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KINETIC-FUNCTIONAL PROFILE OF PATIENTS AT ICU DISCHARGE: A PILOT, CROSS-SECTIONAL STUDY

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ABSTRACT

Introduction: With the advances in the pathophysiological knowledge of comorbidities associated with excessive bed rest, it is of great importance for the physical therapist to

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know how to identify these comorbidities, through the use of instruments that assess and determine the patient's functionality and are related to important clinical outcomes. Objectives: To trace the kinetic-functional profile of patients at discharge after admission to intensive care in the verticalization, peripheral muscle strength and functionality domains and to analyze their respective correlations. Methods: This is an observational, cross-sectional and analytical pilot study carried out in patients hospitalized in the General and Coronary ICUs of the Agamenon Magalhães Hospital, Recife-PE. Data were obtained on patient verticalization (passive and active sedation, bipedaling), peripheral muscle strength, and functionality at ICU discharge of patients undergoing and not undergoing Mechanical Ventilation (MV). Results: The total number of participants in the sample consisted of 19. It was composed of 63.2% males, with a mean age of 65.7 years. An average of 23.6 days of hospitalization was recorded, where 47.4% of the patients needed to undergo Mechanical Ventilation (MV). Regarding the functional milestones, the 1st Passive Sedation took place on average 10.7 days after admission, while the 1st Active Sedation took an average of 10.7 days and the 1st Standing Station took an average of 13.3 days. The dynamometry resulted in an average of 21.35±7.48 Kgf for men and 16; 28±3.19 for women. MRC, on the other hand, recorded an average of 54.6 points. The functional level was assessed using the PERME and IMS scales, which obtained averages of 22.8 and 6.8; respectively. It was possible to identify a significantly statistical difference between patients who underwent ventilation and those who did not in relation to the days of ICU stay, verticalization, dynamometry (Kgf), MRC, PERME scale, and IMS at discharge. It was also possible to identify a strong correlation between the time taken to reach the functional milestones of verticalization and the length of stay in the ICU. Conclusion: The limitations related to the study design, sampling power and inferential analyses limit the generalization of the data, but it was observed that multimodal kinetic-functional evaluation is able to identify impairments in muscle strength and functionality in patients exposed to bed immobility, making it possible to measure the effectiveness of physical therapy interventions practiced in the study population as essential measures for the prevention and/or recovery of decline functional.

Keywords: Dynamometry. Functional Scales. Functionality. Early Mobilization. Intensive Care Unit.

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INTRODUCTION

The challenges related to the care of critically ill patients have changed in recent decades. The advent of new technologies in the field of health has allowed the survival of people who experience ICU admission to increase significantly. However, new challenges related to the length of stay in the ICU and the side effects of the therapies used arise in this scenario (CALLES, 2017).

In 2018, the Federal Council of Medicine (CFM) conducted a survey that indicated that the number of ICU beds in Brazil was 44,253, where only 49% were allocated to institutions financed by the Unified Health System (SUS) (CFM, 2018). With the beginning of the Coronavirus (COVID-19) pandemic in 2019, the demand for beds increased significantly, reaching 23.59% more beds in 2020, and this increase is predominant in the private system, which is not accessible to the entire population (COTRIM JUNIOR, 2020).

In their systematic review on the epidemiological profile of patients admitted to ICUs in Brazil, Aguiar et al. (2022) identified that there is a predominance of male patients, aged over 60 years, evidencing a population more susceptible to comorbidities and complications associated with hospitalization. It was also seen that cardiovascular diseases (CVDs) represented the main cause of hospitalization in Brazilian ICUs, contributing to the higher risk of morbidity and mortality, since CVDs are the main causes of disability in patients who survived ICU admission (PEREIRA, 2019).

Some time ago, it was believed that in the ICU, patients would necessarily need to be sedated and at total rest in order to recover the physiological stability of their organ systems. This idea was based on the concept that rest would decrease the body's metabolic demand and direct the focus to healing and rest would promote recovery. This concept has been fought in recent times by the awareness of the risks of comorbidities that prolonged bed rest can entail in the individual's functionality, as the decrease or paralysis of muscle contractions causes a reduction in trophism and subjects the body of these patients to weakness and muscle fatigue, delaying the process of withdrawal of mechanical ventilation and consequently, discharge from the ICU and the hospital. (VANHOREBEEK, 2020).

The experience of prolonged hospitalization brings with it physical, psychic and social impacts on the lives of these people even after hospital discharge. The English term PICS – *post intensive care syndrome* or post intensive care syndrome, in Portuguese, refers to this set of comorbidities that decrease life expectancy and quality of life. In this

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scenario, it is also possible to identify a reduction in autonomy in activities of daily living and work, making it unfeasible to return to their normal life and making the patient increasingly dependent on others (SILVA, 2021).

With advances in the pathophysiological knowledge of comorbidities associated with excessive bed rest in the ICU, discussions about the effects of immobility on the musculoskeletal system have gained evidence in the context of Intensive Care. Since patients who evolve with ICU-Acquired Weakness (FAUT) have a high risk of mortality and morbidity with conditions that last even after hospital discharge, reducing their quality of life and making it more difficult for them to return to living in society (VAN WAGENBERG, 2020).

FAUT is defined by Reis (2021) as a bilateral and symmetrical weakness that can affect both skeletal and respiratory muscles, acquired in the course of treatment in Intensive Care when there is no other factor that can cause this weakness besides the disease itself and its treatment.

In view of the situation presented, alternatives are sought to combat and treat FAUT in the context of Intensive Care. In this sense, motor physical therapy and its benefits, safety and efficacy in combating immobility and weakness has been increasingly discussed in the scientific community. Early mobilization, despite concerns about the safety of its execution, has stood out as an essential resource to combat prolonged bed rest (VON DER HEIDE et al, 2022). Current studies, such as the systematic review carried out by Carvalho (2022), show its efficacy, safety, and feasibility with very low chances of adversity if done correctly.

It is of great importance for the Physical Therapist professional to know how to act in the identification of these comorbidities, through the use of instruments that assess and determine the patient's functionality, so that they are able to carry out a therapeutic planning appropriate to their condition (CORDEIRO, 2022). Functional assessment can be defined as the investigation of factors that may reduce the individual's functional independence, which consists of the ability to perform Activities of Daily Living (ADLs) and tasks related to the home environment, thus being able to live alone without needing the help of others. To perform these tasks, the individual needs to have good cognitive and motor, social and physical performance (FERREIRA, 2018).

Functional assessment also serves as a parameter to measure the effectiveness of some treatment applied to the patient. Knowing the individual's previous functional

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condition, it is possible to compare it with the post-intervention condition and identify whether the conduct had positive or negative impacts on the patient, thus directing the most appropriate treatment for each patient according to their response to the interventions and also being able to visualize a functional prognosis for this patient. (MATURANA et al., 2017).

In view of these factors, there is a need to trace the kinetic-functional profile of patients at discharge after admission to intensive care in the verticalization, peripheral muscle strength, and functionality domains, and to analyze their respective correlations.

METHODOLOGY

This is an observational, cross-sectional, analytical and pilot study. Performed in the Coronary ICUs and General ICU of the Agamenon Magalhães Hospital, located at Estr. do Arraial, 2723 - Casa Amarela, Recife – PE.

A convenience sample of 19 patients admitted to the aforementioned ICUs was captured. The study population was composed of patients of both sexes, who were discharged from the ICU at the time of the evaluation, with any level of education, who had been hospitalized in the Intensive Care Unit (ICU) for more than 7 days.

The following inclusion criteria were considered: patients who had been hospitalized in the ICU for at least seven days and who were discharged from the unit, aged 18 years or older, with sufficient motor capacity and level of consciousness to cooperate with the assessment (Glasgow Coma Scale: motor response with a score ≥ 4, verbal response ≥ 4, eye opening ≥3), clinically and hemodynamically stable, and having signed the informed consent form (ICF). Patients with mobility limitations who are previous users of wheelchairs do not have bed restrictions prior to admission to the ICU for a period of more than 30 days. The exclusion criteria were: patients who were discharged from the hospital before undergoing the evaluation or who were discharged to the ward more than two days ago. Patients who have hemodynamic instability at the time of evaluation.

Initially, the patient was invited to participate in the research, where the Informed Consent Form (ICF) was presented and explained, which contained all the risks and benefits of the research, all the steps of the evaluation in detail, as well as the contact of the researchers and the ethics committee to clarify any doubts. After consent, clinical-epidemiological data were collected, such as hospital records, age, gender, baseline diagnosis, date of admission, number of days of ICU stay, history of Orotracheal Intubation

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(OTI), days of mechanical ventilation, exposure to sedation and vasoactive drugs, and whether there was a history of sepsis. Data were also collected on verticalization functional landmarks, such as the first passive sedation in bed, the first active sedation and the first bipedstation, through the collection instrument (APPENDIX A) developed by the researcher.

The first test performed with the physical collaboration of the patient was the evaluation of palmar grip strength through upper limb dynamometry, performed with the Baseline® Hydraulic Hand Dynamometers, which belongs to the Agamenon Magalhães Hospital and was provided at no cost for the research. The test was performed with the patient in secession using the dominant upper limb with the shoulder in adduction, elbow in 90º flexion, neutral forearms and wrists holding the dynamometer with the help of the therapist doing the support, the patient will be allowed to adapt to the instrument and the test, after that, 3 maneuvers will be performed where the patient will press the rods with as much force as he can for 4 seconds, with 1 minute of rest between maneuvers. The 3 values (kgf) were recorded and it was considered the highest among them.

The second test was given by an evaluation of muscle strength through the Medical Research Council (MRC) scale, which bilaterally evaluates the strength of 6 muscle groups of the upper limbs (shoulder abductors, elbow flexors and wrist extensors) and lower limbs (hip flexors, knee extensors and ankle dorsiflexors) scoring each movement from 0 to 5, with 0 being no sign of muscle contraction and 5 being a muscle strength capable of overcoming marked manual resistance. The maximum score of the test is 60 points, with a result equal to or less than 48 as indicative of FAUT. To perform the test, the patient was positioned in bed or the bed was positioned in a seated position and he was asked to make the necessary movements, first so that he did not suffer the action of gravity, and then with the application of manual resistance imposed by the researcher, following verbal commands and words of encouragement so that the test is performed in the best possible way.

The second moment of the evaluation was applied to the PERME Scale, which was performed based on the researcher's observation of the patient's clinical status and the evaluation of the level of mobility. The scale consists of 7 items that assess the patient's functional and mental status, which are divided into: 1. Mental State 2. Potential Barriers to Mobility 3. Functional Strength 4. Bed Mobility 5. Transfer 6. March 7. Endurance. The

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maximum score of this scale is 30 points, and the higher the score, the greater the functional capacity of the patient evaluated.

Next, the IMS scale was applied, which does not depend on the patient's physical exertion, therefore, it was answered by the researcher according to the patient's functional status at the time of discharge. This scale is widely used and easy to apply, its score ranges from 0 to 10, where 0 the patient is completely restricted to bed and 10 the patient performs an independent ambulation and without the aid of walking devices. This evaluation was always carried out by the same evaluator, in order to avoid interpretation bias.

COLLECTION, STORAGE AND PROCESSING OF DATA

The present study was approved by the Research Ethics Committee of the Agamenon Magalhães Hospital, under CAAE number: 64984022.2.0000.5197. Data collection was carried out between November 2022 and January 2023.

As the data were recorded in the instrument contained in Appendix A, they were reviewed and then transposed to a digital database of Microsoft Office Excel 365® with private access by the authors of the research.

Descriptive statistical analysis was performed using mean, standard deviation and confidence interval measures for variables with normal and median distribution and interquartile range for non-normal distribution, as well as absolute and relative frequency for qualitative variables. The distribution of normality was evaluated using the Shapiro-wilk test, followed by appropriate statistical treatment according to the variables studied

For differences between groups, the Mann-Whitney U was used. Correlation measures were made by applying Kendall's Tau coefficients. This coefficient can express different degrees and types of correlation, which are considered weak when between 0.001 and 0.3, moderate when between 0.4 and 0.6 and strong when between 0.7 and 0.999. It may or may not reach statistical significance. In addition, negative coefficients are considered when the correlation between dependent and independent variables has inversely proportional behavior and positive when directly proportional.

For all tests, $p < 0.05$ was considered significant and the data were presented in tables and the calculations were performed with the aid of the IBM SPSS Statistics software, version 29.0.0.0

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RESULTS

The total number of the sample was 19 participants. Table 1 contains the data on the general characterization of the sample in relation to the personal profile and clinical-epidemiological data of the research participants. The sample was composed mostly of male participants (63.2%), with a mean age of 65.7 years. It can be observed that 89.4% of the participants had some heart disease as the underlying diagnosis.

Regarding previous comorbidities, Systemic Arterial Hypertension (SAH) was present in the history of 89.5% of the sample, the second most frequent comorbidity was Diabetes Mellitus (DM), registered in 47.4% of the participants. Regarding the length of stay in the ICU, an average of 23.6 days of hospitalization was recorded, where 47.4% of the patients needed to be submitted to Mechanical Ventilation (MV). The participants who required the use of MV remained on ventilatory assistance for an average of 23.1 days, and among these, they were submitted to the use of sedatives for 8.4 days (on average), but none of the patients required the use of neuromuscular blockers.

Table 1: Characterization of the Sample Profile.

Variables	Mean±SD [95%CI]	N(%)
Age (years)	65.7±15.078 [49.80-81.86]	-
Men	-	12(63,2%)
Women	-	7(36,8%)
Heart disease	-	17(89,4%)
Other pathologies	-	2(10,6%)
Systemic Arterial Hypertension (SAH)	-	17(89,5%)
Diabetes Mellitus (DM)	-	8(47,4%)
Days of hospitalization in the ICU	23.6±32.8 [13.58-48.08]	-
Use of Mechanical Ventilation	-	9(47,4%)
Mechanical Ventilation Days	Rev. 23.1±37.1 [5.27-21.40]	-
Use of Neuromuscular Blocker	-	0
Sedation days	8.4±18.7 [3.32-20.68]	-
Sepsis	-	4(21,1%)
IMS of Admission	0.5±0.7 [-0.26-0.60]	-

Source: survey data.

Although Sepsis is a recurrent finding in Intensive Care patients, only 4 (21.1%) participants in the study evolved to this condition. Regarding the functional profile of the participants, assessed by the IMS scale at the time of ICU admission, the mean score was

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0.5 (Table 1). Considering that 0 means that the patient is completely restricted, it is possible to notice that the participants were admitted to the unit with little or no active movement in bed.

Table 2 shows the results of the functional assessment in which the patients in the study were submitted at the time of ICU discharge. The first data in the table refer to the number of days in which certain functional milestones of verticalization were reached, which are related to the exit from the bed and the evolution of the functional prognosis, these are: 1st Passive Sedation (on average 10.7 days), 1st Active Sedation (on average 10.7 days) and 1st Two-Legged Standing (on average 13.3 days).

Table 2: Results of the Functional Assessment.

Variables	**Average±DP**	**[95%CI]**
Days until 1st Passive Sedation	10.7±12	[5,74-26,26]
Days until 1st Active Sedation	10.2±9.7	[10,74-30,59]
Days until 1st Two-Way	13.3±11.1	[11,89-35,11]
Dynamometry (Kgf)		
Men	21.35±7.48	[11,55-20,45]
Women	16; 28±3.19	
MRC	54.6±5.8	[47,25-58,08]
PERME scale	22.8±6.8	[14,44-25,89]
IMS high	6.8±2.8	[4,07-8,60]

Source: authors.

DISCUSSION

The epidemiological profile of Brazilian Intensive Care Units (ICUs) has been transformed over the last decades, reflecting the increase in life expectancy and the consequent prevalence of chronic and degenerative diseases. In this study, a predominance of male patients, aged over 60 years and with a high rate of hospitalization for cardiovascular diseases was observed, findings that corroborate the review by Aguiar et al. (2022), which identified this same pattern in 113 Brazilian ICUs. Systemic arterial hypertension (SAH) was the main associated comorbidity, which is in line with evidence

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that cardiovascular diseases are the leading cause of death in Brazil and worldwide, affecting about 30 million Brazilians (SILVA et al., 2022). The high frequency of heart disease in the sample can be explained by the fact that the data collection was mostly performed in a Coronary Care Unit.

The mean length of hospital stay observed was longer than that described in the literature. Previous studies report averages of 5 to 7 days (SANTOS, 2017; RAMOS, 2021), while in this study, the ICU stay was prolonged, possibly due to the inclusion of patients with long periods of mechanical ventilation (MV), such as a participant who remained hospitalized for 147 days, 120 of which were on MV. This factor may have skewed the mean, making it higher than the usual values. Mechanical ventilation, although essential, can lead to complications such as respiratory infections and lung injuries, impacting the length of hospital stay (CARVALHO, 2022). The mobility of critically ill patients is compromised by multiple factors, with sedation being one of the main ones. Long-term use of sedatives reduces muscle tone and accelerates ICU-acquired weakness (FAUT). Strategies such as "daily wake-up" have been adopted to reduce these impacts, allowing patients to progressively regain mobility and improve their response to physical therapy (DALOIA, 2021; RIBEIRO, 2016). The average sedation time observed in the present study was consistent with the literature, where 83.8% of patients remain sedated between 1 and 5 days (BARBOSA, 2020).

The incidence of sepsis in the sample (21.1%) was lower than the national average, where about 19.3% of hospitalizations in the Northeast region between 2017 and 2021 evolved to death from sepsis (LINS, 2022). Regarding functional mobility, the patients had an average of 0.5 points on the ICU Mobility Scale (IMS) at admission, showing total bed restriction, an expected finding for individuals admitted to the ICU with severe clinical conditions.

Prolonged immobility leads to an accelerated loss of muscle strength, with reductions of up to 27% in quadriceps strength in just 15 days in healthy individuals, and this effect is even more pronounced in the elderly (HASHEM, 2016). In this study, early mobilization occurred late, with an average of 10 days for the first sedation and 13 days for the first bipedstation, values higher than those reported in the literature (SOUSA, 2019; CAMPOS, 2021). Factors such as clinical severity, duration of mechanical ventilation, and prolonged sedation may have contributed to this delay.

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The evaluation of peripheral muscle strength revealed that, despite the expected reductions, the mean strength values on the Medical Research Council (MRC) scale were higher than the cutoff point for FAUT (48 points), indicating partial preservation of functionality. However, previous studies have shown that critically ill patients often have values below this threshold at ICU discharge, correlating with longer hospital stays and worse prognosis (RODRIGUES, 2020; DURÃES, 2020).

Post-ICU functionality was assessed by the ICU Mobility Scale (IMS) and Perme Score, showing impaired mobility and dependence for activities of daily living. There is a strong correlation between low scores on these scales and worse outcomes, including higher mortality risk (LIMA, 2020).

Finally, it was observed that patients undergoing mechanical ventilation had worse functional performance in almost all the variables analyzed, except age. Studies indicate that prolonged periods of MV are associated with lower muscle strength, poorer functionality, and longer hospital stay (CANELHAS, 2022; SOUSA, 2021). Although this study did not assess long-term clinical outcomes, the correlation between ventilation time and delayed mobilization suggests that strategies to reduce MV time and optimize early physical therapy may improve functional outcomes.

The cross-sectional design of the study does not infer a causal relationship between the variables, but rather to establish associations between them, but allows the construction of new hypotheses that can be expanded in future studies with larger sampling, longer follow-up time, and with the inclusion and/or qualification of other variables that are of interest for better clinical practice.

The convenience sampling technique, as well as the absence of data available for quantification of ideal N, prevents adequate control of selection bias, and does not allow external validation of the data, i.e., the generalization of the findings to populations other than those belonging to the group studied.

There was increased variance in the amplitude of some variables with the presence of outliers, which implies a limited internal validation of the data, but these effects were predicted in the face of non-probabilistic sampling and were minimized with the observation of the normality of the distributions and adequacy of the inferential statistics.

The limited amount of hypothesis tests and more robust statistical analyses through the data obtained are a result of the embryonic nature of this research. However, it is believed that through the analysis of the results of this study, new hypotheses can be

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tested and applied in the future, seeking to expand the results and make them available to the entire local community, assisting in the planning of physical therapy actions and continuous improvement of its agents.

CONCLUSION

In this study, it was possible to identify the existence of reduced peripheral muscle strength and functionality in patients who were hospitalized in the ICU, through a functional assessment. A significant difference was found between patients who underwent mechanical ventilation and patients who did not require this resource.

The multimodal kinetic-functional assessment proved to be a simple set for identifying and monitoring muscle weakness and reduced functionality in patients exposed to immobility in bed, making it possible to measure the efficacy of physical therapy interventions practiced in the study population as essential measures for the prevention and/or recovery of functional decline.

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