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Original Article

Impact of Breathing Exercises on Postoperative Fatigue Severity after Cardiothoracic Surgery

Randa Mamdouh Gad Allah

Department of Nursing Surgery, Military Medical Academy, Cairo, 11291

(Correspondence: rmamdouh0603@gmail.com)

Abstract

Background: Fatigue is common after major surgery such as cardiothoracic surgery where its technique involves sternotomy incision and postoperative mechanical ventilation which may affect the breathing ability and may delay recovery. Fatigue is generally defined as a feeling of lack of energy and motivation that can be physical, mental, or both. Breathing exercises enrich and support the circulation and blood flow all over the body by improving the quality of breathing. Respiratory efficiency addresses the physical and psychological conditions of the patients. **The aim of the study**: was to evaluate the effect of breathing exercises on post-operative fatigue severity after cardiothoracic surgery. **Subjects and methods**: A quasi-experimental study was used to fulfill the aim of this study. This study was conducted at the cardiovascular ICU and cardiovascular inpatient units in International Medical Center. A sample of 50 adults undergone cardiothoracic surgeries was included in the study. The tools of this study consisted of four parts; Patient demographic characteristics and clinical data sheet and the Rhoten Visual Analogue (VAFS) Fatigue Scale. Lung capacity was measured using incentive spirometry. **The results:** revealed that fatigue severity was lower during performing breathing exercises than before performing breathing exercises and was lower after a week of performing breathing exercises. **Recommendations:** The study recommended discussing with the responsible health team the availability of setting breathing exercises as a part of routine pre and post-operative care.

Keywords: Breathing Exercises, Postoperative Fatigue, Cardiothoracic Surgery.

Introduction

Following cardiothoracic surgery, pulmonary system affection may deprive the body cells of enough oxygen **(**Courtney, 2017). The respiratory efficiency addresses the physical and the psychological conditions of the patients, where, appropriate breathing meets the body's needs and provides optimal conditions for health. Also, breathing exercises enrich and support the nervous system, circulation, and blood flow all over the body by improving qualities in breathing; they can positively affect emotions and cognition (Courtney,2018). Post-operative fatigue is a multifaceted diverse concept that has both physiological and psychological and is still not well understood (Alaigh, 2015). It is a subjective appraisal of the body's feelings; as well pain and

pain medication may influence the perception of fatigue (Bernice, 2016).

Chest physiotherapy consisting of breathing exercises and an incentive spirometer, techniques to clear bronchial secretions, and early mobilization are given to increase lung ventilation and prevent chest infection (Smeltzer and Bare, 2015). Teaching the patient to deep breaths before surgery and continue a specific routine after surgery may affect the physical and psychological status of the patient (Gabriel *et al*, 2019).

SIGNIFICANCE OF THE STUDY

The major **surgery such as cardiothoracic is followed by a pronounced increased feeling of fatigue extending throughout the first month in about one-third of patients** (Christensen, 1982)**. Fatigue also correlates with postoperative deterioration** and may delay the patient's recovery (Tom and Kehlet, 2015). Moreover, Zaccaro *et al.* (2018) in Italy reported that slow breathing techniques act to enhance autonomic, cerebral, and psychological flexibility in a scenario of mutual interactions. Also, the evidence of links between parasympathetic activity, and CNS activities (increased EEG alpha power and decreased EEG theta power) related to emotional control and psychological well-being in healthy subjects.

AIM OF THE STUDY

The current study aimed to identify the impact of breathing exercises on post-operative fatigue severity after cardiothoracic surgery.

Research Hypothesis

H1: patients who receive breathing exercises were expected to inhibit post-operative fatigue after cardiothoracic surgery.

SUBJECTS AND METHOD

The aim of this study was to identify the impact of breathing exercises on post-operative fatigue after cardiothoracic surgery.

To fulfill the study aim, the following research question will be answered: What is the impact of breathing exercises on post-operative patient fatigue after cardiothoracic surgery?

The methodology followed in the conduction of the study is portrayed under four main designs:

I- Technical design.
II- Operational design.
III- Administrative design.
IV- Statistical design.

I- Technical Design: The technical design entails the study design, study setting, subjects, and tools for data collection.

Study design: A quasi-experimental research design was applied to fulfill the aim of this study.

Study Setting: This study was conducted at the cardiovascular ICU and cardiovascular inpatient units in International Medical Center.

Subjects: Adult patients undergoing cardiothoracic surgery and acting under their own control were included in the study. Patients were enrolled preoperatively according to inclusion and exclusion criteria.

Inclusion criteria: Adult patients of both sexes undergoing cardiothoracic surgery. All patients undergoing bypass surgery and sternotomy opening technique.

Exclusion criteria: Current or past history of neurological disorders, depression or/ and musculoskeletal disorders

Sample type: A purposeful sampling technique was used in the study.

Data collection tools

Tool one: Patient's demographic characteristics and clinical data:

Patient demographic characteristics: Demographic characteristics such as age, sex, and BMI.

A. Patient's clinical data: Clinical data such as type of operation, hemoglobin level, and past history.

Tool two: **1-Lung capacity measurements sheet:** Patients lung capacity was measured using a simple intensive Spirometer to identify the maximal amount of air, that can be inspired and held after several normal breaths, it was developed and modified by the author (Nettina, 2014; Alexander *et al*, 2015).

The scoring system

The amount of air inspired was recorded and categorized as the following;

< 600 ml was given	One mark
600 - < 900 ml was given	Two marks
900 - <1200 ml was given	Three marks

2- Rhoten Visual Analogue Fatigue Scale (VAFS):

This scale VAFS was used to measure fatigue severity. It is a numerical linear scale ranging from zero to ten, corresponding to the degree of fatigue. Where (0) indicates no fatigue and (10) indicates total exhaustion. This scale was marked by the patients; it was adopted after (Fisher *et al*, 2022).

The scoring system: Rhoten Visual Analogue used the following:

(0-2) = no fatigue.
(3-4) = mild fatigue.

(5-6) = moderate fatigue.

(7-9) = sever fatigue.

(10) = maximum fatigue.

II. Operational design

Pursed lip breathing was used for all patients postoperatively while performing breathing exercises for four days. The patient's post-operative fatigue was assessed while performing breathing exercises for four days and once after one week of performing breathing exercises.

Each patient was visited individually six times per day for four days and encouraged to perform breathing exercises every two hours for the first four postoperative days starting from 10 am until 8 pm.

- Pursed lip breathing was used as the following; three sets of 10 deep breaths with a 30- to 60-s pause between each set.

- **Patient's post-operative fatigue assessment:**
- Assessment was done before the first visit at 10 am and after the last visit at 8 pm daily to assess the effect of performing coughing and breathing exercises, as well as, once after one week of performing breathing exercises to assess the delayed effect of the technique.
- Each patient was assessed individually by the researcher for fatigue severity.

III- Administrative design: To carry out this study, permission was obtained from the responsible authorities in the International Medical Center after explaining the study's aim.

Ethical Considerations: Oral approval was obtained from subjects who agreed to participate in the research after declaring the aim of the study to them. Also, they were informed about their rights to withdraw from the research at any time. Any medical changes in the patient's condition were reported to the responsible doctor. All patient data were used for research purpose.

IV- Statistical Design: Data was collected, coded, tabulated, and analyzed using SPSS version 12

Computer package. Numerical variables were presented as a mean and standard deviation, while categorical variables were presented as frequency and percentage. Analysis of numerical variables was performed by unpaired or paired t-test as appropriate, while that of categorical variables was performed by MC Nemar test or Wilcoxon signed Rank test as appropriate. Correlations between variables were estimated by the Spearman correlation coefficient test. Analyses of numerical variables among smokers were performed by the Kruskal – Wallis test with the application of the Mann-Whitney test and a post Hoc test.

Results

Part one: Demographic characteristics of the patients included in the study

Table (1) showed that more than a third 36% of the patient's ages ranged from 55 to 60 years with a mean SD of 56 ± 3.9. More than half of the patients 56% were males, while, less than half of the patients were considered overweight with SD 27 ± 1.7 as estimated by their BMI.

Table (2) shows that more than half of the operation types among patients had coronary artery bypass 74%. Regarding hemoglobin, it was found that more than a third of the patients 36 % had hemoglobin levels ranging from 12 – 14 g \dl. Regarding past history less than half of the patients had diabetes.

Part two:

Table (3)clarified that fatigue severity after coughing and breathing exercises with a mean ± SD of 1.095± .400 was higher than that before coughing and breathing exercises with a mean ±SD of 1.655 ± .280 and the difference was without significant (p> 0.05).

Table (4) showed that two third of the patients 60 % had mild fatigue severity after one week of performing breathing exercises, while, two third of patients 30% had severe fatigue

severity before performing breathing exercises and the difference was statistically significant (P< 0.05).

Table (5) Clarified that lung capacity after doing breathing exercises with a mean ±SD of 1.600 ± .831 was higher than that during performing breathing exercises with a mean ± SD of 1.405±.549 and the difference was not statistically significant (p = 0.05).

Table (6): shows that the majority of patients 70% had lung capacity measurements ranging from 600 -900 ml after one week of performing breathing exercises while a third of the patients %30 had the same lung capacity before performing breathing exercises and the difference was statistically significant (P< 0.05).

Part one: Demographic characteristics of the patients included in the study

Table 2: Frequency and percentage distribution of demographic characteristics of the patients (N= 50)

Characteristic	Frequency	%
Age of the patients in years:		
40 - 45	8	16
45 › 50	10	20
50 › 55	14	28
55 ≥ 60	18	36
Mean ± SD	56 ± 3.9	
Gender:		
Male	28	56
Female	22	44
BMI:		
Underweight ≤ 18.5	1	2
Normal 18.5 - 24.9	10	20
Overweight 25 - 29.9	20	40
Obese 30 – 40	19	38
Mean ± SD	27 ± 1.7	

Table 3: Frequency and percentage distribution of clinical findings of the patients (N = 50)

Characteristics	**Frequency**	**%**
Type of operation:		
CABG surgery	37	74
Valve surgery	13	26
Hemoglobin level:		
14 – 18 g \ dl	5	10
12- 14 g \ dl	26	52
10 ≤ 12 g \ dl	19	38
Past history:		
Diabetes	23	46
Renal troubles	5	10
Hepatic troubles	4	8
Non	18	36

Part two:

Table 3: Comparison between fatigue severity before and after doing breathing exercises during four days.

Item	After performing breathing exercise	Before performing breathing exercise	t-test	P- value
	Mean ± SD	Mean ±SD		
Fatigue severity	1.095 ± .400	1.655 ± .280	0.82	0.06

Table 4: Comparison between fatigue severity before and after a week of coughing and breathing exercises.

Fatigue severity	Before doing coughing and breathing exercises		A week after doing coughing and breathing exercises		Wilcoxon signed ranks test	P- value
	No.	%	No.	%		
No fatigue	0	0 %	17	34 %	--	0.04*
Mild	2	4 %	30	60 %		
Moderate	18	36 %	2	4 %		
Sever	30	60 %	1	2 %		

*Significant at P<0.05.

Table 5: Comparison between lung capacity measurements before and after doing breathing exercises.

Item	During performing breathing exercises	Before performing breathing exercise	T-test	P value
	Mean ± SD	SD		
Lung capacity	1.600 ± .931	1.405 ± .549	1.02	0.05

Table 6: Comparison between lung capacity before and after a week of doing breathing exercises.

Lung capacity	Before doing breathing exercises		After doing breathing exercises		Wilcoxon signed ranks test	P-value
	No.	%	No.	%		
< 600 ml	35	70 %	5	1 0 %	--	0.02*
600 - < 900 ml	15	30 %	35	70 %		
900 - <1200 ml	0	0 %	10	20 %		

*Statistically significant at P<0.05.

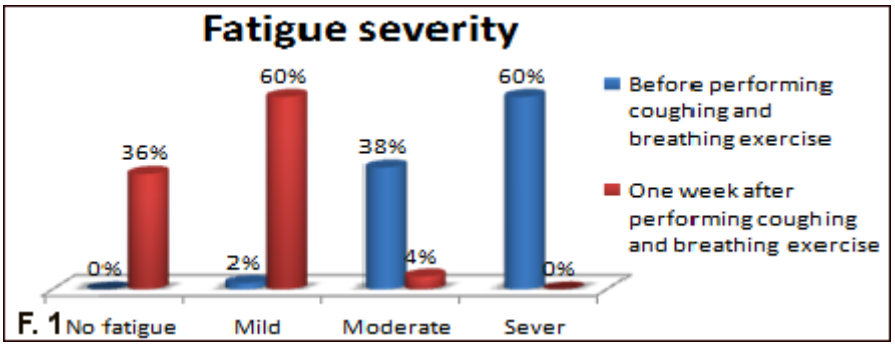

Figure 1: Patients 60% had mild fatigue severity, but none after one week of breathing exercises.

Discussion

In the present study, the majority of patients' ages ranged from 50 -60 years old, and 36% of patients' age ranged from 55 to 60 years with a mean SD of 56 ± 3.9. This is in line with ***(Thom et al. 2020)***. who indicated that cardiac surgery increased among people over the age of 50 years where old age people are at more risk for cardiovascular diseases because heart-related problems tend to increase in this advanced age. Also, more than half of the patients 56% were males, this agreed with Manap *et al.* (2018) in Malaysia, who reported that cardiovascular diseases were more common in males than in females and comes in line with (Rashed .2020) who mentioned that the Ministry of Health and Population in Egypt indicated that, cardiovascular diseases are more common in males than in females. BMI in this study showed that the majority of the patients represented overweight and obese categories with SD 27 ± 1.7 as estimated by their BMI. (Jee et al. 2019) provided strong evidence that, the association between BMI

and ischemic heart disease is graded progressively throughout the entire BMI range. In the present study, postoperative fatigue severity was lower after performing breathing exercises with a mean of ± SD of 1.095 ± .400 than that during performing breathing exercises with a mean ±SD of 1.655 ± .280 for four days and the difference was statistically significant (p> 0.05). as well 60 % had mild fatigue severity after one week of performing breathing exercise, while, two-thirds of patients 30 % had severe fatigue severity before performing breathing exercise and the difference was statistically significant (P< 0.05).

This agreed with Laila A., Thoraya (2020), and Zakerimoghadam (2014), who reported that respiratory exercise is effective in reducing fatigue among postoperative patients Also, this data agreed with Shenoy and Paul (2023) and Nagwa et al, (2020). Who found that pursed lip breathing improves muscle function, and airflow and promotes ventilation, which relieves fatigue. Moreover, this agreed with Jones *et al.* (2014) and Tiep *et al.* (2016), who reported that breathing rehabilitation techniques such as pursed lip breathing could significantly increase the oxygen level, reduce oxygen consumption, improve the exchange of oxygen and carbon dioxide in all the cells which improve the body function and decrease fatigue feeling. Thus, pursed lip breathing assisted the patients toward optimal capabilities in carrying out their activities of daily living, Nevertheless, this finding disagreed with Christensen et al. (1982), who reported no correlation between the degree of postoperative fatigue and oxygen consumption. In the present study, Lung capacity after performing breathing exercise with a mean ±SD of 1.600 ± .831 was higher than that before performing breathing exercise with a mean ± SD of 1.405±.549 and the difference was not statistically significant (p = 0.05). The majority of the patients 70% had lung capacity measurements after performing breathing exercises higher than before performing breathing exercises with significant difference (P< 0.05).

This data agreed with Darlene and Chang (2014), who reported that patients who did breathing exercises after surgery for four days had better lung function than the group that did not do breathing exercises. Besides, Fregonezi (2015) reported that pursed lip breathing and some other breathing exercises prolonged expiration leading to lower respiratory rate and higher tidal volume; the end result is an improvement in ventilator efficiency. Also, Schmidt *et al.* (2016) explained that the effect of the back pressure of pursed lip breathing was to slow exhalation to minimize small airway collapse, promote lung expansion, and enrich the circulation with oxygen.

Conclusion

The outcome results proved that fatigue severity was lower during performing breathing exercises than before performing breathing exercises, and it was lower after one week of performing breathing exercises.

AS breathing exercises support the body and enrich the circulation with oxygen, which improves all the physiological conditions of the

body as well as psychological well-being, which in consequence affects fatigue. As evidenced by previous research, the Performance of relaxation breathing exercises is a non-pharmacologic intervention that should be encouraged by nurses to improve the overall quality of care of patients and reduce fatigue.

Recommendation

Discussing with the responsible authorized health team the availability of setting breathing exercises as a part of routine pre and post-operative care allowed the patients to continue practicing breathing re-training after discharge as a beneficial exercise.

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