The Outcome of Prolonged Mechanical Ventilation in Elderly Patients: Are the Efforts Worthwhile?

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Summary
We studied the outcome of prolonged (> 3 days) mechanical ventilation in 181 patients aged 70 and over and determined the risk factors for in-hospital mortality. The overall in-hospital mortality for the entire study group was 57.5%. The previous medical history did not influence the final outcome. Shock during the intensive care unit (ICU) stay and an admission diagnosis of cardiac arrest were independently correlated with in-hospital mortality. We conclude that the prognosis for patients aged 70 and over who need prolonged mechanical ventilation is mainly dependent on the acute health status and the occurrence of complications during the ICU admission.

Introduction
In 1992, health care expenditure in the United States constituted 14% of the gross domestic product and was projected to reach 30% by the year 2030 [1]. Treatment in an intensive care unit (ICU) is especially expensive and costs were estimated at approximately 20% of total hospital costs [2]. Discussions about the application of critical care resources in patients who are expected to derive little or no benefit are numerous, both medical and political. Among the most seriously ill are those patients who need prolonged mechanical ventilation.

As the population is growing older each year, the number of elderly patients in the ICU increases, accounting for between 17% and 48% of all admissions [3-5]. The elderly patient is presumed to benefit less from intensive care treatment and several prognostic scoring systems consider increasing age as an important independent risk factor for in-hospital mortality. However, a recent review on this subject concluded that age alone is not an acceptable predictor of critical illness with regard to mortality and quality of life of the survivors and therefore it is inappropriate to withhold intensive care from all elderly patients, because many may return to their previous life-style [6]. We need to identify those elderly patients who may not benefit from intensive care, so that appropriate decisions regarding life-sustaining therapy may be made in advance or during the early phase of their critical illness.

Only a few studies have concentrated on the outcome of prolonged mechanical ventilation (> 3 days) in elderly (aged ≥ 70) patients and most studies consist of a relatively small number of patients [7-9]. Therefore, we reviewed our experience in this patient group and specifically tried to determine the factors that influence final outcome.

Materials and Methods
The study was performed in the medical intensive care unit (MICU) of an 850-bed tertiary care university hospital. All patients aged 70 years and over who needed prolonged (> 3 days) mechanical ventilation between 1 January 1970 and 31 December 1990 were included in the study. Twelve per cent of the medical records could not be retrieved. Finally, a total of 181 patients were studied. The following items were recorded from the medical records: sex, age, previous medical history, date of hospital admission and discharge or death, date of ICU admission and discharge, primary diagnosis at the time of admission according to the diagnostic list that is part of the APACHE 3 scoring system, duration of mechanical ventilation, highest FiO2 and PEEP required, and the complications occurring during admission in our unit. The APACHE 3 score was calculated for every patient [4]. We used the worst physiological value over the first 24 hours. Although the APACHE 3 score was only recently developed, it consists primarily of clinical and laboratory parameters that were routinely recorded from 1970 onwards in all patients admitted to our ward. A missing item was considered to be normal. The APACHE 3 score could not be calculated in only two patients.

Statistical methods: All data are presented as mean (SD) or median with range. Normality was checked by visual inspection of the probability plot and tested by the Lillefors and Shapiro—Wilks test. To compare differences between survivors and non-survivors we used the χ² or Fischer exact
test for categorical data and Student's t test or Mann–Whitney test for continuous data. Logistic regression analysis was used to determine the independent risk factors for in-hospital death. All statistical tests were performed using the commercially available software package SPSS for Windows™.  

Results  
A total of 181 patients (119 M, 62 F) were included in the study. The median age was 75 years (range 70–94). Table I shows the admission diagnosis and main reason for mechanical ventilation for the entire study population with the associated in-hospital mortality. Overall in-hospital mortality was 57.5%. Mortality was the highest for the patients admitted after a cardiac arrest. The patients spent a median of 12 days (range 4–102) on the mechanical ventilator. Forty-one patients (23%) were ventilated for more than 3 weeks. In-hospital mortality for these patients was 58.5% and not significantly different from the entire study group. 

Median ICU and hospital days were 12 (range 4–107) and 25 (range 4–268) respectively. The APACHE 3 score could be calculated in all but two patients. The median score was 67 (25 percentile: 55, 75 percentile: 83). Mortality increased with increasing APACHE 3 scores (Figure). 

Tables II–IV show the differences between survivors and non-survivors. Survivors spent more days in the ICU and remained in the hospital for a much longer time. As the study was retrospective, we limited the previous medical history to four clearly obtainable items: congestive heart failure (NYHA 3 or 4), myocardial infarction, cerebrovascular accident and chronic obstructive pulmonary disease (COPD). The previous medical history was not significantly different between the survivors and the non-survivors. This was also true if two items were combined. The APACHE 3 score was significantly higher in the non-survivors compared with the survivors [44 (15) vs. 34 (13), p < 0.001]. When comparing the individual components of the APACHE 3 score, only the heart rate and serum creatinine were significantly different between survivors and non-survivors. When we compared the incidence of major ICU complications in the survivors and non-survivors, only the occurrence of shock was associated with in-hospital mortality. 

To determine the independent factors that correlated with in-hospital survival, logistic regression analysis was performed using a forward stepwise selection including the following variables: the presence or absence of cardiac arrest as the reason for admission, serum creatinine during the first 24 hours, heart rate during the first 24 hours and shock during admission. Shock during admission (p < 0.001) and a cardiac arrest as the admission diagnosis (p = 0.006) were independently correlated with the final outcome. No patient survived to hospital discharge if both these factors were present. 

Discussion  
The use of mechanical ventilation has increased in the past decades and, as the population is growing older, more elderly patients are likely to receive this treatment. In a recent study from New York State, 72% of patients receiving mechanical ventilation were older than 60 years [10]. Although numerous studies describe mechanical ventilation related morbidity and mortality, only few deal with prolonged mechanical ventilation in the elderly [7-9, 11-13]. Overall mortality in these studies ranged between 41 and 78%. This is comparable with the results from our study. The in-hospital mortality for the patients ventilated more than 3 weeks was comparable with the mortality rate for the entire study group. This is in agreement with the study of Gracey et al. [9] who reported that hospital mortality was similar in patients receiving mechanical ventilation for 7–14 days vs. more than 29 days. This indicates that after a few days, additional duration of mechanical ventilation does not significantly affect outcome and is not an important criterion to withdraw therapy. Furthermore, within the patient group studied (aged 70 years and over and mechanical ventilation > 3 days) age by itself was not an important
outcome predictor. However, in our study none of the patients older than 85 years (n = 8) survived to hospital discharge. The same results were found by McLean et al., although they mainly studied postoperative patients [14].

Old age per se is not an important outcome predictor, but coexisting chronic diseases, the functional status and the severity of the acute illness probably are. Chronic health status is regarded as an important outcome predictor for patients in the ICU. For example, many authors describe the impact of COPD on the ICU survival rate [15, 16]. We were unable to find this relation in our patients. One of the main reasons for this discrepancy may be that mechanical ventilation is regarded as inappropriate in end-stage COPD with respiratory insufficiency and so there may exist a selection bias towards the relatively mild cases. COPD was considered to be present if this diagnosis was made by a pulmonologist and the patient used maintenance bronchodilator or corticosteroid therapy. In only a few cases, the results of previous lung function tests could be obtained, and these were insufficient to make any conclusions about differences between survivors and non-survivors. On the other hand a previous myocardial infarction, cerebrovascular accident and congestive heart failure likewise did not influence the final outcome. The influence of immunosuppression, chronic renal failure, and liver cirrhosis could not be determined due to the small number of patients in these groups.

We agree with Sage and co-workers that the reason for admission and the acute health status are the best outcome predictors [17]. We showed a strong correlation between the APACHE 3 score and the survival rate. An admission diagnosis of cardiac arrest, shock after 24 hours, serum creatinine during the first 24 hours and the maximal heart rate during the first 24 hours were all correlated with in-hospital mortality. Logistic regression analysis showed shock and cardiac arrest to be the main independent outcome predictors.

A considerable number of patients in our study suffered serious complications during their ICU stay. As mentioned above, shock had a big impact on the survival rate. In contrast in-hospital cardiac arrest (usually witnessed ventricular fibrillation), major transfusion (> 4 units), acute dialysis or surgery, re-intubation or pneumothorax were not correlated with outcome. However, definite conclusions cannot be made due to the low frequency of these complications.

The subject of this study makes a retrospective design almost inevitable, but raises the usual questions. The most important shortcoming is the fact that we were unable to control for the influence of numerous obtainable covariants. Our starting point was that only clearly described and unequivocal items should be recorded. Therefore we believe that the conclusions regarding these items are correct. Some laboratory data such as bilirubin and albumin were not always available. As described, they were regarded as being normal. We included patients admitted between 1970 and 1990, during which therapy and outcome for these patients might have changed. However, most of the patients were admitted during the last 10 years and we were unable to demonstrate a trend towards an improved survival rate over these years.

We conclude from these data that the outcome of prolonged mechanical ventilation in patients aged 70 and over is mainly dependent on the admission diagnosis and acute physiological derangements and not on age and chronic health status.
References


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