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Research Article

Investigating the Effects of Performing the Early Mobilization Protocol on Postoperative Hemorrhaging in Cardiac Surgery Patients

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ABSTRACT

Background: Most adverse effects following cardiac surgery, including hemorrhaging, are related to immobility. The early mobilization of the patient in enhanced recovery after surgery (ERAS) can counteract these adverse effects. Despite the awareness, however, the protocol has a low performance rate due to numerous barriers. The present research aims to investigate the effectiveness of performing the early mobilization protocol on hemorrhaging in cardiac surgery patients.

Methods: This research is a clinical trial study conducted in 2023-2024 at Ali Ibn AbiTalib Hospital in Zahedan, Iran, on 100 patients undergoing cardiac surgery. Purposive sampling was used based on the inclusion criteria. Hemorrhaging risk assessment in patients was evaluated according to the preoperative checklist. The early mobilization protocol was performed on day 2 after surgery on patients in the intervention group with mild to low risk of hemorrhage. The statistical tests of repeated measures, chi-square, and independent t-test were used for data analysis in SPSS 26.

Results: There were no statistically significant variations in the demographic characteristics of patients in the intervention and control groups. The mean and standard deviation (SD) of the blood volume loss in patients over three different time periods (days 2, 3, and 4 after surgery) were 326.500±16.81, 69.300±11.41, and 51.200±3.82 in the intervention group, respectively, and 350.00±16.81, 325.00±11.41, and 82.10±3.82 in the control group, respectively, indicating the effectiveness of performing the early mobilization protocol ($P < 0.001$).

Conclusion: Performing the early mobilization protocol can reduce the volume of bleeding after cardiac surgery and the early discharge of patients, thus leading to reduced complications. Nurses as the main care providers in intensive care units play a key role in performing the protocol.

Introduction

The prevalence of cardiovascular diseases (CVDs) as the leading cause of mortality globally [1] is on the rise [2] and it is projected that 1 in every 4 people in the US will be affected by a form of CVD by 2030 [3]. According to WHO, an estimated 23.6 people will lose their lives to CVDs by 2030. The mortality rate in Iran due to CVDs has also been reported at 46 percent [5]. An estimated 15 million Iranians are affected by the disease, with an annual mortality of around 138,000 people accounting for nearly 40 percent of the mortality rate in the country [6].

Advances in surgical interventions, such as thrombolytic treatment, balloon angioplasty, laser angioplasty, and atherectomy procedures, have improved cardiac care

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quality measures in managing cardiac patients. But in many patients, surgery is the only choice of treatment [7], and coronary artery bypass grafting (CABG) in some patients continues to remain the first and best known treatment [8].

Although cardiac surgery is a reliable method to improve myocardial blood supply, there are still several postoperative complications [9], including massive hemorrhaging [9-11] leading to increased blood transfusion, secondary surgery, long-term hospitalization, prolonged mechanical ventilation (PMV), increased length of special care [12], decreased cardiac output (DCO), deep vein thrombosis (DVT), pneumonia, pressure sore, atelectasis, and muscular weakness [13]. A major part of these complications is linked to the prolonged immobility of the patient [14]. The early mobilization of the patient in intensive care units can reduce these complications [15-16].

Early mobilization is the application of physical activity 2-5 days after the onset of critical disease, aiming to prevent complications due to prolonged immobility [15]. ICU nurses as the care providers who spend the most time with patients play a pivotal role in their early mobilization, thus preventing the rise of complications [13].

Despite this awareness, however, the protocol continues to have a low performance rate due to numerous barriers [17]. These include the extensive use of tranquilizers, delirium, patient safety concerns [13], cultural factors of practice including non-acceptance of early mobilization by nurses, inclination to maintain the status quo, further training requirements, lack of adequate resources and equipment, time restraints, and workforce shortages [18-19].

Given the significance and barriers of early mobilization in managing the postoperative complications of cardiac surgery in patients, the present research aims to investigate the effects of performing the early mobilization protocol on postoperative hemorrhaging in patients undergoing cardiac surgery.

Methods

This is a clinical trial study. The statistical population consisted of all patients undergoing cardiac surgery in Zahedan in 2023-2024. Based on the study by Hassani et al. (2012) [18], the sample size was estimated at 46 participants in each group with 95% CI and 95% statistical power based on the following formula. To ensure sample size, a sample size with potential dropouts and the possibility of performing statistical tests was determined at 50 participants in each group. In total, 100 cardiac surgery patients entered the study with availability sampling and were randomly assigned to the two intervention and control groups.

$$n = \frac{(Z_{1-\frac{\alpha}{2}}+Z_{1-\beta})^2(S_1{}^2+S_2{}^2)}{(\bar{X}_1-\bar{X}_2)^2} = 46/42$$

$Z_{1-\frac{\alpha}{2}} = 1.96$ $S_1 = 1/25$

$\overline{X_1} = 1/78$ $Z_{1-\beta} = 1.64$

$S_2 = 0/92$ $\overline{X_2} = 0/96$

The research setting was the open-heart ICU of Ali Ibn AbiTalib Hospital in Zahedan. The inclusion criteria consisted of an age range of 18-100 years, definitive diagnosis of cardiac surgery, undergoing CABG heart surgery, scoring ≤ 19 in the questionnaire for predicting postoperative bleeding in patients who had undergone cardiac surgery (patients with mild to high risk) and left ventricular ejection fraction (LVEF) above 30 percent. The exclusion criteria for the study included scoring ≥ 20 in the questionnaire for predicting postoperative bleeding in patients who had undergone cardiac surgery, uncorrected coagulation disorder, prolonged PMV for more than 24 hours, drainage >100 cc/hour in the second 4 hours after admission to the special care unit, specific postoperative restricted movement, massive uncontrollable bleeding, severe postoperative hemodynamic instability (HDI), neurological history, movement disorder, and death.

Data collection tools in this research included forms for demographic information and disease information, questionnaire for predicting bleeding after cardiac surgery which was completed in-person by the researcher before intervention, and bleeding volume recording charts for patients.

Questionnaire for predicting bleeding after cardiac surgery

The questionnaire assessed the five domains of type of surgery, preoperative anticoagulant management, surgical skills, cardiopulmonary bypass (CPB) time, and priority setting for surgery, including a score range of 5-22. The score range included 5-9 for low bleeding risk, 10-14 for mild bleeding risk, 15-19 for high bleeding risk, and 20-22 for very high bleeding risk after surgery. The content validity index (CVI) of the questionnaire was calculated at 80.03. Ten nurses in 5 groups of two were used to determine the reliability of the tool. The Kappa coefficients calculated for the 5 groups were 0.99, 0.95, 0.99, 0.99, and 0.99, respectively, indicating the high internal consistency reliability of the tool [9].

To conduct the research, we referred to the open-heart ICU and coordinated with the ward cardiac surgery subspecialists and anesthesiologists. Patients who were candidates for cardiac surgery meeting the inclusion criteria were selected using the purposive sampling method. Next, the objectives of the study were explained to the patients, and the informed consent form and questionnaire for predicting bleeding after cardiac surgery were completed by them. Participants with a mild to low risk of bleeding were included in the study. If the patient was extubated 18 hours after cardiac surgery,

initial patient evaluation was performed and their data was collected.

In the intervention group, early mobilization was performed on cardiac surgery patients over 8 stages. At each stage before the intervention, the blood pressure and heart rate of the patient were checked and the protocol was performed under the direct supervision of the researcher if there were no signs of hemodynamic instability and arrhythmia. A minimum of 3-hour intervals were allowed between the stages, as follows:

Stage 1: On day two after surgery, the patient in the CICU was placed in a sitting position by dangling their legs at the side of the bed for 5 minutes before returning to the lying position.

Stage 2: After dangling their legs, the patient was able to leave the bed if there were no signs of complications (arrhythmia, chest pains, and dyspnea) and sit on the chair beside the bed for 5 minutes before returning to bed for rest.

Stage 3: The patient sat on the chair beside the bed for 10 minutes before returning to bed for rest.

Stage 4: The patient stood by the bed and walked for 10 minutes before returning to bed for monitoring.

Stage 5: Initially, the patient walked next to the bed for 5 minutes and in the CICU ward for 10 minutes – 10 paces forward and 10 paces back as tolerated - before returning to bed.

Stage 6: The patient walked next to the bed for 5 minutes and in the CICU ward for 10 minutes with 10 paces forward and 10 paces back before returning to bed.

Stage 7: The patient walked in the CICU ward with 22 paces forward and 22 paces back for 15 minutes before returning to bed.

Stage 8: Stage 7 was repeated. If there were no complications, the patient was placed in a state of relative rest. The entire process of the patient leaving the bed lasted 24 hours.

The volume of patient bleeding on days 2, 3, and 4 after surgery was managed and recorded at a set time.

In the control group, the demographic data questionnaire, patient information form, and questionnaire for predicting bleeding after cardiac surgery were also completed first by the researcher. The patient left the bed on day 3 day after surgery according to the routine of the ward. If there were no complications on day 3, the patient was initially moved from the bed to the bedside chair where they sat for 5-10 minutes. Next, if there were no signs of complications, they walked next to the bed for 5-10 minutes before returning to bed. The process was repeated twice daily and the patient rested in bed for the rest of the day. On day 4 after admission, the patient initially walked next to the bed for 15 minutes if there were no complications and paced up and down the CICU ward for 15 minutes. They were placed in a state of relative rest if there were no complications. The volume of bleeding in the patients of the control group was also managed and recorded on days 2, 3, and 4 after surgery.

The data was collected and analyzed in SPSS 26. At first, the normality of data distribution was checked with the Shapiro-Wilk test. Given the normal distribution of data, the mean for the two groups over the three time periods was compared using the repeated measures test. Chi-square and independent t-tests were used to test the demographic data of patients.

Results

There were 100 participants in the present study. The mean age was 63.36±10.20 years in the intervention group and 65.46±10.42 years in the control group (P = 0.31). There were 48 female patients (19 in the intervention group and 29 in the control group) and 52 male patients (31 in the intervention group and 21 in the control group). According to the chi-square test, there was no statistically significant variation in terms of gender distribution (P = 0.07). The majority of patients in the intervention group (94%) and control group (98%) were married. According to the chi-square test, there was no statistically significant variation in terms of marital status distribution (P = 0.61). The majority of patients in the intervention group had a history of diabetes (60%) and hypertension (62%). According to the chi-square test, there were no statistically significant variations in terms of underlying health conditions for DM (P = 0.16) and HTN (P = 0.39) (Table 1).

The results of the independent t-test showed that the mean weight of patients was 62.26±13.00 kg in the intervention group and 61.08±13.49 kg in the control group. There were no statistically significant variations between the two groups (P = 0.65). In terms of the duration of weaning from mechanical ventilation, the time was 15.02±1.33 hours for the intervention group and 14.96±1.27 hours for the control group. There were no significant statistical variations in the two groups (P = 0.81) (Table 2).

The results for the volume of bleeding showed that the mean and SD for the volume of bleeding in patients in the intervention group during the three time periods (days 2, 3, and 4 after surgery) were 326.500±16.81, 69.300±11.41, and 51.200±3.82, respectively, indicating the effectiveness of performing the early mobilization protocol. The mean and SD for the volume of bleeding in patients in the control group during the three time periods were 350.00±16.81, 325.00±11.41, and 82.10±3.82, respectively.

The repeated measures analysis showed that the interaction variable of time and group is significant. Namely, the model of mean changes for the volume of hemorrhaging in patients undergoing cardiac surgery during the three measurement periods (days 2, 3, and 4 after surgery) in the intervention and control groups were different (P < 0.001) (Table 3).

Table 1- Frequency distribution of demographic and clinical characteristics of the intervention and control group of patients undergoing open heart surgery

Variable	Group	Intervention Number (percentage)	Control Number (percentage)	P×
Gender	Men	10(31/3)	9(26/5)	0/07
	Female	19(38/0)	29(58/0)	
Marital status	Single	3(6/0)	1(2/0)	0/61
	Married	47(94/0)	49(98/0)	
smoking	usage	8(16/0)	7(14/0)	0/779
	disuse	42(84/0)	43(86/0)	
Diabet	Suffering	30(60/0)	23(46/0)	0/161
	absence of disease	20(40/0)	27(54/0)	
HTN	Suffering	31(62/0)	35(70/0)	0/398
	absence of disease	19(38/0)	15(30/0)	

×Chi-square test
The significance level is p<0.05

Table 2- Average demographic and clinical characteristics of the intervention and control groups of patients undergoing open heart surgery

Variable	Intervention M±SD	Control M±SD	P××
Age	63/10 ± 36/20	65/46 ± 10/42	P=0/31 df=98 t= 1/01
Weight	62/26± 13/00	61/08± 13/49	P=0/65 df=98 t= 0/44
Left ventricular ejection fraction (EF)	42/30 ± 6/16	41/50 ± 5/73	P=0/503 df=98 t= 0/67
Duration of isolation from mechanical ventilation device	15/02 ± 1/33	14/96 ± 1/27	P=0/819 df=98 t= 230

×× Independent t test
The significance level is p<0.05

Table 3- Variance analysis of repeated measurements of bleeding volume in patients undergoing open heart surgery in Zahedan city in two intervention and control groups in three time periods

Source of change	sum of squares	Degrees of freedom	Average	Test statistics	meaningful	Test power
Time	12082140/08	1	12082140/08	1324/735	0/00×	1
Group	801350/083	1	801350/083	87/863	0/00×	1
The interaction of time and group	870888/667	2	435444/333	71/019	0/00×	1
Error	698487/500	98	7127/423	-	-	-

×Two-way analysis of variance with repeated measurements

Discussion

The results of the present research showed that the mean changes for the volume of hemorrhaging in cardiac surgery patients in the intervention group during days 2, 3, and 4 after surgery were reduced, showing the effectiveness of performing the early mobilization protocol in this group. In the control group, on the other hand, mean changes for the volume of hemorrhaging in cardiac surgery patients on days 3 and 4 after cardiac surgery - namely during the days when early mobilization is performed on the patient according to ward routine– were reduced but no change was observed on days 2 and 3. Overall, the comparison of means for the volume of hemorrhaging in patients on days 2, 3, and 4 after cardiac surgery in the control and intervention groups showed significant variations ($P < 0.001$).

Based on the ERAS guidelines for lung surgery, Batchelor et al. (2019) also found that early mobilization

was a factor in reducing postoperative complications [19]. Although the target group in the study was different from the present research, it still showed the effectiveness of performing early mobilization on postoperative complications, and therefore, the results are consistent with the present research.

Notably, hospitalization can rapidly decline performance, especially in older adults [20]. One of the main causes is the adverse physiological effects of long-term bed rest and inactivity. Inactivity increases insulin resistance, disrupts the digestive system, leads to cardiovascular, respiratory, and musculoskeletal system fatigue, and exposes patients to a higher risk of thromboembolism [21]. Thus, performing early mobilization for patients after surgery is safe and possible, leading to optimal health outcomes. Engel et al. (2021) showed that mothers who were less mobile after delivery (when venous thromboembolism (VTE) is a main cause of maternal mortality) developed complications after discharge and that there was a significant correlation between the level of mobility after a C-section procedure and fewer postoperative complications [22].

Zhou et al. (2022) also showed the effects of early mobilization on postoperative complications in patients undergoing liver transplants (ERAS in patients with hepatocellular carcinoma undergoing hemihepatectomy) [23]. Zanini et al. (2019) showed that training protocols including early mobilization and upper and lower body exercises significantly improved physical fitness and total lung capacity (TLC) in patients who were hospitalized for 6 days, and one mother after CABG surgery [24]. These results are, therefore, consistent with the findings of the present research.

A study by Latifian et al. (2022) also showed that early mobilization after cardiac surgery led to significant improvement in the diaphragm muscle strength in the intervention group and postoperative hemodynamic changes (reduced blood pressure and increased heart rate). Given that it has no negative effects on hemodynamics, it is a safe intervention [25]. Considering that postoperative physical activity improves hemodynamic and respiratory parameters in patients following cardiac surgery [26], performing the early mobilization protocol can play a pivotal role in managing the postoperative complications of cardiac surgery, including a reduced volume of hemorrhaging in patients. Although the significance and effectiveness of early mobilization on postoperative complications have been shown in studies, no research was conducted to date on investigating the effects of performing early mobilization on the volume of hemorrhaging after cardiac surgery. Thus, this research presents helpful findings to improve health and reduce complications in patients after cardiac surgery, playing an effective role in optimizing performance by nurses.

Study limitations included the long period of data collection and lack of cooperation by some patients due to the fear of having several chest tube drainages and connections. Efforts were made to alleviate the fear with explanations given by the researcher and the cooperation of every single patient.

Conclusion

After Surgical operations, it is useful for patients to get out of bed early to prevent complications after surgery. One of the care strategies for the early exit of patients from the bed is the implementation of the early movement protocol, which was used in this study for patients after open heart surgery, and the results show its effective results on this group of patients.

Ethics approval and consent to participate

The present article is part of a research project. This study was approved by the ethics committee at Zahedan University of medical science (IR.ZAUMS.REC.1402.391) and IRCT Code: IRCT20231120060120N2, Autonomy, independence, confidentiality and privacy of the participants were considered. Participants were informed about the study. The written and oral informed consent was obtain in order to take notes or record their audio. The participants were free to exit the study whenever.

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