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Admission factors associated with prolonged (>14 days) intensive care unit stay☆,☆☆

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ABSTRACT

Purpose: To describe the admission factors associated with prolonged (>14 days) intensive care unit (ICU) stay (PIS).
Materials and Methods: Retrospective analysis of 3257 admissions during a 1.5-year period in a tertiary hospital. We tested the association between clinically relevant variables and PIS (>14 days) through binary logistic regression using the backward method. A Kaplan-Meier curve and the log-rank test were used to compare hospital outcomes for ICU survivors between patients with and without PIS.
Results: In total, 6.6% of all admissions had a prolonged stay, consuming over 40% of all ICU bed-days. Illness severity; respiratory support at admission; performance status; readmission; admission from a ward, emergency room or other hospital; admission due to intracranial mass effect; severe chronic obstructive pulmonary disease; and the temperature at admission were all associated with PIS in a multivariate analysis. The created model had a good area under the curve (0.82) and was calibrated (Hosmer-Lemeshow test $p = 0.431$). Post hoc analysis on ICU survivors on in patients with at least two days of ICU stay yielded similar results. Hospital survival after ICU discharge was similar for patients with and without PIS (log-rank test $p = 0.50$).
Conclusion: A small number of ICU admissions consume a great proportion of ICU bed-days. Illness severity, a need for support and performance status are important predictors of PIS. Patients who survive a PIS have similar hospital mortality to patients with a shorter stay.

1. Introduction

Depending on the definition employed, 4% to 11% of patients admitted to the intensive care unit (ICU) will have a prolonged ICU stay (PIS) [1–3]. It has been suggested that up to 45% of all ICU days may be consumed by this apparently small percentage of patients [3]. Identifying patients at risk of a prolonged stay may help ICU management and avoid a shortage of ICU beds.

Despite the increased use of resources, patients who eventually survive a PIS have acceptable long-term outcomes, including quality of life [2,4], even if specific subgroups, such as patients on prolonged mechanical ventilation [5] or the elderly [6], are considered. Therefore, a prolonged ICU length of stay (LOS) by itself should not be considered as a marker of poor outcome or a futile expenditure of resources [1].

Certain studies have focused on admission features and their impact on PIS [2,3], suggesting that illness severity, age and a need for organ support are all related to PIS [2,7]. However, none of the previous analyses has reported the impact of previous performance status (PS) on ICU LOS. Because PS has an important role in patient prognosis [8], its role in ICU LOS should be addressed.

We performed a retrospective analysis of all patients admitted to a tertiary ICU in Brazil during a 1.5-year period to evaluate the admission features associated with PIS. All of the patients' demographic data, need for organ support and clinical data (including PS) were recorded at admission. As a secondary end-point, hospital mortality after ICU discharge was also evaluated, categorizing patients as those with or without PIS.

2. Methods

2.1. Population

We retrospectively evaluated all critically ill patients admitted to a tertiary hospital in São Paulo, Brazil, from January 2011 to June 2012. The ICU is a mixed 34-bed unit with an in-house intensivist available 24/7. All data were collected in a database system during the ICU stay

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as part of the ICU routine (Epimed Monitor, Epimed®, Rio de Janeiro, Brazil). The collected data included demographic data, the reason for admission, previous PS, comorbidities, the LOS before ICU admission, a need for organ support and severity indexes. The local ethics committee approved the study protocol and waived the need for informed consent due to the study's strictly retrospective and observational features.

2.2. Outcome definition

PIS was defined as an ICU LOS of more than 14 consecutive days [2]. Readmissions were included in the analysis because ICU readmission was one of the factors hypothesized to be related to PIS. For mortality analysis after ICU discharge, however, only the last ICU admission was considered because including a previous admission with a known outcome would increase bias. ICU readmissions less than 48 hours before discharge were considered as discharge failure and grouped as a single ICU admission.

2.3. Variable selection

A univariate analysis of factors that were preemptively associated with PIS due to clinical relevance was performed. Variables were tested for normality using the Kolmogorov-Smirnov test. Parametric data were compared using a t-test or analysis of variance. The Mann-Whitney or Kruskal-Wallis test was used for nonparametric data. Categorical variables were compared using the chi-square test. The variables included in the univariate analysis were age, body mass index, the LOS before ICU admission, a modified PS (see below), whether the admission was a readmission, the presence of major comorbidities (heart failure, dementia, chronic obstructive pulmonary disease (COPD) on ambulatory oxygen therapy, liver failure with Child-Pugh score B or C [9], chronic kidney disease on dialysis, a solid metastatic tumor or hematological malignancy), the site of origin (operating room, emergency room, ward or other hospital/nursing home; patients admitted from another hospital or a nursing home were included in the same group), the specific reasons for admission (sepsis or intracranial mass effect), the admission severity index (SAPS3 score [10]), the admission time (night or day), a need for organ support in the hour following ICU admission (vasoactive drugs, non-invasive ventilation, mechanical ventilation or dialysis) and other clinical data at admission (temperature, creatinine levels, platelet count, mean arterial pressure and heart rate).

2.4. Performance status

PS was evaluated at ICU admission through a short patient or family/caregiver interview performed by the nurse who was responsible for data collection (CLP). PS is routinely evaluated at our institution for all admissions, and data are recorded in the same database. PS was categorized based on the need for help to perform self-care and categorized as 0, 1 or 2. A PS of 0 was defined as no help needed, corresponding to Eastern Corporative Oncologic Group performance status (ECOG) classes 0–2. A PS of 1 was defined as capable of limited self-care (ECOG 3), whereas a PS of 2 meant that the patient was unable to perform any self-care (ECOG 4) [11].

2.5. Multivariate logistic regression

All variables with $p < 0.25$ in the univariate analysis were included in a binary logistic regression using the backward method. Collinearity between variables was evaluated through calculation of the variance inflation factor [12]. An arbitrary threshold of 10 was used to define collinearity. The created model was tested through the creation of an receiver operating characteristic (ROC) curve [13,14]. The Hosmer-Lemeshow test was used to test the model's calibration [15]. A post hoc analysis of factors related to PIS in ICU survivors was also performed to evaluate whether the exclusion of patients who perished in the ICU would change our results.

2.6. Other analysis

Hospital survival after ICU discharge was compared between ICU survivors in both groups through a Kaplan-Meier curve and the log-rank test [16]. We also evaluated ICU LOS in quartiles of SAPS3 scores, categorizing patients as those with any degree of impairment (PS of 1 or 2) or without impairment (PS of 0). All analysis was performed using SPSS version 19.0 (IBM Corporation, Armonk, NY). $P < .05$ was considered significant.

3. Results

In total, 3257 ICU admissions (2908 patients) were included in the analysis, of which 203 (6%) admissions were longer than 14 days. The number of patients who had an ICU LOS greater than 14 days was divided into 5-day intervals and is shown in Fig. 1. PIS consumed 42% of the 14811 ICU days evaluated.

The characteristics of the entire population and of the patients according to the presence or absence of PIS are shown in Table 1. Patients with PIS were older (70.3 ± 16.1 vs 65.8 ± 16.8 years; $P < 0.001$), had a worse PS, had a higher SAPS3 score at admission (58.8 ± 15.3 vs 42.5 ± 14.7; $P < .001$), had a longer hospital LOS before ICU admission (3 [0-12.5] vs 1 [0-3]; $P < .001$), were more frequently admitted from the ward, were more frequently admitted due to sepsis (30% vs 11%; $P < .001$) or intracranial mass effect (2.5% vs 0.2%; $P < .001$) and more often had comorbidities. Regarding the need for organ support at admission, patients with PIS required vasoactive drugs (23% vs 9%; $P < .001$), mechanical ventilation (24% vs 10%; $P < .001$) and noninvasive ventilation (28% vs 11%; $P < .001$) more frequently than patients without PIS. Patients with PIS had a higher heart rate and a higher temperature at admission (94.5 ± 22.5 vs 87.2 ± 21.7 bpm and 36.5 ± 0.92 vs 36.1 ± 0.86, respectively; both $p < 0.01$). The variables included in the model after univariate analysis were age; PS; SAPS3 score; the LOS before ICU admission; readmission, the site of origin and admission due to sepsis or intracranial mass effect; a previous diagnosis of heart failure, dementia, COPD on oxygen therapy, cirrhosis, a metastatic solid tumor or a hematological tumor; the use of organ support (noninvasive ventilation, mechanical ventilation or vasoactive support); and clinical admission features (the lowest mean arterial blood pressure, temperature and heart

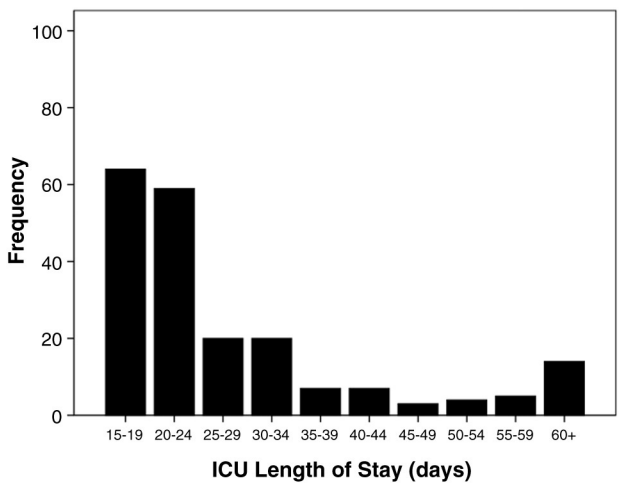

Fig. 1. Number of admissions in each 5-day interval, from 15-60 days (total: 203 admissions).