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RESEARCH ARTICLE

EFFICACY OF FORCED EXPIRATORY TECHNIQUES ON WOUND DRAINAGE IN POST CORONARY ARTERY BYPASS GRAFTING PATIENTS

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ABSTRACT

Back ground: Coronary Artery Bypass Grafting is a surgery to replace blocked arteries with healthy blood vessels and failure to fully evacuate a hemothorax post coronary artery bypass graft can lead to development of fibrothorax. Fibrothorax restricts the lung, and can begin as early as 1-2 weeks after the surgical procedure. Patients with fibrothorax report initial dyspnea. For mechanically ventilated patients, progressive difficulty with adequate ventilation due to restrictive lung mechanics can be seen. **Aim of the study:** The aim is to prove the effect of using Forced Expiratory pressure techniques with deep breathing exercises on wound drainage, decreasing length of stay in ICU, decreased time of TT insertion and improvement of Lung Compliance. **Materials and methods:** 40 male overweight Post Coronary Artery Bypass Grafting patients their age ranged between 55:65 years old were recruited from CardioTech open resuscitation unit were divided into two equal groups in number group A (20 patients) (study group) and group B (20 patients) (control group). Pre and Post assessment was performed for both groups in the form of percentage of change of fluid exudates from mediastinal and left intra-pleural thoracotomy tubes and percentage of change in peak cough flow. Both groups have performed 3 sessions two in the second day postoperative and one on the third day in the form of percussion, vibration, shaking, deep breathing exercises, incentive spirometer, acapella and circulatory exercises with adding 10 minutes of forced expiratory techniques for the study group. **Results:** showed no significant difference in both groups in fluid exudate from Mediastinal tubes where mean % of change for treatment group was 6.53% and that for control group was 5.08% with p value of 0.355 and also showed significant increase in % change in Left intra-pleural fluid level in treatment group with mean of 12.69% over control group with mean of 5.23% with p value of 0.001. **Conclusion:** Adding forced Expiratory Techniques to traditional physical therapy treatment may enhance wound drainage only in left Intra-pleural thoracotomy tubes and nearly has no effect on Mediastinal ones in Post CABG patient or his cough strength at all.

INTRODUCTION

Current practice guidelines recommend coronary artery bypass grafting (CABG) as the standard procedure for patients with unprotected Left Main Coronary Artery disease (1). Indications for chest tube placement include: (a) pneumothorax; (b) penetrating chest trauma; (c) severe blunt chest trauma; (d) hemothorax; (e) chylothorax; (f) symptomatic pleural effusion; (g) bronchopleural fistula; (h) chemical pleurodesis for benign and malignant conditions; (i) postoperative use in thoracic/cardiac surgery; and (j) complicated parapneumonic effusion or empyema (2). Cumulative rates of early (<24hrs post-placement) and late (>24hrs post-placement period) chest tube complications are approximately 3 and 8-10%, respectively (3). The lung is the most commonly injured organ during TT placement. Patients with decreased lung compliance, consolidation of the underlying parenchyma or significant pleural adhesions are at increased risk for laceration. These conditions prevent normal displacement of the lung when confronted by the chest tube. The use of a trocar and an inability to sufficiently explore the pleural space prior to tube placement also increase the risk of lung laceration. (4)

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Fibrothorax: Failure to fully evacuate a hemothorax can lead to development of fibrothorax. Retained blood within the pleural space causes inflammation and fibrous changes involving the parietal and visceral pleurae. Fibrothorax restricts the lung, preventing it from fully expanding, and can begin as early as 1-2 weeks after the initial injury. Patients with fibrothorax report initial dyspnea. For mechanically ventilated patients, progressive difficulty with adequate ventilation due to restrictive lung mechanics can be seen. Radiographic imaging may show the retained hemothorax, loculated collections, and/or collapsed lung. Once fibrothorax develops, primary management is operative and consists of "freeing" the restricted lung. Any retained fluid is evacuated surgically, and the fibrous adhesions removed to facilitate lung re-expansion. A formal decortication may be required. Fibrothorax can be prevented by adequately draining the hemothorax early in the course of the process. A retained hemothorax should be evacuated before it causes fibrosis. Over 95% of hemothoraces are effectively treated by TT alone (5). Persistent post-CABG effusion can occur. Pleural fluids and pleural tissue in early-stage lesions were characterized by lymphocytosis. With time, the inflammatory changes were replaced by fibrosis that resulted in dyspnea and, at times, trapped lungs requiring surgical intervention (6)

Statement of the problem: Which of forced expiratory techniques with traditional physical therapy treatment or traditional physical therapy treatment alone will increase the fluid exudates and cough strength post Coronary Artery Bypass Grafting?

Purpose of the Study: The purpose is to compare between using the Forced Expiratory pressure techniques with traditional physical therapy treatment on fluid exudates, and cough strength Post Coronary Artery Bypass Grafting.

Significance of the study:

Fibrothorax

- Fibrothorax is defined as fibrosis within the pleural space and is sometimes referred to as pleural peel. It may occur secondary to haemothorax following Coronary artery bypass grafting.
- Fibrothorax can be prevented by adequately draining the hemothorax early in the course of the process. A retained hemothorax should be evacuated before it causes fibrosis. Over 95% of hemothoraces are effectively treated by TT alone. (5)
- Normal intra-pleural pressure is negative. However, if air or fluid enters the pleural space, intra-pleural pressure becomes positive. Air is eliminated from the pleural space into the drainage chamber when intra-pleural pressure is greater than +2cmH20. Thus, air moves from a higher to lower pressure along a pressure gradient. The drainage chamber has a vent to allow air to escape the chamber, and not build up within the chamber.(6)
- During vigorous coughing, intrathoracic pressures may reach 300 mm of Hg and expiratory velocities may approach 800 km per hour. (7)
- Expiratory positive pressure from the patient helps push air and fluid out of the chest (e.g. cough, Valsalva maneuver).(8)

This Study will assess the effect of forced expiratory techniques addition to traditional physical therapy treatment on preventing prolonged TT insertion and thus improving Lung Compliance quickly.

Subject& methods

Ethical consideration: Before the initiation of the study a concent form will be obtained from each subject as an agreement to be included in the present study. Each subject will receive detailed explanation of procedures of measurement devices and the purpose of the study will be explained to each subject. This study was approved by Ethical comity of faculty of physical therapy, Cairo University (No:P.T.REC/012/003305 – 15/7/2021). Forty male patients with age ranged from 55 to 65 years old were recruited from CardioTech OR unit at Ibrahim Badran Hospital in Giza Egypt. They are randomized into two groups; 20 patients in the treatment group (TG) and 20 patients in the control group (CG), Undergoing Coronary Artery Bypass Grafting via Median sternotomy

Inclusion Criteria

- Forty men patients from CardioTech OR unit
- Their age will be ranged from (55-65 years old)
- Their BMI will be ranged from 25 to 29.9 kg/m^2

Exclusion Criteria

- Haemodynamically unstable patients
- Very severe cases of exacerbations
- Cases of respiratory failure
- Cases with decompensated comorbid disease
- Unstable general cases after surgery
- Uncontrolled hypertension
- Neuromuscular condition that would interfere with the exercises test and inability to follow instructions

Design of the study

This study was a cross sectional study

The patients were be divided into 2 equal groups in number (A and B)

- **Group A:** 20 patients did traditional physical therapy treatment only post CABG
- **Group B:** 20 patients did both traditional physical therapy treatment and forced expiratory pressure techniques

Instrumentation

Evaluative Tools

- Intercostal Tube or Thoracotomy Tube to assess level of pleural fluid after procedure
- Peak Cough Flow assessment PCF

Therapeutic Tools: for both groups (study & control)

- Incentive Spirometer
- Cough and huff techniques (Forced Expiratory Pressure Techniques FEPTs)
- Deep Breathing Exercises (DPEs)
- Acapella to ensure airway clearance in both groups
- Percussion, vibration and shaking techniques

For Study group only Forced Expiratory Techniques as Cough and Huff were used in addition

Procedure

Evaluating procedure: Before the treatment: patient wore comfortable gown that must be loose that didn't interfere with Traditional Physical Therapy treatment , check the thoracic belt that it was in proper position and not interfering with patient's ability to breathe or cough, all connections were proper and all readings were appearing on monitor.

Evaluating procedure was be divided into two parts: Evaluation procedure in the form of volume of fluid exudates from Thoracotomy tubes (Mediastinal and Left Intra-pleural tubes) and Peak Cough Flow assessment for cough strength

Treatment procedures

Group A (Studying Group)

- Ask the patient to take deep breath from his nose expire it from his mouth.
- Then use percussion, vibration and shaking techniques to assist in coughing
- If the patient was fearful of coughing due to pain ask him to hug a pillow during coughing.
- If the patient didn't know how to cough learn him how to do coughing

•**Deep Coughing:** Start by taking a deep breath. Hold the breath for 2-3 seconds. Use your stomach muscles to forcefully expel the air. Avoid a hacking cough or merely clearing the throat. A deep cough is less tiring and more effective in clearing mucus out of the lungs.

•**Huff Coughing:** Huff coughing, or huffing, is an alternative to deep coughing if you have trouble clearing your mucus. Take a breath that is slightly deeper than normal. Use your stomach muscles to make a series of three rapid exhalations with the airway open, making a "ha, ha, ha" sound. Follow this by controlled diaphragmatic breathing and a deep cough if you feel mucus moving.

- •Use the Incentive Spirometer in forced expiration to assist in coughing
- •Use circulatory exercises in whole joints of the body but avoid bearing on hands or pulling with his arms
- •Finish the session with cooling down by using deep breathing exercise techniques
- •The session time will not exceed 20 minutes to avoid fatigue or any arrhythmias OR it will be ended the time the patient asks due to fatigue.

Group B (Control group): All the previous steps will be done except Forced Expiratory Techniques and Forced Expiration During The use of Incentive Spirometer.

Analysis of results: This study was designed to investigate the effect of forced expiratory techniques on wound drainage in Post Coronary Bypass Grafting patients in both Mediastinal and Left intra-pleural thoracotomy tubes, and effect of these techniques on enhancing cough of those patients. Thoracotomy tubes were used to assess level of fluid in both mediastinal and left intra-pleural insertions, and Peak Cough Flow Meter device to assess the expired volume before and after the intervention. The study was made for three sessions two on the second day post CABG (morning and evening) and one on the third day post CABG (Morning).

Group A (Studying Group): Twenty patients were included in this group, the data in the table (1) represented their median age 58.55 ±2.74 years old ranged from 55 to 65 years old, their median BMI 27.07 ±1.46 ranged from 25 to 29.9 kg\m^2

Group B (Control group): Twenty patients were included in this group, the data in table and fig. represented their median age 59.75 ±3.01 years old, ranged from 55 to 65 years old, their median BMI 27.21 ±1.17 ranged from 25 to 29.9 kg\m^2 There was no significant difference between both groups in their ages where their p value was 0.195 and no significant difference in their BMI with p value 0.740

Treatment Group: The table no. 2 demonstrated the difference between the level of fluids before the first session and after the third session and although for Peak Cough flow using Paired T test:

- There was significant increase of level of fluid in Mediastinal Tube after the third session with mean of 614 cm on before the first session with mean of 578.5 cm with p value 0.010
- There was significant increase of level of fluid in Left Intra-pleural Tube after the third session with mean of 658.5 cm on before the first session with mean of 586 with p value < 0.001
- There was significant increase in the flow of air in PCF after the third session with mean of 209.5 liter\min. over before the first session of mean 143.5 liter\min. with p value < 0.001

Control Group: The table no. 3 demonstrated the difference between the level of fluids before the first session and after the third session and although for Peak Cough flow using Paired T test:

- There was significant increase of level of fluid in Mediastinal Tube after the third session with mean of 572 cm on before the first session with mean of 544.5 cm with p value < 0.001
- There was significant increase of level of fluid in Left Intra-pleural Tube after the third session with mean of 597 cm on before the first session with mean of 567 with p value < 0.001
- There was significant increase in the flow of air in PCF after the third session with mean of 170 liter\min. over before the first session of mean 128.5 liter\min. with p value < 0.001
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Table No. 1

	Normal	Studying group		Control group			
		Mean	Standard Deviation	Mean	Standard Deviation	P value	S
Age (years)	55-65	58.55	2.74	59.75	3.01	0.195	NS
BMI (kg\m^2)	25-29.9	27.07	1.46	27.21	1.17	0.740	NS

Table No. 2

	Treatment group		P value	
	Mean	Standard Deviation		Sig.
Mediastinal Before 1st	578.50	73.15	0.010	S
Mediastinal After 3rd	614.00	77.96		
Left Pleural Before 1st	586.00	74.79	<0.001	S
Left Pleural After 3rd	658.50	97.67		
PCF Before 1st	143.50	49.23	<0.001	S
PCF After 3rd	209.50	52.96		

Table No. 3

	Control group		P value	
	Mean	Standard Deviation		Sig.
Mediastinal Before 1st	544.50	40.58	<0.001	S
Mediastinal After 3rd	572.00	41.50		
Left Pleural Before 1st	567.00	30.11	<0.001	S
Left Pleural After 3rd	597.00	40.01		
PCF Before 1st	128.50	21.10	<0.001	S
PCF After 3rd	170.00	24.27		

Table No.4

	Treatment group					Control group					P value	Sig.
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum		
Mediastinal % change	6.53	9.26	6.67	-20.00-	24.00	5.08	1.53	5.17	1.89	9.62	0.355	NS
Left Pleural % change	12.69	12.13	10.69	-15.38-	38.33	5.23	2.59	5.00	1.82	10.34	0.001	S

Table No. 5

	Treatment group					Control group					P value	Sig.
	Mean	SD	Median	Minimum	Maximum	Mean	SD	Median	Minimum	Maximum		
PCF % change	55.31	44.65	54.20	-6.25-	144.44	33.73	9.70	36.36	14.29	46.15	0.184	NS

Percentage of change in Level of fluid between both groups: Non-Parametric MANN Whinty Test (table no.4). There was no statistically significant change between both treatment and control groups in Mediastinal tubes where mean % of change for treatment group was 6.53% and that for control group was 5.08% with p value of 0.355.

There was significant increase in % change in Left intra-pleural fluid level in treatment group with mean of 12.69% over control group with mean of 5.23% with p value of 0.001. Percentage of change in PCF between both groups: Non-Parametric MANN Whinty Test. The table no. 5 demonstrated the percentage of change in Peak Cough Flow volume between treatment and control group where there is no significant difference between % of change in treatment group of mean 55.31 % and that of control group was 33.73 % with p value of 0.184

DISCUSSION

Forty male patients were enrolled in this study with their age ranged from 55 to 65 year old. Participants assigned into 2 groups, 20 patients in the studying group, and 20 patients in the controlled group. P values less than 0.05 was considered statistically significant.

The results of this study showed that there was significant difference in Left intra-pleural thoracotomy tubes which measured by using the level of fluid between the studying and controlled groups before the first session and after the third session and there was no significant difference in the mediastinal thoracotomy tubes which measured by using the level of fluid between the studying and controlled groups before the first session and after the third session. To our knowledge few studies addressed the effect of forced expiratory techniques on wound drainage in post CABG patients. Our study showed a significant increase in the level of fluid in left intra-pleural thoracotomy tubes after putting cough program for those patients in the studying group.

A possible explanation for this increase is Chest drainage systems work by combining the following three efforts: (8) Expiratory positive pressure from the patient helps push air and fluid out of the chest (e.g. cough, Valsalva maneuver). And another opinion states that: A one-way valve mechanism to expel air out of the pleural space and prevent the re-entry of atmospheric air into the pleural space is achieved by an underwater seal. The underwater seal consists of the distal end of the drainage tubing submerged at about 2 cm below the surface of sterile water or saline. During expiration or coughing, air from the pleural space is expelled through the tubing, and the depth at which the drainage tube is

submerged is the hydrostatic pressure to be overcome. In addition, the underwater seal produces a siphon effect which enhances drainage. (9) In contrast and according to Langley et.al, 2009 (10) who said that: However, these chest tubes are upsetting, reduce respiratory effort by causing significant pain and eventually hamper coughing and ambulation, which are important in preventing pulmonary complications and enhancing recovery after surgery. And other opinion states that: It is uncertain whether impaired renal function really causes increased pleural drainage volume. Uraemia may complicated by a fibrous pleuritic and pleural effusion according to Shields et.al, 2005 (11). And on the other hand our study showed there is no significant difference between study and control groups in Mediastinal fluid drainage volume after putting cough program in studying group only and a possible explanation for this is:

The difference in drainage output could most probably be explained by the larger surgical trauma to the lymphatic vessels in the mediastinal pleura, which could cause a combination of increased pleural fluid formation and decreased lymphatic clearance from the pleural space according to Lagarde SM et.al, 2007 (12)

And other explanation for this is: Pain and irritation can be very annoying and is potentially caused by chest tubes; some have suggested that the insertion of more than 1 chest tube per patient may exacerbate pain and discomfort, causing a decrease in ambulation that could negatively influence patient outcome according to Eryilmaz et.al, 2006 (13). In contrast: Normal intra-pleural pressure is negative. However, if air or fluid enters the pleural space, intra-pleural pressure becomes positive. Air is eliminated from the pleural space into the drainage chamber when intra-pleural pressure is greater than +2cmH20. Thus, air moves from a higher to lower pressure along a pressure gradient. The drainage chamber has a vent to allow air to escape the chamber, and not build up within the chamber. According to Pryor et.al, 2008 (14). And our study showed that there is no significant difference between both study and control group in increasing cough efficiency after putting cough program for study group where the percentage of change in Peak Cough Flow volume between treatment and control group where is of no significant difference between % of change in treatment group of mean 55.31 % and that of control group was 33.73 % with p value of 0.184. And a possible explanation for this and according to Koyilil, et.al 2019 (15):

“Cough was found to peak between 3rd and 5th postoperative day. The severity of cough was not significantly correlated with basic cardiac pathology, the type of surgery performed, the duration of cardiopulmonary bypass or the basic left ventricular function. The duration of manipulation of the heart in off pump CABGs and postoperative fluid balance and the smoking status of the patient too had no influence. All patients had a reduction in their lung volume and correlated significantly with severity of cough. A lung volume reduction to less than 65% of the preoperative level resulted in more severe cough. We conclude that post cardiac surgery cough primarily results from lung volume reduction following surgery. So control of this cough should be aimed at prevention of postoperative lung volume reduction.” And our study was performed in the 2nd and the beginning of the 3rd day only so we cannot reach the peak cough flow by the patient and thus there will be no significant difference between both groups after putting cough program in the 2nd and 3rd days following the surgery.

Conclusion

So it can be concluded that Forced Expiratory Techniques may enhance wound drainage only in left Intra-pleural thoracotomy tubes and nearly has no effect on Mediastinal ones or the cough strength following Coronary Artery Bypass Grafting surgery.

REFERENCES

Yu, X. P., Wu, C. Y., Ren, X. J., Yuan, F., Song, X. T., Luo, Y. W. & Chen, F. (2016). Very long-term outcomes and predictors of percutaneous coronary intervention with drug-eluting stents versus coronary artery bypass grafting for patients with unprotected left main coronary artery disease. Chinese medical journal, 129(7), 763.

Abramian, O., Kolman, D., &Abramian, E. (2016).Oncological Airway Emergencies in the Critical Care Unit.In Oncology Critical Care.IntechOpen.

Kwiatt, Michael, et al.(2014). "Thoracostomy tubes: a comprehensive review of complications and related topics." International journal of critical illness and injury science 4.2: 143.

Ianniello, Stefania, Maria Gabriella Merola, MatteoPignatelli, Riccardo Ferrari, MargheritaTrinci, and Vittorio Miele. (2018)."The Follow-Up of Patients with Thoracic Injuries."In Diagnostic Imaging in Polytrauma Patients, pp. 491-508.Springer, Cham.

Третьяков , А. А., and В. И. Николаев. (2014). "Emergency surgery of military traumas= Неотложнаяхирургиябоевыхповреждений.

LO Mauro, Maria Antonella.(2012). "Voluntary cough mechanics in health and Duchenne muscular dystrophy." .

Polverino, Mario, et al.(2012)."Anatomy and neuro-pathophysiology of the cough reflex arc." Multidisciplinary respiratory medicine 7.1 1-5.

Gambazzi F, Schirren J. (2003).(Thoracic drainage. What is evidence based?). *Chirurg*. Feb. 74 (2):99-107.

SladenRN. (1987). The post thoracotomy patient. In: Marshall B, LongneckerDE, Fairley HB, eds. Anesthesia Jor thoracic procedures. Boston: Blackwell Scientific, 1987: 552-6.

Langley, Malinda Elizabeth Pauley.(2009)."Pain management after cardiac surgery.".

Shields, Thomas W., (2005). ed. General thoracic surgery. Vol. 1. Lippincott Williams & Wilkins,.

Lagarde, S. M., et al. (2007). "Predictive factors associated with prolonged chest drain production after esophagectomy." Diseases of the Esophagus 20.1 (2007): 24-28.

Eryilmaz, Sadik, et al.(2006). "Effect of posterior pericardial drainage on the incidence of pericardial effusion after ascending aortic surgery." The Journal of thoracic and cardiovascular surgery 132.1: 27-31.

Pryor JA, Prasad AS.(2008).Physiotherapy for respiratory and cardiac problems: adults and paediatrics. Elsevier Health Sciences; Mar 6.

VijayakumarKoyilil, Mohanakrishnan, H.A. Rieyaz, John Rajpathy, Selvakumar P, Deneshkumar V. (2019). Non infective cough in immediate post cardiac surgery patients. International Journal of Contemporary Medicine Surgery and Radiology.;4(4):D75-D80.

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