleura cavity (if he penetrated it), and two tubes were in mediastinum (around the heart). This finding was not matching with *Çevik, et al., (2020)*, in study entitled: "Effect of Applying Cold Gel Pack to the Sternum Region on the Postoperative Pain after Open-Heart Surgery ", who noted that, the majority of all groups had two chest tubes only.

Regarding **duration** of the chest tubes, the present study result revealed that, more than one third of patients in the both groups removed chest tubes after 24-36 hours following cardiac surgery; for early ambulation of patients after surgery. On the other hand, importance of the early removal of chest tubes after cardiac surgery is recommended to lower occurrence of air leaks, decrease infection, morbidity rate and pain associated to chest tubes placement (*Kawaguchi, et al., 2021*).

Therefore, this finding supported by *Keawnantawat, et al., (2018)*, in study entitled: "Effectiveness of Cold Therapy in Reducing Acute Pain among Persons with Cardiac Surgery", who stated that, more than half of the studied patient's removed chest tube after one to three days.

Concerning **location** of the chest tubes, the present study result revealed that, more than two third of patients from the both groups had mediastinal and pleural chest tubes; this due to the technique of cardiothoracic surgeon that required pleural chest tube to prevent hemo/pneumothorax and allow complete lung expansion, also it was noted that, removal of mediastinal and pleural chest tubes were more painful than mediastinal tubes alone; due to force and pulling that cause traumatic chest injury in the parietal pleura, fibers, intercostal tissue and muscles. In addition, pain felt in different anatomical locations (*Aktaş & Karabulut, 2019*).

Therefore, this finding was similar to *Sandhya, (2019)*, in his study entitled: "Effectiveness of Ice Compress Application upon the Level of Pain among Patients with Chest Drainage", who confirmed

that, chest tube location was in both mediastinal and pleural drain with 50% and 73% among the patients post cardiac surgery.

But the previous finding disagreed with *Elmokadem & Ibraheem (2017)*, who carried out study entitled: "Cold Application and Breathing Exercises to Reduce Pain and Anxiety during Chest Tube Removal", and stated that, more than three quarter of patients had pleural chest tubes.

According to **indications** of the chest tubes, the present study result revealed that, about two third of patients in both groups had hemothorax; which might be due to the main drainage immediate after manipulation of surgery is blood coming from mediastinum cavity (around the heart) or from the new graft, the pericardium opening and/or due to cardiopulmonary bypass machine connection.

On the other hand, this finding was consistent with *Soydan & Uğraş, (2021)*, in the study entitled: "Effect of Different Cold Application Materials on Pain during Chest Tube Removal: Three-arm Randomized Controlled Clinical Trial", who stated that, more than half of groups of patients had hemothorax. While, this finding was not matching with *Hsieh, et al., (2017)*, who reported that, more than two third of patients had pleural effusion.

Regarding the **relation between the chest tubes characteristics and pain intensity**, during CTR and after application of the relaxation technique, the present study result revealed that, there was a statistically significant relation between the pain intensity, number of the chest tubes and duration of the chest tubes among the study group. Otherwise, three chest tubes which cause more pain than two. Regarding duration of the chest tubes; the tubes attachment to surrounding tissue could cause pain if left in place for too long.

On the same line, this finding was agreed with *Elmetwaly & El Sayed, (2020)*, who conducted study entitled: "Chest Tube Removal: Efficacy of Cold Application and Breathing

Exercise on Pain and Anxiety Level ", who reported that, there was a high statistically significant relation between the pain intensity, number and duration of the chest tubes.

Also, there was a highly statistically significant relation between location of the chest tubes and pain intensity; this due to mediastinal and pleural chest tubes reported to cause more pain during the removal than mediastinal tubes alone, because presence of many sensory nerves on the site of pleural cavity (*Mohammadi, et al., 2018*).

Conclusion

The results of this study concluded that, level of patient's performance in the study group improved after the relaxation technique intervention. (This supported the first hypothesis). Also, relaxation technique had a positively significant effect regarding alleviating pain intensity for the study group of patients during chest tube removal following cardiac surgery compared with the control group. (This supported the second hypothesis).

Recommendation

Based on the result of this study, the investigator recommended that:

- Provide and educate all patients undergoing cardiac surgery with designed instructional illustrated Arabic poster regarding the relaxation technique using slow deep breathing exercise to improve hemodynamic stability.
- Apply slow deep breathing exercise combined with described analgesic for all patients during chest tube removal following cardiac surgery to alleviate their pain.
- Further study should be replicated on large sample and in different hospitals settings in order to generalize the results.

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