

Time spent in different body positions is associated with functional performance in critically ill patients: a prospective study

O tempo de permanência em diferentes posições corporais está associado ao desempenho funcional em pacientes críticos: um estudo prospectivo

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Abstract

Introduction: Critically ill patients are exposed to immobility. Critical patient spend more time in bed rest and the physiologic effects can impact on functional capacity. Mobility and high posture have been encouraged for these patients. Few studies have objectively measured how long patients spend lying, sitting or standing during intensive care unit (ICU) stay and if there is association with functional outcomes. **Objective:** To evaluate the time patients spend lying, sitting and standing during ICU stay and its association with status functional at ICU discharge. **Methods:** This was a prospective observational study that included 161 patients older than 18 years, admitted to the ICU, who presented Barthel index score = 100 points before hospitalization. An accelerometer was used to assess patient's mobility during the stay in ICU. The variables used in the analysis were percentage of time and amount of time in sitting, standing and lying down. The patient's functionality was assessed using the Barthel index at ICU discharge. **Results:** Patients spent 89% of the time lying down, 7% seated and 4% on standing position. The age (OR = 1.08; 95%CI 1.04 – 1.13) and percentage of time lying down (OR = 1.1; 95%CI 1.04 – 1.17) were independent factors for functional dependence. Time in standing (OR = 0.76; 95%CI 0.66 – 0.88) was associated with maintenance of functionality. **Conclusion:** There is association with time in bed rest and worse status functional at ICU discharge. On the other hand, the time in standing position was a protective factor for functional dependency.

Keywords: Critical care. Functional status. Mobility limitation. Physical therapy modalities. Posture.

Resumo

Introdução: *Pacientes criticamente enfermos são expostos à imobilidade. Pacientes críticos passam mais tempo em repouso no leito e os efeitos fisiológicos podem impactar a capacidade funcional. Mobilidade e posturas elevada têm sido encorajadas para esses pacientes. Poucos estudos mediram objetivamente quanto tempo os pacientes passam deitados, sentados ou em pé durante a internação na unidade de terapia intensiva (UTI) e se há associação com desfechos funcionais.* ***Objetivo:*** *Avaliar o tempo que os pacientes passam deitados, sentados e em pé durante a internação em UTI e sua associação com o status funcional na alta da UTI.* ***Métodos:*** *Trata-se de um estudo observacional prospectivo que incluiu 161 pacientes maiores de 18 anos, internados em UTI, que apresentaram escore de índice de Barthel = 100 pontos antes da hospitalização. Um acelerômetro foi usado para avaliar a mobilidade dos pacientes durante a internação na UTI. As variáveis usadas na análise foram porcentagem de tempo e quantidade de tempo sentado, em pé e deitado. A funcionalidade dos pacientes foi avaliada usando o índice de Barthel na alta da UTI.* ***Resultados:*** *Os pacientes permaneceram 89% do tempo deitados, 7% sentados e 4% em pé. A idade (OR = 1,08; IC95% 1,04 – 1,13) e o percentual de tempo deitado (OR = 1,1; IC95% 1,04 – 1,17) foram fatores independentes para dependência funcional. O tempo em pé (OR = 0,76; IC95% 0,66 – 0,88) foi associado à manutenção da funcionalidade.* ***Conclusão:*** *Há associação entre tempo em repouso no leito e pior estado funcional na alta da UTI. Por outro lado, o tempo em pé foi fator de proteção para dependência funcional.*

Palavras-chave: *Cuidados intensivos. Estado funcional. Limitação da mobilidade. Modalidades de fisioterapia. Postura.*

Introduction

The hospitalization of critically ill patients can result in poor short- and long-term functional status after intensive care unit (ICU) admission.[1,2] Functional loss may be associated with several factors, such as the length of immobility during ICU stay, which is very common in critically ill patients.[3,4] The physiological effects of bed rest can negatively impact physiological adaptations, affecting the skeletal, cardiovascular, and respiratory systems.[5] Each of these systems has a role in maintaining physical capacity, and alterations can impair functional performance.

Bed rest results in loss of muscle mass and muscle atrophy.[6] Prolonged bed rest associated with critical illness leads to decreased muscle protein synthesis and decreased muscle mass, especially in the lower extremities.[7] These changes lead to deleterious effects on muscle strength, with 1 to 1.5% of quadriceps strength lost for each day of bed rest.[8] Bed rest can increase resting heart rate and reduce stroke volume. Thus, the cardiac capacity to respond to any level of physical activity decreases, and patients may develop orthostatic intolerance.[9,10] The respiratory system can also be profoundly altered by the effects of bed rest and the disease itself. Patients who are immobilized for a few days are more likely to acquire lung infections and ventilator-associated pneumonia. In patients who require mechanical ventilation for more than seven days, the incidence of ICU-acquired (neuromuscular) weakness is reported to be between 25 and 60%.[11,12] This weakness may contribute to increased duration of mechanical ventilation (MV) and delayed weaning from MV.[13]

Thus, some authors, on studies in the ICU, have implemented protocol with postural changes added to other types of physical interventions.[14-16] Early removal from bed, time spent in higher postures such as sitting and standing, as well as changes in body position have been encouraged,[17,18] and shown better functional outcomes.[14,15,19] Some studies have demonstrated benefits in which it appears to decrease the length of hospital stay, increase the patient's ability to recover activities of daily living, improve functional recovery, and accelerate the time to weaning in patients with prolonged mechanical ventilation.[15,16,20]

There are contraindications to the practice of early mobilization, such as systolic arterial hypertension above 170 mmHg, intracranial hypertension, unstable fractures, open abdominal wounds and acute myocardial infarction.[15] However, it is known that there are safety criteria when it comes to mobilizing critically ill patients.[21] Previous data demonstrate that progressive mobilization can be safe and the incidence of reported adverse events is low (≤ 4%).[22,23]

Current evidence has shown the importance of activity in the ICU, but little is known specifically about time in different body positions and outcomes.[24] Functional scales have been used to monitor and analyze the mobility of these patients.[25,26] However, few studies have objectively measured how much time patients spend lying, sitting or standing during the ICU stay and whether there is any association with functional outcomes.[4,27,28]

We hypothesized that time spent in different body positions could be associated with functional status at discharge. The aim of this study was to evaluate the total time patients spend lying down, sitting and standing during their ICU stay and to analyze its association with functional status after discharge from the ICU.

Methods

This prospective observational study was conducted at a mixed ICU of a tertiary hospital in Brazil. Patients were followed through ICU admission to ICU discharge. A convenience sample was collected. Potentially eligible patients were identified from the daily ICU screening on the first day of admission until two days. The study was approved by the Hospital das Clínicas FMUSP Ethics Committee (approval number 2.166.942). All patients or surrogate provided written informed consent before data collection began. The report of the study conforms to STROBE guidelines.

ICU physiotherapy usual care was available seven days per week for 24 hour per day. At this hospital, patients received physical rehabilitation therapy twice a day. The routine of physiotherapy care includes postural changes, active-assists and active mobilization, as well as bed positioning, bedside and armchair transfers, orthostatism, and walking, without a pre-established routine or rehabilitation protocol. However, there is a consensus to follow established recommendations from the litera-ture, which include neurological criteria, such as the patient's level of cooperation; respiratory criteria, such as inspired oxygen fraction and respiratory rate; and hemodynamic criteria, such as the progression of vasoactive drug doses, for example, as well as considerations like unstable fractures or bleeding.[21]

Elegibility

The study included adult patients (≥ 18 years old) who were admitted directly to the ICU, with no previous hospitalization time. Patients that came from other ICUs, from the ward or with previous hospitalization time in other hospitals in the study period prior to ICU admission were excluded. Not were eligible for the study patients that presented a Barthel index (BI) score less than 100 points before hospitalization, with contraindications for mobilization[21] (or medical order), neurological diagnosis associated with motor disorders, and amputees at hospitalization. Participants were excluded from the study if, at the time of the final assessment of functionality, they did not show cognitive and collaborative ability to participate.[11] Patients with less than three days of ICU, with loss of assessment, unable to participate in assessment at discharge[11] and who died were excluded from the final analysis.

Assessment

Data about age, gender, body mass index, reason for hospitalization, severity of the disease, measured via Simplified Acute Physiology Score 3 (SAPS III),[26] and comorbidities, classified via the Charlson Comorbidity Index,[29] were collected from patients' chart. The level of pre-hospital functionality was assessed by questioning the patient or responsible, considering the functional state two weeks before admission to the ICU. SAPS III is a prognostic system consisting of 20 variables, based on patient characteristics, the indication for ICU admission, and physiological derangements at the time of admission, aiming to establish a predictive mortality index for patients admitted to ICU. The Charlson Comorbidity Index is a tool specifically developed to assess long-term mortality risk based on a weighted index calculated according to specific comorbid conditions.

During the ICU stay, data about use of vasoactive drugs and sedation and corticosteroids and antibiotics, presence of sepsis, hemodialysis, use and duration of invasive and noninvasive mechanical ventilation, tracheostomy and presence of hypoglycemia were recorded. Data on mechanical ventilation and the use of vasoactive drugs were generally considered as absolute values. Individual observations regarding parameters and dosages for each patient, considering the complexity of the case, were left to the judgment of the institution's physiotherapists, as the study was observational in nature.

Mobility levels

A tri-axial accelerometer was used to assess patient's mobility.[30,31] The accelerometer Actigraph GT3X® is able to detect changes in acceleration through vertical, horizontal and perpendicular axis. This monitor of activity is a method for continuously quantify the level of mobility and body position.[32] The accelerometer was placed on the patient's dominant ankle on the first day in ICU to measure the mobility level and the time spent in each posture. All patients were followed up daily to confirm appropriate positioning of the Actigraph devices on each patient. Staff and patients were advised not to remove the accelerometer from the patient's ankle at any time during all ICU stay (included during the shower and exams). At ICU discharge, accelerometer was removed and data were uploaded onto a computer for analysis. The patient's mobility was recorded during the day, whole ICU stay and the time analyzed was between 7am and 7pm.

Only patients providing complete accelerometer data during all the period were included in this analysis. Data from accelerometers were analyzed by the software ActiLife 6®. The variables used in the analysis were percentage of time and amount of time sitting, standing (orthostatism) and lying down.[33]

Functional status

No later than one day after discharge from the ICU, the patient was assessed to complete a questionnaire for functionality analysis. The patient's functionality was assessed using the BI scale. The BI scale assesses 10 activities of daily living (ADLs) such as: feeding, bathing, grooming, dressing, bowels, bladder, toilet use, transfers, mobility, stairs.[34,35] The questionnaires were applied by the same trained physiotherapist who was blinded to accelerometer data. Patients were classified as functionally dependent if they observed a decrease of 15 points or more in the BI index in relation to the previous index.[36]

Statistical analysis

The Kolmogorov-Smirnov test was used to verify the normality of the data. The patients' characterization data were presented as mean and standard deviation or median and interquartile ranges, according to the normality test results. Absolute number and percentage were also used for categorical variables. To build the regression models, the functional dependence was considered the dependent variable, and time spent in each body position (lying, sitting and standing), age (in years), classification via Charlson Comorbidity Index and other clinical variables from patient's ICU stay were included as independent variables. After the variables for the final model were initially selected through forward stepwise regression, logistic regression was performed and the odds ratio was calculated. All analysis were performed using Sigma Stat Version 3.0 software and the statistical significance was set at 0.05, with a 95% CI.

Results

During the study, 318 patients were admitted to the ICU, of which 99 did not meet the inclusion criteria; therefore, 219 patients were eligible for the study, but 58 patients were excluded for the reasons described in the flowchart (Figure 1). Thus, in the end, 161 patients participated in the study.

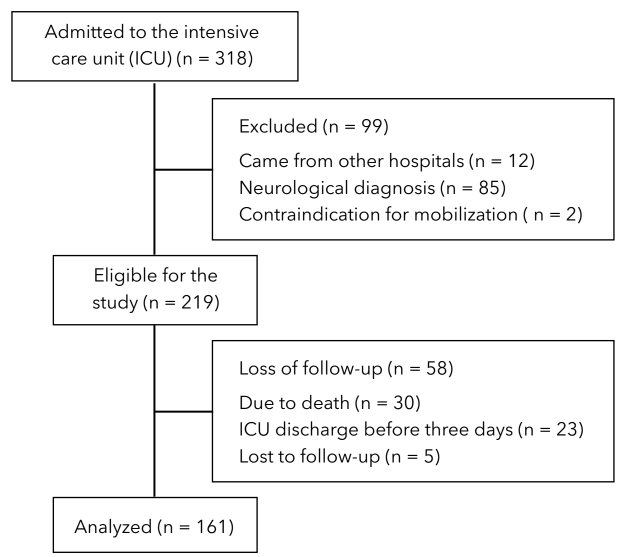

Figure 1 - Flowchart trial profile.

The most part (65%) of included patients was not elderly (< 60 years old). The SAPS III ranged from 23 to 86 points and they were admitted to the ICU for respiratory reasons. The duration of using invasive mechanical ventilation ranged from 1 to 14 days. Complete data are presented in Table 1.

As provided for in the eligibility criteria, initial patients' functional independence was full at the ICU admission. The Barthel index was used at ICU discharge to assess the patients' functionality. Sixty-five patients (40%) reduced their BI score by 15 points or more. They were classified as functionally dependent (Table 2). Patients spend most part of time lying down, follow by time seated and standing position (Table 2).

Table 1 - Characteristics of critically ill patients (n = 161)

Variables	n (%)
Female	81 (50)
Age (years)*	57 ± 15
SAPS III (points)*	53 ± 11
Charlson comorbidity index (points)*	3.0 ± 2.0
Respiratory admission	45 (28)
Surgical	34 (20)
Sepsis	72 (44)
Use of sedative drugs	33 (20)
Duration of sedation (days)*	2.0 ± 1.6
Use of vasopressors	85 (53)
Duration of vasopressor (days)*	2.3 ± 1.0
Use of corticoids	67 (42)
Use of invasive mechanical ventilation	86 (53)
Use of noninvasive ventilation	22 (17)
Time under mechanical ventilation (days)*	3.0 ± 2.0
ICU length of stay (days)*	8.0 ± 5.0

Note: *Data presented as mean ± standard deviation. SAPS = Simplified Acute Physiology Score; ICU = intensive care unit.

Table 2 - Time in different postures and functional status

Variables	Mean ± SD
Functional status	
ICU discharge Barthel Index (score)	82.5 ± 20.7
Functional dependence at ICU discharge*	65 (40)
Time spent in different postures	
Percentage of time in standing	4%
Percentage of time seated	7%
Percentage of time lying down	89%
Time spent standing (hours)	0.5 ± 0.3
Time spent seated (hours)	0.8 ± 0.6
Time spent lying down (hours)	10.8 ± 0.9

Note: *Data are expressed as n (%). Time was measured for 12 hours/day during all the stay in ICU and it is expressed as mean of all days measured. SD = standard deviation; ICU = intensive care unit.

The results of the first regression analysis showed that patients' functional dependence (decrease of 15 points or more on BI index) after ICU stay was independently associated with time spent lying down ($p = 0.003$), age ($p < 0.001$) and comorbidities classified via Charlson index ($p = 0.025$), with test's power of 1.0 for alpha = 0.05. All other variables tested (SAPS, reason of ICU admission, mechanical ventilation use, drugs use) were included in the regression analysis but did not remain in the final model.

Elderly condition resulted in 8% increase in the odds of presenting functional dependence at ICU discharge: odds ratio (OR) = 1.08; 95%CI 1.04 –1.13. The percentage of time spent lying down increased the odds of presenting functional dependence at ICU discharge by 10% (OR = 1.1; 95% CI 1.04 – 1.17), as shown in Table 3.

Table 3 - Association between percentage of time in different postures and functional dependence after ICU discharge

Variables	Odds ratio	95% CI
Older agea	1.08	1.04 – 1.13
Percentage of time lying down[a]	1.10	1.04 – 1.17
Percentage of time in standing[b]	0.76	0.66 – 0.88

Note: Data from the multivariate logistic regression analysis. ICU = intensive care unit. CI = confidence interval. [a]R^2 = 0.264. [b]R^2 = 0.149.

On the other hand, another model on regression analysis results showed that time spent standing was independently associated with patients' functional dependence, however, acting as an only protective factor for this outcome (OR = 0.76; 95% CI 0.66 – 0.88). All other variables tested (age, Charlson index, SAPS, reason of ICU admission, mechanical ventilation use, drugs use) were non-significant. The time spent in sitting position was not related to functional dependence at ICU discharge.

Discussion

The aim of this study was to evaluate the time spent in different body positions during ICU stay and its association with functional status at ICU discharge. The main finding of our study was that the time in the specific's positions experienced by patients during ICU stay is associated with outcomes as functional status at

ICU discharge. The patients' time spent in lying down was associated with worse functional status and time spent standing was associated with better functional status.

Our data showed that, from the moment of admission to discharge from the ICU, even in a period during the day that could be used to mobilize patients, most of the time they spend lying down. A recent systematic review showed that in acute-care settings, time spent in lying or sitting positions was 89–99% for inpatients in medical or surgical wards and 100% for ICU patients.[37] Even patients with lower acuity illness, including those who were younger and without restraints, were still inactivity during the day.[38] The longer time in lying position, more time the patient is exposed to the deleterious effects of immobility on essential systems for preserved functionality.[3,9] The opposite also is true. Studies have shown that early activity reduces losses in muscle and functional status.[16,39] Our study corroborates theses finds, since we showed standing positions are protective for functional dependence.

Activities in bed may not be enough to prevent and avoid impairments that depend, for example, on weight bearing, verticalization. A study that performed standing posture using the tilt table did not find benefits for muscle strength.[40] However, a study comparing the patient's body position change performed passively (by professionals) or actively (by patients themselves) showed that the metabolic demand is greater in the active form.[41] The standing posture in our study was performed actively or assisted. This could explain why time sitting in a chair was not associated with greater functionality, as this body position by itself would not require intense or moderate muscle activity. This body position may bring benefits for other outcomes, but which were not measured via functionality scale. Several barriers can be encountered in clinical practice for the mobilization of these patients, such as number of professionals, delirium, and pressure injuries. However, the literature has shown that some can be overcome with, for example, the presence of family members, equipment, and protocols. The importance of mobilization must be the motivator for overcoming barriers.[42]

Our results show that older adults are particularly exposed to the deleterious effects of immobilization. The losses of muscle mass and strength and functionality are associated with disability and mortality in hospitalized older patients.[43] Hartley et al.[44] showed hospitalized older (> 70y) patients were lying for 62.6% of the time, sitting for 34.2%, standing but not moving for 2.0%, and standing and moving for 1.2% of the time. Our study expands the knowledge in the field, since we demonstrated older age increases odds of presenting functional dependence at ICU discharge.

The patients' mobility level was analyzed 12 hours a day during all the ICU stay. Accelerometry is an objective and quantitative technique, providing continuous monitoring of mobility and having been proved effective for monitoring individuals in ICU.[32] There were no difficulties in using the device in the ICU or episodes of failure, data loss or equipment loss, and there was good acceptance from patients.

Our study has some limitations. This study was conducted in a single ICU, what may impact on the generalization of findings and mixed population. Physiotherapeutic interventions, such as the number of interventions, which could impact time in different body positions, were not evaluated.

It is well recognized that bed rest and low mobility can cause impairment to various organs and body structures. Our data add information showing that there is an association between the time in bed rest and functional status after ICU discharge. Our results are important to raise awareness about the barriers to out of bed activities and to create opportunities to overcome them. Thus, eligible patients could be encouraged to take higher postures out of bed for longer time while in their ICU stay. Therefore, future studies may highlight the importance of the time in interventions that motivate and encourage mobility in randomized controlled trials.

Conclusion

There is an association with time in bed rest and worse status functional at ICU discharge. On the other hand, the time in standing position was a protective factor for functional dependency. We conclude that the level of mobility presented by ICU patients, based on the time spent in sitting position or standing, were very low.

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Authors' contributions

CNP, CF, and DSS were responsible for the study conception and design. CNP and DSS collected the data, and all authors participated in the data analysis. CNP and DSS wrote the manuscript, which was reviewed by CNP, ACL, RA and DSS. All authors approved the final version.

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