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Clinical application of the ProVent score in Korean patients requiring prolonged mechanical ventilation: A 10-year experience in a university-affiliated tertiary hospital

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ABSTRACT

Purpose: We evaluated the clinical usefulness of a prognostic scoring system ("the ProVent score") in Korean patients requiring prolonged mechanical ventilation.
Material and methods: We retrospectively analyzed the data of 184 patients in a medical intensive care unit of a tertiary care hospital between January 2004 and December 2013.
Results: The patients' median age was 65 years, and 66.8% were male. One-year mortality was 67.4%. On day 21 of mechanical ventilation, the ProVent score was 0 in 13 patients (7.1%), 1 in 39 patients (21.2%), 2 in 73 patients (39.7%), 3 in 42 patients (22.8%), and greater than or equal to 4 in 17 patients (9.2%). For patients with a ProVent score ranging from 0 to greater than or equal to 4, 1-year mortality was 46.2%, 53.8%, 68.5%, 76.2%, and 88.2%, respectively. The Kaplan-Meier curves of 1-year survival for each ProVent score showed statistically significant differences (log-rank test: $P = .001$). Logistic regression analysis showed that only thrombocytopenia was independently associated with 1-year mortality in our cohort (odds ratio = 4.786, $P < .001$).
Conclusions: In our study, the ProVent score could be applied to predict 1-year mortality for patients requiring prolonged mechanical ventilation in Korea. Among variables contributing to this score, only thrombocytopenia was an independent prognostic factor for 1-year mortality.

1. Introduction

Currently, there are an increasing number of patients with prolonged dependence on mechanical ventilation (MV) and other intensive care therapies after surviving acute critically ill states in the intensive care unit (ICU) [1]. Among them, patients requiring *prolonged mechanical ventilation* (PMV) are defined as those who receive it for at least 21 days [2]. These patients tend to face high mortality, experience significant physical and emotional morbidity, and incur high costs to health care systems [1,3]. In addition, as the population ages and medical techniques advance, the number of these patients appears to be increasing [4–7]. Therefore, patients requiring PMV will remain an important public health challenge in the future.

Regarding the process of decision making about long-term care for patients on PMV, communication between attending physicians and patients, along with their families, is crucial. However, several studies reported discordance between physicians and patients' families regarding estimated 1-year outcomes [8,9]. Based on these reports, decision making for these patients would be difficult because of the uncertainties associated with their outcomes. Also, a mortality prediction model for these patients would be helpful to inform discussions of long-term prognoses among critical care physicians and patients or their families.

For these reasons, Carson et al [10,11] developed and validated a mortality prediction model ("the ProVent score"), which estimated 1-year mortality for patients receiving at least 21 days of MV. Another study validated this model in a non-US country and reported that this score accurately identified patients at high risk of death [12]. Therefore, this model might be helpful to ICU physicians to help estimate the long-term prognosis.

However, it is still questionable whether this model could be applied successfully in Asian ICUs. Asian ICUs (including Korea) differ from those in Western countries in many aspects related to medical expenses, familial support, the concept of death, and social customs.

Abbreviations: APACHE, Acute Physiology and Chronic Health Evaluation; AUC, area under the curve; CI, confidence interval; DNR, do not resuscitate; ICU, intensive care unit; LOS, length of stay; MV, mechanical ventilation; PMV, prolonged mechanical ventilation; ROC, receiver operator characteristic; SOFA, Sequential Organ Failure Assessment.

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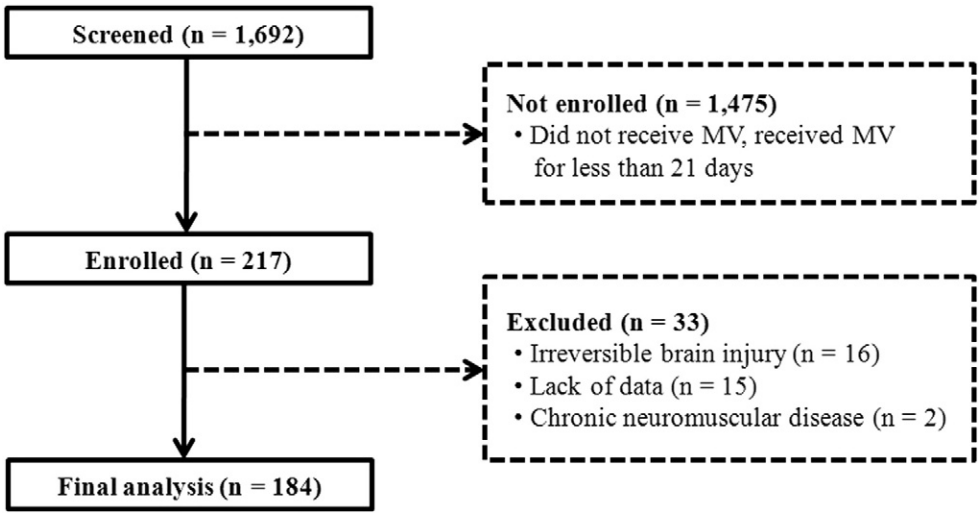

Fig. 1. Flow of recruited and enrolled study participants.

Moreover, no large-scale, multicenter study has evaluated the long-term outcomes of these patients in Korea; therefore, the usefulness of this model in Korean ICUs is unknown.

The aim of this study was to analyze the performance of the ProVent score in Korean ICU patients requiring PMV. We also compared the results with those from other countries to identify any distinct differences [11,12].

Table 1
Baseline characteristics and outcomes

Characteristics	n = 184
Age, y	65 (19-91)
Male sex	123 (66.8)
Comorbidities	148 (80.4)
Chronic pulmonary diseases	51 (27.7)
Chronic endocrine diseases	49 (26.6)
Chronic renal insufficiency	47 (25.5)
Chronic cardiac diseases	34 (18.5)
Hematooncologic diseases	31 (16.8)
Chronic neurologic diseases	28 (15.2)
Chronic hepatic diseases	11 (6.0)
Immunosuppression	6 (3.3)
ICU admission diagnoses	
Pulmonary disease (including pneumonia)	154 (83.7)
Shock	46 (25.0)
Hematooncologic diseases	22 (12.0)
Neurologic diseases	11 (6.0)
Infectious diseases other than pneumonia	11 (6.0)
Endocrine diseases	11 (6.0)
Gastrointestinal diseases	7 (3.8)
Postoperative state	6 (3.3)
Trauma	4 (2.2)
APACHE II score on admission day	22 (7-42)
SOFA score on admission day	8 (1-18)
MV duration, d	35 (21-160)
ICU LOS, d[a]	38 (14-161)
Hospital LOS, d	61 (22-338)
Tracheostomy during ICU stay	140 (76.1)
Weaning from MV	70 (38.0)
ICU mortality	85 (46.2)
Hospital mortality	92 (50.0)
1-y cumulative mortality after day 21 of MV	124 (67.4)

Values are presented as median (range) for continuous variables or as numbers (percentage) for categorical variables.

[a] One patient maintained receiving MV in ward after ICU discharge (ICU LOS of this patient was 14 days).

2. Material and methods

2.1. Study design

This retrospective study was performed in a 12-bed medical ICU at the Pusan National University Hospital in Busan, Korea. This hospital is a university-affiliated tertiary referral academic care hospital with 1100 beds and a separate 7-bed adult coronary care unit. The staff in the medical ICU consist of 1 full-time specialist, 1 clinical fellow in pulmonary and critical care medicine, 2 resident physicians, and 1 intern, with a nurse-to-patient ratio of 1:3. Overnight physician care was provided by the fellow and resident physicians. In addition, full-time physical and respiratory rehabilitation therapies were available for all patients. Consultation services were accessible for all the subspecialists in the hospital. All patients were managed according to therapeutic recommendations based on early goal-directed therapy and a lung-protective ventilator strategy [13,14].

All investigators contributed to the design of the study and confirmed that study objectives and procedures were honestly disclosed. Medical records and laboratory and radiologic findings of all enrolled patients were reviewed by 4 investigators (JHM, MHK, ESJ, and KL). They completed a case report form, and data from the inclusion period were collected and analyzed from January to June 2015. The statistical analysis of our results was performed by a statistician (YHK).

This study was conducted with approval for the Institutional Review Board of Pusan National University Hospital (E-2015051), but we did not obtain informed consent from each patient because this was an observational, retrospective study. Our study had no impact on patient treatment.

2.2. Study subjects

The inclusion period extended from 1 January 2004 to 31 December 2013. Survival status in all patients was obtained until 31 December 2014. Patients who were admitted to the medical ICU and received MV for at least 21 days after initial intubation were retrospectively enrolled. Exclusion criteria were age less than 18 years, diagnosis of acute or chronic neuromuscular disease, requirement for long-term MV before ICU admission, and lack of data about patient characteristics or outcomes. These inclusion and exclusion criteria were the same criteria used in previous studies [11,12]. Patients with irreversible brain injury or death diagnosed by a neurologist were also excluded from the study, regardless of the length of ICU admission, because