Pulmonary Function Status After Implementing Chest Physiotherapy for Extubated Cardiothoracic Surgery Patients

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Abstract

Chest physiotherapy considered basic nursing interventions for patients undergoing cardiothoracic surgery to improve breathing efficiency, oxygenation and pulmonary functions. **Aim of the study:** to evaluate the pulmonary function status after implementing chest physiotherapy for extubated cardiothoracic surgery patients**. Design**: Quasi experimental research design (study and control) was used in this study. **Setting:** cardiothoracic intensive care unit and cardiothoracic department at cardiothoracic hospital that belongs to Minia University Hospitals, Egypt. Two tools: 1. Socio demographic and medical Assessment sheet. 2. Oxygenation level assessment sheet. **Results:** mean age of study and control groups were (38.4±5.4) & (37.2±4.8) year respectively. (40%) from the study group suffered myocardial infarction and did coronary angioplasty, (43.3%) of the control suffered coronary artery stenosis (33.3%) among them did coronary angioplasty. Regarding breathing sound, and pulmonary function test there is statistical significant difference between both groups presented by p value <0.05, also there were significant difference between both groups related to all items of the arterial blood gases test presented by P value with (.031*, .004**, .020*, .013* & .003**). **Conclusion:** This study concluded that chest physiotherapy had a positive effect on patient's pulmonary function status which reflected on the patients outcomes post cardiothoracic surgery. **Recommendations**: All cardiac surgery patients should receive an explanation about chest physiotherapy before their operations.

Keyword: Extubated, Chest Physiotherapy, Cardiothoracic Surgery, Immediately & Pulmonary Function.

Introduction

Cardiovascular diseases (CVD) are a tutorial of diseases that involves angina, myocardial infarction, heart failure, cardiomyopathy, abnormal heart rhythms, valvular heart disease, and aortic aneurysms. **(Alshvang, 2018).** CVD occurs when plaque build-up within the arteries supplying blood to the myocardial muscle. Arteries narrowed with plaque become harden and the blood supply through it decreased. The location of the plaque determines the sort of heart condition **(Aggarwal, et al., 2016).**

Cardiothoracic surgery is a surgical procedure that emerged to correct CAD conditions. Heart valves replacement, repairing damaged or abnormal areas of cardiac muscle, implanting medical devices like a pacemaker, and cardiac replacement are the most cardiothoracic surgery famous **(Choi & Dor, 2019).** Coronary artery bypass grafting (CABG) also is one **of** the famous sort of cardiothoracic surgery, in which surgeons takes a healthy artery or vein from elsewhere in the body and connects it to provide reperfusion distal to the blocked area **(Bäck, M., et al., 2017).** Valvular heart surgery involves repairing or replacing the diseased valve with a human-made valve or with a biological valve made up of pig, cow or human heart tissue **(Shulman & Bisno, 2015).**

Insertion of a ventricular assist device (VAD) is a mechanical pump that supports heart function and blood flow **(Lu, etal., 2016).**

The National Heart, Lung, and Blood Institute considered cardiothoracic surgeries as major surgeries that have many postoperative complications. Pulmonary complication (PC) defined as any obstacles distressing the respiratory system after surgical anaesthesia as oxygenation defects, and ventilator-associated pneumonia (VAP). Pain, bleeding, surgical site infection, damaged cardiac tissues, kidneys, liver impairment, stroke and death are the other forms of postoperative complications **(Azevedo, et al., 2016).**

Preoperative patient teaching earlier to surgery support the recovery, increases satisfaction, and decreases postoperative problems as presented in recent researches **(Webb, et al., 2016).** Preoperative teaching about chest physiotherapy and using of incentive spirometer will be helpful for patient undergoing cardiothoracic surgery as reported by **(Derakhtanjani, et al., 2019)**. Preoperative teaching also should supports patient's understanding of the necessity of coughing and breathing exercise successfully in spite of incisional pain to accomplish positive

consequences postoperatively. Early mobilization is real in successful postoperative respiratory outcomes **(Gonçalves, et al., 2016).**

Chest physiotherapy comprises postural drainage, chest percussion, and vibration, deep breathing and coughing exercises. Chest physiotherapy considered one of the standard nursing interventions for patients after CABG to reduce postoperative pain and improve breathing efficiency, promotes lung expansion, strengthen respiratory muscles, and eliminate respiratory secretions **(Shakouri, et al., 2015).**

Significance of the study

Cardiovascular diseases (CVD) will increase the number of deaths to 23.6 million by 2030. Deaths, at a given age, from CVD are common in developing world, while rates have declined in most of the developed world since the 1970s. CAD deaths in males is (80%) while (75%) in females as reported by **(Azevedo, et al., 2016).** `Patients were exposed to many pulmonary function problems and oxygenation defect, pain, atelectasis and prolonged stay in ICU. So the current study emphasised on preoperative teaching to improve the postoperative patient's pulmonary functions, and oxygenations level.

Aim of the Study

to evaluate the pulmonary function status after implementing chest physiotherapy for extubated cardiothoracic surgery patients**.**

Hypothesis of the study

Applying Chest physiotherapy will improve pulmonary function status among immediately extubated patients with cardiothoracic surgery.

Subjects & Methods

Research Design: Quasi experimental research design (study & control groups) was utilized to fulfil the purpose of this study.

Subjects: The study was included convenient adult patients undergoing elective cardiothoracic surgery at cardiothoracic surgery unit. Patients enrolled in the study classified equally into two groups (study and control groups).

Inclusive Criteria included: Conscious extubated patients who will be able to practice chest physiotherapy, patient undergoing valve replacement, and/or coronary artery bypass grafting (CABG).

Exclusive Criteria included: chronic obstructed pulmonary disease (COPD) patients, diabetic patient, cardiac congenital anomalies and respiratory infection conditions.

Setting: The current study was carried out at cardiothoracic intensive care unit (CICU) and cardiothoracic surgery department at cardiothoracic hospital that belongs to Minia University Hospitals. The cardiotheoretic surgery department consists of 4

rooms with 16 beds, and cardiothoracic ICU, which contain only 8 beds.

Study Duration: The study data were collected over a period of eight months, starting from July 2018 to February 2019.

Tools of Data Collection: The current study data was collected by using two tools that developed by the researcher. The content of the tools was established after extensive literature review. Such 'Bruner, A. S., & Doris, L. (2008). Suddarth's textbook of medical surgical nursing' & 'Morton, P. G., Fontaine, D. K., Hudak, C. M., & Gallo, B. M. (2005). Critical care nursing: a holistic approach (Vol. 1). Philadelphia: Lippincott Williams & Wilkins'.

First Tool: Socio demographic and medical Assessment sheet: Is an interview assessment sheet, it was included **two parts**: **1st part** covers socio-demographic data of the patient as age, gender, marital status. **2nd part** covers medical data as: medical diagnosis, type of cardiac surgery, presence of any chronic disease, past cardiac surgery and past hospitalization.

Second Tool: **oxygenation level assessment sheet**: It was collected by the researchers from patients after cardiothoracic surgery and after their extubation to assess the patients' oxygenation level; this assessment was collected through three parts. **1st part: Mechanical ventilation parameter:** It was collected before the removal of patient's ETT according the cardiothoracic unit policy. It includes seven items, friction of inspired oxygen, tidal volume, Mode, Rate, PEEP, pressure support (PS), Endotracheal tube size, and tube cuff pressure.

2nd part: specific respiratory system included the examination of patient's breathing Sound. which assessed three times at the first week during the 1st, 3rd and 7th days after patient's extubation. **3rd part: laboratory Investigation findings as:** Arterial Blood Gases test (ABGs) to assess patient's oxygenation level (PH, PaO_2, $PaCO_2$, HCO_3, SaO_2) it was assessed three times per day (once per nursing shift). The researcher was recorded all the ABGs findings for studied subjects who extubated to estimate its mean average. Sputum culture sensitivity test used to assess presence of respiratory infection. It was assessed two times at the first week (3rd and 7th days) after patient's extubation.

Preoperative education for patient undergoing cardiothoracic surgery about chest physiotherapy measure as: Using of spirometer before and after surgery, breathing and coughing exercises, pursed lip breathing, purpose of percussion, and vibration.

Tools validity and Reliability

The content of the tools were examined by a five experts, four in medical surgical nursing department

at faculty of nursing Minia University and one cardiologist at the surgical cardiothoracic unit. The Cronbachs alpha test were, used to test the content reliability it was (0.94).

Pilot Study using 10% (6 patients) of the total sample to test objectivity, feasibility, and applicability of the data collection tools. The pilot sample was not included in the study because of the needed modification that was done.

Ethical Consideration

an authorized agreement to apply the study was granted from the ethical committee of the Faculty of Nursing, Dean of the Faculty of Nursing, Minia University, Hospital's Director, and approval from Egypt academic for research centre and technology. Patients were voluntary participated in this study. Written permission were obtained from patients and the researchers informed about the purpose, practice, benefits, of the study, follow up, and he /she has the right to withdraw from the study at any time without any rationale. Confidentiality was ensured through coding of all data and protecting the obtained data.

Study procedure

Preparatory phase: The current study was conducted by preparing of the different data collection tools, in addition to obtaining written consent from the study subjects who was scheduled for cardiothoracic surgery after the researchers are explained about purpose and nature of the study.

Implementation phase

The implementation phase was stated for both groups during their preoperative period to identify patient who met inclusion and exclusion criteria. The study tools (tool one and two) were collected from control group firstly by the researchers then they was started to collect from the study group through following steps: first step was initiated assessment by using the first tool, after that, the preoperative educational sessions for patients about chest physiotherapy strategies through demonstration by researchers and re-demonstration by patients until their performances were accepted. All these measures were formulated by researchers in educational brochure was given to the patients to remember them about this strategies training preoperatively. The brochure was offered in Arabic language and it was include clear instruction about physiotherapy implantation steps, frequency and supported by photo or graphs. Patients teaching sessions were 3-4 sessions for one week preoperatively. Duration of each session for study group was ranged from 20 to 30 minutes a day.

Evaluation phase

The study tools which collected from both groups (study and control) were evaluated according to scheduled days that were previously mentioned in study tools description.

Statistical analysis of data

Data were summarized, tabulated, and presented using descriptive statistics in the form of frequency distribution, percentages, means and the standard deviations using a statistical package for the social science (SPSS), version (20). Numerical data were expressed as mean and SD. Qualitative data were expressed as frequency and percentage. Probability (P-value) is the degree of significance, less than 0.05 was considered significant and correlation coefficient was done by using Pearson correlation test. ANOVA test was used to compare two different mean among study and control group.

Results

Table (1): Distribution of studied subjects (study and control groups) according to their socio demographic data (N=60).

	Study group (N=30)		Control group (N=30)		X2
	N	%	N	%	P value
Age					
18 - <33	10	33.3	12	40	1.020
33 - <48	11	36.7	11	36.7	
48 - 60	9	30	7	23.3	.059
Mean SD	38.4±5.4		37.2±4.8		
Gender					
Male	17	56.7	19	63.3	1.009
Female	13	43.3	11	36.7	.061
Marital status					
Married	23	76.7	22	73.3	0.989
Unmarried	7	23.3	8	26.7	0.68
Educational level					
Don't read and write	3	10	4	13.3	
Read and write	5	16.7	8	26.7	1.114
Preparatory	11	36.7	10	33.3	
Secondary	7	23.3	5	16.7	.056
University	4	13.3	3	10	
Residence					
Rural	20	66.9	19	63.3	1.205
Urban	10	33.3	11	36.7	.051
Occupation					
Owner of a craft	7	23.3	9	30	
Farmer	9	30	8	26.7	1.077
Employer	12	40	9	30	
does not work	2	6.6	4	13.3	.055

Table (2): Distribution of studied subjects (study and control group) according to their medical data (N=60).

	Study group (N=30)		Control group (N=30)		X^2
	N	%	N	%	P value
Medical diagnosis					
Myocardial infarction	12	40	10	33.3	1.110
Mitral valve stenosis	8	26.7	7	23.4	
Coronary artery stenosis	10	33.3	13	43.3	.060
Type of cardiac surgery					
Coronary Angioplasty	12	40	10	33.3	1.300
Mitral valve replacement	8	26.7	7	23.4	
Coronary artery bypass graft	6	20	8	26.7	
Stent placement	4	13.3	5	16.6	.051
Risk factor *select more answer					
Smoking	6	20	9	30	1.998
Physical inactivity	14	46.6	10	33.3	
High blood pressure	9	30	13	43.3	
Obesity	7	23.4	8	26.7	.049*
Chronic disease					
Yes	27	90	26	86.7	0.997
No	3	10	4	13.3	.062
Past cardiothoracic surgery					
Yes	7	23.4	3	10	2.001
No	23	76.6	27	90	.041*
Past hospitalization					
Yes	19	63.3	17	56.7	1.004

Table (3) Distribution of mean average scores of mechanical ventilator parameters for studied groups before their extubation (N. =60).

	Mean score of Study group	Mean score of Control group	X2	P value
Tidal volume	451.6±72.84	448.6±71.7	1.008	.056
Fio2	0.44±0.15	0.48±0.18	1.103	.051
Rate	16.3±2.05	17.2±2.11	1.019	.054
PEEP	7.86±1.67	8.14±1.57	0.986	.063
PS	13.10±2.0	14.15±3.3	1.030	.053
ETT size	8.4±0.46	8.5±0.94	0.938	.052
Cuff pressure	18.69±3.9	18.86±4.8	0.763	.061

N.B. the mechanical ventilator parameters were assessed once before patient's extubation.

Table (4): Comparison between frequency distribution of the study and control groups according to breathing sound through the first seven days post their extubation.

	Study group (N=30)			Control group (N=30)			X^2 P value
	Normal	Crackles	Wheeze	Normal	Crackles	Wheeze	
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	
1st day	22 (73.3)	7 (23.3)	1 (3.3)	16 (53.3)	10 (33.3)	4 (13.4)	2.088 .043*
3rd day	17 (56.6)	11 (36.7)	2 (6.7)	10 (33.3)	14 (46.7)	6 (20)	2.263 .040*
7th day	19 (63.3)	10 (33.3)	1 (3.3)	12 (40)	11 (36.7)	7 (23.3)	3.038 .036*

Table (5) Comparison between (study and control group) related to pulmonary function test by using spirometer tool through the first seven days post their extubation.

	Mean score of Study group	Mean score of Control group	X^2	P value
Vital Capacity (VC)	76.3± 9.4	65.9± 12.2	6.471	.009**
Forced Vital Capacity (FVC) (%)	74.00 ± 8.4	63.44± 6.6	3.087	.019*
Forced Expiratory Volume in one second (FEV1) (%)	75.20 ± 5.9	64.07 ± 7.1	2.968	.021*
FEV1/FVC Ratio	0.99 ± 0.16	0.89 ± 0.20	4.606	.011*
Maximal voluntary ventilation (**MVV**)	88.6 ± 8.6	80.3 ±5.4	4.007	.010*
Total lung capacity (TLC) (%)	87.21 ± 7.6	80.5± 8.2	2.996	.020*
Function residual capacity (FRC)	79.08 ± 8.4	73.11 ± 9.3	3.060	.014*
Residual volume (RV) (%)	72.05 ± 5.9	70.8 ± 5.7	1.869	.038*

Table (6): Comparison between (study and control group) related to arterial blood gases value through the first seven days post their extubation.

	Mean of Study group (N=30)	Mean of Control group (N=30)	X^2	P value
PH	7.34±0.36	7.30±0.39	1.996	.031*
Pa O2/mmhg	92.03±3.40	90.10±4.8	6.097	.004**
Pa Co2/mmhg	46.2±6.70	49.8±7.5	2.979	.020*
HCO3/meq/L	20.10±3.1	19.3±2.6	4.160	.013*
O2 sat (%)	96.11±4.1	94.5±2.1	5.999	.003**

Table (7) Comparison between frequency distribution of (study and control groups) related sputum culture sensitivity post extubated endotracheal tube.

	Study group (N=30)		Control group (N=30)		X^2 P value
	Positive	Negative	Positive	Negative	
	N (%)	N (%)	N (%)	N (%)	
3rd day	6 (20)	24 (80)	7 (23.3)	23 (76.7)	1.041 .056
7th day	4 (13.3)	26 (86.7)	5 (16.7)	25 (83.3)	1.007 .061

Table (1): Showed mean aage of both study and control group were (38.4±5.4) and (37.2±4.8) year respectively. As regard to gender and marital status, (56.7% and 76.7%) respectively among the study group were male and married, nearly similar to the control group, (63.3% and 73.3%) respectively. In relation to the educational level, it was found that, (36.7%) of study group and (33.3%) of the control had preparatory educational.

Table (2): Presented that, (40%) from the study group suffered from myocardial infarction and did coronary angioplasty, similar to (43.3%) of the control group suffered from coronary artery stenosis but only (33.3%) among them were did coronary angioplasty. (20 &46.6 %) respectively of the study group were smoker and physical inactive. And (30 &33.3 %) from the control group had the same risk factors. Also, (90%) & (86.7%) of both groups were suffered from chronic disease. Moreover, (76.6 & 90%) from both groups didnt have past cardiothoracic surgery or were hospitalized previously respectively.

Table (3): Shows there were no statistical significance differences between both groups of the study (study & control groups) related to the 7th parameters of mechanical ventilator.

Table (4): Revealed that (73.3%) of study group had normal sound at 1st day, while (53.3%) of control group had normal sound. Also, only (3.3%) of study group had wheeze at 7th day, while (23.3) of control group had the same sound at the same day of the study. There a statistical significant difference between study and control group related to breathing sound at 1st day, 3rd day and 7th day presented by p value (.043, .040 & .036) respectively.

Table (5): Detected that, there was high significant difference between control and study group in all items related to pulmonary function test at p value <0.05.

Table (6): Showed Mean & SD score of the ABGs test it observed that the PaO2 level for the study group was (92.03±3.40) but it was (90.10±4.8) for the control group also regarding to the O2 saturation it was (96.11±4.1) for the study group but (94.5±2.1) for the control group. There were statistical significant difference between study and control group related to all items of the ABGs test presented by P value with (.031*, .004**, .020*, .013* & .003**).

Table (7): Detected that 20% of study group had positive culture at 3rd day, while 23.3% of control group had positive culture. Also, only 13.3% of study group had wheeze positive culture at 7th day, while 16.7 of control group. Also this table revealed that there was no significant difference between control

and study group related to culture sensitivity at 3rd day and 7th day at p value >0.05.

Discussion

Cardiothoracic surgery induces severe postoperative deficiency of pulmonary function, increases in hospital length of stay (LOS) , and mortality. Chest physiotherapy were used by many practitioners post cardiothoracic physiotherapy in order to improve the breathing, oxygenation and decline in respiratory complications **(Vervoort, et al., 2020).** Therefore the study aimed to evaluate pulmonary function status after implementing chest physiotherapy for immediately extubated patients with cardiothoracic surgery.

The demographic characteristics of study group revealed that the mean age of them was 38.4±5.4 year. As regard to gender and marital status, more than half and high percentage of the study group were male and married respectively. These results supported with the study conducted by (**Kim & LaCamera, 2020**) they reported that mean age of studied patient was 36.8±5.7. Relation to the educational level, the present results showed that, more than one third of the study group had preparatory education level. These results incongruent with a study performed by **Elsaed, et al., 2020**, who reported that more than half of the intervention patients had university education and residing at urban areas. Regarding medical data, the current results presented that, more than one third of the study group suffered from myocardial infarction and undergoing coronary angioplasty. The present study was in agreement with a study performed by **Andonian, et al., (2020)** who detected that more than one third of studied patients undergoing coronary angioplasty.

The present study observed that majority of the study group had chronic disease. While, they didn't have past history of cardiothoracic surgery and were hospitalized previously. These results supported with the study performed by **Pencina, et al., (2019)** who presented that chronic disease as HTN and DM had effect on coronary heart disease.

Related pulmonary function by using spirometer tool the present study revealed, Vital Capacity stated that the Mean ± SD score of study group was 76.3± 9.4, related residual volume, mean score of study group was 72.05 ± 5.9, related FEV1/FVC ratio, stated that mean score of study group was 0.99 ± 0.16,total lung capacity stated that mean score of study group was 87.21 ± 7.6, and the forced vital capacity detected that mean score of study group was 74.00 ± 8.4/ this results in the same line with, **Maagaard, et al., (2020)** who concluded that open heart surgery is associated with reductions in

lung function and diminished ability by the patient to breathe deeply and cough effectively. Reduced pulmonary function (FVC, FEV 1 , and PEFR) after cardiothoracic surgery patient's might be due to post-operative pain, location of surgical ports, along with anaesthetic, analgesic usage.

The present study revealed that Mean ± SD score of study group related to (VC), (FVC), (FEV1), and FEV1/FVC Ratio were (76.3± 9.4, 74.00 ± 8.4, 75.20 ± 5.9 and 0.99 ± 0.16, respectively). Also, detected that there was high significant difference between study and control group related to Vital Capacity at p value <0.01. Also, there was significant difference between study and control group related to forced vital capacity, forced expiratory volume in one second, FEV1/FVC ratio and maximal voluntary ventilation at p value <0.05. The current study was in line with **Duymaz, et al., (2020**) they found that patient's respiratory functions after doing chest physiotherapy were elevated, all values of pulmonary functions were increased, VC, TV, FEV1/FVC, and PEF there also statistical significant improvement in chest physiotherapy group.

Also the present result was supported **Taşkin, et al., (2020**) they showed that chest physiotherapy improved pulmonary function as (VC), (FVC), (FEV1), andFEV1/FVC Ratio. Regarding pulmonary function the study group's total lung capacity, function residual capacity and residual volume were (87.21 ± 7.6, 79.08 ± 8.4 and 72.05 ± 5.9, respectively). Also, detected that there was significant difference between study and control group related to pulmonary function at p value <0.05. These results cohort with research performed by **Derakhtanjani, et al., (2019**) whom reported that chest physiotherapy improve lung capacity after cardiothoracic surgery.

Related breathing sound the current study demonstrated that slight less than three quarters of them had normal breathing sound at 1stday. Also, more than half and a less than two thirds of them had normal breathing sound at 3rdday and 7thday, respectively. Also the present study reported statistical significant difference between study and control group related to breathing sound at 1st day, 3rd day and 7th day at p value <0.05. These results agree with study performed by **Xavier, et al., (2019**) who reported that chest physiotherapy decrease crackles and wheezing in postoperative paients. Also, regular with the study conducted by **Patman, (2019**) who studed the effect preoperative physiotherapy education on the prevention of postoperative pulmonary complications following open upper abdominal surgery, **Patman, (2019**)

stated that immediate chest physiotherapy postoperative enhance breathing sound and prevent nosocomial pneumonia among surgical patients.

Regarding culture sensitivity: The present results of study group, indicated that more than three quarters of them their culture sensitivity was negative at 3rdday and 7thday. Also this table revealed no significant difference between study and control group related to culture sensitivity at 3rd nd 7th day at p value >0.05.These finding supported with data performed by **Boden, et al., (2018**) who detected that preoperative physiotherapy help in prevention respiratory complication as decreasing tracheal secretion. Also, current study detected that the Mean ±SD score of study group related to PH, Pa O2, Pa Co2, HCO3 and O2 sat were (7.34±0.36, 84.03±8.40, 46.2±6.70, 20.10±3.1 and 84.11±9.9, respectively). Also this table detected that, there was high significant difference between study and control group related to Pa O2 and O2 sat at p value <0.01. Also, there was significant difference between study and control group related to PH, Pa Co2 and HCO3 at p value <0.05.

These results agreement with the study conducted by **(Abd Elbaky, et al., 2018 & Oshvandi, et al., 2020)** stated that breathing exercise improves the following items of arterial blood gases results (PH, Pa O2 and HCO3). Also the present study in line with **Yazdannik, et al., (2016**) whom observed the effect of incentive spirometry on arterial blood gases following coronary artery bypass graft (CABG), they detected that incentive spirometry caused significant progress in the arterial blood gas parameters (PaO2, SaO2, and PaCO2) on the third postoperative day.

In conclusion **Zanini, et al., (2019**) revealed that early chest physiotherapy post-operative enhance total lung capacity, pulmonary functions test and residual volume. **Taşkin, et al., (2020**) stated that chest physiotherapy improve pulmonary function, strengthen respiratory muscle, exercise capacity, and decrease the length of hospital stay in patients after pulmonary resection. **Duymaz, et al., (2020**) found that chest physiotherapy that applied to patient undergoing cardiothoracic surgery showed that the patients improved their respiratory functions, regulated arterial blood gases, oxygen saturation was increased, functional capacity, pulmonary functions, decreased dyspnea levels and improved quality of life.

Conclusion
These results concluded that chest physiotherapy had positive effect on patients pulmonary functions, breathing sound and arterial blood gases level which improves the patients' outcomes post cardiac surgery.

Recommendations

- All cardiac surgery patients should receive an explanation about chest physiotherapy before their operations.
- Chest physiotherapy should be included as important element in protocol of care for cardiothoracic patients and emphasizing to teach for them during preoperative education.
- All cardiac intensive care unit nurses should implement physiotherapy for each patients according to physician 's order
- Repetition of the current research on a large probably sample on other surgery types.

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