ORIGINAL ARTICLE

Behavior of the Perme Scale and Correlation with Clinical Outcomes in the Postoperative of Coronary Artery Bypass Grafting

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Abstract

Background: There are limiting factors that influence the assessment of mobility after cardiac surgery. Therefore, the Perme intensive care unit mobility score scale becomes more appropriate because it analyzes physical and psychological limitations in the intensive care unit (ICU), taking into account extrinsic problems.

Objective: Describe the behavior of the Perme scale and its correlation with clinical outcomes in the postoperative stage of cardiac surgery.

Materials and methods: This is a prospective cohort study. The patients were evaluated in four moments, to analyze the perception of pain, the degree of dyspnea, muscle strength, and functionality according to the Perme scale which ranges from 0 to 32 points. It was applied at hospital admission, ICU discharge, admission to the ward (UI), and hospital discharge. Values expressed as Delta 1 (d1) and Delta 2 (d2) were used to determine the comparison of preoperative and hospital discharge, respectively.

Results: Twenty-one patients were included. Among the correlation variables at the different moments, it was perceived that cardiopulmonary bypass time d1 ($r = 0.19$; $p = 0.42$); d2 ($r = 0.07$; $p = 0.98$); ICU time d1 ($r = 0.34$; $p = 0.17$); d2 ($r = 0.35$; $p = 0.16$); hospital time d1 ($r = 0.17$; $p = 0.54$); d2 ($r = 0.21$; $p = 0.47$) and mechanical ventilation (MV) time d1 ($r = 0.09$; $p = 0.70$); d2 ($r = 0.44$; $p = 0.06$) showed no statistically significant difference. The variables hospital admission (31 ± 1) and ICU discharge (20 ± 4) showed significant losses in the length of stay in these units.

Conclusion: The evaluation performed with the Perme scale showed significance when comparing the values between ICU admission and discharge. However, in relation to the clinical outcomes of this study, no relevant correlations were proven.

Keywords: Cardiac surgery, Functionality, Intensive care unit, Mobility limitation.

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Highlights

The Perme intensive care unit mobility score effectively assesses mobility and limitations in cardiac surgery patients. While significant differences were noted between intensive care unit (ICU) admission and discharge scores, correlations with clinical outcomes were not statistically significant, highlighting the need for further research on mobility assessments post-surgery.

Introduction

The World Health Organization (WHO) states that cardiovascular diseases (CVD) are the leading cause of death worldwide, accounting for 32% of all deaths.[1] According to the 2020 Cardiovascular Statistics, in 2017, 21,474 coronary artery bypass grafting (CABG) surgeries were performed in Brazil's public healthcare system. These patients had an average hospital stay of 12.2 days, with a mortality rate of 5.37%.[2]

Coronary artery bypass grafting is indicated in patients with significant and symptomatic coronary disease, or with a high risk of cardiac events when medical therapy alone is inadequate to manage ischemia or enhance life quality, post-surgical patients often experience compromised respiratory function, reduced lung capacity, and peripheral muscle strength, and decreased functional capacity and mobility. Components intrinsic to the surgical process and recovery phase, including factors such as anesthesia, sternotomy, cardiopulmonary bypass, mechanical ventilation, tubes, monitoring equipment, and the presence of chest and mediastinal drains, can significantly impede mobilization and limit movement.[3–6]

During this time, patients may face prolonged immobility due to the severity of their medical condition, potentially leading to acquired muscle weakness in the ICU. Therefore, it is essential to understand the functional status of the patient in the ICU requires a well-defined approach to set goals and methods for enhancing postoperative mobility.[7,8] The Perme ICU mobility score, developed by Christiane Perme,[9] was designed to assess the mobility of

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critically ill patients quantitatively, taking into account factors such as muscle strength and the presence of devices that could hinder movement during hospitalization.

The scale has been translated into Portuguese and validated, allowing for effective evaluation of patient mobility in these settings of 15 items across 7 categories: mental status, potential mobility barriers, functional strength, bed mobility, transfers, gait, and endurance. It has a total score that can range from 0 to 32, and the higher the score, the less of a barrier to the patient's mobility.[9]

In the ICU environment, it is crucial to begin mobilization and physical exercise as early as possible, as these interventions are linked to positive outcomes. In this context, the Perme scale serves as a vital tool for assessing the factors that affect the mobility of critically ill patients. Thus, this study aimed to describe the performance of the Perme scale and its correlation with clinical outcomes in the postoperative period following cardiac surgery.

Materials and Methods

Study Design

This study was designed as a prospective observational investigation, carried out at the Instituto Nobre de Cardiologia in Feira de Santana, between September 2017 and March 2018.

Inclusion and Exclusion Criteria

Patients of both genders who underwent on-pump CABG with sternotomy and were over the age of 18 were included in the study. The following exclusion criteria were applied: individuals with cognitive impairments or other conditions that limited their ability to properly respond to the questionnaires, as well as patients with a history of neurological disorders or lower limb amputations, were excluded, as these factors could potentially influence the evaluation of functionality and quality of life who were readmitted to the ICU before the post-discharge evaluation, those who passed away, those who could not be reached for follow-up, and patients with respiratory infections.

Ethical Aspects

In line with Resolution 466/12, this research was reviewed and approved by the Ethics and Research Committee of Nobre University Center, under approval number 2.262.095. All individuals were invited to take part in the study, and those who agreed provided their written informed consent by signing the Informed Consent Form.

Study Protocol

Data collection was conducted by the standard protocols of the physical therapy service for postoperative care after cardiac surgery were assessed at four distinct time points. The objective was to evaluate the patient's progress and recovery throughout the rehabilitation process of perception of pain, level of dyspnea, peripheral muscle strength, and functionality/mobility. Before each assessment, relevant patient characteristics were recorded on a designated evaluation form. All assessments were conducted by a single evaluator. These evaluations took place at four key points: Preoperatively, upon ICU admission, at ICU discharge, and at hospital discharge. The purpose was to monitor changes over time and investigate their association with clinical outcomes, including functional decline.

Analyzed Variables

Pain perception was measured using the visual analog scale (VAS), a validated one-dimensional tool in Brazil that is easy to use. The patient indicated the intensity of their current pain, offering a reliable assessment of pain severity.[10,11] To assess dyspnea, the modified Borg scale was employed. Participants rated their shortness of breath on a scale from 0 (no dyspnea) to 10 (maximum severity of dyspnea).[12]

Peripheral muscle strength was evaluated using the Medical Research Council (MRC) sum score. While seated with their feet securely supported, patients' bilateral muscle strength in the following muscle groups was assessed and graded: shoulder abductors, elbow flexors, wrist extensors, hip flexors, knee extensors, and dorsiflexors. Muscle strength was rated on a scale from 0 to 5, where 0 indicated no muscle contraction and 5 represented normal strength.[13]

The patient's mobility was assessed using the Perme scale, which evaluates functional mobility through 15 items divided into 7 categories: Mental status, potential mobility barriers, functional strength, bed mobility, transfers, gait, and endurance. The total score ranges from 0 to 32, with higher scores indicating a greater level of independence and less need for assistance.[9]

Statistical Analysis

The data collected were analyzed using both descriptive and inferential statistics. Normally distributed data were summarized with means and standard deviations, while skewed data were presented as medians with interquartile ranges. Categorical variables were reported as absolute and relative frequencies. To compare means across evaluations, the paired samples Student's *t*-test was used. For non-normally distributed data, the Wilcoxon test was applied. Pearson's or Spearman's correlation tests were conducted to assess the relationships between quantitative variables. All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS), version 20.0. A *p*-value of less than 0.05 was considered statistically significant for all tests.

Results

A total of 21 individuals participated in the study, with a predominance of male patients, 12 of whom (57%) were male. The average age of the participants was 61 $\pm$12 years. The most prevalent comorbidity was systemic arterial hypertension, which affected 17 (81%) of the patients. The average length of stay in the ICU was 3 $\pm$ 1 days, while the average hospital stay was 11 $\pm$ 4 days. Further details on sample characteristics are presented in Table 1.

The Perme variables on admission were 31 $\pm$ 1, ICU discharge 20 $\pm$ 4, and hospital discharge 29 $\pm$ 3 (Table 2).

To establish the difference in functionality, evaluated by the Perme, we established a delta. Delta 1 corresponds to the evolution from admission to ICU discharge, with a decrease of 11 $\pm$ 3 ($p < 0.001$). Delta 2 is the difference between hospital admission and discharge, with no difference of 2 $\pm$ 2 ($p = 0.34$) (Table 3).

Among the correlation variables at different time points, we observed the following results: Cardiopulmonary bypass time ($r = 0.07$; $p = 0.98$), ICU stay ($r = 0.35$; $p = 0.16$), hospital stay ($r = 0.21$; $p = 0.47$), and mechanical ventilation (MV) time with the best result ($r = 0.44$; $p = 0.06$). However, none of these correlations reached statistical significance (Table 4).

Table 1: Clinical and surgical data of the patients studied

Variables	*n = 21*
Gender	
Male	12 (57%)
Female	9 (43%)
Age (years)	61 ± 12
BMI (kg/m^2)	26 ± 3
Comorbidities	
Diabetes mellitus	10 (48%)
Systemic arterial hypertension	17 (81%)
Dyslipidemia	7 (33%)
Sedentarism	4 (19%)
Smoking	4 (19%)
Type of surgery	
Coronary artery bypass grafting	16 (76%)
Valve replacement	5 (24%)
Surgery time (minutes)	298 ± 51
CPB time (minutes)	95 ± 17
MV time (hours)	8 ± 4
Grafts number	3 ± 1
Drains number	2 ± 0.3
ICU stay (days)	3 ± 1
Hospital stay (days)	11 ± 4

CPB, cardiopulmonary bypass; ICU, intensive care unit; MV, mechanical ventilation

Table 2: Perme scale values at different times of hospitalization

Variables	*Mean*
Perme at admission	31 ± 1
Perme at discharged from ICU	20 ± 4
Perme at admission to the ward	22 ± 4
Perme at hospital discharge	29 ± 3

Table 3: Comparison of the Perme scale at hospital admission with ICU and hospital discharge

Perme	*Mean*
Hospital admission	31 ± 1
ICU discharge	20 ± 4
p[a]	<0.001
Delta 1	11 ± 3
Hospital admission	31 ± 1
Hospital discharge	29 ± 3
p[a]	0.34
Delta 2	2 ± 2

ICU, intensive care unit. [a]Paired student's *t*-test

Table 4: Correlation between variations at different time points with clinical outcomes

	Delta 1		*Delta 2*	
Variables	*r*	*p-value*	*r*	*p-value*
CPB time	0.19	0.42	0.07	0.98
MV time	0.09	0.70	0.44	0.06
ICU stay	0.34	0.17	0.35	0.16
Hospital stay	0.17	0.54	0.21	0.47

CPB, cardiopulmonary bypass; ICU, intensive care unit; MV, mechanical ventilation

Discussion

In the analysis of our results, it was possible to observe that the Perme score was able to reproduce the mobility status of patients in the postoperative period of cardiac surgery at different moments from admission to hospital discharge. We can see that when we compared the values of hospital admission 31 ± 1 with ICU discharge 20 ± 4 we found a delta difference of 11 ± 3 a statistically significant value <0.001 representing the impact on functional mobility. At the time of hospital discharge, the values returned to levels near the baseline (31 ± 1 vs 29 ± 3), which supported the improvement in the patient's mobility status. However, no correlation was found between these values and clinical outcomes.

We conducted a literature search and our study appears to be the first to use the Perme score to assess the mobility of patients undergoing cardiac surgery from admission to discharge. It is crucial to analyze the profile of patients who are often subjected to the use of multiple invasive devices, as these can pose barriers to mobilization. Identifying these challenges is essential, along with developing strategies and protocols to ensure that these devices do not hinder the progression of mobilization and active exercises.

Seeking to understand the behavior of the scale, Langley and Sheppeard[11] used the Perme score to predict the functional status of patients undergoing liver transplantation. They found that patients were discharged with better functional mobility compared to their condition upon admission to the inpatient unit. The authors also found a correlation between the Perme scale score at ICU discharge and the length of MV. These findings align with ours, as we observed that patients were discharged with higher mobility scores compared to their ICU discharge, and we also found a strong correlation with MV time. Borg[12] reported that upon admission, about 37% of patients had a score of zero (indicating minimal barriers), while 13% had a score of three. At ICU discharge, 57% of patients scored a two, and 31% scored a three, suggesting that barriers to mobilization persisted throughout the hospitalization. Our study did not separate the results in this way, so we cannot make a direct comparison to the cited study, but our patient profile typically includes individuals admitted to the ICU on MV, with peripheral and central catheters and intravenous infusions, all of which can be potential barriers to mobilization.

Devices such as invasive blood pressure monitors, bladder catheters, peripheral venous catheters, central venous catheters, and even chest and mediastinal drains are essential in the immediate postoperative period of cardiac surgery to ensure adequate monitoring and vital function preservation. However, these devices can negatively impact mobility, either directly or indirectly by reducing pulmonary function.[13] Pereira et al.[14] demonstrated the decline in pulmonary function by evaluating the impact of drains on the pulmonary function of patients after cardiac surgery, showing a reduction when compared to preoperative levels and with the presence of two drains.

It is critical to initiate mobilization as early as possible to prevent prolonged bed rest and functional decline, as robust data already exist in the literature linking extended hospital stays to increased mortality.[8] Patients who remain in the ICU for prolonged periods are at risk of developing ICU-acquired muscle weakness, leading to muscle atrophy and other complications. This is primarily caused by catabolic processes, an imbalance in protein synthesis, and structural changes related to heightened inflammation and/or muscle necrosis.[15,16]

Gosselink et al.[17] conducted a systematic review and found mobilization strategies to include active upper and lower limb exercises, cycle ergometer, walking, and step training. A key finding of this study was that initiating early movement helped improve the distance covered in the 6 MWT. The average distance walked by participants in the intervention group varied between 299.0 and 433.0 meters, while those in the control group walked between 272.0 and 331.0 meters. The minimal clinically significant distance was 54 meters, indicating a notable improvement in physical function at the time of hospital discharge. This difference is quite relevant when compared to other patient profiles, in coronary artery disease this difference is 25 meters and in other pathologies, it oscillates between 14 and 30 meters.[18,19]

With the same objective of understanding the effects of early mobilization, Kanejima et al.[20] evaluated the impact of early mobilization on clinical and functional outcomes of patients undergoing CABG who underwent transfer from bed to armchair on the first postoperative day and ambulation on the second day still with the presence of two drains. Results show that there was an improvement in clinical outcomes such as length of stay in ICU and length of hospital stay, and functional outcomes such as functional independence and distance walked on the 6 MWT at hospital discharge.[21]

In this context, where the Perme Score is becoming increasingly utilized as the primary tool for assessing the mobility of hospitalized patients, Thielo, Bohannon and Crouch[22] reviewed existing literature and developed a rehabilitation protocol that is structured into four levels, based on the Perme Score results. The Perme scale proves to be an essential tool for identifying barriers to mobilization, which is especially important for patients recovering from cardiac surgery, where early movement is crucial to rehabilitation. This scale aids in evaluating the effectiveness of various mobilization strategies, including progressive mobilization, active exercises, sitting and standing, standing, stair climbing, and walking. Critically ill patients require meticulous attention and specialized care, particularly when developing a therapeutic plan to initiate mobilization and gradually progress to exercise.[23–25]

The current study does have some limitations, such as the small sample size and the absence of a sample size calculation.

Conclusion

Based on the findings of this study, we can conclude that the behavior of the Perme scale correlates well with the functional outcomes of patients undergoing cardiac surgery. The scores in the pre-surgical evaluation, at ICU discharge, and during ward admission until the time of discharge reflect different moments of the patients' functional status. However, they showed no correlation with the clinical outcomes.

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