ORIGINAL ARTICLE

Efficacy of Early Mobilization on Arterial Blood Gases among Post-Cardiac Pediatric Patients in the Intensive Care Unit: A Randomized Controlled Trial.

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Abstract

Background: Early mobilization and post-operative physical therapy enhance oxygenation, preserve adequate breathing conditions, and preserve patent airway.

Objectives: This study sought to ascertain the effectiveness of early mobilization on arterial blood gases in pediatric patients recovering from heart attacks in intensive care units.

Methods: Following institutional review board ethical permission, a single-blind, randomized clinical trial was carried out from December to May. The method of simple random sampling was applied. Twenty (CI 95%) was the sample size. Ten individuals were assigned at random to either the early mobilization and physiotherapy care (EMPC) or conventional physiotherapy care (CPC) groups. Computer-generated random numbers were used to assign eligible participants to each group (Research Randomizer Software). The participants were the only blind ones. SPSS version 26 was used for data analysis. To find the difference between the pre and post values, the Mann Whitney U test was used.

Results: Majority of the participants were males (75%) as compared to females (25%). A calculated sample of 20 participants was obtained for this study. the total VSD, ASD and TOF patients were 60%, 35% and 5% respectively. No statistically significant association was determined between heart rate (p-value 0.491, SPO2(0.564), PH(0.622), HCO3(0.404) and x ray findings of infiltrates (0.207) and atelectasis (0.067). respectively. While a statistically significant association was observed in Reparatory rate (0.016), PCO2(0.042) among both the groups.

Conclusion: Results of our study concluded that early mobilization with traditional physical therapy have significant effects on the Respiratory rate and PCO2 values in post pediatric cardiac surgery patients, and the chi square test results show that there is positive association between the early mobilization.

Keywords: Arterial blood gases, early mobilization, post cardiac pediatric patients

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INTRODUCTION:

Heart problems effect 80 to 10 infants out of every 1,000 live births, making it one of the most prevalent congenital disorders at birth.[1] Despite the availability of cardiovascular drugs, marketing, and minimally invasive choices, the actual number of heart surgeries in western countries has remained consistent over the past ten years, despite the fact that millions of individuals benefit from these treatments annually.[2,3] However, open heart surgeries are still linked to a higher risk of lung problems, cardiovascular illness, and extended hospital and intensive care unit (ICU) stays, all of which raise healthcare costs.[4] However, early mobilization and physiotherapy have been considered crucial elements that seem to improve quality of life by preventing or minimizing post-operative complications after heart surgery, as well as post-procedural functional capacity and muscle weakness.[5]

Physical therapy and early mobilization are being used in this context as part of health services and postoperative treatment to help patients recover from surgery, prevent and improve pulmonary complications, facilitate in social rehabilitation, minimize the adverse consequences of surgery, and minimize requirements for strict bed rest.[6] Multiple research studies demonstrate that early mobilization and post-operative physical therapy improve oxygenation, maintained adequate breathing conditions, and preserved patent airway.[4,7] However, there are evidence that the physiotherapist's role in patients having heart surgery shortens hospital stays, helps patients walk as soon as possible, and decreases the duration of time they spend in the critical care unit (ICU).[8,9]

According to Georgios Afxonidis et al., there were significant improvements in oxygen saturation, arterial PO2, and lactate levels among the two different groups before and after the intervention (p = 0.022, 0.027, and 0.001, respectively) when traditional physical therapy and early mobilization were combined in the intensive care unit.[9] According to a 2017 study by According to Syed et al., the treatment group's partial pressure of oxygen in arterial blood gases was greater (P value <.05) after receiving early mobilization and conventional physical treatment of cardiac protocols.[10]

The results obtained from another trial demonstrated a statistically significant increase in PaO2 and SaO2, indicating that early mobilization and conventional chest physical therapy considerably improved arterial blood gas compared to the baseline. [11]

Early mobilization of patients after heart surgery The practice of hospitalizing patients in the intensive care unit (ICU) has a positive effect on cardiovascular conditioning, which suggests improvement of functional capacity, a shorter hospital stay, and a lower mortality rate, in addition to preventing ICU-acquired weakening and encouraging strength of the muscles.[12] Early mobilization is one of the key concepts in post-cardiac surgery rehabilitation. ABGs are an important parameter in the intensive care unit. There hasn't been much research done on how mobilization, when used in addition to chest physical therapy, affects ABG. The purpose of the study is to ascertain the impact of mobilization on ABG levels as an outcome measure. [13]

Despite the importance of chest physical therapy, the benefits of early mobilization in the pediatric population have not been investigated. Furthermore, physical therapy and early mobilization approaches are only discussed orally and have not yet been put into practice. Considering the aforementioned, we conducted a randomized-controlled trial to investigate the effects of better conventional physiotherapy and early mobilization on patients undergoing pediatric heart surgery. Our specific goal was to evaluate how early mobilization in combination with conventional cardiac physical therapy would affect arterial blood gases.

METHODS

To examine the impact of early mobilization and exercise on children patients undergoing cardiac surgery between the ages of 8 months and 3 years from December to May, a single-blinded randomized control experiment was created. The study's methodology and all testing procedures followed the CONSORT Standard Statement's guidelines for documenting randomized trials. [12]

Pediatric cardiac surgery patients who matched the inclusion criteria and were hospitalized to the intensive care unit (ICU) provided the data. The study comprised a cohort of both male and female pediatric heart surgery patients. The method of simple random sampling was applied. The sample size, as determined by the EPI Info sample size calculator, was 20 (CI 95%). In this trial, 10 patients had been randomly assigned to the traditional physiotherapy treatment (CPC) group and 11 to the

Early initial mobilization and physiotherapy care (EMPC) group. Computer-generated random numbers were used to assign eligible participants to each group (Research Randomizer Software).

A written informed permission to take part in the trial, a Glasgow Coma Scale score of 15, and musculoskeletal and cardiovascular conditions appropriate for carrying out the suggested exercises were the inclusion criteria. Conversely, the following criteria were used to omit patients from the study: (1) a medical emergency, non-elective cardiac surgery; (2) hemodynamic abnormalities that prevented protocol performance; (3) breathing discomfort or invasive ventilator support or oxygen saturation below 90%; (4) severe neurological sequelae or neurodegenerative disorders; and (5) any mobile disability that prevented them from performing exercise in accordance with our protocol.

Because the study was a single blinded trial, neither group's presence was known to the participants. The assessor measured the specified outcomes of interest after gathering the data.

RESULTS:

Patient/demographics characteristics:

The demographics included data on gender, age, age of the parents, history of diagnosis, history of mother gestational diabetes, type of diseases and down syndrome. The details are as follow.

Age in years	**3.00**	**15.0 %**
	4.00	40.0 %
	5.00	45.0 %
Gender	Male	75 %
	Female	25 %
Age of Parents	<25	15.0
	26 to 29	55.0
	>30	30.0
History of heart disease in parents	Yes	20.0
	No	80.0
gestational maternal diabetes	Pregestational	20.0
	Gestational	45.0
	none	35.0
congenital disease	VSD	60.0
	ASD	35.0
	TOF	5.0
Down syndrome	Yes	20.0
	No	80.0

Effect of early mobilization and Pre and post values of arterial blood gases:

Effect on Heart rate:

Regarding the study's main finding, Table 2 compares the arterial blood gas measurements of the experimental and control groups and reveals that the majority of the data did not differ much. The findings of the men's Whitney test indicate that there is no significant difference (p Value = 0.491) between the two groups, and the analysis of the observed heart rate using the test of normality reveals that the data is non-normally distributed, with a heart rate of 0.015.

Effect on Respiratory rate:

There is a substantial difference among the experimental and control groups, as evidenced by the men's Whitney test findings p value of 0.016 and the respiratory rate at discharge normalcy test results of 0.010.

Effect on Mean arterial pressure:

The Men Whitney Test result (p-value 0.564) indicates that there is no significant correlation with early mobilization, and the Mean Arterial Pressure shapiro-Wilk test sig value is 0.006, which is not normally distributed.

Effect on SP02:

The SPO2 on normality (p-value 0.4) is normally distributed, with an independent sample T test p-value of 0.622, and there is no discernible difference between the groups. The Menn Whitney test p-value of 0.878 and the discharge temperature normality test (0.010) both show no association. PO2 on discharge had a p-value of 0.003 for the Shapiro-Wilk test and 0.082 for the Menn Whitney test.

Effect on PH, HCO3, PCO2 :

Both the Menn Whitney test (p-value 0.003) and the PCO2 Shapiro-Wilk test (p-value 0.042) indicate a significant difference between the two groups. According to the Menn Whitney test (p-values of 0.404 and 0.207, respectively) and the Shapiro-Wilk test (p-values of 0.000 and 0.195, respectively), there is no discernible difference between the groups. There is no discernible difference between the two groups' X-ray results (p-values of 0.067 and 0.317, respectively).

Variable	Experimental Group (n = 10)	Control Group (n= 10)	*p*-Value
Heart Rate at discharge from ICU	77	76	0.491
Respiratory rate at discharge from ICU	13.8	17.9	0.016
Mean Arterial Pressure	70	72	0.564
SPO2	95	95	0.622
Body temperature (°C):	96	96	0.878
Arterial blood gases			
PO2	157	120	0.082
PCO2	39	34	0.003
pH (pH):	7	7	0.404
HCO3	23	22	0.27
Chest X-Ray Findings post treatment			
Atelectasis	1.7	2.0	0.067
Infiltrates	1.9	2.0	0.317

DISCUSSION:

The PH, PO2 Heart Rate, and SPO2 did not alter after mobilization, according to the analysis of the intervention's outcomes; nevertheless, the PCo2 (Significant P value 0.03) and the respiratory rate (p-value 0.016) did differ significantly.

With the exception of elevated PCO2, these results did not, however, manifest as appreciable variations in post-intervention arterial blood gas values. The establishment of specific physiotherapy techniques and a planned physiotherapy program, which may result in improved clinical results and quicker postoperative recovery, reducing the period of hospitalization and the ensuing financial burden, requires larger randomized, controlled trials.[9]

Heba et al. did a study in 2020 that only involved chest physical therapy and the measurement of arterial blood gases (ABG). In the study's findings, there was a considerable improvement in arterial blood gas exchange as compared to the baseline, as evidenced by a statistically significant rise in PaO2 and SaO2. Declining resistance and blockage brought on by secretions that raise airway pressure and reduce submission could be used to characterize the improvement of ABG. Physical treatment for the chest helps to enhance lung mechanics and remove secretion buildup. [11]

In a research by Felcar et al., 141 infants with hereditary heart disease, ranging in age from one day to six years, were split into two groups at random. One group underwent physical therapy programs before and after surgery, while the other group only received post-surgical rehabilitation. The two groups' differences were judged to be statistically significant by the study. [14]

In 48 children with pneumonia, Campos et al. examined the impact of increased expiratory flow (IEF) on heart rate, respiratory rate, and oxygen saturation. Prior to, during, and five minutes following physical treatment, the variables were evaluated. The authors concluded that this physiotherapeutic method for bronchial cleanliness is successful in enhancing lung function after finding a statistically significant rise in oxygen saturation and a statistically significant decrease in heart and respiratory rate following intervention with IEF. [14,15]

CONCLUSION:

According to the study's findings, early mobilization combined with conventional physical therapy significantly affects patients' respiratory rates and PCO2 levels after paediatric heart surgery. The results of the chi square test also indicate a positive correlation between early mobilization and PCO2 levels.

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