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Relationships between mortality, morbidity, and physical function in adults who survived a period of prolonged mechanical ventilation☆,☆☆,★

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Abstract

Purpose: This study aimed to report mortality, morbidity, and the relationship between these outcomes with physical function in patients who survived prolonged mechanical ventilation during an intensive care unit (ICU) admission.

Methods and Materials: Records were reviewed for Western Australian residents admitted to an ICU in 2007 or 2008 who were ventilated for 7 days or longer and survived their acute care stay. Records were linked with data maintained by the Department of Health.

Results: A total of 181 patients (aged 52 ± 19 years) were included in this study. In the 12 months after discharge, 159 (88%) survived and 148 (82%) had been hospitalized. Compared with those who were ambulating independently when discharged from acute care, those who were not had more admissions (incident rate ratio, 1.81; 95% confidence interval, 1.28-2.57) and a greater cumulative length of hospital stay (10 [37] vs 57 [115] days, $P < .001$) over the first 12 months after discharge. Time between admission to ICU and when the patient first stood correlated with the number of admissions ($R_s = 0.320$, $P < .001$) and cumulative length of stay ($R_s = 0.426$, $P < .001$) in the 12 months after discharge.

Conclusions: For survivors of prolonged mechanical ventilation, physical function during acute care was associated with hospitalization over the following 12 months.

The cost associated with admission to an intensive care unit (ICU) is significant [1,2]. Given the resource implications, it is important to consider outcomes in ICU survivors, such as mortality and morbidity, after discharge from acute care. Data suggest that those who survive to hospital discharge have a poorer prognosis for as long as 15 years

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when compared with the general population of similar age and sex [3]. After an ICU admission, factors associated with poorer survival include increased age, the presence of comorbid conditions, and the occurrence of a new cancer [3].

Morbidity is also high among ICU survivors. One metric of morbidity that reflects economic burden is hospitalizations. In those who require ICU care, hospital readmission is common [4], with approximately 40% of those who required mechanical ventilation (MV) for at least 72 hours being readmitted within 2 months of discharge [5]. Factors that increase the risk of readmission include being discharged somewhere other than to their home, longer periods of MV during the ICU stay, being 80 years or older, and being female [6]. With the exception of being female, these factors are likely surrogates for poorer function at the time of discharge. Notwithstanding these results, mortality and morbidity after discharge from acute care in the subgroup that requires a period of prolonged MV have received little attention. An appreciation of outcomes in this subgroup is particularly important given that they consume the greatest proportion of the total ICU budget [7].

To our knowledge, no study has explored the relationships between physical function, mortality, and morbidity in ICU survivors. This is surprising given the recent interest in the role of rehabilitation during critical illness, which has been shown to be safe and confer gains in physical function [8,9]. Data indicating that the physical function achieved during an admission for critical illness impacts on long-term health outcomes such as mortality and morbidity would strengthen the rationale for further research into the effects of rehabilitation, including early mobilization, in the ICU setting.

We have recently published the results of a study that explored physical function in a group of people who were intubated and ventilated for 7 or more consecutive days and who survived their acute care stay (ie, the index admission) [10,11]. In the current report, we extend these results using linked data through the Department of Health in Western Australia (WA) to report (i) mortality and its causes in the 12-month period that followed discharge from the index admission, (ii) hospitalizations in the 12-month period before the index admission, and (iii) hospitalizations in the 12-month period that followed discharge from the index admission. We also explored the relationship between physical function reported during the index admission with subsequent mortality and morbidity.

1. Methods

1.1. Study criteria

Criteria for this study comprised residents of WA who were admitted to a level 3 ICU in 2007 or 2008, had been intubated and ventilated for 7 days or longer, and survived the index admission. Patients were identified using an in-house database of ICU admissions.

1.2. Data collection procedures

1.2.1. Chart review

Approval was obtained from all relevant Human Research Ethics Committees, which included a waiver for consent. All medical records, 24-hour ICU flow charts, nursing observation charts, and allied health notes of each patient who met the study criteria were reviewed, and information was extracted using a standardized form. This form was piloted and modified to optimize the extent to which both investigators extracted the same information [10,11]. The main variables of interest extracted to meet the aims of the current study pertained to the attainment of functional milestones. These comprised the time after admission to the ICU when the patient first sat out of bed and when they first stood, regardless of the level of support required to do so, as well as the capacity to ambulate independently at the time of discharge from the index admission (ie, when they left the acute care hospital). Consistent with earlier work, *independent ambulation* was defined as being able to walk, with or without a gait aid (eg, walking frame), but without the need for physical assistance or supervision from a health care professional [8,9]. Data regarding descriptive variables (ie, age, sex, and Acute Physiology and Chronic Health Evaluation [APACHE] II scores) and length of stay were also extracted. For those patients who had more than 1 ICU admission in 2007 or 2008, only data pertaining to their first admission that met the study criteria were extracted.

1.2.2. Mortality and morbidity

Linked mortality and morbidity information for our sample was obtained from the Department of Health in WA. Data were obtained regarding hospitalizations that commenced in the 12-month period before the index admission to demonstrate that hospitalizations increased after the index admission. Thereafter, *morbidity* was defined in terms of hospitalizations that commenced in the 12-month period after discharge from the index admission. In addition, data were obtained regarding mortality and its causes in the 12-month period after discharge from the index admission. These data were linked with our own database (MS Excel 2003), which contained the information extracted from the medical records.

1.3. Statistical analysis

Analyses were undertaken using Statistical Package for the Social Sciences, version 19 (SPSS Inc, Chicago, Ill). Frequency histograms were used to check the distribution of all continuous variables, and thereafter, descriptive statistics were reported as mean ± SD or median (interquartile range) for parametric and nonparametric data, respectively.