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Mobilization Levels of Cardiac Surgery Patients in the Early Postoperative Period

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Keywords
Cardiac surgery · Early mobilization · Post-surgical nursing

Abstract

Introduction: Early mobilization after cardiac surgery positively affects the improvement of the physical, social, and psychological functions of patients. This study was carried out to evaluate the mobilization levels of cardiac surgery patients in the early postoperative period with the ICU-Mobility Scale (IMS). ***Methods:*** This descriptive and observational study was conducted with 104 patients and 15 nurses between February and June 2021 in a cardiovascular surgery intensive care unit in Turkey. Data were collected with an information form and the IMS. ***Results:*** A statistically significant relationship was found between the time the patients reached the 1st, 3rd, 4th, 6th, 7th, and 8th levels of the IMS in the intensive care unit and the American Society of Anesthesiologists (ASA) score, cardiopulmonary bypass time, aortic cross-clamping time, operation time, and intubation time ($p < 0.05$). In addition, nurses reported that they had a little difficulty and high satisfaction during the application of the scale. ***Conclusion:*** Mobilization after cardiac surgery is affected by some factors during and after surgery. The IMS is an inexpensive, easy, and effective method that can be used to evaluate and classify the mobilization levels of patients in the intensive care unit after cardiac surgery.

Introduction

One of the effective nursing interventions in intensive care units (ICU) is mobilization, and it is a link in the fast-track surgical chain. Mobilization is used in treatment by all disciplines in order to improve respiratory functions and early extubation, support the cardiovascular system, prevent immobilization complications, improve psychological well-being, and therefore shorten the length of stay (LOS) of patients in the ICU and hospital [1, 2]. One of the important components of enhanced recovery after surgery (ERAS) protocol is "early recovery after surgery," and mobilization is recommended within the first 24 h,

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even in intensive care patients undergoing radical surgery, provided that their vital signs are stable [3]. It has been reported that early mobilization after cardiac surgery has positive effects on improving the physical, social, and psychological functions of patients [1, 2, 4, 5].

Although early mobilization is recommended after cardiovascular surgery, there is no consensus or standardization on the best types of mobilization and their optimal intensity and duration [1, 5]. In ICU, mobilization methods include active-passive range of motion (ROM) exercises, changing positions, raising the head of the bed, turning in the bed, in-bed exercises, sitting by the bed, moving from the bed to chair, standing, and walking activities [6, 7]. As the patients begin to wake up from anesthesia after they are admitted to the ICU after cardiac surgery, they experience mobilization levels such as sitting, standing, and walking, which first starts in bed and then reaches independent walking outside the bed [7, 8].

There is not enough research on the experience of the ICU-Mobility Scale (IMS), which classifies the patients' mobilization levels in the ICU. In addition, the time to reach the mobilization levels experienced by patients in the ICU after cardiac surgery may vary according to their individual and disease characteristics. Although early mobilization is safe and well-tolerated by most patients, many patients often feel unprepared [4]. More evidence is needed regarding patients' experience of safe and effective mobilization levels in the ICU after cardiac surgery. Fast, easy, and reliable reporting of the mobilization level in the ICU is important for both improving patient outcomes and safe clinical practice. Therefore, this study was conducted to evaluate the mobilization levels of cardiac surgery patients in the early postoperative period with the IMS.

Material and Methods

Design and Sample

This descriptive and observational study was conducted with 104 patients and 15 nurses between February and June 2021 in a cardiovascular surgery intensive care unit (CVS-ICU) of a training and research hospital in Turkey. The inclusion criteria included patients who underwent cardiac surgery such as coronary artery bypass graft (CABG) surgery, Bentall surgery, valvular surgery, or atrial or ventricular septal defect repair, who were over 18 years of age, and who had willingness to participate in the study. The number of cardiac surgeries was 118 between the dates of the study, and since 2 patients were reoperative CABG, 8 patients required surgical revision, and 4 patients died after surgery, the study was completed with 104 patients. The inclusion criteria for nurses were to have been working as a nurse in the CVS-ICU for at least 1 year and to volunteer to participate in the study. The number of nurses working in the CVS-ICU of the hospital was 18, and 3 nurses did not participate in the study. So, the study was completed with 15 nurses.

Table 1. Characteristics of the patients

		n	%
Gender			
Female		38	36.5
Male		66	63.5
Cigarette smoking			
Yes		47	45.2
No		57	54.8
Alcohol usage			
Yes		23	22.1
No		81	77.9
Chronic disease			
Yes		93	89.4
No		11	10.6
Type of surgery			
CABG		53	51
Heart valve surgery		42	40.3
Bentall procedure		7	6.8
ASD primer repair		2	1.9
	$\bar{X} \pm SD$	Min	Max
Age, years	61.73±12.13	26	84
BMI, kg/m^2	27.25±4.77	18	40
ASA	2.88±0.47	1	4
EuroSCORE	2.78±2.50	0	13

CABG, coronary artery bypass graft; BMI, body mass index; ASA, American Society of Anesthesiologists Score.

Data Collection Tools

FORM 1: Nurse Data Form 1

This form consists of some questions created by the researchers, including some demographic characteristics such as age, gender, and working time of the nurses.

FORM 2: Patient Observation Form

This form consists of 25 questions created by the researchers, including some demographic (13 questions) and surgical (12 questions) characteristics of patients admitted to the CVS-ICU after cardiac surgery, and IMS [9].

ICU-Mobility Scale (IMS)

It was developed by Hodgson et al. [7] to provide a structured method for patients' mobility data in ICU in a fast, easy, and applicable way. It consists of 11 items that score, classify, and define the mobilization level of patients as a result of observation between 0–10 from nothing (lying/passive exercises in bed, score of 0) to

Table 2. Cardiovascular surgery characteristics of the patients

	Median	1st and 3rd quartiles	Min	Max
Cardiopulmonary bypass time, min	112	87.50–153.50	27	363
Aortic cross-clamping time, min	70	52.25–107.25	11	321
Operation time, h	5.25	4.50–6.50	2.8	11.2
Total intubation time, h	9.50	7.50–15.37	3.5	112.5
The length of stay in ICU, h	56.25	44.12–79.00	20	187.5
The length of stay in hospital, days	8.00	6.00–10.00	4	33

min, minutes; h, hours; ICU, intensive care unit.

Table 3. Times to reach the levels of the IMS

IMS	Median	1st and 3rd quartiles	Min	Max
0-nothing (lying in bed)	0.00	0.00–0.00	0	0
1-sitting in bed, exercises in bed	9.25	6.50–14.75	10	112.5
2-passively moved to chair (no standing)	–	–	–	–
3-sitting over edge of bed	22.75	19.50–31.00	10.5	120
4-standing	22.75	19.50–22.75	10.5	120
5-transferring bed to the chair	–	–	–	–
6-marching on spot (at bedside)	23.25	19.62–31.00	10.5	120
7-walking with assistance of 2 or more people	30.00	25.00–36.00	15	125
8-walking with assistance of 1 person	38.75	30.00–45.87	18	134
9-walking independently with a gait aid	–	–	–	–
10-walking independently without a gait aid	–	–	–	–

independent ambulation (score of 10). The Turkish validity and reliability of the scale were studied by İbrahimoğlu et al. [8]. Since the IMS is not a Likert-type scale, Cronbach's alpha could not be calculated for internal reliability.

FORM 3: Nurse Data Form 2

This form consists of 2 questions evaluating how difficult and satisfied the CVS-ICU nurses are with the use of the scale measuring 0–10 points.

Procedure

At the beginning of the study, CVS-ICU nurses were informed about the study and trained about mobilization and how to use the IMS by the researchers and filled out "FORM 1." Afterward, cardiac surgery patients who met the inclusion criteria and were admitted to the CVS-ICU were observed with "FORM 2." The mobilization level evaluation in "FORM 2" was made with the IMS. Nurses evaluated the patients with the IMS in terms of the level of mobilization from the 0th postoperative day until they were sent to the service. On the 11 items of the mobilization scale, from 0 to 10, the mobilization level of the patients at which time they reached after the surgery was marked. Since all patients were still under anesthesia when they were admitted to the CVS-ICU after surgery, they started the IMS with a 0 level. In the unit, patients who underwent elective cardiac surgery were not passively or actively moved from bed to chair, so the patients were not evaluated in the 2nd "passively moved to chair (no standing)" and 5th "transferring bed to chair" levels of the IMS. In addition, patients were transferred to the clinic before reaching the 9th and 10th levels of the IMS in the ICU, as there was no independent walking criterion without auxiliary personnel for patients to leave the ICU within the procedures of the unit. Evaluations made according to the scale were recorded on the "FORM 2" by the ICU nurses. After reaching the sample size of the patients undergoing cardiac surgery, the CVS-ICU nurses who participated in the study were asked to fill out "FORM 3".

Table 4. Patients' characteristics and their relationship to the total intubation time

	Total intubation time	
	r	*p* value
Age	0.032	0.747
BMI, kg/m^2	−0.017	0.865
EuroSCORE	0.082	0.409
ASA	0.178	0.071
Cardiopulmonary bypass time	0.441	**<0.001***
Aortic cross-clamping time	0.405	**<0.001***
Operation time	0.423	**<0.001***
The length of stay in ICU	0.503	**<0.001***
The length of stay in hospital	0.339	**<0.001***

BMI, body mass index; ASA, American Society of Anesthesiologists Score; ICU, intensive care unit; *r*, Spearman correlation. *$p < 0.05$.

Table 5. Patients' characteristics and their relationship to the times to reach the levels of IMS

	1-sitting in bed, exercises in bed		3-sitting over edge of bed		4-standing		6-marching on spot (at bedside)		7-walking with assistance of 2 or more people		8-walking with assistance of 1 person	
	r	*p* value	*r*	*p* value	*r*	*p* value	*r*	*p* value	*r*	*p* value	*r*	*p* value
Age	−0.008	0.936	0.043	0.661	0.041	0.683	0.052	0.601	0.085	0.393	0.119	0.228
BMI, kg/m^2	0.002	0.980	−0.063	0.527	−0.080	0.420	−0.086	0.384	−0.099	0.316	−0.100	0.311
EuroSCORE	0.026	0.792	0.012	0.903	0.075	0.451	0.086	0.385	0.086	0.383	0.114	0.249
ASA	0.152	0.123	0.203	**0.039***	0.236	**0.016***	0.238	**0.015***	0.264	**0.007***	0.245	**0.012***
Cardiopulmonary bypass time	0.338	**<0.001***	0.343	**<0.001***	0.379	**<0.001***	0.393	**<0.001***	0.368	**<0.001***	0.266	**<0.001***
Aortic cross-clamping time	0.287	**0.003***	0.327	**0.001***	0.366	**<0.001***	0.379	**<0.001***	0.350	**<0.001***	0.247	**0.012***
Operation time	0.296	**0.002***	0.348	**<0.001***	0.367	**<0.001***	0.378	**<0.001***	0.364	**<0.001***	0.303	**0.002***
Total intubation time	0.897	**<0.001***	0.803	**<0.001***	0.801	**<0.001***	0.809	**<0.001***	0.809	**<0.001***	0.753	**<0.001***

BMI, body mass index; ASA, American Society of Anesthesiologists Score; *r*, Spearman correlation. *$p < 0.05$.

Data Analysis

SPSS-21.0 statistical program was used to analyze the data. For continuous variables, mean, standard deviation, minimum and maximum values for normal distribution and median, 1st and 3rd quartiles, minimum and maximum values for not normally distribution were used. For categorical variables, number and percentage were used. The Kolmogorov-Smirnov test was used to evaluate the conformity of continuous variables to normal distribution. Spearman's correlation tests were calculated to determine the relationship between the descriptive tests and scales. The correlation values were evaluated as 0–0.20 = very weak, 0.20–0.40 = weak, 0.40–0.60 = moderate, and 0.60–0.80 = strong. $p < 0.05$ was considered statistically significant [10].

Results

The mean age of patients was 61.73 ± 12.13 and 66 (63.5%) were male. Other demographic characteristics of the patients are shown in Table 1.

When some intraoperative and postoperative cardiovascular characteristics of the patients were examined, it was found that the median cardiopulmonary bypass time was 112 min, the median aortic cross-clamping time was 70 min, the median operation time was 5.25 h, and the median intubation time was 9.5 h. The median LOS in the ICU and hospital were 56.25 h and 8 days, respectively (Table 2).

When the mobility levels of the patients after they were admitted to the ICU after surgery were evaluated with the IMS, all patients started the mobilization scale with the 0 level as soon as they were admitted to the ICU. It was determined that the median time for patients to reach the 1st level was 9.25, 3rd level was 22.75, 4th level was 22.75, 6th level was 23.25, 7th level was 30.00, and the last 8th level was 38.75 h (Table 3).

While there was no statistically significant relationship between the patients' age, body mass index (BMI), EuroSCORE, and American Society of Anesthesiologists (ASA) values and the total intubation time, a statistically significant positive relationship was determined between cardiopulmonary bypass time, aortic cross-clamping time, operation time, the LOS in the ICU, and the LOS in the hospital and the mean intubation times ($r = 0.441$, $r = 0.405$, $r = 0.423$, $r = 0.503$, $r = 0.339$, $p < 0.001$). As the cardiopulmonary bypass time, aortic cross-clamping time, and operation time of patients increase, the intubation time of patients in the ICU also increases. In addition, as the intubation time of patients increases, the LOS in the ICU and the LOS in the hospital also increases (Table 4).

While there was no statistically significant relationship between the patients' age, BMI, and EuroSCORE values

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and the transition time to the levels of the IMS, it was determined that there was a statistically significant and positive weak relationship between ASA, cardiopulmonary bypass time, aortic cross-clamping time, and operation time, and a statistically significant and positive strong relationship between total intubation time and the transition time to the all levels of the IMS ($p < 0.05$). As the cardiopulmonary bypass time, aortic cross-clamping time, operation time of the patients during the intraoperative period, and intubation time in the postoperative period, the average transition time to all levels of the IMS also increases (Table 5).

The mean age of the nurses was 28.80 ± 4.23 (min: 22, max: 38) and 86.7% ($n = 13$) were women. The mean working time was 7.53 ± 3.54 (min: 2, max: 15) years, and the mean working time in CVS-ICU was 4.87 ± 3.00 (min: 1, max: 10) years. It was determined that the average degree of difficulty of the nurses was 1.20 ± 1.52 (min: 0, max: 5) points, and the average degree of satisfaction of the nurses was 9.60 ± 0.63 (min: 8, max: 10) points during the application of the IMS.

Discussion

Early mobilization after cardiac surgery is crucial to the success of improved recovery [3, 11–14]. Although there are different techniques and periods proposed for mobilization, there is not enough evidence on how they should be optimal [1]. The absence of a definition and how it should be of early mobilization and the different starting points are the most important reasons for this situation. Mobilization, which starts at the most appropriate time according to the patient's condition after cardiac surgery, is a key factor for recovery [1]. In addition, type of surgery, anesthesia, surgical trauma, and the patient's preexisting health problems may affect the planning of the patient's mobilization levels after cardiac surgery [15]. Therefore, this study was carried out to evaluate the mobilization levels of cardiac surgery patients in the early postoperative period with the IMS.

In this study, the median time to reach the 1st, 3rd, 4th, 6th, 7th, and 8th mobilization levels of the scale was between 9.25 and 38.75 h (Table 3). In patients admitted to the hospital, mobilization is defined as "walking, standing, and sitting on a chair with or without assistance" and "getting a patient out of bed, for example, sitting out of bed, toileting at bedside or to a bathroom, standing, and ambulation" [16, 17]. Therefore, mobilization ranges from bed positioning to unassisted walking [1]. Early mobilization performed by taking a few steps at the bedside between 6 and 8 h after surgery is one of the effective and evidence-based nursing interventions that improve patient care outcomes and prevent complications associated with immobilization [2]. In addition, the appropriate early mobilization dose is defined by individual tolerance and clinical efficacy [18]. Although there is no study in the literature that directly recommends the time and intensity of mobilization of patients after cardiac surgery, mobilization practices are recommended as a ROM exercises: sitting by the bed, moving from the bed to chair 2–3 times on the operation day, and walking in a room in the first postoperative day, if a patient is able [19, 20]. According to the ERAS, it is recommended that the patient spends 2 h out of bed in the first 24 h after surgery and 6 h a day until discharge in the following days. Timing of the initiation of mobilization after cardiac surgery varied between studies. According to the studies, mobilization was initiated during the period of intubation [21], postextubation [22], or on the first postoperative day [23, 24].

Mobilization in the ICU includes not only walking activities but also active-assisted exercises, active-passive ROM exercises, bed mobility activities such as turning in bed, changing position, raising the head of the bed, rolling, bringing, and transfer to upright sitting in or near the bed, transferring from bed to chair or commode, pre-gait exercises, marching on the spot, and ambulation (with or without mobility aids) [6, 7]. Among the studies examining the mobilization activities performed in the ICU on the postoperative first day after cardiac surgery, it is stated that mobilization activities include body positioning in Patman et al. [21], sitting over the edge of the bed in Cacau Lde et al. [24], passive mobilization in Herdy et al. [22], active limb exercises and ambulation in Hirschhorn et al. [23] study. In this study, the transition time of the patients to the first level of the scale almost coincides with their extubation time. The fact that the mobilization levels that started with extubation ranged from sitting in the bed to walking with the assistance of one person in the first 2 days postoperatively indicates that the mobilization of the patients is compatible with the early mobilization recommendations in the literature.

Although it is suggested that mechanical ventilation does not constitute an obstacle for the mobilization of patients after elective surgery [11], endotracheal extubation wait in the mobilization protocol of the unit where this study was conducted. Patients followed up without complications move mostly in the bed until the planned extubation, and after the extubation, they perform sitting on the side of the bed, standing up, and walking activities

[21–23]. In this process, while patients are expected to exceed the IMS levels according to the planned extubation time, many factors may affect the extubation time of patients after cardiac surgery. In this study, a statistically significant positive relationship was determined between cardiopulmonary bypass time, aortic cross-clamping time, operation time, the LOS in ICU, the LOS in the hospital, and the intubation times (Table 4). As the cardiopulmonary bypass time, aortic cross-clamping time, and operation time of patients increase in the intraoperative period, the intubation time of patients in the ICU also increases. In addition, as the intubation time of patients increases, the LOS in the ICU and the LOS in the hospital also increase. Today, there is a debate about the most appropriate extubation time after cardiac surgery. Although there are studies indicating that extubation is successful in the operating room, due to the rapid changes in hemodynamic instability and the risk of bleeding in the first few hours after surgery, patients in most centers are extubated in the ICU after hemodynamic stability is achieved. Although it has been shown that the optimal time for this period is between 2 and 8 h, the current trend is to extubate within the first 12 h postoperatively [25]. Postoperative intubation time of patients may be affected by some individual and disease characteristics. In the literature, it has been reported that age, total perfusion time, aortic cross-clamping time, total operation time, minimum body temperature, use of inotropic agents, use of intra-aortic balloon pump, amount of drainage, and blood transfusion are among the factors prolonging the postoperative extubation time [9, 26]. Delayed extubation may cause delayed mobilization and prolong the LOS in the ICU and hospital [1].

In this study, it was determined that a statistically significant and positive weak relationship between ASA, cardiopulmonary bypass time, aortic cross-clamping time, and operation time, and a statistically significant and positive strong relationship between total intubation time and the transition time to the levels of the IMS (Table 5). As the cardiopulmonary bypass time, aortic cross-clamping time, operation time of the patients in the intraoperative period, and intubation time in the postoperative period increase, the average transition time to all levels of the IMS also increases. The degree of trauma during surgery affects postoperative recovery [27]. A high ASA level is associated with a high risk of complications both intraoperatively and postoperatively [28]. Therefore, it is expected that these patients experience the mobilization levels more delayed in the postoperative period. In addition, depending on the surgery and the degree of intraoperative trauma, prolonged cardiopulmonary bypass time, aortic cross-clamping time, and total operation time also cause patients to stay in the cardiopulmonary bypass machine longer, receive more anesthesia, and remain hypothermic for a longer period, thus slowing the recovery in the postoperative period [15]. Delayed recovery may cause the patient to wake up late, be extubated late, and thus mobilize late [1]. In this study, the positive and significant relationship between the patients' intraoperative characteristics and the transition time to the levels of the IMS may be related to their later recovery due to the increase in the degree of intraoperative trauma.

In this study, 83.33% (n = 15) of the CVS-ICU nurses participated. In the literature, it has been reported that intensive care nurses have positive attitudes toward early mobilization, and sometimes they have misunderstandings, negativity, and barriers [29]. With the implementation of a protocol for the early mobilization in the ICU, more patients can be mobilized in a shorter time [30, 31]. To overcome barriers and standardize protocols, the classification of types of mobilization is important [8]. It was determined that the average degree of difficulty of the nurses was 1.20 ± 1.52 (min: 0, max: 5) points, and the average degree of satisfaction of the nurses was 9.60 ± 0.63 (min: 8, max: 10) points during the application of the IMS. Despite the busy ICU environment, the IMS was administered with ease. With the IMS, the lowest and highest daily mobility levels in ICU patients can be easily evaluated, and it facilitates the provision of language unity between different disciplines serving in teamwork for the same purpose in the intensive care unit, especially physicians and nurses [7].

Conclusion

Early mobilization after cardiac surgery has positive effects on recovery. The IMS is an inexpensive and easy method that can be used to evaluate the mobilization levels of patients in the ICU in the early period after cardiac surgery, and it does not require any equipment. Using the scale creates a common language about mobilization within the healthcare team. In this context, nurses have important responsibilities in the patient-specific planning of mobilization after cardiac surgery. It can be suggested that nurses should use the scales to ensure unity in patient mobilization practices and to standardize these practices. In addition, it is recommended to consider that the patients' individual and disease characteristics who can be encountered in the perioperative period affect the mobilization levels in the postoperative period.

Limitations

This study has a few limitations. First, this study was conducted by a single surgical team in one hospital in Turkey. So, the results cannot be generalized for other surgeries. Second, the fifth, ninth, and tenth levels of the IMS could not be evaluated due to unit procedures. In addition, in this study, the mobilization levels of the patients were evaluated based on observation. For this reason, the data according to the mobilization levels are limited to the observations of the nurses.

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Statement of Ethics

This study protocol was reviewed and approved by the University Ethics Committee, approval number 28.12.2020/216. Before the study, institutional permission from the hospital and written informed consent from the participants were obtained. The study was conducted in accordance with the Declaration of Helsinki.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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Author Contributions

Each authors contributed equally to the paper. Özlem İbrahimoğlu and Nurdan Gezer drafted the study. Özde Öğütlü collected the data. Özlem İbrahimoğlu, Nurdan Gezer, and Özde Öğütlü drafted the manuscript. Özlem İbrahimoğlu suggested the topic, supervised study, and reviewed the manuscript. All authors read and approved the final manuscript.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further inquiries can be directed to the corresponding author.

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