Effect of Nursing Exercise Protocol on Hemodynamics and Functional Capacity among Patients after Cardiac Surgery

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ABSTRACT

Context: Exercise interventions are the cornerstone of cardiac rehabilitation. The exercise program consists of respiratory physiotherapy, neck and shoulder exercises, walking, and cycling. The purpose is to prevent respiratory complications, neck and shoulder pain and increase the physical functional level.

Aim: This study evaluates the effect of applying nursing exercise protocol on hemodynamics and functional capacity among post-cardiac surgery patients.

Methods: Quasi-experimental research design utilized in the current study. A purposive sample, including 60 male and female patients, classified equally into two equal groups; study group (n= 30) and control group (n= 30), collected through 14 months. This study was carried out in the inpatient cardiac surgery department and the outpatient cardiac clinic of Cardiothoracic Surgery Hospital in New Minia City. Four tools were utilized in collecting data; named Health Assessment Record; Six Minute Walk Distance Test; Modified Medical Research Council Scale (MMRC) for measuring dyspnea; and Nursing Educational Protocol Checklist.

Results: Current study findings displayed an improvement of total distance walked among study groups compared to the control group. It also showed highly statistically significant differences between the groups related to total distance walked after 12th-week post-discharge documented by p-value (0.000).

Conclusion: The current study findings concluded that the nursing educational protocol in the form of deep breathing, incentive spirometer; coughing, and early ambulation induces a significant improvement in hemodynamic variables and six-minute walk distance, recommending that hospitals should implement the nursing educational protocol as a routine hospital policy among all cardiac surgical patients in all age groups.

Keywords: Cardiac Surgery, nursing educational protocol, functional capacity, hemodynamics

1. Introduction

Currently, cardiovascular disease (CVD) is a public health problem. According to the World Health Organization (WHO), about 17 million people die annually from cardiovascular diseases. Coronary artery bypass grafting is a useful alternative for the treatment of CVD *(Winkelmann Dallazen, Bronzatti, Lorenzoni, & Windmöller, 2015).* Surgical treatment remains the therapeutic option related to better survival of individuals with coronary heart disease, as well as in patients with valvular heart diseases, thus helping to improve blood supply and oxygen to the heart, relieving chest pain, enabling physical activity, and improving the overall quality of life *(Cordeiro et al., 2016).* The incidence of postoperative complications among cardiac surgery ranges from 3% to 16% after Coronary Artery Bypass Graft and 5%-7% after valvular heart surgery *(Naveed, Azam, Murtaza, Ahmad, & Baig, 2017).*

Hemodynamic instability is common after cardiac surgery related to postoperative myocardial dysfunction and decreased ventricular compliance. The overall goal of hemodynamic management is to maintain adequate organ perfusion and oxygen delivery *(Stephens & Whitman, 2015).*

The functional status may also be impaired post-cardiac surgery due to multiple factors, including; surgical procedure, tissue trauma, and other related factors *(Papadopoulos et al., 2013).* Post cardiac surgery patients limit their activities to a higher level than recommended by physicians following surgery to manage the continued postoperative pain experienced between two to twelve weeks. Limiting activities of those patients not only puts patients at risk of developing complications but can also prevent a timely return to normal activities and successful rehabilitation *(Sethares, Chin, & Costa, 2013).*

Regular exercise training improves cardiac contractility, reducing cardiac work and myocardial oxygen demand. Besides, it enhances hemodynamic responses such as resting and maximum blood pressure and heart rate. On the other hand, it is worth mentioning that since exercise training involves large muscle groups, it produces cardiovascular adaptations and improves myocardial

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perfusion, leads to increased exercise tolerance, evaluated by exercise test and 6-MWT *(Ghashghaei, Sadeghi, Marandi, & Ghashghaei, 2012).*

It is the nurse's responsibility to educate the surgical patients on the importance of regular gentle leg exercises and early mobilization to reduce the risk of postoperative complications. Instructions concerning the frequency and duration of each exercise after cardiac surgery vary notably in clinical practice *(Snowdon, Haines, & Skinner, 2014).*

Regular exercise training has been shown to cause a positive effect on cardiorespiratory function and other regulatory mechanisms with associated enhancement of physical performance in general populations and populations at risk, such as the elderly *(Karanfil & Møller, 2018).* During hospitalization, the exercise program consists of respiratory physiotherapy, neck and shoulder exercises, walking, and cycling. The purpose is to prevent respiratory complications such as atelectasis and pneumonia, neck and shoulder pain, and increasing the physical functional level *(Højskov et al., 2017).*

2. Significance of the study

Heart disease is the leading cause of death in Egypt, with ischemic heart disease (IHD) and stroke accounting for 21% and 14% of all deaths, respectively. Overall, cardiovascular disease (CVD) mortality accounts for 46% of all mortality. The high prevalence of cardiovascular risk factors contributes to cardiovascular morbidity and mortality generally in the Middle East and particularly in Egypt *(Elshamy, Abdelaziz, Gado, & Hammed, 2016).* In Africa, Egypt performs the highest heart surgery volume; Egypt performed 45% of WHO projected annual heart surgery volume in 2015 *(Nwiloh, Smit, Mestres, & Yankah 2018).*

Postoperative hemodynamics and functional capacity have important implications for patient recovery after cardiac surgery**;** exercise training programs reduce postoperative complications and improve postoperative physiological functional capacity. Early participation in prescribed postoperative exercise programs is an integral component of rapid recovery protocols leading to optimal surgical outcomes**.** So, this study was carried out to investigate the effect of applying nursing exercise protocol for patients after cardiac surgery.

3. Aim of the study

The present study aimed to evaluate the effect of applying nursing exercise protocol on hemodynamics and functional capacity among patients after cardiac surgery.

3.1. Research hypothesis

The study hypothesized that:

- Patients undergoing open-heart surgery who will be exposed to nursing exercise protocol (study group) will significantly improve hemodynamic parameters compared to the (control group).
- Patients undergoing open-heart surgery exposed to nursing exercise protocol (study group) will significantly improve functional capacity compared to the (control group).

4. Subjects & Methods

4.1. Research design

A quasi-experimental research design (study/control group) was utilized to achieve the aim of the current study.

4.2. Research Setting

This study was carried out in the inpatient cardiac surgery department and followed up in the outpatient cardiac clinic of Cardiothoracic Surgery Hospital in New Minia City.

4.3. Subjects

A purposive sample of 60 patients, male and female (who selected according to the inclusion criteria) collected through 14 months, and they were classified equally into two groups; study group (n =30) who performed the nursing exercise protocol and control group (n =30) who are subjected to routine hospital care (early ambulation in the first 24 hours postoperatively and waking in the second day postoperative until discharge without specific physical or breathing exercises). The sample size is chosen based upon the following sample calculation formula.

$$N = \frac{(t)^2 \times p\,(1-p)}{(m)^2}$$

$$N = \frac{(1.96)^2 \times 0.07\,(1-0.07)}{(0.05)^2}$$

Inclusion Criteria

- All adult (18-60 years) patients admitted to the cardiac surgery department
- Hemodynamically Stable
- Conscious
- Free of Complications

Exclusion Criteria

- Patients are undergoing invasive or noninvasive mechanical ventilation for a period exceeding 24 hours after admission to the Intensive Care Unit (ICU)
- Patients contraindicated to perform the exercise

4.4. Tools of data collection

Four tools were used to collect data in this study.

4.4.1. Health Assessment Record

It covered two main parts:

The first part was designed to assess the patients' sociodemographic data like age, gender, occupation, level of education, marital status, and phone number.

The second part concerned with medical data based on *Lewis, Dirksen, Heitkemper, Bucher, and Harding (2014)*; it includes medical diagnosis, type of surgery, presence of chronic diseases, smoking and body mass index (BMI), hemodynamics (Temperature, Heart Rate, Blood Pressure, Respiration, and Oxygen Saturation). The reference ranges were for temperature (36.5-37.5^{o} C), heart rate (60-100 beat per minute), systolic blood pressure (90-140 mmHg), diastolic blood pressure (60-95 mmHg), respiratory rate (12-20 cycle per minute), and peripheral oxygen saturation (≥ 95%) *(Hong et al., 2013) and (Elliott & Coventry, 2012)*. Each variable of the hemodynamics was measured every day for five continuous days (one-time pre-intervention and four times post-intervention).

4.4.2. Six Minute Walk Distance Test

It was adopted from *Chen et al. (2015)*. This test is used to assess the submaximal level of functional capacity for the studied subjects. This test measures the distance that a patient can quickly walk on a flat, hard surface in 6 minutes (6MWD). The following parameters; Modified Medical Research Council Dyspnea Scale (MMRC), Peripheral Oxygen Saturation (SPO2), and Heart rate recorded at the starting and end of the test. The patient can stop the test if any of these manifestations occurred; dyspnea, fatigue, increase heart rate, chest pain or angina-like symptoms, persistent SPO_2 <85%. The test used eight times (one-time pre-intervention, one time immediately post-discharge, and six times every two weeks post-discharge)

4.4.3. Modified Medical Research Council Dyspnea Scale (MMRC)

This scale used to evaluate the severity of dyspnea among the postoperative open heart surgery patient's, it adopted from *Fletcher, Mendonca and Pereira (1959)*. Scale total score ranked from 0 to 4. Grade (0) counted with breathlessness with strenuous exercise (No dyspnea). Grade (1) is considered when shortness of breath occurred when hurrying on level ground or walking up a slight hill (Mild dyspnea). Grade (2) leveled when breathlessness causes slower on the level walking than people of the same age (Moderate dyspnea). Grade (3) is considered when the patient stops for breath after walking about 100 yards or after a few minutes on level ground (Severe dyspnea). Grades (4) counted if the patient was too breathless when dressing or leave the house (very severe dyspnea). The test used eight times (one-time pre-intervention, one time immediately post-discharge, and six times every two weeks post-discharge)

4.4.4. Nursing Exercise Protocol Observation Checklist

It adopted from *García, Lago, Oquendo, and Rivas Estany (2014)* that includes two parts:

The first part included respiratory physiotherapy, consisted of 11 steps (incentive Spirometer include three steps, deep breathing include four steps, and breath and cough exercise include four steps)

The second part includes upper and lowers limb exercises consisted of 58 steps (upper and lower limb ROM include 48 steps, walking include three steps, and sternal precautions include seven steps)

They were applied to improve hemodynamics variables and functional capacity post cardiac surgery. Scoring system: The maximum score value was 69 (respiratory physiotherapy 11 points and upper & lower limb exercises 58 points), each item observed, categorized, and scored into either done = one or not done= 0 on all items of the evaluation checklist. These scores are further classified as unsatisfactory performance levels (less than 60%) and a satisfactory level of performance of more than 60%). The exercise evaluation checklist observed two times (one time pre-intervention and the second time immediately post-discharge)

4.4.5. Nursing Exercise Protocol

Nursing Exercise Protocol formulated by the investigator after revising extensive relevant literature review *García et al. (2014); Højskov et al. (2017)*. The applied protocol aimed to improve hemodynamic variables and functional capacity among open-heart surgery patients.

Nursing exercise booklet designed in a simple Arabic language. It developed and supported with photos and illustrations to help the patient understanding the content of the booklet. The booklet consisted of the introduction of cardiac surgery, the importance of exercise, the complete description of exercises in the intensive care unit, the intermediate care unit, the cardiac surgery department, and then at home. It includes deep breathing exercise, deep breath, and cough exercise and incentive spirometer, upper and lowers limb range of motion, walking, and sternal precautions.

The investigator had trained the study subjects about the nursing exercise booklet in the preoperative phase to ensure the subject's ability to perform these exercises postoperatively. The investigator asked the participants to perform breathing exercises (5–10 breaths and incentive spirometer 3–5 min) from 2 to 3 times a day. Physical exercises include shoulder and head exercises, resistance training, leg endurance, and walking (5–10 times of each exercise two times per day from postoperative day one until hospital discharge and then ten repetitions two times per day from hospital discharge until the end of the follow-up phase).

4.5. Procedures

Content validity was done to identify the degree to which the used tools measure what was supposed to be measured. The developed tools examined by a panel of nine experts in the field of the study, one assistant professor and two lecturers of Medical-Surgical Nursing, Faculty of Nursing at Minia University and two assistant professors of cardiac surgery Department, Faculty of Medicine at Minia University, and three Professors and one Assistant Professor of Medical-Surgical Nursing, Faculty of Nursing at Ain Shams University and according to their opinion some modifications applied for developed tools.

Reliability was ascertained statistically by using the Alpha Cronbach test to ensure that the study tools are reliable. Reliability of Health Assessment Record, Six-Minute Walk Test, MMRC Dyspnea Scale, and Nursing

Exercise Protocol Observation Checklist was (0.96, 0.76, 0.84 & 0.71) respectively.

A pilot study was carried out on 10% (n = 6) of the total sample to test the clarity of tools, estimate the time required for fulfilling it, and test the research process's feasibility. Some modifications have been done based on the pilot study results, and the subjects were not included in the actual sample.

Official permission to conduct the study obtained from the Ethical committee of the Faculty of Nursing, Dean of Faculty of Nursing, and Manager of Cardiothoracic Surgery, Minia University Hospital, and agreement from Egypt Academic for Research Center and Technology to carry out this study. Subjects who participated in this study were voluntary, and each involved subject informed about the purpose, procedure, benefits, and nature of the study, and that he/she had the right to withdraw from the study at any time without any rationale, then written consents obtained. Confidentiality and anonymity of each subject were ensured through coding of all data and protecting the obtained data.

The preparatory phase included reviewing the current and relevant literature and theoretical knowledge of the various related aspects using textbooks, articles, and periodicals to develop the data collection tools. The implementation phase included the preoperative and postoperative period, and during this phase, the nursing exercise protocol was implemented.

Preoperatively, the sample selected according to inclusion and exclusion criteria admitted to the inpatient cardiac surgery department; Patients were equally enrolled in this study as control and study groups. The investigator obtained written consent from those (study and control group) who accepted participating in this study. Data collection started from the control group firstly, then from the study group. These patients scheduled for the nursing exercise protocol informed by the investigator individually about the purpose and nature of the study.

The investigator has started data collection by using Health Assessment Record, as well as, Six Minute Walk Distance Test, Modified Medical Research Council Scale (MMRC) for measuring the severity of dyspnea, and the Nursing Exercise Protocol Checklist. The investigator collected these data preoperatively (pre-intervention) for only one time as a baseline assessment.

Preoperative training about the nursing exercise protocol over one or two days was done by the investigator to each participant in the study group through face-to-face interviews to follow the prescribed instructions. The total number of sessions for data collection & training of the study group patient was 2 - 3 sessions preoperatively varied according to each participant's understanding. Duration for each session ranged from 30 to 45 minutes.

The first session (overview about cardiac surgery); at the beginning of this session, the investigator introduced herself and explained the objective of the research; each study group patients has given a nursing exercise protocol booklet, and the investigator illustrated the content of the booklet, give the patients simple information about anatomy and physiology of the heart, cardiac surgery, and preoperative routine events.

In the second session (pre and postoperative exercises), the investigator gave the patients a detailed explanation about each exercise and help the patients develop skills related to respiratory physiotherapy (deep breathing, coughing exercise, an incentive spirometer), change positioning, ambulation, and extremities exercises.

The investigator also gave the patients instructions regarding the duration and frequency of each previous skill to ensure that each patient performs these exercises accurately after their hospital discharge and during staying at home. The demonstration and re-demonstration have been done to ensure that the participant can perform these procedures competently. On the other hand, the investigator trained the nursing staff in the cardiac surgery department as a co-investigator to follow the study group during their specific work shift.

Postoperatively, the investigator continued data collection every day started from surgery day until discharge. The investigator assessed adult patients during the morning and evening shifts at the inpatient cardiac surgery department. The assessment tools and study scales collected from the control group first started the study group's collection. Before discharge, the investigator emphasized the importance of follow-up visits for all subjects (study and control) and arranged with the patients the time and place for follow-up every two weeks postoperatively in the outpatient cardiac surgery clinic.

Evaluation Phase: The last phase of the proposed teaching program is the evaluation phase. The investigator-assessed both the study and control group using the second, third, and fourth tools before discharge (after applying the nursing educational protocol). A line of contact (by telephone) was established between the investigator and subjects of both groups for feedback, monitoring, and provision of needed consultation and help.

Follow-up for both (study & control group) started after two weeks from discharge and continue for three months. The investigator assessed the two groups every two weeks in the outpatient clinic using a second and third tool.

4.6. Data analysis

Data were summarized, tabulated, and presented using descriptive statistics in a frequency distribution, percentages, means, and standard deviations as a measure of dispersion. A statistical package for the social science (SPSS) version (20) was used for statistical analysis of the data. Numerical data expressed as mean & SD. Qualitative data expressed as frequency and percentage. For quantitative data, a comparison between two variables made using the student's t-test. Probability (P-value) is the degree of significance; less than 0.05 was considered significant. The smaller the P-value obtained, the more significant is the result of less than 0.001 considered highly significant. The correlation coefficient was made by using the Pearson correlation test. Fisher's exact test is a way to test the association between two categorical variables when small cell sizes (expected values less than 5). Chi-square test is used when the cell sizes are expected to be large. If the sample size is small (or, you have expected cell sizes <5). The significant level was considered at p value ≤0.05, and highly significantly at p value ≤0.01.

5. Results

Table 1 reveals the distribution of the studied patients according to their demographic data. The table displayed no statistically significant difference between the two groups regarding demographic data before implementing the nursing exercise protocol. The mean age among the study and control groups was nearly similar (40.7±12.3 and 44.9±11.5), respectively. Regarding gender, it found that the highest percentages among the study and control group were female (63.3% and 56.7%), respectively. Also, it noticed that the larger percent (33.3%, 30 %) of study and control groups respectively could not read and write.

Table 2 shows that the highest percentages of both groups (study and control) having rheumatic heart disease 56.7% & 63.3%, respectively. As regarding type of surgery, it was found that the highest percentage of both groups (study and control) had valve surgery 83.3% & 76.7%, respectively. Regarding the presence of chronic illness, it was observed that the highest percentage of both groups (study and control) had hypertension (30% and 23.3%), respectively, while 16.7 % and 20% had diabetes mellitus, respectively. There was no statistically significant difference between the two groups regarding their medical data before implementing the nursing exercise protocol.

Table 3 reveals no statistically significant differences between the study and control group regarding the performance of the exercise protocol preoperatively (before implementing the exercise protocol). At the same time, the findings show a highly significant improvement between the study and control groups postoperatively (after implementing the exercise protocol) as documented by p-value (0.000).

Figure 1 shows that the mean score regarding each exercise level of performance increased in the study group compared to the control group post implementing nursing exercise protocol.

Table 4 shows that the mean values of the vital signs and oxygen saturation measurements among the studied subjects were within the normal range along the 1st five days (pre and post-intervention). The table shows statistically significant differences between the two groups on the fifth day concerning temperature, pulse, respiration, and oxygen saturation compared to no statistical significance differences at the baseline on the first day before intervention.

The table shows that the mean value of temperature, pulse, systolic, and diastolic blood pressure measurements was in the normal range during the 1st five days with a slight increase in the mean of the study group compared to the control. The table shows high statistically significant differences among both groups regarding the respiration during 2nd day post-intervention documented by p-value (0.001). Also, there were statistically significant differences among both groups regarding the respiration during third, fourth, and fifth-day post-intervention documented by p-value (0.049, 0.05, and 0.029).

From the same table, it was noticed that there were statistically significant differences among both groups regarding oxygen saturation during third day post-intervention documented by p-value (0.04). Moreover, there were highly statistically significant differences among both groups during the fourth- and fifth-day post-intervention documented by p-value (0.001 and 0.000).

Table 5 reveals that the mean measurement of oxygen saturation and heart rate during the six-minute walk test before implementing the nursing exercise protocol was in the normal range for the study and control group (before and after the test), with no statistically significant difference between the two groups. Also, the table showed a statistically significant improvement in oxygen saturation and heart rate at the end of the six-minute walk test after implementing the nursing exercise protocol (at the end of the follow-up phase), as documented by p-value (0.038 and 0.019), respectively.

Table 6 shows the improvement of total distance walked related to the 6-minute walk distance test among the study group compared to the control group. It was noticed that; the mean value of the total distance was reduced shortly after cardiac surgery (discharge visit). Also, there were statistically significant differences between both the study and control group during the 6th-week post-discharge. Moreover, it found that there were highly statistically significant differences between both groups related to total distance walked during the 8th, 10th, and 12th-week post-discharge. Also, it noticed that the mean difference of the total distance walked between the pre-intervention and the end of follow-up (after 12 weeks) was 39.9 for the study group compared to 9.4 for the control group.

Table 7 reveals the improvement in the level of dyspnea among both study and control groups. The table showed that the highest percentage of both study and control groups were free from all dyspnea grades in the pre-intervention visit 63.3 %, 66.7 %, respectively. In comparison, 16.7 % and 23.3% of both study and group experienced a high level of dyspnea (grade Ш) with a non-significant difference between the study and control group before and immediately after discharge. In contrast, 100%, 80% of both study and control group had not experienced dyspnea during 12th-week post-discharge, and 0%, 6.7% of both study and group respectively had a high level of dyspnea (grade Ш) in the same week with a statistically significant difference between both groups.

Moreover, it noticed that statistically significant differences between both groups related to the level of dyspnea during 2nd, 4th, 8th, 10th-week post-discharge documented by p-value (0.010, 0.012, 0.024, and 0.024) respectively.

Table 8 reveals a positive, statistically significant correlation between exercise performance score and total distance walked postoperatively among study group during

4th, 6th, and 12th-week post-discharge documented by (p= 0.032, 0.050 and 0.047).

Table (1): Comparison of both study and control groups regarding their demographic data (n=60).

Demographic Data	Study (n=30)		Control (n=30)		Significance Test	P-value
	No.	%	No.	%		
Age / Years						
18 - > 30	7	23.3	3	10	t= 1.36	0.179
30 - > 40	8	26.7	9	30		
40 - > 50	8	26.7	8	26.7		
≤ 50	7	23.3	10	33.3		
Mean ± SD	40.7±12.3		44.9 ±11.5			
Gender						
Male	11	36.7	13	43.3	χ^2 = 0 .278	0.598
Female	19	63.3	17	56.7		
Occupation						
Employer	15	50	14	46.7	χ^2 = 0.067	0.796
Not Employer	15	50	16	53.3		
Level of Education						
Cannot read and write	10	33.3	9	30	χ^2 = 1.096	0.895
Read & write	8	26.7	6	20		
Primary	5	16.7	6	20		
Secondary	5	16.7	5	16.7		
Bachelor	2	6.7	4	13.3		
Marital Status						
Single	4	13.3	7	23.3	χ^2 = 3.01	0.390
Married	25	83.3	22	73.3		
Divorced	1	3.3	1	3.3		

Table (2): Comparison of both study and control subjects regarding medical data (n=60).

Medical Data	Study (n=30)		Control (n=30)		Sig. Test	P-value
	No.	%	No.	%		
Current Diagnosis						
Rheumatic Heart Disease	17	56.7	19	63.3	χ^2 = 0.492	0.782
Ischemic Heart Disease	11	36.7	10	33.3		
Atrial Septal Defect	2	6.7	1	3.3		
Type of Surgery						
Coronary Artery Bypass Graft	5	16.7	7	23.3	χ^2 = 0.417	0.519
Valve Surgery	25	83.3	23	76.7		
Presence of Chronic Illness						
None	15	50	15	50	χ^2 = 0.674	0.879
Diabetes mellitus	5	16.7	6	20		
Hypertension	9	30	7	23.3		
Chronic Obstructive Pulmonary Disease	1	3.3	2	6.7		
Smoking						
None	20	66.7	22	73.3	t= -0.602	0.550
10-20 cigarettes/day	7	23.3	6	20		
21-30 cigarettes/day	3	10	2	6.7		
> 30 cigarettes/day	0	0	0	0		
Body Mass Index (BMI)						
18.5-24.9	17	56.7	17	56.7	t=0.771	0.444
25-29.9	10	33.3	12	40		
> 30	3	10	1	3.3		
Mean ± SD	24.4±1.6		24.7±1.3			

Table (3): Comparison of study and control group regarding the level of performance of exercises pre and post-implementing nursing exercise protocol (n=60).

Nursing Exercise Protocol Score	Study (n=30)		Control (n=30)		p-value
	No.	%	No	%	
Pre Intervention					
Satisfactory	0	0	0	0	0.248
Unsatisfactory	30	100	30	100	
Post Intervention					
Satisfactory	27	90	0	0	0.000
Unsatisfactory	3	10	30	100	

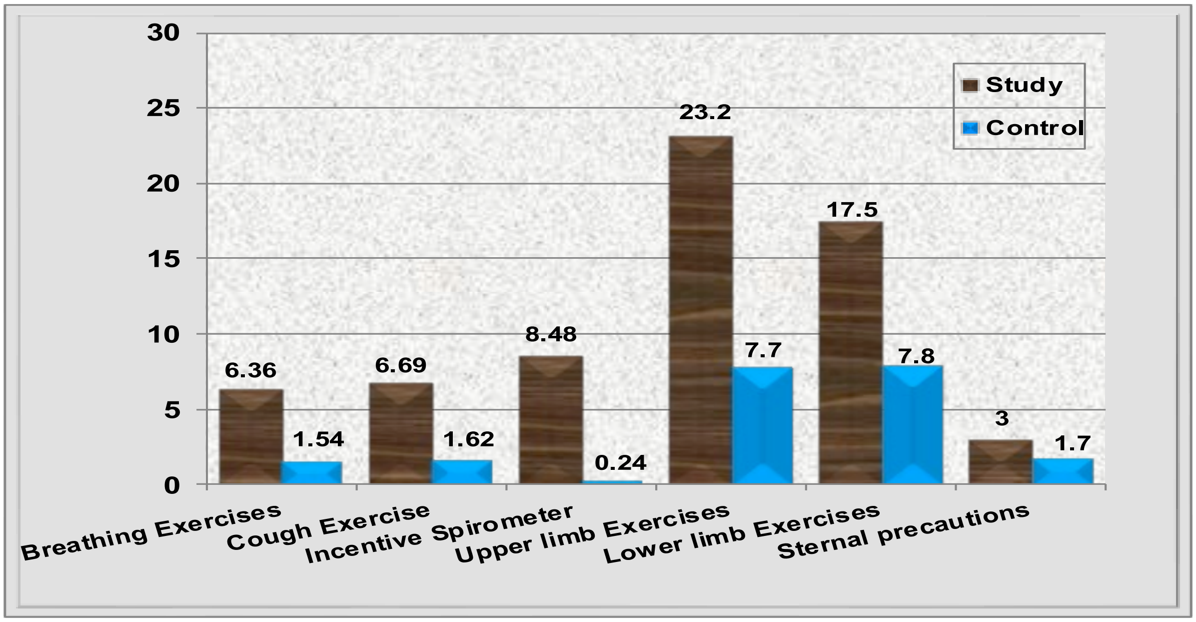

Figure (1): Mean score of study and control group regarding the level of performance of exercises post implementing nursing exercise protocol (n=60).

Table (4): Comparison between study and control groups regarding their hemodynamic variables pre and post implementing the nursing exercise protocol (n=60).

Hemodynamic Variables		Study (n=30)	Control (n=30)	T-test	P-value
		Mean±SD	Mean±SD		
Temperature	1st day (Pre)	37.1±0.36	36.9±0.15	1.72	0.09
	2nd day (Post)	37±0.20	37±0.11	1.24	0.219
	3rd day (Post)	37.2±0.27	37±0.11	1.49	0.140
	4th day (Post)	37±0.21	37.2±0.27	2.97	0.004
	5th day (Post)	37±0.18	36.9±0.11	2.84	0.006
F (P-value)		3.07(0.017)			
Respiration	1st day (Pre)	15.3±0.96	15±1.5	0.886	0.379
	2nd day (Post)	16.8±1.2	18.4±2.2	3.61	0.001
	3rd day (Post)	15.1±0.75	16.3±3.1	2.01	0.049
	4th day (Post)	15.2±0.76	16.2±3.04	1.84	0.050
	5th day (Post)	15.03±0.66	16.3±3.10	2.24	0.029
F (P-value)		44.5(0.000)			
Pulse	1st day (Pre)	86.1±4.6	85.8±6.5	0.219	0.827
	2nd day (Post)	85.1±4.04	82.5±3.8	2.57	0.013
	3rd day (Post)	85.1±4.04	82.6±4.4	2.23	0.029
	4th day (Post)	84.9±3.9	82.4±4.04	2.37	0.021
	5th day (Post)	85±4.04	82.5±4.1	2.31	0.024
F (P-value)		5.15(0.001)			
Systolic BP	1st day (Pre)	134.8±6.5	138.1±7.01	0.356	0.712
	2nd day (Post)	113.6±12.1	120.7±12.9	2.18	0.033
	3rd day (Post)	129.2±5.5	128.6±7.9	0.326	0.746
	4th day (Post)	128.8±5.4	128.2±8.1	0.312	0.757
	5th day (Post)	128.8±5.4	128.5±7.9	0.132	0.895
F (P-value)		45.5(0.000)			
Diastolic BP	1st day (Pre)	78.2±8.5	72.6±9.8	1.18	0.069
	2nd day (Post)	80.7±4.2	84.6±4.8	3.29	0.024
	3rd day (Post)	80.5±3.9	82.4±5.3	1.60	0.115
	4th day (Post)	80.2±3.9	81.4±5.1	0.992	0.326
	5th day (Post)	80.2±3.9	81.4±5.1	0.992	0.326
F (P-value)		37.7(0.000)			
Oxygen Saturation	1st day (Pre)	95.5±0.50	95.3±0.74	1.61	0.365
	2nd day (Post)	94.7±1.02	94.2±2.02	2.26	0.306
	3rd day (Post)	95.7±1.1	95.1±1.2	5.45	0.04
	4th day (Post)	96.8±0.59	94.1±1.5	31.8	0.001
	5th day (Post)	96.8±0.59	93.4±1.6	36.9	0.000
F (P-value)		16.2 (0.000)			

Table (5): Mean score of study and control groups concerning oxygen saturation and heart rate during six-minute walk pre and post implementing the nursing exercise protocol (n=60).

Variable	Study (n=30)	Control (n=30)	P-value
	Mean±SD	Mean±SD	
Pre-intervention			
SpO_2 at the start	95.5±0.50	95.3±0.74	0.231
SpO_2 at the end	95.1±0.68	94.9±0.99	0.294
HR at the start	82.8±3.8	83±3.93	0.869
HR at the end	83.6±3.6	84.9±3.96	0.09
Post-intervention			
SpO_2 at the start	95.5±0.50	95±0.70	0.365
SpO_2 at the end	94.7±1.02	94.2±2.02	0.038
HR at the start	82.9±3.7	83.3±4.1	0.697
HR at the end	83.4±3.2	85.8±4.3	0.019

Table (6): Mean score of study and control group regarding total distance walked related to 6-minute walk pre and post implementing nursing exercise protocol.

Time	Total distance walked		P-value
	Study (n=30)	Control (n=30)	
	Mean±SD	Mean±SD	
Pre-intervention	157.7±40	154.4±48.7	0.773
Immediately Post Discharge	140±45.8	126.3±39.9	0.221
After 2 Weeks	145.7±49.6	140.5±31	0.629
After 4 Weeks	161.1±39.5	151.1±42	0.347
After 6 Weeks	170.3±37.4	147.7±35.4	0.020
After 8 Weeks	178.1±33.9	154.1±36.4	0.011
After 10 Weeks	192.1±24.4	158.7±39.8	0.000
After 12 Weeks	197.6±21.4	163.8±38.8	0.000
Mean difference (pre-intervention and after 12-week post-intervention)	39.9	9.4	0.000

Table (7): Distribution of study and control groups regarding dyspnea pre and post implementing the nursing exercise protocol (n=60).

Dyspnea Grades	Study (n=30)		Control (n=30)		Fisher's exact	p-value
	No.	%	No.	%		
Pre-intervention						
Grade (0)	19	63.3	20	66.7		
Grade (I)	3	10	1	3.3		
Grade (П)	3	10	2	6.7	1.57	0.748
Grade (Ш)	5	16.7	7	23.3		
Discharge visit (Post-intervention)						
Grade (0)	22	73.3	16	53.3		
Grade (I)	2	6.7	2	6.7		
Grade (П)	3	10	5	16.7	3.19	0.545
Grade (Ш)	1	3.3	2	6.7		
Grade (IV)	2	6.7	5	16.7		
After two weeks						
Grade (0)	25	83.3	18	60		
Grade (I)	0	0	1	3.3		
Grade (П)	3	10	4	13.3	11.18	0.010
Grade (Ш)	2	6.7	7	23.3		
After four weeks						
Grade (0)	27	90	20	66.7		
Grade (I)	0	0	1	3.3		
Grade (П)	2	6.7	2	6.7	9.15	0.012
Grade (Ш)	1	3.3	7	23.3		
After six weeks						
Grade (0)	27	90	23	76.6		
Grade (I)	2	6.7	4	13.3	3.17	0.196
Grade (П)	1	3.3	3	10		
After eight weeks						
Grade (0)	28	93.3	24	80		
Grade (I)	2	6.7	3	10	5.8	0.024
Grade (П)	0	0	3	10		
After ten weeks						
Grade (0)	30	100	24	80		
Grade (I)	0	0	3	10	5.99	0.024
Grade (П)	0	0	3	10		
After 12 weeks						
Grade (0)	30	100	24	80		
Grade (I)	0	0	4	13.3	5.99	0.024
Grade (Ш)	0	0	2	6.7		

Table (8): Correlation between exercise performance score and total distance walked post implementing the nursing exercise protocol (n=60).

Total Distance Walked	Exercise Performance Score			
	Study		Control	
	r	P	r	P
Discharge Visit	0.166	0.382	0.039	0.837
After 2 Weeks.	0.244	0.194	-0.280	0.134
After 4 Weeks.	0.393	0.032	-0.136	0.473
After 6 Weeks.	0.354	0.050	-0.008	0.967
After 8 Weeks.	0.342	0.065	0.009	0.962
After 10 Weeks.	0.329	0.076	0.039	0.837
After 12 Weeks.	0.365	0.047	0.002	0.910

6. Discussion

Functional status can be improved by high-quality therapeutic exercises, even in a short time, like waiting for surgery. Exercise training should be considered to improve perioperative outcomes and functional status *(Hulzebos, Smit, Helders, & van Meeteren, 2012)*.

As regard to demographic characteristics and their medical data, the findings of the present study show that there is no statistically significant difference between the two groups regarding demographic characteristics and their medical data, this reflects homogeneity between the two groups in terms of demographic, clinical, and surgical variables enabled the investigator to consider the impact observed in the intervention group as a consequent to performed nursing educational protocol. These results supported by *Thirapatarapong and Chumwong (2017)* supported these results and studied the preoperative pulmonary training program in patients with coronary artery bypass graft surgery and found no significant difference between the two groups regarding the baseline characteristics such as age, sex, and comorbidities.

The findings of the present study show that the mean age among study and control groups was nearly similar (40.7±12.3 and 44.9 ±11.5) respectively, this is related to the commonality of heart diseases that required surgical intervention among younger patients from this age group, and that the highest percentages among study and control group were females, a possible explanation for this could be the fact that females are exposed to more cardiovascular risks in their lifetime than males. This finding agrees with *Fahmy (2017)*, in a study titled "physical rehabilitation program to improve the physical and functional status after hospitalization of open-heart surgery" and reported that the mean age among study and control groups (35.7±6.08 and 41±10.6), respectively and *Nyawawa, et al. (2010)* study titled "one year experience of cardiac surgery at Muhimbili national hospital", who reported that 79% of all patients who had cardiac surgery were females.

This result is in contrast with *Borges et al. (2016)* study titled "Effects of aerobic exercise applied early after coronary artery bypass grafting on pulmonary function, respiratory muscle strength, and functional capacity", and reported that the mean age among study and control groups (62.5±7.1 and 62.8±4.2) respectively and *Guo, East and Arthur (2012),* who investigated the effect of "a preoperative education intervention to reduce anxiety and improve recovery among Chinese cardiac patients" and reported that more than half of cardiac surgery patients were males.

Regarding the medical data among the studied subjects, the present study shows that the highest percentages of both the study and control group had rheumatic heart disease. The investigator rationalized that by the increased incidence of rheumatic heart disease in low and middle-income countries. Also, more than two-thirds of both study and control groups had valve surgery; this is related to the highest percentage of rheumatic heart disease among the studied sample affecting the heart valves. Nearly half of both study and control groups were suffering from hypertension or diabetes mellitus. Also, the highest percentages of both the study and control groups are nonsmokers with an average body mass index.

The previous findings supported by *Musuku et al. (2013)* in a study titled "The synergies in open-heart surgery in Zambia" and reported that 71.4% of studied patients had rheumatic heart disease and *Gelijns et al. (2014)*, who examined the "Management practices and major infections after cardiac surgery" and found that the valvular surgery was the most common operation type. In addition to *Miranda, Silva, Caetano, Sousa, and Almeida (2011)* in a study titled "Evaluation of pain intensity and vital signs in the cardiac surgery postoperative period" and found that half of the studied population suffered from diabetes mellitus (DM) or systemic hypertension.

Regarding the level of performance of exercise after the implemented nursing exercise protocol, the present study's findings show that the highest percentage of the study group patient had possessed a satisfactory score regarding the level of performance post implementing the nursing educational protocol. This finding is supported by *Riaz, Kazmi, Naqvi, and Rizvi (2017),* who investigated the "Pre and postoperative physiotherapy for patients after open-heart surgery." The study demonstrated that the respondents to preoperative information regarding deep breathing, mobilization, supported coughing, range of motion exercises, and postoperative sternotomy restrictions were 95% of all patients.

As regards the hemodynamic variables among the studied subjects, the present study findings show that the mean values of the vital signs and oxygen saturation measurements among the studied subjects were within the normal range with statistically significant improvement in the study group compared to controls; these variations may be due to the positive effect of the implemented nursing exercise protocol. These findings supported by *Ghashghaei et al. (2012)*, investigated the effect of "Exercise-based cardiac rehabilitation in improving hemodynamic responses after coronary artery bypass graft surgery" and found that cardiac rehabilitation program has a significant effect on hemodynamic responses.

The present study findings display the mean value of temperature among the studied subjects was within the normal range, with a slight increase in the mean value of the study group compared to controls; this slight increase may be just as hazardous as intraoperative hyperthermia in addition, this change was not accompanied by any signs of infection or visible illness as mentioned by *Nussmeier, (2005)* in a study titled "Management of temperature during and after cardiac surgery." This result is not supported by *Stiller et al. (1994),* who evaluates the "Efficacy of breathing and coughing exercises in the prevention of pulmonary complications after coronary artery surgery" and reported that the mean temperature of both groups was normal with no significant differences any stage of treatment during postoperative days.

The present study displays a decrease in the mean value of respiratory rate among the study group compared to controls. The investigator regarded the Effect of the implemented chest physiotherapy (deep breathing, coughing exercises, an incentive spirometer), which help stabilize the respiratory rate. *Tariq et al. (2017)* support this result in a study titled "Postoperative outcome of early ≤ 3 Mets (metabolic equivalent of tasks) of physical activity on patients outcomes after cardiac surgery", who reported stabilization of respiratory rate among both early activity and control group with a gradual decline in respiratory rate of the early activity group only.

In the present study, it has been noticed that the mean value of pulse among the studied subjects was within the normal range, with a slight increase in the mean value of the study group compared to controls. The possible explanation for the increase in heart rate may be due to implemented exercise protocol, which may increase sympathetic nerve activity to the heart and blood vessels during exercise sessions. This result is in contrast with *Thapa and Pattanshetty (2016)* in the study titled " Effect of chair aerobics as low-intensity exercise training on heart rate, blood pressure and six-minute walk distance after coronary artery bypass graft surgery through phase I cardiac rehabilitation" who demonstrated a decrease in heart rate of the studied subjects post-intervention

The present study findings displayed that the mean value of systolic and diastolic blood pressure among the studied subjects was within the normal range, with statistically significant differences among both groups during the second-day post-intervention; this could be due to the Effect of the inotropic agents that routinely administered post cardiac surgery. This result agrees with *Ghashghaei et al. (2012)*, who found that cardiac rehabilitation significantly affects resting and maximum systolic blood pressure and resting and maximum diastolic blood pressure.

The present study findings display a significant statistical difference between both groups regarding peripheral oxygen saturation (SpO_2) during 3rd, fourth and 5th-day post-intervention; the investigator referred that to the Effect of the implemented chest physiotherapy (deep breathing, coughing exercises, an incentive spirometer). This result is supported by *Tariq et al. (2017)*, who documented that early physical activity led to a marked improvement in oxygen saturation in the experimental group.

Regarding the dyspnea scale, the present study's finding illustrates that the study group was dyspnea-free at the end of the follow-up phase, with a statistically significant difference between the study and control groups at the twelfth week. This result agreed with *Karaszewski, (2014)* study titled "Comparison of two models of hospital rehabilitation in patients after coronary artery bypass grafting" and confirmed a statistically significant difference between the studied groups concerning dyspnea scale and confirmed that patients in the exercise training group demonstrated better exercise tolerance and lower levels of dyspnea.

In addition, this result was in line with *Kodric et al. (2013),* who evaluated the Effect of "inspiratory muscle training for diaphragm dysfunction after cardiac surgery" and documented that the MMRC dyspnea score significantly improved after 6 and 12 weeks in the exercise training group compared with the control group. The previous findings supported the first research hypothesis.

Regarding the total distance walked during the 6-minute walk test, the present study's findings show that the mean value of the total distance was reduced shortly after cardiac surgery. This finding agrees with *Riaz et al.'s (2007)* study titled "the 6-min walking test early after cardiac surgery. Reference values and the effects of the rehabilitation program documented that distance walked during the 6-minute walk test was significantly shorter after cardiac surgery. This result, in line with *Ximenes et al. (2015)*, examined the "Effects of resistance exercise applied early after coronary artery bypass grafting" and found a decrease in total distance walked in 6-minute walk test between preoperative period and hospital discharge.

In the present study, it has been noticed that the mean value of the total distance walked during the 6-minute walk test quickly improves after the nursing exercise protocol, as shown at the end of the follow-up by a significant increase in the distance walked by the study group. The investigator referred that to the positive Effect of the nursing educational exercise protocol on walking performance and exercise tolerance after surgery. This finding agreed with *Pattanshetty, Borkar and Khetan (2014)*, who illustrated that the six-minute walk distance had demonstrated a significant improvement in exercise capacity following twelve weeks of exercise training.

In addition, *Ali (2017)* evaluated the "Physical function and sternal management following cardiac surgery via median sternotomy" and documented a significant decrease of physical function in the early postoperative period followed by a significant improvement at four weeks and three months postoperative.

The current study findings revealed that the mean difference in total distance walked before the intervention and at the last follow-up visit after applying the nursing exercise protocol was 39.9 meters. This result in line with *Alexiev, Terziev and Gotcheva (2017)*, who investigated the "effects of an early cardiac rehabilitation following heart surgery in patients over 70 years" and confirmed that most patients showed >10% increase in distance walked between the two tests pre and after the intervention; this increase should be considered a genuine improvement in functional capacity because of the therapeutic intervention. These findings supported the second research hypothesis.

The present study findings displayed a statistically significant positive correlation between the exercise performance score and the total distance walked among the study group after three months of follow-up. The investigator postulates that the difference between 6-minute walk tests at each assessment point indicates that adaptation occurs by subjects undertaking the exercise protocol. The improvement is considered an outcome of the presented nursing exercise protocol.

This result in line with *Bellet et al. (2011)*, who investigated the "Repeated six-minute walk tests for outcome measurement and exercise prescription in outpatient cardiac rehabilitation" and documented an improvement in 6-minute walk tests before and after exercise-based cardiac rehabilitation. *Chen-An et al. (2018)* found similar findings. When validating the 6-minute walk test as an indicator of recovery in patients undergoing cardiac surgery and documented that the cardiac rehabilitation and the total distance walked during the 6-minute walk tests had moderate to high correlation (r=0.47 to 0.62).

7. Conclusion

Based on current study findings, it can be concluded that the following nursing exercise protocol in the form of deep breathing and coughing, incentive spirometer, early ambulation, and ROM induce significant improvement in hemodynamic variables (that support the first research hypothesis) and six-minute walk distance post-cardiac surgery (that support the second research hypothesis).

8. Recommendations

- Hospitals should recommend implementing nursing exercise protocol as a routine hospital policy among all adult cardiac surgical patients.
- Periodic training about the nursing exercise protocol for cardiac surgery patients should be developed for nursing staff because they implement them.

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