In-Hospital and 5-Year Mortality of Patients Treated in the ICU for Acute Exacerbation of COPD*

A Retrospective Study

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Study objectives: The prognosis of patients with COPD requiring admission to the ICU is generally believed to be poor. There is a paucity of long-term survival data. We undertook a study to examine both the in-hospital and 5-year mortality rates and to identify the clinical predictors of these outcomes.

Design: We conducted a retrospective cohort study of 57 patients admitted to the ICU between January 1999 and December 2000 for acute respiratory failure attributable to COPD.

Results: The mean (±SD) age of the study population was 70 ± 8 years. More than 90% of patients required intubation, and the mean duration of mechanical ventilation (MV) was 2.3 ± 2.2 days. The in-hospital mortality rate for the entire cohort was 24.5%. The mortality rates at 6 months and 1, 3, and 5 years were 39.0%, 42.7%, 61.2%, and 75.9%, respectively, following admission to the ICU. The median survival time for all patients was 26 months. The mortality rate at 5 years was 69.6% for patients who were discharged alive from the hospital. Using multivariate analysis, hospital mortality correlated positively with age, previous history of MV, long-term use of oral corticosteroids, ICU admission albumin level, APACHE (acute physiology and chronic health evaluation) II score, and duration of hospitalization. No factors predictive of mortality at 5 years were identified.

Conclusions: We support previous findings of good early survival and significant but acceptable long-term mortality rates in patients who have been admitted to the ICU for acute exacerbation of COPD. Increased age, previous history of MV, poor nutritional status, and higher APACHE II score on ICU admission could be identified as risk factors associated with increased mortality rates. Long-term survival of patients with COPD who required MV for an acute exacerbation of their disease cannot be predicted simply from data available at the time of intubation. Physicians should incorporate these factors in their decision-making process.

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Key words: acute respiratory failure; COPD; exacerbation; ICU; mortality; survival

Abbreviations: APACHE = acute physiology and chronic health evaluation; IMV = invasive mechanical ventilation; NIPPV = noninvasive positive-pressure ventilation.

COPD is a leading cause of death worldwide with a continued rising mortality rate, and it represents a major socioeconomic burden.[1] The natural course of COPD is characterized by a progressive decline in pulmonary function and recurrent exacerbations. Acute respiratory failure may ensue, requiring admission to the ICU for assisted ventilation. The prognosis of this group of patients who require admission to the ICU is commonly believed to be grim. Studies[2–13] have reported varying in-hospital mortality rates of 20 to 82% because of differences in disease severity and heterogeneous patient mix. Data on long-term survival after hospital discharge is limited. The longest follow-up study[14] so far reported a mortality rate of 64% at 3 years. Physicians treating these patients often have a dilemma in the institution of mechanical ventilation, and opinions are widely varied.[15]

We provide additional information to the short-term and long-term survival in this group of COPD patients. We also identified prognostic factors for both hospital and long-term outcomes to assist the clinician in making the difficult decisions of institut-

ing intensive care management in order to allow for better utilization of medical resources.

Materials and Methods

Study Population

All of the consecutive patients who were admitted to the ICU at the National University Hospital in Singapore over a 2-year period between January 1, 1999, and December 31, 2000, for the primary diagnosis of acute respiratory failure or arrest secondary to COPD were retrospectively studied. COPD was identified from the patient's premorbid pulmonary function testing results or, if unavailable, from the patient's history with a compatible physical examination finding in accordance with the American Thoracic Society guidelines.[16] *Exacerbation* was defined by the presence of an increase in at least two of the three symptoms, dyspnoea, cough, and sputum purulence severe enough to warrant hospital admission without concomitant evidence of pneumonia (new infiltrates on chest radiograph). Patients with pneumonia, pulmonary edema, ARDS, asthma, pulmonary embolism, and pneumothorax, as well as those with existing tracheostomy or long-term ventilatory support, were excluded from the study. Hospital admissions subsequent to the index admission were not considered in the primary analysis.

The decision for intubation was made by the treating team with no set criteria. Noninvasive positive-pressure ventilation (NIPPV) was infrequently utilized at our hospital during the period of study and is initiated for moderate respiratory acidemia in the absence of depressed mental status. Invasive ventilation was used at the discretion of the attending physicians in the emergency department or ICU based on the presence of respiratory arrest, hemodynamic instability, altered mental status, life-threatening gas exchange abnormalities, and failed trial of NIPPV. All of the patients received protocolized treatment with aerosolized salbutamol and ipratropium bromide, systemic corticosteroids, theophylline, and controlled oxygen therapy directed by blood gas or pulse oximetry levels in spontaneously breathing patients. Weaning from mechanical ventilation commenced once the patient was capable of initiating a spontaneous breath by the progressive reduction in pressure support ventilation as tolerated.

Clinical Data

Data were collected retrospectively.

Epidemiologic and Baseline Data

The age, gender, smoking status, and functional status of the patients were documented. Active smoking status was defined as having smoked within the last 6 months. The level of functional activity related to dyspnoea was graded on a four-point scale.[14] Comorbid conditions were quantified according to the index of Charlson et al.[17] Recorded information about outpatient medical therapy included information regarding the use of home oxygen, theophylline, and long-term oral and inhaled steroids. The long-term use of oral corticosteroids was defined as the daily use of prednisolone, ≥ 5 mg/d, during the month before hospital admission or an equivalent. The number of previous hospitalizations with an acute exacerbation of COPD and prior mechanical ventilation, as well as the baseline best-spirometric and blood gas values during an outpatient visit with the patient in stable condition or immediately preceding hospital discharge when available within 3 years of hospital admission, were recorded.

Hospital Admission

Hematocrit, serum albumin, ECG evidence of right heart strain, and the presence of peripheral edema suggestive of cor pulmonale were noted from the time of hospital admission. Arterial blood gas measurements were noted directly before the institution of mechanical ventilation or for spontaneously breathing patients on admission to the ICU. The severity of illness was measured using the APACHE (acute physiology and chronic health evaluation) II scoring system. The level of consciousness was graded by the following scale: (1) alert; (2) drowsy; and (3) comatose or arrest. Initiation of mechanical ventilation with or without preceding NIPPV was recorded. The duration to intubation was also documented.

Outcome and Follow-up

In-hospital and ICU mortality and length of hospital stay were determined for each patient. Patients were followed up 5 years after discharge from the hospital by review of the clinical notes, telephone contacts, and via the death registration record for the state in event of out-of-hospital deaths. Information on the current survival status, survival time, number of hospital admissions for acute exacerbation of COPD, and time to first readmission following hospital discharge were collected.

Statistical Analysis

All of the statistical analyses were performed using a statistical software package (SPSS for Windows, version 11.5; SPSS Inc; Chicago, IL). Descriptive data are presented as mean ($\pm$SD) or median (range). Comparisons between groups were made by using the Student t test, Mann-Whitney test, χ^2 test, or Fisher exact test. Independent predictors of hospital and long-term mortality were identified using logistic regression analysis. A p value of < 0.05 was considered to be significant. Kaplan-Meier curves were used to demonstrate survival characteristics and plots.

Results

Between January 1, 1999, and December 31, 2000, 60 patients were admitted to the ICU with a primary admission diagnosis of COPD. In the event that a patient presented to the ICU on more than one occasion, only the data from the first hospital admission were analyzed. Thus, 57 patients were analyzed. Patient characteristics are listed in Table 1. The mean age was 70 $\pm$ 8 years, the overwhelming majority were men, and almost half were still actively smoking. Thirty-one patients (55%) had two or more comorbid conditions of which nearly half were attributable to cardiac cause. Twelve percent were using home oxygen, and 30% were using long-term steroids. Pulmonary function test results were available for three quarters of the patients. The majority (60%) of the patients were in stage III and IV of their disease according to the Global Initiative for Chronic Obstructive Lung Disease criteria for COPD severity, and 20% of the patients had chronic type 2 respiratory failure.