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The effects of discharge to an intermediate care unit after a critical illness: A 5-year cohort study☆,☆☆,★

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ABSTRACT

Purpose: The impact of the intermediate care unit (IMCU) on post–intensive care unit (ICU) outcomes is controversial.
Materials and Methods: We analyzed admissions from January 2003 to December 2008 from a mixed ICU in a teaching hospital in Brazil with a high patient-to-nurse ratio (3.5:1 on the ICU, 11:1 on the IMCU, 20-25:1 on the ward). A retrospective propensity-matched analysis was performed with data from 690 patients who were discharged after at least 3 days of ICU stay.
Results: Of the 690 patients, 160 (23%) were discharged to the IMCU. A total of 399 propensity-matched patients were compared: 298 were discharged to the ward and 101 were discharged to the IMCU. Ninety-day mortality rate was similar between the IMCU and ward patients (22% vs 18%, respectively, $P = .37$), as was the unplanned ICU readmission rate ($P = .63$). In a multivariate logistic regression, discharge to the IMCU had no effect on the 90-day mortality rate ($P = .27$).
Conclusions: In a resource-limited setting with a high patient-to-nurse ratio, discharge to IMCU had no impact on 90-day mortality rate and on unplanned readmission rate. The impact of discharge to the IMCU on the outcome for critically ill patients should be evaluated in further studies.

1. Introduction

Up to one third of the total mortality that occurs after a critical illness occurs after a successful discharge [1,2]. This high mortality rate after a discharge from the intensive care unit (ICU) emphasizes the need for additional attention to this complex decision-making process. Optimizing the discharge is one of the many challenges that should be addressed by future research studies [3].

Intermediate care units (IMCUs) have been proposed to deliver transitional care between the ICU and the ward for patients recovering from a critical illness [4]. The supposed objective of the IMCU is to continuously provide patient care with a reduced bed to nurse ratio. Two mechanisms may be related to the impact of IMCU on prognosis. First, IMCU may allow earlier discharge of critically ill patients, thereby reducing ICU length of stay (LOS) and costs, without changing mortality [4-7]. Secondly, IMCU may provide a longer better care after discharge, reducing postdischarge mortality. Nevertheless, there are no randomized controlled studies, and the current literature is controversial, being that they are mainly before and after studies or post hoc analyses without further adjustments [4,8-11]. Indeed, implementation of an IMCU has not been associated with reduced costs [5] and may add patient stress due to the additional transfer process [12]. Furthermore, discharge to an IMCU was recently described as an independent risk factor for an ICU readmission [8,9,13]. The impact of IMCU may be even more relevant on resource-limited settings with a high patient-to-nurse ratio.

One of the possible modifiable factors involved in a post-ICU prognosis is the destination facility. The impact of a transfer to an IMCU after an ICU discharge is still unknown. The aim of the present study was to evaluate if an IMCU admission, instead of a ward transfer, after a critical illness was associated with post-ICU outcomes.

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2. Materials and methods

2.1. Population

The patient population in this study included all living patients discharged from an adult ICU after at least 72 hours of stay from Hospital das Clínicas, a tertiary teaching hospital in São Paulo, Brazil, from January 2003 to December 2008. Patients discharged to another ICU or to another hospital were excluded.

This study protocol followed the statements of the Declaration of Helsinki. The institutional review board, called the *Comissão para Análise de Projetos de Pesquisa*, reviewed and approved this study (protocol no. 107 443). The requirement for written informed consent was waived because there was no intervention, and only a database that had guaranteed confidentiality was used.

2.2. Intensive care

Our study included patients discharged from a mixed ICU with 7 beds. This unit followed current standard-of-care practices, including sedation, nutritional, mechanical ventilation, and hemodynamic monitoring protocols. An intensivist was available on site 24 hours a day, 7 days a week (24/7). The staff comprised 1 senior physician, 1 critical care fellow, and 3 residents from the internal medicine program. At night, there was 1 senior physician and 1 resident. The health staff comprised 2 nurses and 3 nurse assistants on a 24/7 schedule in addition to a respiratory therapist who was on a 12/7 schedule.

2.3. Intermediate care unit

The referral IMCU at our hospital, at the time of this study, was an 11-bed unit with 1 nurse, 2 nurse assistants, and an intensivist consultant who was available 24/7. The staff comprised 1 senior physician, 2 critical care fellows, and 5 residents from the internal medicine program. At night, there was 1 senior physician on-call and 2 residents, 1 of which was from the critical care program. The intensivists evaluated the patients at the IMCU on a daily basis. A respiratory therapist consultant was also available on a 24/7 schedule. All of the decisions about the IMCU patients were shared with the IMCU team. The senior physician of the ICU and IMCU were from the same department and were in contact about the transfer process and follow-ups, thereby minimizing the loss of any important information regarding a patient's condition.

Patients on the IMCU received routine nurse care, basic vital signs monitoring (continuous electrocardiogram, oxygen saturation, and automated blood pressure measurements), frequent reassessments of neurologic status (at least 4 times a day), monitoring of urinary output and fluid balance, and 2 sessions of respiratory therapy a day. Mechanical ventilation was not allowed on the IMCU. Need for oxygen supplementation of more than 50% through Venturi mask was considered an indication for transfer to the ICU. Brief periods of noninvasive ventilation (<2 hours per period) were allowed. Continuous infusion of vasopressors, continuous antiarrhythmic agents, or vasodilators (including nitroprusside) was not allowed on the IMCU. Intermittent venous hemodialysis was allowed on the IMCU.

2.4. General wards

Our hospital contains wards for medical and surgical specialties. The mean nurse-to-patient ratio, at the time of this study, was 1 nurse for every 20 to 25 patients and 1 nurse assistant for every 4 to 6 patients. The staff for each ward was variable, consisting of mainly residents and medical students who were under the supervision of an assistant physician. On the weekends, the availability of the ward staff was lower than during the weekdays.

2.5. Discharge criteria

The patients were discharged to the ward or to the IMCU at the discretion of the attending intensive care physician. In brief, a discharge from the ICU was only considered if the reason for admission was solved or controlled. Patients who demanded any dose of vasopressors, inotropes, or intravascular vasodilators and/or intravenous antiarrhythmic agents were not discharged because those therapies were not allowed on the IMCU (see before). The need for noninvasive ventilation for more than 2 hours per day period (ie, morning, afternoon, and night) was considered a contraindication to an ICU discharge.

2.6. Data collection

All data were recorded prospectively with a computerized physician order entry system. The admission data included age, the reason for admission, the physiological data, the Sequential Organ Failure Assessment (SOFA) score, and the Acute Physiology and Chronic Health Evaluation II (APACHE II) score [14,15]. The daily SOFA score and physiological variables were also collected. The patients were followed up to 90 days after their ICU discharge with the hospital online system.

2.7. Outcomes

The primary end point for this study was the patient mortality rate over a 90-day period after an ICU discharge. The secondary end points included the hospital mortality rate and the unplanned ICU readmission rate.

2.8. Statistical analysis

Patients were categorized into 2 groups according to their discharge destinations. The discharge destinations were either the ward or the IMCU (these groups are described as the ward group and the IMCU group, respectively). Categorical and continuous data are presented as percentages and as the mean ± SD (or median and 25th-75th percentile), respectively. Categorical variables were compared using the χ^2 or Fisher exact tests, as appropriate. The quantitative continuous variables were compared using the unpaired Student *t* test or the Mann-Whitney *U* test for parametric and nonparametric variables, respectively.

Because the discharge process was not randomly assigned in our study population, a selection bias was accounted for by using the propensity scores [16-19] and a standard multivariate logistic regression. For more information on propensity score and multivariate analysis, see the online supplement.

The Kaplan-Meier method, with a log-rank test, was used to analyze the time to discharge from the hospital for living patients. The association between an unplanned ICU readmission and discharge to either the IMCU or the ward was assessed according to the Fine and Gray model [20]. This model extends the Cox regression model by taking into account any competing risk data and by considering the hazard function associated with the cumulative incidence function (CIF). Thus, the informative censoring was taken into account, that is, after dismissal from the ICU, a patient could be discharged from the hospital (censored), readmitted to the ICU, or die in the hospital without an ICU readmission (informative censoring, that is, the survival time of an individual does depend on censoring). Therefore, the CIF and the Fine and Gray model allowed for handling of both the time-to-event and the informative censoring [21,22].