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Original Article

Impact of early mobilization on clinical and functional outcomes in patients submitted to coronary artery bypass grafting

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Abstract: Introduction: Heart surgery is a feature that has grown a lot in recent years. Due to the complications that can be generated, the importance of prevention emerges, thus seeking effective protocols that generate improvement in clinical and functional outcomes to promote a shorter hospital stay and readmission. Objective: To evaluate the impact of early mobilization on clinical and functional outcomes in patients undergoing coronary artery bypass grafting. Methodology: This was a prospective cohort study. Patients were evaluated preoperatively through the Medical Research Council (MRC), Functional Independence Measurement (FIM), Six-Minute Walk Test (6MWT). After the surgery they were divided into two groups: the mobilized group (MG) where patients performed bed transfer to armchair on the 1st postoperative day and ambulated on the 2nd day, and the non-mobilized group (NMG) who underwent passive kinesiotherapy in bed. At ICU discharge, mechanical ventilation (MV) time, intensive care unit stay (ICU) and mortality were compared. At hospital discharge, preoperative tests were repeated to compare with admission. Results: A total of 103 patients were admitted, 59 (57.3%) males, mean age 64 ± 8 years. Time of MV it was 6 ± 2 (MG) vs 10 ± 3 (NMG) hours, P = 0.02, ICU stay it was 2 ± 2 (MG) vs 4 ± 3 (NMG) days (P ≤ 0.001), length of stay hospital was 8 ± 4 (MG) vs 14 ± 5 (NMG) days (P ≤ 0.001), FIM -4 ± 2 (MG) vs -11 ± 4 (NMG) points (P ≤ 0.001) and distance traveled 37 ± 10 (MG) vs 78 ± 11 (NMG) meters (P < 0.001). Conclusion: Early mobilization is associated with improvement in clinical outcomes such as MV time, ICU stay, hospital and functional outcomes, on the FIM scale and distance traveled.

Keywords: Myocardial revascularization, early ambulation, physical therapy

Introduction

Cardiac surgery is a feature that has grown in recent years and is one of the most positive procedures in the world, as it generates increased survival for patients undergoing treatment [1]. In 2015, cardiac surgeries were performed in Brazil around 76,100, most frequently during this period myocardial revascularization and valve prosthesis implantation [2].

Postoperatively, patients are referred to the Intensive Care Unit (ICU) using mechanical ventilation, chest drains, and often dependent on vasoactive drugs, in favor of hemodynamic stability [2]. Risk factors such as smoking, high blood pressure, obesity, physical inactivity, use of drugs such as antibiotics, muscle blockers, corticosteroids may increase the length of stay in the ICU, as well as the increase in mechanical ventilation and sedation may lead to muscle weakness [3, 4].

ICU patients could develop motor deficits because they were not assisted by a multidisciplinary team [5]. The consequences generated by immobility can have repercussions for months or years after a long stay in the hospital, thus the importance of preventing complications and returning patients to their functional capacity reducing the risk of hospital readmission [4]. Thus, there is the importance

of rehabilitation programs, which have been increasingly indicated and recommended for their usefulness and great effectiveness showing evidence in improving the treatment of patients with heart problems [6].

Physiotherapy has a prominent role, due to the importance of performing exercises during the postoperative. In the ICU, the term mobilization is used to relate physical activity with intensity that provides physiological benefits, such as improved central and peripheral circulation, improved ventilation, metabolism and alertness [7]. Mobilization generates great advances during the hospitalization period, it is increasingly being proven that it is safe, viable and can generate great functional results [8]. Some strategies used in mobilization are passive and active movement activity, decubitus training, cycle ergometer use, bed and bedside exercises, bed-to-chair transfer training, ambulation among many other exercises [6].

Thus, clinical outcomes became positive from the use of early mobilization in many ICU patients with various pathologies and demonstrated beneficial results in physical functioning, greater functional mobility, pain reduction and shorter hospital stay [9].

However, there are few studies that demonstrate the effectiveness of early mobilization in patients undergoing cardiac surgery and, thus, we do not see many results that prove the great benefits in the clinical outcome of these patients. Therefore, the aim of this study is to observe the impact of early mobilization on clinical and functional outcomes in patients undergoing coronary artery bypass grafting.

Material and methods

This is a prospective cohort study conducted at a referral cardiology hospital in the interior of the state of Bahia from January 2019 to October 2019. The research was approved by the Research Ethics Committee of the Noble Faculty (No. 2.088.633), and all participants, upon being invited to participate and agreeing, signed the Informed Consent Form before the study began.

Eligibility criteria

We included individuals of both sexes, aged 18 years or older and submitted to myocardial revascularization via median sternotomy with cardiopulmonary bypass. Exclusion criteria were patients with previous previous cardiac surgery, patients with any type of physical limitation such as amputation or need to use an auxiliary device, as well as pre-existing pulmonary disease such as chronic obstructive pulmonary disease or restrictive, neurological sequelae and neuromuscular diseases such as amyotrophic lateral sclerosis and myasthenia gravis.

Study protocol

All patients had their peripheral muscle strength assessed preoperatively by the Medical Research Council (MRC). In addition, functional independence was assessed using the Functional Independence Measurement (FIM) and distance covered by the Six-Minutes Walking Test (6MWT).

After the evaluation, the patients were referred to the operating room and soon after to the ICU. During the time spent in this unit no researcher had any influence on the conducts performed by physiotherapy. On ICU discharge day, it was verified which patients underwent early mobilization. For this study early mobilization was defined as the patient who performs bed transfer to armchair on the first postoperative day and who ambulates on the second day.

Patients who underwent these two conducts were referred to the mobilized group (MG) and those who underwent passive kinesiotherapy in bed went to the non-mobilized group (NMG). Also, at this time of ICU discharge, clinical outcomes such as mechanical ventilation time (MV), length of ICU stay and ICU mortality were compared.

The patients went to the inpatient unit where they continued to receive physical therapy assistance, without interference from the researchers. At hospital discharge, other clinical outcomes were analyzed, such as length of stay and hospital mortality. Functional tests (MRC, FIM and 6MWT) were repeated to compare admission with discharge and between mobilized and non-mobilized groups. Evaluations at all times were performed by a blinded examiner.

Measuring instruments

The first assessment is the MRC scale tests the peripheral muscle strength with the patient

Table 1. Clinical and surgical characteristics of patients undergoing coronary artery bypass grafting

Variable	MG (n-55)	NMG (n-48)	P
Sex			SS[a]
Male	31 (56%)	28 (58%)	
Female	24 (44%)	20 (42%)	
Age (years)	63 ± 9	64 ± 8	SS[b]
BMI (kg/m^2)	25 ± 4	26 ± 4	SS[b]
Comorbidities			
SAH	31 (56%)	25 (52%)	SS[a]
DM	22 (40%)	19 (40%)	SS[a]
DLP	20 (36%)	17 (35%)	SS[a]
Smoking	8 (15%)	6 (13%)	SS[a]
Sedentary lifestyle	13 (24%)	13 (27%)	SS[a]
Number of grafts	2 ± 1	2 ± 1	SS[b]
Surgery time (min)	254 ± 66	278 ± 79	SS[b]
CPB time (min)	88 ± 22	94 ± 31	SS[b]
Aortic clamping time	99 ± 34	107 ± 44	SS[b]
Number of Drains	2 ± 1	2 ± 1	SS[b]

a. Chi-square test; b. Independent Student's t test; BMI-Body Mass Index; SAH-Systemic arterial hypertension; DM-Diabetes Mellitus; DLP-dyslipidemia; CPB-cardiopulmonary bypass; SS-No significance (P > 0.05).

lying supine, ventral, lateral and sitting. Consist of bilateral assessment of upper and lower limbs to reduce dominance influences and possible asymmetrical involvement of muscle groups. Twelve muscle groups are evaluated. The movements evaluated are shoulder abduction, elbow flexion, wrist extension, hip flexion, knee extension and ankle dorsiflexion. The best score obtained (comparing both sides) is recorded. Its grading ranges from 0 to 5, where 0 there is no visible muscle contraction and 5 the normal force. To obtain a total score ranges from 0 (complete tetraparesis) to 60 (normal) [10].

The second evaluation was made using the functional independence measurement questionnaire (FIM). The FIM aims to quantitatively evaluate the care requested by a person to perform a series of motor and cognitive tasks of daily living. Self-care, transfer, locomotion, sphincter control, communication, and social cognition, including memory, social interaction, and problem solving, were evaluated. The activity evaluated receives a score from 1 (total dependence) to 7 (complete independence), so the total score ranges from 18 to 126. It is very important to emphasize that the FIM is not a self-applied instrument and requires training for its use [11].

The third evaluation was the six-minute walk test that aims to evaluate the submaximal functional capacity of the individual to perform daily activities. The test was performed in the hospital corridor with a time of six minutes according to the patient's capacity, was measured before and after the test the blood pressure, pulse saturation, heart rate and observed symptoms of fatigue and dyspnea. Performed with the help of two professionals with verbal stimuli in the incentive to complete the test. It was noted the course covered the number of turns performed in six minutes, calculating the variables [12].

Data analysis

Data were analyzed using the Statistical Package for Social Sciences 20.0 software. Normality was assessed by the Shapiro-Wilks test. Data were expressed as mean and standard deviation. Categorical variables were verified using Chi-square. Comparison between groups was performed using the independent Student's t test. To evaluate some variables, we calculated the delta, which represents the preoperative value minus hospital discharge. It was considered significant when $P < 0.05$.

Results

During the research period, 120 patients were admitted, 17 of whom were excluded (1 due to previous cardiac surgery, 3 due to physical limitation, 13 due to pre-existing pulmonary disease). The prevalence was male with 59 patients (57.3%) and with a mean age of 64 ± 8 years. **Table 1** shows the intergroup analysis of the clinical data; homogeneity between them can be observed.

Table 2 shows the clinical and surgical results between the groups submitted to coronary artery by-pass grafting. Of the analyzed variables the time of MV presented a statistically significant value ($P = 0.02$), as well as the length of stay in the ICU and hospital ($P < 0.001$).

Table 3 shows the functional results between the groups submitted to myocardial revascularization. Comparing the results of the groups on

Table 2. Clinical and surgical results among the groups submitted to coronary artery bypass grafting

Variable	MG (n-55)	NMG (n-48)	P
MV time (hours)	6 ± 2	10 ± 3	0.02[a]
ICU mortality	1 (2%)	2 (4%)	SS[b]
Hospital mortality	1 (2%)	2 (4%)	SS[b]
ICU stay time (days)	2 ± 2	4 ± 3	< 0.001[a]
Length of hospital stay (days)	8 ± 4	14 ± 5	< 0.001[a]

a. Independent Student's t test; b. Chi-square test; MV-Mechanical Ventilation; ICU-Intensive Care Unit; SS-No significance (P > 0.05).

Table 3. Functional results among the groups submitted to coronary artery bypass grafting

Variable	MG (n-55)	NMG (n-48)	P[a]
FIM			
Preoperative	125 ± 1	125 ± 1	SS
Hospital Discharge	121 ± 2	114 ± 4	< 0.001
Δ	-4 ± 2	-11 ± 4	< 0.001
MRC			
Preoperative	58 ± 1	59 ± 1	SS
Hospital Discharge	55 ± 2	54 ± 3	SS
Δ	-3 ± 2	-5 ± 2	SS
Travelled distance			
Preoperative	402 ± 23	390 ± 31	SS
Hospital Discharge	365 ± 33	312 ± 39	0.02
Δ	37 ± 10	78 ± 11	< 0.001

a. Independent Student's t test; FIM-Functional Independence Measure; MRC-Medical Research Council; SS-No significance (P > 0.05).

the FIM scale and the distance covered in Delta both presented the significance of P ≤ 0.001. There were losses in the mobilized and non-mobilized group, but when compared the loss was smaller in the mobilized group.

Discussion

In the present study it was found that clinical factors such as mechanical ventilation time, ICU stay and hospital stay, and functional factors such as functional independence and walking distance were significantly better in the group that performed early mobilization. It is noteworthy that the study points to the damage that can occur when the patient has no indication to start physical activities.

It can be observed that these highlighted variables are associated with the execution of the protocol where it was applied quickly and effectively after the first postoperative day, which according to Brito et al. [13] the ultimate goal of early mobilization in MV patients is to reduce the loss mobility, increase functional independence and favor ventilatory weaning.

Luna et al. [14] stated that early mobilization in the ICU is possible and effective, at no additional cost, allowing the patient to be discharged faster, demonstrating the beneficial effects of the protocol. The purpose of this study is to confirm that early mobilization is a great tool for the recovery of these patients and should be used effectively.

There are several factors that can lead to functional decline in the postoperative period of cardiac surgery, mobilization appears as an alternative, proving to be safe and viable.

Santos et al. [15] in their longitudinal and retrospective study argue the importance of mobilizing the patient, ie, getting him or her out of bed early, as it has an impact on the maintenance and preservation of functionality and may reduce the chances of clinical diseases and hospital death, as demonstrated in our study, through functional, clinical and surgical variables.

Laizo et al. [16] verified the hospital stay in patients who underwent cardiac surgery. It was identified that one of the causes of prolonged ICU stay is due to respiratory complications and hemodynamic instability. Although the present study has different objectives, it was verified that in both cases, when the patient is prepared and evaluated preoperatively, there are fewer losses in the general clinical picture, thus demonstrating significance regarding ICU stay and stay hospital.

The ICU mortality rate is a worrying factor and the same is addressed in the study by Santos et al. [15], where they reported that the number of deaths was relevant, as it is linked to patients who had severe clinical conditions, especially in the pre-intra and postoperatively. However, our study did not obtain significance in relation to the data, since the profile of patients mostly underwent elective surgeries, which generate better patient preparation, thus reducing risks and complications. Since we did

not obtain urgent clinical cases thus decreasing the rich during surgery and postoperatively, this cannot be correlated with the study presented above.

Burtin et al. [17] found that the use of a cycle ergometer is possible and reliable in an ICU, leading to an improvement in functional capacity, with no changes in cardiorespiratory parameters. Our study was limited to sedation training and orthostasis, ambulation where it was applied throughout the hospitalization period, since the cycle ergometer obtained good results, so its integration into the protocol is important.

Our mobilization protocol was based on sedation, ambulation between the first and second day. In the Cacau et al. [18] study was investigate the integration of virtual reality in the mobilization protocol, which served as a tool to evaluate functionality improvement, proving its satisfactory gain and its effectiveness. Contribution to a greater ability in locomotion, evolving until the moment of hospital discharge.

Another promising resource was evaluated by Cerqueira et al. [19], where he used neuromuscular electrostimulation (NMES) to prevent muscle trophism, to avoid functional decline and impairment of quality of life. However, NMES did not show effectiveness in these requirements nor for ambulation, as they may be associated with the severe health status of patients who were debilitated and with preoperative restrictions.

Fernandez et al. [20], in a systematic review, analyzed and evaluated interventions based on rehabilitation and early mobilization in critically ill patients. Through the study can confirm that there are results in advancing the improvement of muscle strength, functionality, reduced time of MV and hospitalization, hospital discharge and activities of daily living. This paper reiterates the conclusions of the present study.

In this study, significance was presented in the distance covered, demonstrating that after early mobilization in the recovery of mobilized patients, an improvement in the results of this scope was obtained. Cordeiro et al. [21], in their study, did not show any interference with early ambulation while staying in the intensive care unit or hospital discharge, which emphasizes that the number of patients mobilized may have interfered with the result, also because it is not a routine to walk in the unit intensive therapy.

We believe that the findings verified in this study can be repeated in patients undergoing other major surgeries, such as lung and upper abdomen surgeries, however, as it was not the direct objective of the present study, we cannot guarantee such reproduction of results.

The limitations of this study are that it does not evaluate patients through the severity state scale, which analyzes whether the mortality rate was low due to the clinical case of the patients. No sample size calculation was performed to determine if there is a margin of error to validate the search parameters.

Conclusion

It was concluded that early mobilization in patients undergoing coronary artery by-pass grafting contributed to the improvement of clinical outcomes such as reduced MV time, ICU stay and hospital stay. Functional outcomes demonstrated effects by maintaining muscle strength and functionality. Thus, allowing to demonstrate that this protocol is extremely important for the recovery of patients submitted to this surgery.

Disclosure of conflict of interest

None.

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