Effect of Protocol of Care on Clinical Outcomes of Patients with Chest Tube Post Cardiothoracic Surgery

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Abstract

Cardiothoracic surgery is a surgical specialty, which deals with the diagnosis and management of surgical conditions of the heart, lungs and esophagus [1] .Chest tube (CT) is an invasive procedure which inserted post cardiothoracic surgery to facilitate lung expansion and allowing the drainage of fluids from the chest cavity. **Aim:** this study aimed to evaluate the effect of protocol of care on clinical outcomes of patients with chest tube post cardiothoracic surgery. **Materials and method** a quasi-experimental research design was conducted at Cardiothoracic Surgery Department at Tanta University hospital. A purposive sample of 80 adult patients with chest tube based on statistical power analysis were selected and divided into two equal group 40 patients in each group as follows: **Group 1**: (Study group): consist of 40 adult patients were received protocol of care implemented by the researcher. **Group 2:** (Control group): consists of 40 adult patients who were received routine nursing care by hospital nursing staff. **Three Tools** were used to collect the data .**Tool (I)** Biosocio-demographic characteristics. **Tool (II)** Chest tube assessment, **Tool (III)** Pain assessment. **Results:-** The mean duration of ICU stay in control group (6.77) was higher than in the study group (4.97) days, more than half (52.6%)of the patients in the control group at the 7th day of the study had elevated body temperature comparing to none in the study group, nearly two third (62.5%) of patients has a positive culture swab in the control group at the 7th day of the study group ,compared to about third(35%) of patients in the study group. More than half of patients (52.5%) in the control group had a severe pain during removal of chest tube compared to small percentage (5.0%) in the study group. **Conclusions and recommendations:-**Protocol of nursing care which was composed of deep breathing and coughing   exercises, sterile technique during chest tube dressing, and cold application, are recommended for all cardiothoracic surgical patients with chest tube.

Keywords: Protocol of Care, Clinical Outcomes, Cardiothorathic Surgery

INTRODUCTION

Cardiothoracic surgery is a surgical specialty, which deals with the diagnosis and management of surgical conditions of the heart, lungs and esophagus[1] .Chest tube (CT) is an invasive procedure which inserted post cardiothoracic surgery to achieve two objectives, facilitate lung expansion and allowing the drainage of fluids from the chest cavity which accumulates during the postoperative period , which allows a complete expansion of the lung, restoration of negative pressure in the thoracic cavity and thereby restoring the normal ventilation [2-4].

According to American Heart Association, annually more than 448,000 patients underwent a cardiothoracic surgery including coronary artery bypass grafting (CABG), valve replacement or repair, or repair of structural defects have estimated that more than100,000 chest tubes per year in the United States are placed for a traumatic injury alone [5]. A review of Cardiothoracic surgeries at Cardiothoracic Department at Tanta University Hospital statistical records have revealed that about 200 patients who underwent cardiothoracic surgeries during the period from 2013 to 2014 [6].

Thoracostomy drainage is an integral component in the care of cardiothoracic surgical patients. These chest tubes are inserted during the postoperative period to drain accumulated air, blood, and fluid from the chest cavity .By preventing these accumulations, severe complications can be avoided for the heart and the lung ,restore the negative pressure to the pleural space to re expand a collapsed or partially collapsed lung, and prevent reflux of drainage back into the chest so allow the lungs to expand [6, 7] . After CABG inserting chest tubes (CT) was aimed to maintain heart and lung stay functioning [7-12].

There is no clear data about the optimum time for chest tube removal after cardiothoracic surgery, but most drains are removed from 5 to 10 days post insertion [13-15]. Although tube thoracotomy is fairly effective, it may be associated with significantly morbidity and mortality. The complications rate associated with this procedure is up to 30%. These complications have been broadly classified as either technical or infective. Technical cause includes tube malposition, subcutaneous emphysema, chest drain dislodgement, and nerve injuries, cardiac and vascular injuries, esophageal injuries, cardiac dysrhythmias and chest tube obstruction [16, 17]. That is significantly associated with increasing the rates of a trial fibrillation and renal failure which can be life- threatening.

Infective complications of CT include empyema, pneumonia, pain and surgical site infection. Infections at the site of chest tube insertion can travel up the tube to the lungs and cause lung infection. The risk of infection

increases with each passing day that the tube remains in the body [17-20].

Critical care nurse (CCN) has a key role in assessing life-threatening conditions, instituting appropriate interventions, and evaluating the outcomes of these interventions. (CCN) also provides an ongoing assessment and early recognition and management of complications while fostering healing and recovery. Keeping CTs in place; however, is associated with the increased pain and discomfort for the patient, mechanical irritation of the heart and pericardium, and an increased incidence of infection [20] .Caring for the patients with chest tube immediately pre and post cardiothoracic operation, it is important. The immediate concern for CCN to assess respiratory and cardiovascular functioning, assess homodynamic state hourly post operative ,Observe the site of chest tube insertion, the dressing status, the underwater seal, and assess the amount of drainage, fluctuation and tidaling to maintain the patency of the drainage system and functioning of the drainage system [21,22].

On other hand, the CCN should assist the patient for early ambulation at the end of the first post operative day, position the patient in semi- flower's position and change the patent position every 2 hours. Position the drainage system in an upright position and below the level of the heart and encourage the patient to do deep breathing and coughing exercises which open the air way, improve lung expansion and facilities drainage of fluids [22, 23] .

Considering the importance of pain management as the highest nursing priority, using cold application around the tube insertion site for 20 minutes before the procedure to alleviate the pain post insertion and during the removal of the tube [24, 25].

In Egypt, there are a limited number of studies that investigate the caring of chest tube Therefore, the present study was done for implementing protocol of care to minimize chest tube related pain and reduce the rate of complication.

The aim of the study is to:

Evaluate the effect of protocol of care on clinical outcomes of patients with chest tube post cardiothoracic surgery.

Research hypothesis:

The study group who is exposed to protocol of care may exhibits minimal pain and post-operative complications than the control group.

Research Design:

The present study was utilizing a quasi- experimental research design.

Setting:

The study was conducted at the Cardiothoracic Surgeries Department at Students Hospital affiliated to Tanta University.

Subjects:

A purposive sample of 80 adult patients with chest tube based on power analysis were selected and divided into two equal groups with 40 patients in each group as follow:-

Group 1: (Study group): consists of 40 adult patients who received a protocol of care implemented by the researcher.

Group 2: (Controls group): consists of 40 adult patients who received routine nursing care by hospital nursing staff.

Inclusion criteria:

The sample of this study was selected according to the following criteria:

Planned cardiothoracic surgery, adult patients, of both sexes (from 21-60 years old), patients who have one or two mediastinal chest tubes or pleural tubes, patients who are free from skin infection in the site of insertion.

Tools of data collection

Three tools were used in this study to collect pertinent data related to the aim of the study .These tools were:-

Tool (1) Biosocio-demographic Characteristics:

This tool was developed and used by the researcher after reviewing of related literature to assess biosciodemographic data. It comprised two parts as follows:

Part (one): Patient's sociodemographic: characteristics. This includes patient's name, age, sex, marital status, educational level, and occupation.

Part (two): Clinical data: This includes.

A-Past medical history :-as previous hospitalization, past history of lung or heart disease , bronchial asthma, chronic obstructive pulmonary disease (COPD), diabetes mellitus, hypertension ,kidney disease ,Liver disease, neurological disease and or cancer .

B-Past surgical history:-as past cardiothoracic surgery, or abdominal surgery

C-Current medical history:-This includes diagnosis, types of cardiothoracic surgery, duration of ICU stay, vital signs, oxygen saturation and arterial blood gases.

D-Smoking history: - duration of smoking, type of smoking, number of tobacco consumed per day.

Tool (II): Chest Tube Assessment Tool:
This tool was developed and used by the researcher after reviewing of the related literature [87, 88, and 96]. To assess the chest tube drainage system and it consists of five parts.
Part (1): Assessment of the Tube Insertion Site: it was used to assess the tube insertion site for sign and symptoms of infection such as pain, elevated body temperature above (38c), tachycardia presence of redness, hotness, swelling, pus and inflammation of the skin around the tube insertion site.
Part (2): Assessment of the Tube: it was used to assess the size, number, type and patency of the tube, duration of chest tube stay, any clogging in the tube and the fluctuation of the drainage in the tube.
Part (3): Assessment of the Drainage Bottle: it was used to assess the drainage bottle which includes the type of drainage system, air bubbling/ air leaks, amount, type, color and consistency of drainage daily, fluctuation and tidaling of chest tube drainage and any changing of the drainage bottle.
Part (4) Assessment of the Chest Tube Related Complications: it was used to assess the occurrence of the chest tube complications as; bleeding, obstruction, infection, chest pain, tension pneumothorax, subcutaneous emphysema, hypoxemia and dysthymias.
Part (5) Laboratory Studies: This part was used to assess the presence of infection at the tube insertion site as: Blood leukocytes count, blood sample for isolation of different microorganisms and swab culture.
Tool (III): Pain Assessment Tool:
This tool was used to measure pain severity and physiological and behavior changes of pain. This tool was divided into two parts.
Part (1): Pain Intensity Scale:
Part (2): Critical-Care Pain Observation Tool:
Part (1): Pain Intensity Scale:
Numerical rating scale, developed by Galina's C, et al (2006) [24], was used to assess pain intensity in the first two days post -operative and during chest tube removal. The scoring system of this scale range between 0-10 and representing as follows "0" representing no pain, "1-3" representing a mild pain, "4-6" representing a moderate pain, "7-9" representing sever pain, and "10" representing worst pain.
Part (2): Critical-Care Pain Observation Tool:
This tool was developed by Gelinas C, et al (2008) [25]. This tool was used to assess pain in both intubated and non-intubated critical care patients. This tool contains four domains: facial expressions, body movements, muscle tension, and ventilator compliance. The tool score for each domain ranged from 0 to 2,the total score of each domain consisted of three points as (mild or no pain =0 ,moderate =1,severe =2).The total score was derived from a summation of scores of each domain .The total scores range from 0 (no pain) to 8 (most pain) .

Method
1-Administrative Process:
A written approval the hospital was obtained from the responsible authority of Cardiothoracic Intensive Care Unit before conducting this study through official letters from the Faculty of Nursing explaining the purpose of the study.
Data were collected over period of 8 months, started from November 2014 to June 2015.
2-Tool Development:
Three tools were used in this study. Tools I, II were developed by the researcher after a review of the related relevant literature.
3-Content Validity:
The developed tools were tested for content validity by nine jury experts in the field of Medical Surgical, Critical Care Nursing, and Medical Biostatistics and accordingly some modifications were done.
4- Patient Consent:
An informed consent was obtained from each patient included in the Study after explanation of the aim of the study and assuring them of confidentiality of their collected data.
Confidentiality and autonomy were maintained by using the code of number instead of name and the right of withdrawal is reserved.
5-Reliability of the Tool:
Alpha Cronbach's test was used to test tool reliability and reliability factor was =0.896
6- The pilot Study:
A pilot study was carried out on 10 patients to test the feasibility and applicability of the developed tools and a needed modification was done.
7- Phases of Actual Study:
The present study was conducted on   four phases:
I-Assessment Phase:-
An initial assessment was carried out by the researcher for all the study subjects in both the control and study

groups to assess the patients who met the inclusive and exclusive criteria of this study. Assessment was done by using tool (I) part (1, 2) and tool (II) part (1, 2, and 3) for both groups to collect base line data.

2-Planning Phase:

Based on data of assessment phase and literature review, protocol of care was developed, patient's goal, priorities and expected outcomes criteria were formulated as the follows.

Expected Outcomes:

- Enhancing lung expansion and improve the flow of drainage.
- Minimal pain.
- Less complication (e.g., chest tube infection, bleeding, and clogging).
- Less period oh hospital stay

3-Implementation Phase: (Chest Tube Nursing Care Protocol)

The study group received the protocol of care implemented by the researcher for not more than 10 days as the following:

Health teaching for the patient pre and post- operatively about deep breathing and coughing exercises which taught by the researcher and re demonstrated by the patients to the study group pre -operative in three sessions for each patient individually with duration of 20 minutes.

Measures to enhance lung expansion and improve the flow of drainage were applied as follows:

a) Patient positioning: Put the patient in a semi Flower's position in post -operatively for 4 hours, then changing position every 2 hours (low and high Fowler's positioning, sitting position). b) Positioning the drainage system in an upright position below the level of the heart.

c) Early ambulation in the first post -operative day.

Measures to control pain related to chest tube were; Cold application which applied around tube insertion site 3 times.

First Time: (First and second post-operative days)

Cold application (Ice in flexible cold packs wrapped in fine cloth sheaths) was applied around the tube insertion site at the first and second post -operative days every 4 hours for 20 minutes to reduce post-operative pain and irritation [134] .

Second Time: (before chest tube removal)

Cold application during chest tube removal to reduce pain during the removal, the researcher was placed a single layer of sterile gauze pad between the skin and ice pack (around the area of tube insertion) , before the tube removal for 20mintes[23,112,134] .The site was determined on both side of chest tube ,(covering a 6 inches ;15cm) around the tube port using a measuring tape

Third time: (After Chest Tube Removal)

Immediately after the removal of the tube for 15 minutes

Measures to reduce chest tube related infection by using an occlusive dressing

Control group was receiving the routine nursing care provided to the patients by critical care nurses which includes (chest tube dressing, assessment of vital signs every 2 hrs, change the patient's position and using spirometer post-operatively .

4-Evaluation phase:

Evaluation of pain severity was done for both groups (Control and Study groups) immediately after the first and second post- operative day and during the removal of chest tube using tool III.

Evaluation of the occurrence of complications was done daily for both groups (control and study) by using Tool II.

9- Statistical Analysis:

The collected data were organized, tabulated and statistically analyzed using SPSS software (Statistical Package for the Social Sciences, version 16, SPSS Inc. Chicago, IL, USA). For a comparison between means of two groups of parametric data of independent samples, student t-test was used. For comparison, between means of two related groups (before and after data) of parametric data, paired t-test was used. For comparison between more than two means of parametric data, F value of ANOVA test was calculated. Significance was adopted at $p < 0.05$ for interpretation of results of tests of significance [136].

Results

Table (1): Demographic data of the studied patients with chest tube post cardiothoracic

The results of the present study revealed that more than one third of the patients in both control and study group (35%) were between (31-51) years. **In relation to sex**, more than half of the patients in control and study groups were males (62.5% and 55.0% respectively). **Concerning the marital status**, more than two thirds of the patients in the control and study groups were married (87.5%and 75.0% respectively). **Regarding the educational level**, the result showed that about half of the patients in the control group had diploma education (42.5%), while about one third of the study group was read and write 32.5%.

From this table, it can be seen that there was no statistical significant difference between the control and study groups in relation to the age, sex, marital status, educational level and occupation.

Table (2): Medical history data of the studied patients with chest tube post cardiothoracic surgery (Study and Control groups).

It can be noticed that about one quarter of the patients in the study groups were bronchial asthma (20%) ,while the minority (15%) in the control group were COPD .Regarding previous hospitalization ,it was observed that the majority of both the study and control groups had no previous history of hospitalization (67,5% and 77.5% respectively) ,with regard to the past surgical history, we can say that the majority of both the control and study group had no past surgical history .Concerning the current medical history ,it was found that the most common diagnosis in the control group was decortications of the lung and aortic valve replacement (AVR) (27.5% - 25.0%respectively)while in the study group it was lobectomy and mitral valve replacement (MVR) (30% -25.0%).There was statistical significant difference between both studied group in relation to open heart, lobectomy and aortic valve replacement as p= 0.25,0.003, 0.004respectively.

Figure (1): Duration of ICU stay of the studied patients with chest tube post cardiothoracic surgery (Study and Control groups

Regarding the duration of ICU stay, this figure shows that the mean duration of stay in the control group was (6.77) compared to (4.97) in the study group. From this table, it can be seen that there was a statistically significant difference between the control and study groups in relation to the current medical history of open heart, lobectomy and aortic valve replacement as p= 0.025,0.003,and 0.004 respectively and in relation to the duration of ICU stay as P =0.0001.

Figure (2): Respiratory rate among the studied patients with chest tube post cardiothoracic surgery at 5th and 7thpost-operative days with a significant difference between the study and control groups.

This figure illustrates respiratory rate of both the studied groups at the 5th and the 7th day .It was observed that more than half of the patients (62.5%) in control group had tachypnea compared to nearly one third in the study group (31.8%) at 5th day of the study while at the 7th day more than one quarter of the patients (26.3%) in the control group had tachypnea, compared to nothing in study group.

Figure (3): Sound on the affected side among the studied patients with chest tube post cardiothoracic surgery at 1st Sound on the affected side post-operative day with a significant difference between the study and control groups.

It can be seen that there was a statistically significant difference between the two study group as p=.001. Regarding the   normal sound ,it was observed that only (10%) of study group had normal breathing sound ,compared to nothing in the control while about half of the patients in the study group (47.5%) had wheezing breathing, compared to the majority of the control group (87.5%), who had wheezing breathing sound.

Table (3): Pulse among the studied with chest tube post cardiothoracic surgery (study and control groups) at post-operative days of follow up.

This table reveals that the majority of the patients at first day of the study in control group have normal pulse rate 87.5%, compared with 30% in the study group, while at the 7th day only 42.1o% of the patients in the control group have normal pulse rate, compared with all patient in the study group 100%. It can be seen that there was statistically difference between two studied groups regarding the 1st and 7th day of study as p value equal 0.0001, 0.007 respectively.

Table (4): Temperature among the studied patients with chest tube post cardiothoracic surgery at post-operative days of follow up

This table illustrates measuring the body temperature of both of the studied groups (control and the study groups). It was observed that more than half of the patients in the control group at the 7th day of the study had hyperthermia 52.6%, while none in the study group. It can be seen that there was statistically difference between two studied groups regarding the 7th day of study as p = 0.007.

Table (5): Swab culture findings among the studied patients with chest tube post cardiothoracic surgery at first and seventh post-operative days

This table reveals the findings of swab culture among the studied patients at the 1st and 7th day of the study. It was observed that at the 7th day of the study that more than one third of patients in the study group have a positive culture swab (35.0%) while in the control group, more than half of patients (62.5%) have a positive culture swab. From these results we can say that there was statistical significant difference between the both studied groups (control and study) group at 7th day of the study as p =0.014.

Table (6): Chest tube complications among the studied patients with chest tube post cardiothoracic surgery

This table illustrates the distribution of complications among the patients with chest tube. It was observed that infection was the most common complication in both the studied group. The results showed that more than half of the patients in the control group (60.0%) had infection at the chest tube insertion site while about one third of patients in study group were (32.5%).There was a statistically significant difference between both the of

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studied groups as p = 0.014.

Table (7): Pain intensity assessment (Visual analogue scale) (VAS) among the studied patients with chest tube post cardiothoracic surgery (study and control groups) before, during and after tube removal.

This table emphasizes the assessment of pain during the removal of chest tube among the studied patients. It was observed that (52.5%) of control group had a severe pain during the removal of chest tube compared to only (5.0%) in the study had a severe pain during the removal while the majority (80%) in the study group had moderate pain during the removal .There was statistically significant between both the studied group in relation to pain during the removal of chest tube as p=.0001.

Table (8): Mean scores of Visual analogue scale (VAS) of the studied patients with chest tube post cardiothoracic surgery before and after cold application and before, during and after (15 min) of the tube removal.

It was found that the mean scores of Visual analogue scale of the study group before application was (9.20) while after cold application the mean was (6.25). As regard second day, the finding shows that the mean scores of Visual analogue scale of study group before the application was (6.62) while after the cold application the mean was (4.32).

Cornering the pain before the removal of the tube the findings show that the mean of pain intensity of the control group was (7.62) while in the study group the mean was (6.17). In addition, the mean during removal in control group was (8.67) while in the study group. It was (4.50) whereas the mean after removal of the tube in the control group was (6.35) compared to (2.40) in the study group after the removal. It can be seen that there was a statistically significant difference in the study group before and after cold application in the first day before and after application in the 2nd day as p =0.0001. There was statistical significant difference between both the studied group before, during and after the removal of the tube as p = 0.0001.

Table (9): Mean scores of Visual analogue scale (VAS) of the studied patients with chest tube post cardiothoracic surgery at the first day before and after cold application.

This table illustrates the mean score of pain intensity of both the studied groups before, during and after the tube removal. Before the removal, it was observed that the majority of patients (85%) in the control group have a severe pain compared to about half (47.5%) of the patients in the study group who have a moderate and severe pain.

During removal, more than half of the patients in the control group (52.5%) suffered from a severe pain and more than one third (35%) have worst pain during the removal of chest tube while in the study group, the majority (80%) have a moderate pain.

Table (1): Demographic data of the studied patients with chest tube

Variables	The studied patients with chest tube (n=80)						χ^2	P
	Study group (n=40)		Control group (n=40)		Total (n=80)			
	N	%	N	%	n	%		
Age years:							1.056	0.788
21-<31	8	20.0	7	17.5	15	18.8		
31-<41	10	25.0	14	35.0	24	30.0		
41-<51	14	35.0	13	32.5	27	33.8		
51-60	8	20.0	6	15.0	14	17.5		
Sex:							0.464	0.496
Male	22	55.0	25	62.5	47	58.8		
Female	18	45.0	15	37.5	33	41.3		
Marital status:							2.813	0.421
Married	30	75.0	35	87.5	65	81.3		
Divorced	1	2.5	0	0	1	1.3		
Single	5	12.5	2	5.0	7	8.8		
Widow	4	10.0	3	7.5	7	8.8		
Residence:							0.208	0.648
Rural	23	57.5	25	62.5	48	60.0		
Urban	17	42.5	15	37.5	32	40.0		
Education level:							5.040	0.169
Illiterate	8	20.0	9	22.5	17	21.3		
Read and write	13	32.5	11	27.5	24	30.0		
Basic education	9	22.5	3	7.5	12	15.0		
Diplome	10	25.0	17	42.5	27	33.8		
Occupation:							0.577	0.966
Manual work	9	22.5	11	27.5	20	25.0		
Employee	4	10.0	5	12.5	9	11.3		
Technical work	10	25.0	8	20.0	18	22.5		
House wife	5	12.5	5	12.5	10	12.5		
Student	0	0	0	0	0	0		
Not working	12	30.0	11	27.5	23	28.8		

Table (2): Medical history data of the studied patients with chest tube post cardiothoracic surgery (Study and Control groups).

Variables	Study group (n=40)		Control group (n=40)		Total (n=80)		χ^2	P
	N	%	N	%	N	%		
▪Past medical history data:								
-Medical history of disease:								
COPD	3	7.5	6	15.0	9	3	1.127	0.288
DM	2	5.0	0	0	2	2.5	2.051	0.152
Bronchial asthma	8	20.0	3	7.5	11	13.8	2.335	0.105
Liver disease	4	10.0	4	10.0	8	10.0	0.000	1.000
Heart disease	3	7.5	1	2.5	4	5.0	1.053	0.305
Kidney disease	1	2.5	1	2.5	2	2.5	0.000	1.000
·Other disease	1	2.5	3	7.5	4	5.0	4.053	0.399
HCV	0	0	1	33.3	1	25.0	0.000	1.000
Neurological dis.	0	0	1	33.3	1	25.0	0.000	1.000
Pleural effusion	0	0	1	33.3	1	25.0	0.000	1.000
TB	1	100	0	0	1	25.0	0.000	1.000
-Previous hospitalization:								
No	27	67.5	31	77.5	58	72.5	1.003	0.317
Yes	13	32.5	9	22.5	22	27.5		
duration of hospitalization (days):								
Range		0-8		0-2		0-8		
Mean±SD		1.57±2.52		0.26±0.68		0.93±1.97		
t-test				3.100				
P				0.003*				
Past surgical history:								
Heart surgery	3	7.5	0	0	3	7.5	0.000	1.000
Lung surgery	1	2.5	1	2.5	2	2.5	0.000	1.000
Abdominal surgery	1	2.5	0	0	1	1.3	0.988	0.320
Other	1	2.5	1	2.5	2	2.5	0.000	1.000
▪Current medical history (Type of cardiothoracic history):								
Open heart	6	15.0	0	0	6	7.5	FE	0.025*
CABG	4	10.0	6	15.0	10	12.5	0.457	0.499
Decortication of the lung	7	17.5	11	27.5	18	22.5	1.147	0.284
Lobectomy	12	30.0	2	5.0	14	17.5	8.658	0.003*
Mitral valve replacement (MVR)	10	25.0	7	17.5	17	21.3	0.672	0.412
Aortic valve replacement (AVR)	1	2.6	10	25.0	11	13.9	8.293	0.004*
Other (Cancer)	0	0	1	2.5	1	1.3	1.013	0.314
-Duration of ICU stay (days):								
Range		3-8		3-10		3-10		
Mean±SD		4.97±1.27		6.77±2.39		5.87±2.11		
t-test				4.204				
P				0.0001*				

Figure (1): Duration of ICU stay of the studied patients with chest tube post cardiothoracic surgery (Study and Control groups) (n=80).
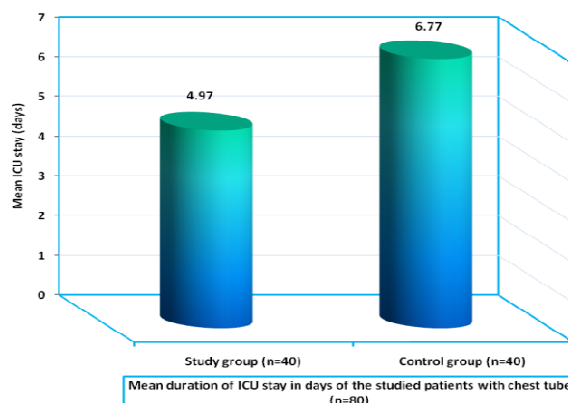

Table (3): Pulse among the studied with chest tube post cardiothoracic surgery (study and   control groups) at post-operative days of follow up (n=80).

Pulse at post-operative days of follow up	The studied patients with chest tube post cardiothoracic surgery at postoperative days of follow up (n=80)												χ^2	P
	Control group (n=40)						Study group (n=40)							
	Bradycardia (<60)		Normal (60-100)		Tachycardia (>100)		Bradycardia (<60)		Normal (60-100)		Tachycardia (>100)			
	N	%	N	%	n	%	N	%	n	%	n	%		
1st day	5	12.5	35	87.5	0	0	28	70.0	12	30.0	0	0	27.286	0.0001*
3rd day	0	0	36	90.0	4	10.0	0	0	32	80.0	8	20.0	1.569	0.210
5th day	0	0	12	37.5	20	62.5	0	0	14	63.6	8	36.4	3.567	0.059
7th day	1	5.3	8	42.10	10	52.6	0	0	11	100	0	0	10.055	0.007*
9th day	0	0	19	100	0	0	0	0	0	0	0	0	-	-
χ^2 P	56.820 0.0001*						44.820 0.0001*							

Figure (2): Respiratory rate among the studied patients with chest tube post cardiothoracic surgery at 5th and 7th post-operative days with a significant difference between the study and control groups.
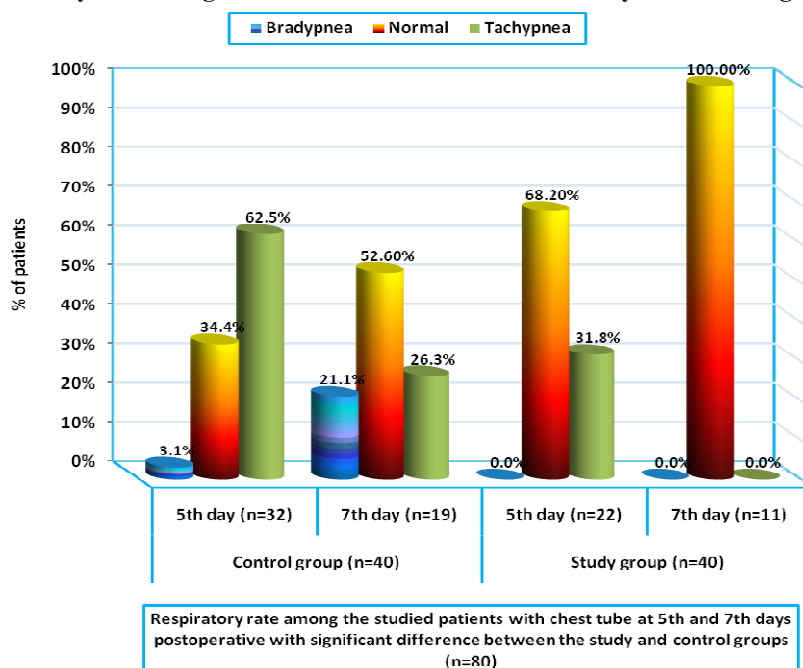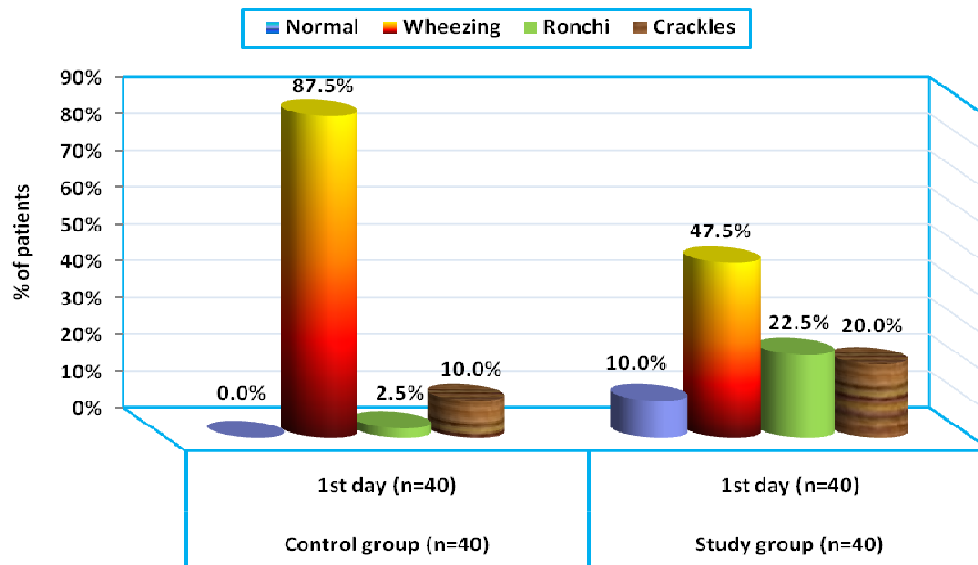
Figure (3): Sound on the affected side among the studied patients with chest tube post cardiothoracic surgery at 1st Sound on the affected side post-operative day with a significant

Sound on the affected side among the studied patients with chest tube at 1st day postoperative with significant difference between the study and control groups (n=80)

Table (4): Temperature among the studied patients with chest tube post cardiothoracic surgery (Study and Control groups) at post-operative days of follow up

Temperature at post-operative days of follow up	The studied patients with chest tube post cardiothoracic surgery at postoperative days of follow up																χ^2	P
	Control group								Study group									
	Hypo-thermia (<36.5c)		Normal (36.5-37c)		Hyper-thermia (37.5-38.5c)		Hyper-pyrexia (>40c)		Hypothermia (<36.5c)		Normal 36.5-37c		Hyperthermia (37.5-38.5c)		Hyperpyrexia (>40c)			
Number	N	%	N	%	N	%	N	%	N	%	N	%	n	%	n	%		
1st day C= (40)S= (40)	29	72.5	11	27.5	0	0	0	0	30	75.0	10	25.0	0	0	0	0	0.065	0.799
3rd day C= (40)S= (40)	3	7.5	32	80.0	5	12.5	0	0	7	17.5	28	70.0	5	12.5	0	0	1.867	0.393
5th day C=(32)S=(22)	12	37.5	20	62.5	0	0	0	0	14	63.6	8	36.4	0	0	0	0	3.567	0.059
7th day C= (19)S=(11)	1	5.3	8	42.1	10	52.6	0	0	0	0	11	100	0	0	0	0	10.055	0.007*
9th day C=(19)S=no one	0	0	19	100	0	0	0	0	0	0	0	0	0	0	0	0	-	-
χ^2 P	58.588 0.0001*								38.830 0.0001*									

Table (5): Swab culture findings among the studied patients with chest tube post cardiothoracic surgery (Study and Control groups) a first and seventh post-operative days

Swab culture findings from tube site postoperative	The studied patients with chest tube post cardiothoracic surgery (n=80)				χ^2	P
	Control group (n=40)		Study group (n=40)			
	N	%	N	%		
▪1st day (n=p: Negative Positive	40 0	100 0	40 0	100 0	0.000	1.000
▪7th day: Negative Positive	15 25	37.5 62.5	26 14	65.0 35.0	6.054	0.014*

Table (6): Chest tube complications among the studied patients with chest tube post cardiothoracic surgery (study and control groups).

Chest tube complications	The studied patients with chest tube post cardiothoracic surgery (n=80)				χ^2	P
	Control group (n=40)		Study group (n=40)			
	N	%	n	%		
Infection	24	60.0	13	32.5	6.084	0.014*
Bleeding	2	5.0	1	2.5	0.346	0.556
Tube clogging (clots)	6	15.0	2	5.0	2.222	0.136
Chest pain	5	12.5	4	10.0	0.125	0.723
Tension pneumothorax	1	2.5	0	0	1.013	0.314
Subcutaneous emphysema	6	15.4	2	5.0	2.340	0.126

Table (7): Pain intensity assessment (Visual analogue scale) (VAS) among the studied patients with chest tube post cardiothoracic surgery (study and control groups) before, during and after tube removal.

Visual analogue scale (VAS)	The studied patients with chest tube post cardiothoracic surgery (n=40)								χ^2 P (Control vs study)
	Control group (n=40)		Study group (n=40)						
	During removal		Before removal		During removal		After removal(15min)		During removal
	n	%	n	%	n	%	N	%	
No pain (0)	0	0	0	0	0	0	0	0	55.398 0.0001*
Mild (1-3)	0	0	2	5.0	6	15.0	30	75.0	
Moderate (4-6)	5	12.5	19	47.5	32	80.0	10	25.0	
Severe (7-9)	21	52.5	19	47.5	2	5.0	0	0	
Worst (10)	14	35.0	0	0	0	0	0	0	
χ^2 P			63.960 0.0001*						

Table (8): Mean scores of Visual analogue scale (VAS) of the studied patients with chest tube post cardiothoracic surgery (Study and Control groups) before and after cold application and before, during and after (15 min) of the tube removal.

Visual analogue scale (VAS) in relation to tube insertion and removal		Mean scores of VAS of the studied patients with chest tube post cardiothoracic surgery (n=80)		t-test	P
		Control group (n=40)	Study group (n=40)	(Control vs study)	
		Range Mean±SD	Range Mean±SD		
First day	Before application	6-10 8.45±1.48	7-10 9.20±0.79	2.821	0.006*
	After application	-	5-8 6.25±0.67	-	-
Paired t-test P		-	19.658 0.0001*		
Second day	Before application	4-9 6.05±1.11	5-9 6.62±0.99	2.459	0.016*
	After application	-	2-6 4.32±1.07	-	-
Paired t-test P			15.489 0.0001*		
Tube removal:	Before removal	6-10 7.62±1.05	3-8 6.17±1.17	5.810	0.0001*
	During removal	6-10 8.67±1.35	3-7 4.50±1.11	15.131	0.0001*
	After removal(15min)	4-9 6.35±1.42	1-5 2.40±1.06	14.084	0.0001*
F value P		32.830 0.0001*	94.444 0.0001*		

Table (9): Mean scores of Visual analogue scale (VAS) of the studied patients with chest tube post cardiothoracic surgery (Study and Control groups) at the first day before and after cold application.

Levels of Visual analogue scale (VAS) in relation to tube removal		The studied patients with chest tube post cardiothoracic surgery (n=80)				χ^2	P
		Control group (n=40)		Study group (n=40)			
		N	%	N	%		
Before removal	Mild	0	0	2	5.0	15.412	0.001*
	Moderate	5	12.5	19	47.5		
	Severe	34	85.0	19	47.5		
	Worst	1	2.5	0	0		
During removal	Mild	0	0	6	15.0	55.398	0.0001*
	Moderate	5	12.5	32	80.0		
	Severe	21	52.5	2	5.0		
	Worst	14	35.0	0	0		
After removal (15 min)	Mild	0	0	30	75.0	52.121	0.0001*
	Moderate	23	57.5	10	25.0		
	Severe	17	42.5	0	0		

Discussion

Chest tube is an invasive procedure which is inserted in a wide range of situations to facilitating lung expansion and allowing the drainage of fluids from the chest cavity Tube insertion is associated with significantly morbidity and mortality. Prevention of these complications, is a vital role of critical care nurse, therefore the aim of the present study was to evaluate the effect of protocol of care on clinical outcomes of patients with chest tube post cardiothoracic surgery.

Regarding the duration of ICU stay, the present study found that the mean duration of stay in the control group (6.77) was higher than in the study group (4.97) days. This is result was supported by **Raiza., et al (2013)** [156], who concluded that the mean duration of stay was 5.35 days in group I (control group) and 4.95 days in group II (study group).

Regarding the vital signs, the results of current study stated that the body temperature lowered in the majority of patients in the control and study groups at the first post-operative day. This finding was supported by **Ho K.M. et al (2009)** [16] **and Paul M et al, (2010)** [165, 4] who found that all the patients post cardiac surgery have a lower body temperature at the first post-operative day.

On other hand at the 7th day the findings revealed an elevated body temperature in more than half of the patients in the control, versus none in the study group .This may be contributed to the poor hand hygiene practice and lack of sterilization and disinfection of equipment used in dressing of chest tube which enhances chest tube infection. This result was in accordance with Liddle C (2013) (166) who stated that a high body temperature is an indicator of infection.

It is believed to be due to chest tube pain, infection and the inflammation around the tube, which cause over activity of sympathetic nervous system where peripheral constriction is an adaptive response that the blood shifts away from the periphery to the heart and the lung when the body perceive a threat or painful stimuli, rather than the infection at chest tube insertion site [166].

In relation to the characteristics of respiration ,the results showed that deep ,regular respiration and symmetrical breathing pattern was higher in the study group than in the control group .Regarding the respiratory sound ,the present study revealed that clear left and right lung sound was higher in the study group than in the control during post-operative days .In addition crackles lung sound was higher in the control group than in the study group . These findings were in line with **Mans Ch, et al ,(2012)** [170] who reported in a similar study that pre and post-operative breathing exercises and inspiratory muscle training improve the lung functioning post-operatively and lowered the rate of diminished breathing sound . Furthermore the finding of present study was supported by **Elkins et al (2015)** [174] who reported that deep breathing and coughing exercises pre operatively significantly improved the rapid shallow breathing post operatively in the study group than in the control.

The present finding also revealed that the majority of male patients were smokers and about two thirds of smoker patients in the study group had infection at chest tube site while the minority of non smoker patients had infection at chest tube infection. These results was agreed with Nakanishi R,(2016)(175)who found that the majority of smoker patients developed the infection of the tube and so delayed wound healing. Similarly,

Agostini P, et al (2010)(176) founded that the presence of smoking history was one of the factors which were significantly associated with the development of post- operative infections, especially, surgical site infection (SSI).

As regards the duration of chest tube, the results revealed that about half of patients in the study group had the tube from 1 to 3 days while more than half of patients in the control group had the tube from 4 to 7 days. This is believed to be due to the deep breathing and coughing exercises which enhance the pleural drainage and lung expansion. These findings were in line with Bruce EA   et al,(2006)(179)who reported that the chest tube is typically removed after cardiothoracic surgery after 24 hrs to 48 hrs. Similarly, Mirmohammad M, et al (2009)(180) found in a similar study that most tubes are removed within 24hrs to 72hrs .

The present study also showed that, nearly two third of the patients have a positive culture swab from the tip of the tube while in the study group one third of patients have a positive culture swab. In addition the infection rate was higher in the control group than in the study group. This explained that most patients in the control group had the chest tube for long period (more than 7 days) than in the study group in addition to that the chest tube is considered a foreign body which might promote infection, increase discomfort , and hinder pulmonary mechanics (182-184)This result was in constant with Yoshikan,et al (2013)(185)who reported that in a similar study, that positive chest tube tip culture, was the only independent risk factor associated with surgical site infection (SSI)post thoracic surgery.

The result of the current study revealed that there were a number of complications in both the control and study groups but less in the study group. It is believed to be due to the protocol of care that was applied in the study group and decrease the length of chest tube duration and ICU stay. This is explained that the thoracic operations impair patients' post operative respiratory function and immune systems, resulting in a relatively high risk for development of post operative complications during the peri operative period. Stephan F, et al (2000) (186).

Regarding the chest tube infection, the findings showed that more than half of the patients in the control group had infection at the chest tube insertion site while about one third of patients in the study group had infection. This result was congruent with Durai and Aragon (2014) (187) who reported that the most common complications of chest tube are surgical site infection, and recurrent pneumothorax. Stephan F, et al (2000) (186) stated that a major complication is postoperative infection, such as pneumonia, empyema, or surgical site infection (SSI).

Similarly this result was in line with Lu MS et al, (2008)(188)who found in a similar study that ,CT associated with complications rate as high as 25%. In addition; ,Labidi M ,et al(2009) (189) found that the general incidence of postoperative complications after thoracic operations is approximately 30%. Also, Kopterides P, et al,(2006)(190) reported that chest tubes are exteriorized through incisions in the chest wall after thoracic surgery, which raises the risk of infection, produce discomfort, and is prone to displacement.

The present findings revealed that the risk of infection increases with the duration of chest tube, this is results was supported by AcasseY,et al(2013)(191).who concluded that the longer the chest tube stays in the chest, the greater the risk for infection, as bacteria can enter around the tube and cause an infection around the lung. The risk of infection is decreased by special care in bandaging the skin at the point where the tube goes into the chest, whereas Am J Respire (2013) (192) stated that infection is usually uncommon less than 5% of cases of the study. Also, Deneuville M, (2002) (193) reported in a similar study, that the rate of infection from Ct insertion range from 1.2%-15%.

Regarding subcutaneous emphysema, the present study also illustrates that the minority of patients in the control group had subcutaneous emphysema. This finding was constant with Jones pm et al, (2011) (195) who concluded that the minority (17.8%) of the sample 135 patients with chest tube had a subcutaneous emphysema , those with SE had a longer length of stay and increased the risk of mortality.

Regarding the Pain intensity of both of the studied groups at the first day, the results revealed that more than half of the patients in both the study and control groups suffered from a severe pain in the first post- operative day. This result was supported by Curry, D. M et al (2006)(202) and Owen S & Gould D (2012)(203) as they reported the same result that more intense severe pain level occurs during the first 2 days following cardiac surgery. Patients described their pain after coronary artery bypass graft surgery with terms such as sore, aching tender, tiring and annoying more often on postoperative days 2nd and 3rd while as for pain in the second day nearly about three quarter of patients in the control and study group ,has a moderate pain. This is a result was congruent with Allibone L (2007) (22) and Moore E (2005) (204) who reported that in the 2nd and 3rd post- operative days, the Pain level decreased significantly. This congruent with Meehan et al (2000) (205) and Mueller et al (2000)(206) reported similar findings for the group of 50 cardiac surgery patients . They found that the maximal pain intensity was significantly higher on the first and second post -operative days and lower gradually during hospitalization until one week.

Concerning the pain intensity during removal of the tube, the findings of the present study illustrated that more than half of the patients in the control group a severe pain during the removal of chest tube. This finding

was congruent with Curry, D. M et al 2006 (202)and Owen S & Gould D 2012(203)who described chest tube removal as a painful and frightening experience and the pain is poorly managed, so the patient's will had a negative emotion. Also, this opinion is concurrent with puntillo et al(2001)(167)and Akrofi M et al (2005)(207)who stated that pain associated with chest tube removal has been poorly controlled in many surgical patients .However, one factor might be a lack of awareness of health care professionals of patients 'pain and distress associated with this procedure .

In addition, **Cline ME et al (2006)** [126] **and Rcimer.,(2003)** [86] showed that in a similar study that the patients who undergo chest tube removal experience a moderate to severe pain, this pain results from the chest endothelial tissue which adheres to the tube tip and at the time of removal the pulling force will shear this adhesion causing a severe pain.

Moreover, the findings of the present study showed that the pain intensity score of chest tube presence decreased significantly in the study group after intervention of cold application .This decrease in pain intensity score can be referred to physiological effects of the cold application intervention that increases the pain threshold, reduce nerve conduction velocity, muscle tone, and reduce inflammatory process.

Also this result was congruent with **Demir Y ,Khorshid L ., (2010)**[114] **,Etoch SW et al.,(2005)**[81] **and Deneuville M,(2002)**[193] who have proved that the application of cold is effective for pain relieving in patients after surgery than other sedative medications. By using ice application, this will help in decreasing giving analgesic for patients after procedures and this is also fortified by the theory that nerve conduction velocity decreased and pain tolerance increased. Also, this finding was in agreements with **Monahan et al (2007)** [208] **and Ross and Soltes (2000)**[209].Who stated that pain intensity decrease by using superficial cold application.

The findings of the present study also revealed that the mean pain intensity scores reported 10 minutes after chest tube removal were extremely low and decreased in the study group than in the control group. This result was supported by **Fayyazi et al., (2010)** [215] , **Friesner, Stacy A et al .,(2006)** [210] and **Raiza et al.,(2013)**[156] who stated that chest tube removal (CTR) improves comfort and reduces pain intensity score .

Conclusion

This study concluded that the incidence of overall complications of chest tube were higher in control than in study group. Using cold application was significantly decreased the level of pain during chest tube removal and infection rate was higher in the control group than in the study group, in addition; using the cold application significantly decreased the level of pain during chest tube removal.

1-Recommendations for patients

All cardiothoracic surgery patients should be given both written and verbal information about pain management, chest tube care, deep breathing and coughing exercises to enhance lung expansion and flow of drainage and how to alleviate chest tube related pain and early signs and symptoms of chest tube complications.

2-Recommendations for clinical practice

Protocol of care which involves deep breathing and coughing exercises, positioning, sterile dressing, and cold application should be carried out as a routine nursing care for critically post-operative patients.

3-Recommendation for administration

Manual procedure about protocol of care of chest tube, written policies for practicing cold application techniques to all postoperative patients, institutionalized written polices and provision of handouts of updated written Standard Operating Procedures chest tube care and guidelines regarding prevention and control of chest tube related infection and recommendations to carry out it regularly in daily life routine of care for all cardiothoracic surgery patients .

4. Recommendations for further research studies:-

Assessment of problems facing critical care nurse regarding the chest tube infection and its effect on their performance and the use of other non-pharmacological pain management.

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