Prognostic factors, clinical course, and hospital outcome of patients with chronic obstructive pulmonary disease admitted to an intensive care unit for acute respiratory failure

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Objective: **To describe prognostic factors, clinical course, and hospital outcome of patients with chronic obstructive pulmonary disease admitted to an intensive care unit for acute respiratory failure.**

Design: **Analysis of prospectively collected data.**

Setting: **A multidisciplinary intensive care unit of an inner-city university hospital.**

Patients: **Patients with chronic obstructive pulmonary disease admitted to an intensive care unit for acute respiratory failure from August 1995 through July 1998.**

Measurements and Main Results: **Data were obtained concerning demographics, arterial blood gas, Acute Physiology and Chronic Health Evaluation (APACHE) II score, sepsis, mechanical ventilation, organ failure, complications, and hospital mortality rate. Fifty-nine percent of patients were male, 63% white, and 36% African-American; the mean age was 63.1 ± 8.9 yrs. Noninvasive mechanical ventilation was tried in 40% of patients and was successful in 54% of them. Invasive mechanical ventilation was required in 61% of the 250 admissions. Sepsis developed in 31% of patients, nonpulmonary organ failure in 20%, pneumothorax in 3%, and acute respiratory distress syndrome in 2%. Multiple organ failure developed in 31% of patients with sepsis compared with 3% without sepsis ($p < .0001$). Predicted and observed hospital mortality rates were 30% and 15%, respectively. Differences in age and arterial carbon dioxide and oxygen tensions between survivors and nonsurvivors were not significant. Arterial pH was lower in nonsurvivors than in survivors (7.21 vs. 7.25, $p = .0408$). The APACHE II-predicted mortality rate ($p = .0001$; odds ratio, 1.046; 95% confidence interval, 1.022–1.070) and number of organ failures ($p < .0001$; odds ratio, 5.524; 95% confidence interval, 3.041–10.031) were independent predictors of hospital outcome; invasive mechanical ventilation was not an independent predictor.**

Conclusions: **Physiologic abnormalities at admission to an intensive care unit and development of nonrespiratory organ failure are important predictors of hospital outcome for critically ill patients with chronic obstructive pulmonary disease who have acute respiratory failure. Improved outcome would require prevention and appropriate treatment of sepsis and multiple organ failure. (Crit Care Med 2002; 30:1610–1615)**

Key Words: Acute Physiology and Chronic Health Evaluation; lung diseases, obstructive; multiple organ failure; outcome assessment; prognosis; ventilation, mechanical

In 1996, about 16 million people in the United States were estimated to have chronic obstructive pulmonary disease (COPD) (1). COPD is the fourth leading cause of death in this country (2). Nearly 112,584 Americans died of COPD in 1998 (2). Although the age-adjusted mortality rate of most causes of death decreased, the age-adjusted mortality rate attributable to COPD increased by 42% between 1979 and 1998 (3).

The annual hospitalization rate for COPD increased from 9.7 to 24.5 per 10,000 population between 1988 and 1998 (3). Many patients with COPD require admission to an intensive care unit (ICU) for acute respiratory failure. Because COPD is more common among the elderly with multiple coexisting illnesses, the clinical course of patients with COPD in an ICU is likely to be complicated by multiple organ dysfunction and increased mortality rates. This study describes the clinical course, complications, mortality rates, and immediate causes of death in patients with COPD who were treated in an ICU of an inner-city, tertiary hospital for acute respiratory failure.

MATERIALS AND METHODS

We analyzed prospectively collected data for 250 hospital admissions of 180 patients with COPD treated in an ICU for acute respiratory failure. Multiple ICU admissions during the same hospitalization were considered as one. COPD was defined by the presence of airway obstruction attributable to chronic bronchitis or emphysema (4). The data were collected as part of a screening protocol for patients admitted to the ICU for severe exacerbation of asthma or chronic obstructive airway disease for a prospective, randomized study of permissive hypercapnia vs. conventional ventilation. This study included all 250 admissions of patients who were treated consecutively in the ICU over a 3-yr period, from August 1995 through July 1998. University Medical Center is a 528-bed, tertiary, urban, university hospital in Jacksonville, FL. It has a 16-bed ICU that provides care to critically ill medical and nontrauma neurosurgical and obstetrical patients. The data collected included age, race, gender, use and type of mechanical ventilation (MV), length of ICU and hospital stay, development of acute respiratory distress

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or systemic inflammatory response syndrome, organ failure, mortality rate, and immediate cause of death.

Acute respiratory distress syndrome was defined in accordance with the American-European Consensus Conference (5). Sepsis was defined by using the American College of Chest Physicians/Society of Critical Care Medicine guidelines (6). Pneumonia was diagnosed clinically by the presence of new or worsening infiltrate on chest radiography, fever or hypothermia, leukocytosis or leukopenia, and purulent respiratory secretions. Bronchoscopy rarely was performed to diagnose pneumonia in these patients in our practice. Cardiovascular, hematologic, renal, and central nervous system failure was defined according to Knaus et al. (7). Liver failure was defined as a bilirubin concentration of ≥102.6 μmol/L and prothrombin time of ≥4 secs plus control. Gastrointestinal failure was defined as gastrointestinal bleeding, intestinal obstruction, or pancreatitis preventing enteral feeding for ≥24 hrs or until death. Multiple organ failure was defined as failure of two or more nonrespiratory organs. Acute Physiology and Chronic Health Evaluation (APACHE) II scores and predicted mortality rates were calculated as described in the literature (8). The standardized mortality ratio was the ratio of actual to APACHE II-predicted mortality.

Invasive or noninvasive ventilation use was based on the judgment of the attending physicians of the emergency department or ICU. In general, noninvasive ventilation was used first. However, invasive ventilation was used from the outset for patients with hemodynamic instability, altered mental status, and life-threatening gas exchange abnormalities. The Servo Ventilator (900C, Siemens-Elema AB, Solna, Sweden) was used for invasive MV. Although the ventilatory approach had some variations, depending on the intensivist and the patient, a lower tidal volume strategy aimed at minimizing dynamic hyperinflation was applied in most patients. In patients with suspected cerebral edema, hypercapnia was avoided. Static and dynamic compliance levels at the initiation of MV were calculated from the recorded peak airway pressure, positive end-expiratory pressure (PEEP), plateau pressure, and tidal volume at initiation of invasive MV in the ICU. Auto-PEEP was measured by occluding the airway at end-expiration with the expiratory pause button of the ventilator.

StatView 5.0 computer software (SAS Institute, Cary, NC) was used for statistical analyses. Standard deviations were calculated for all mean values. Comparisons between groups were made by using the Student's *t*-test, Mann-Whitney test, chi-square test, or Fisher's exact test. We considered $p < .05$ to be significant. When available, continuity-adjusted *p* values were used. MedCalc software (version 6; Mariakerke, Belgium) was used to calculate the area under the receiver-operating characteristic curve (AUC) and the sensitivity and specificity of the APACHE II probability of death and number of organ failures in predicting mortality rate.

RESULTS

The age at first admission, race, and gender of the 180 patients are listed in Table 1. During the 3-yr study period, 36 patients were admitted to the ICU two or more times: one patient each was admitted to the ICU 12, nine, and six times; three patients were admitted four times; seven were admitted three times; and 23 were admitted two times. Among the 155 patients who were dismissed from the hospital during their first ICU stay, 23% were readmitted to our ICU during the 3-yr study period. The causes of acute respiratory failure are listed in Table 1.

The mean APACHE II score was 19.0 ± 7.3, and the predicted mortality rate was 30% ±21%. Figure 1 shows the mortality rate of the patients according to their APACHE II scores. Only one of 23 patients with an APACHE II score of ≤10 and 19 of 41 with a score >25 died. The median length of ICU and hospital stays were 5 and 8 days, respectively. Thirty-seven of 180 patients (21%) died in the hospital during the study period. The in-

Table 1. Age, race, gender, and precipitating causes of respiratory failure in 180 patients (250 hospital admissions) with chronic obstructive pulmonary disease (COPD) treated in the intensive care unit

Variable	Value
Age, yrs, mean ± SD	63.1 ± 8.9
Sex, no. of patients (%)	
Male	106 (59)
Female	74 (41)
Ethnicity, no. of patients (%)	
White	113 (63)
African-American	65 (36)
Asian	1 (<1)
Middle Eastern	1 (<1)
Cause of respiratory failure, no. of admissions (%)	
Acute COPD exacerbation	144 (58)
Unidentified cause	88 (35)
Bronchitis	48 (19)
Noncompliance	8 (3)
Pneumonia	57 (23)
Cardiac	25 (10)
Sedatives	7 (3)
Pneumothorax	4 (2)
Sepsis or ARDS	3 (1)
Other	10 (4)

ARDS, acute respiratory distress syndrome.

hospital mortality rate of the 250 admissions was 15%. The standardized mortality ratio was 0.498. The immediate causes of death were COPD exacerbation in 16 patients (43%), sepsis in ten (27%), multiple organ failure in eight (22%), acute myocardial infarction in one (3%), metastatic cancer in one (3%), and perforated bowel in one (3%). Twenty-five deaths (68%) occurred during the first admission, eight (22%) during the second, two (5%) during the third, and one each (3%) during the fourth and sixth ICU admissions. Of the 144 patients who were admitted only once, 25 (17%) died compared with 12 of 36 patients (33%) who were admitted two or more times ($p = .0587$) during the study period.

Ninety-one episodes of sepsis developed in 77 of 250 admissions (31%). The identified sources of sepsis were pneumonia (n = 64), bronchitis (n = 2), and empyema (n = 1) and infections of the urinary tract (n = 11), bloodstream (n = 6), vascular catheter (n = 1), and abdomen (n = 1). The pathogens were *Pseudomonas aeruginosa* (n = 23), *Staphylococcus aureus* (n = 11), *Streptococcus pneumoniae* (n = 7), *Enterobacter* species (n = 5), *Moraxella catarrhalis* (n = 4), *Haemophilus influenzae* (n = 4), *Escherichia coli* (n = 4), *Klebsiella pneumoniae* (n = 4), *Proteus mirabilis* (n = 4), *Stenotrophomonas maltophila* (n = 1), *Acinetobacter calcoaceticus* (n = 1), *Citrobacter freundii* (n = 1), *Serratia marcescens* (n = 1), *Prevotella melaninogenica* (n = 1), and *Candida albicans* (n = 1).

The types and number of nonpulmonary organ failures that developed in patients in the 250 ICU admissions are listed in Table 2. Multiple organ failure developed in patients in 24 (31%) of the 77 admissions in which the ICU course was complicated with sepsis, compared

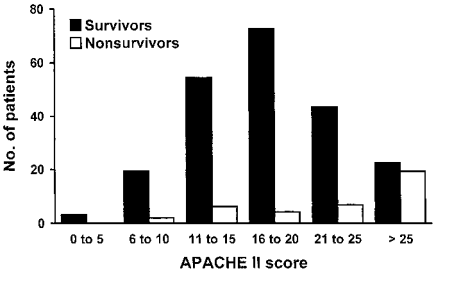

Figure 1. Acute Physiology and Chronic Health Evaluation (*APACHE*) II scores of survivors and nonsurvivors with chronic obstructive pulmonary disease admitted to an intensive care unit for respiratory failure.

with five (3%) of the 173 admissions in which the ICU course was not complicated with sepsis ($p < .0001$). Acute respiratory distress syndrome developed in four patients (2% of admissions).

The differences between survivors and nonsurvivors are listed in Tables 3 and 4. There was no significant difference in length of hospital stay between survivors and nonsurvivors (Table 4). The length of ICU stay was longer for nonsurvivors than survivors (Table 4). Logistic regression analysis showed that the number of organ failures and the APACHE II-predicted hospital death rate were independently associated with hospital mortality rate (Table 5). The development of sepsis and invasive MV were not independent prognostic factors of hospital outcome (Table 5). The AUC of the APACHE II prognostic system in predicting hospital mortality was 0.748 (95% confidence interval, 0.690–0.801). With a threshold value of >50%, the sensitivity and specificity of APACHE II probability of death for predicting hospital mortality were 54% and 91%, respectively. The AUC of the number of organ failures for predicting hospital mortality was 0.851 (95% confidence interval, 0.800–0.892). With a threshold value of >0, the sensitivity and specificity of number of organ failures for predicting hospital mortality were 76% and 90%, respectively.

Invasive MV was used for 153 patients (61% of admissions). Noninvasive positive-pressure ventilation was used for 99 patients (40% of admissions) and was successful for 52%. Subsequently, invasive MV was required for the patients in 40 of these 99 admissions (40%). Six patients refused endotracheal intubation and died. Of the 153 admissions in which patients required invasive MV, the median duration of invasive MV was 6 days. Of the 40 admissions in which patients required invasive MV after noninvasive ventilation failed, seven patients (18%) died, compared with 24 patients of 113 admissions (21%) who had invasive MV from the outset ($p = .7808$). Among patients who required invasive MV, initial auto-PEEP, static compliance, and dynamic compliance levels were measured during 151 admissions; levels were not significantly different between survivors and nonsurvivors. Pneumothorax developed in five patients (3%) (spontaneously in three, during bag ventilation after endotracheal intubation in one, and during invasive positive pressure MV in one); two of these patients died.

Table 2. Type and number of nonpulmonary organ failures that developed in 180 patients with chronic obstructive pulmonary disease during 250 intensive care unit admissions

Organ Failure	No. of Patients	% of Admissions
Type		
Cardiovascular	42	17
Neurologic	18	7
Gastrointestinal	15	6
Renal	12	5
Hematologic	6	2
Liver	1	<1
No. of organ failures		
0	200	80
1	21	8
2	17	7
3	7	3
4	2	<1
5	3	1

Table 3. Differences in baseline characteristics between 213 survivors and 37 nonsurvivors

Characteristic	Survivors	Nonsurvivors	*p*
Age, yrs, mean ± SD	62.5 ± 8.6	63.9 ± 8.3	.3442
Ethnicity, no. of patients (%)			.9503
White (n = 161)	137 (85)	24 (15)	
African-American (n = 87)	74 (85)	13 (15)	
Asian (n = 1)	1 (100)	0	
Middle Eastern (n = 1)	1 (100)	0	
Gender, no. of patients (%)			.9262
Male (n = 147)	126 (86)	21 (14)	
Female (n = 103)	87 (84)	16 (16)	
Arterial pH	7.25 ± 0.10	7.21 ± 0.12	.0408
Arterial CO_2 tension, mm Hg	60.9 ± 20.1	56.6 ± 17.5	.2254
Arterial oxygen tension/fraction of inspired oxygen, mm Hg	210 ± 106	204 ± 111	.7271
Median APACHE II score ± SD	17.9 ± 6.4 (17)	25.6 ± 8.7 (26)	<.0001
Predicted mortality rate, %	26.2	50.3	<.0001

APACHE, Acute Physiology and Chronic Health Evaluation.

Table 4. Differences in the incidence of sepsis, number of organ failures, need for mechanical ventilation, and length of hospital and intensive care unit (ICU) stay between 213 survivors and 37 nonsurvivors

Factor	Survivors	Nonsurvivors	*p*
Sepsis, no. (%)	52 (24)	25 (68)	<.0001
No. of organ failures ± SD (median)	0.14 ± 0.48 (0)	1.87 ± 1.48 (2)	<.0001
Mechanical ventilation, no. (%)			.0037
None (n = 38)	38 (100)	0	
Invasive (n = 153)	122 (80)	31 (20)	
Noninvasive (n = 59)	53 (90)	6 (10)	
Hospital days, mean no. ± SD (median)	11.5 ± 14.3 (8)	16.8 ± 22.1 (10)	.0845
ICU days, mean no. ± SD (median)	7.6 ± 12.7 (4)	15.5 ± 20.9 (8)	.0003

Table 5. Multiple logistic regression analysis of the association of in-hospital mortality with potential prognostic factors

Factor	*p*	Odds Ratio (95% CI)
No. of organ failures	<.0001	5.524 (3.041–10.031)
APACHE II-predicted mortality rate	.0001	1.046 (1.022–1.070)
Invasive mechanical ventilation	.2927	0.501 (0.138–1.816)
Sepsis	.9096	0.933 (0.284–3.070)

CI, confidence interval; APACHE, Acute Physiology and Chronic Health Evaluation.

DISCUSSION

This study described the clinical course of 250 hospitalizations of 180 patients with COPD admitted to an ICU of an inner-city hospital for acute respiratory insufficiency. Almost all patients were African-American or white. Nonpulmonary organ failure developed in 20% of patients and sepsis in 31%. The hospital mortality rate (15%) was lower than the mortality rate predicted by the APACHE II prognostic system (30%). Differences in age, gender, and ethnicity between survivors and nonsurvivors were not significant. Underlying COPD, sepsis, and multiple organ failure were the immediate causes of 34 of the 37 deaths. Compared with survivors, nonsurvivors had a higher APACHE II score and a lower arterial pH but a similar ratio of arterial oxygen tension to inspired oxygen fraction and arterial carbon dioxide tension. The incidence of sepsis and the number of organ failures were higher among nonsurvivors than survivors. Among patients who required invasive MV, differences in auto-PEEP, dynamic compliance, and static compliance levels between survivors and nonsurvivors were not significant.

Overall, the inpatient population at our hospital consists of an equal number of African-Americans and whites, with few from other ethnic groups. However, in the present study, 63% of patients were whites and 36% were African-Americans. This finding is consistent with the prevalence of COPD in general, and severe COPD in particular, being lower among African-Americans than among whites (9, 10). Connors et al. (9) found that 50% of patients who were hospitalized for acute exacerbation of COPD required readmission to the hospital within 6 months. Although most patients in that study were admitted to the ICU, patients who were treated in a non-ICU setting were also included (9). Moran et al. (11) reported that 23% of their patients required repeat admission to the ICU for acute COPD exacerbation over 4.25 yrs. In our study, 23% of patients who survived the first ICU stay required readmission to the ICU during the 3-yr period. We may have underestimated the ICU readmission rate because we have not collected data on patients who may have been admitted to other hospitals during the study period.

The mortality rate associated with acute respiratory failure in patients with COPD has declined in recent years (12). The mortality rate of patients with COPD who had acute respiratory failure was 26% before 1975, compared with 10% after 1975 (12). The majority of patents with acute exacerbation of severe COPD were admitted to the ICU in the Study to Understand Prognoses and Preferences for Outcomes and Risks of Treatments (SUPPORT), and the hospital mortality rate was 11% (9). However, another study of 362 patients with COPD who were admitted to the ICU for acute exacerbation of severe COPD showed a hospital mortality rate of 24% (13). Differences in disease severity and patient mix may partly explain the variations in hospital outcome. The severity of nonpulmonary organ dysfunction was not measured in most of the studies. Some studies excluded patients with COPD whose respiratory failure was precipitated by identifiable causes, such as pneumonia, pulmonary embolism, heart failure, and other known causes. Studies with such exclusions are likely to have a lower mortality rate because they include mostly patients whose acute respiratory failure is precipitated by an exacerbation of bronchitis, which is more readily reversible or self-limited. Although COPD is listed as the fourth common cause of death in the United States, the immediate causes of death in patients with COPD admitted to the ICU for acute respiratory failure have not been well described. In a study by Moran et al. (11), respiratory factors were responsible for 50% of recorded deaths in patients treated in the ICU for acute exacerbation of COPD. Among patients with COPD treated with noninvasive MV for acute hypercapnic respiratory failure, Moretti et al. (14) mentioned cardiac failure, pneumonia, pulmonary embolism, shock, and multiple organ failure as the main causes of death. Hill et al. (15) reported that 20% of patients with COPD admitted to the ICU died of multiple organ failure. In our study, nearly half of the deaths were attributable to sepsis and multiple organ failure.

Similar to the study by Seneff et al. (13), we did not find significant differences in gender and ethnicity between survivors and nonsurvivors. Although age did not influence the hospital outcome of our patients, it has been an independent risk factor for hospital mortality rates for patients with COPD and other diseases of the lower respiratory tract admitted to the ICU (9, 16). However, the association of age with hospital mortality rate is modulated by other coexisting diseases and the severity of acute illnesses. Some studies have shown that age is of minor or of no importance for hospital mortality rate (11, 13). The severity of illness manifested by physiologic abnormalities and complications that develop during patients' ICU stays has a strong influence on hospital outcome of patients with COPD with acute respiratory failure. In our study, we measured initial severity of illness by the APACHE II prognostic system and the ICU complication rate by the number of organ dysfunctions; both were independently associated with hospital outcome.

Previous studies have identified physiologic factors such as forced expiratory volume in 1 sec and arterial blood gas abnormalities to be important predictors of mortality rate (13, 17–20). However, such respiratory variables are more important for long-term outcome than for hospital survival (17–19). Hill et al. (15) found no significant relationship between arterial blood gas concentrations and hospital mortality rate. Recent spirometry measurements were not available for most of our patients at the time of the ICU admission. In the present study, low arterial pH was associated with increased mortality rate, and arterial oxygen and carbon dioxide tensions were not.

In selected patients with COPD who have acute respiratory failure, noninvasive MV can reduce the need for endotracheal intubation and can reduce in-hospital mortality rate (14, 21, 22). We tried noninvasive ventilation in 40% of admissions, with a success rate of 54% in avoiding endotracheal intubation or death. Although invasive MV is associated with high mortality rates, it was not an independent risk factor for hospital outcome in our study. This is similar to the finding by Seneff et al. (13). The mortality rate of patients with COPD requiring invasive MV ranged from 31% to 80% before 1980 (23–27) and 30% to 50% since 1980 (13, 15, 28–32). The hospital mortality rate was 20% for our patients who required invasive positive pressure ventilation. Although a comparison of the different studies is not easy because of the heterogeneity of the patient populations, with differences in causes of acute respiratory failure and severity of illness, the low mortality rate in the present study may reflect the recent practice of using lower tidal volumes during positive pressure ventilation. Although we did not find significant differences in plateau pressure

Physiologic abnormalities at admission to an intensive care unit measured by the Acute Physiology and Chronic Health Evaluation II prognostic system and development of nonrespiratory organ dysfunction were associated with a lower survival rate.

and auto-PEEP between survivors and nonsurvivors among patients requiring invasive MV, strategies aimed at reducing dynamic hyperinflation are likely to decrease the incidence of hemodynamic compromise and barotrauma in patients with COPD requiring positive pressure ventilation. No randomized, controlled trials have studied patients with obstructive airway disease. However, observational studies indicate that permissive hypercapnia reduces the mortality rate of patients with status asthmaticus (33, 34).

Measurement of severity is important in describing and comparing treatment regimens and disease outcomes. The APACHE, Simplified Acute Physiology Score, and Mortality Probability Models prognostic systems are used to predict the outcome of critically ill patients admitted to ICUs (8, 35–37). However, few studies have addressed the role of these prognostic systems in predicting the mortality rates of patients with COPD who were treated in ICUs for acute respiratory failure. Although its discrimination power was not impressive, the Simplified Acute Physiology Score was higher for nonsurvivors than survivors in a study of 322 patients with chronic respiratory insufficiency who were admitted to an ICU for acute respiratory failure, 45% of whom had COPD (38).

In a multiple-center study from France, the mortality rate for patients with COPD who had a Simplified Acute Physiology Score between 10 and 15 was 12% (39). Among 362 ICU admissions for COPD exacerbation from the original APACHE III database, nonsurvivors had a higher APACHE III score than survivors (13). The power of the APACHE III equation in predicting hospital outcome of critically ill patients with COPD who had acute respiratory failure was shown to be higher than that of the APACHE II equation (40). However, because of the proprietary nature of the APACHE III prognostic system, APACHE II is more widely used in studies of critically ill patients. Among patients hospitalized for acute respiratory failure, APACHE II scores were shown to be higher in nonsurvivors (15). Similar to our findings, a study from Australia showed the actual mortality rate of critically ill patients with acute exacerbation of COPD to be less than that of the APACHE II-predicted mortality rate (10). In the study by Sun et al. (40) the AUC was 0.787 for APACHE II and 0.833 for APACHE III; the AUC for the APACHE II was 0.748 in our study. Because the APACHE II prognostic system was developed about 2 decades ago and did not include any measurement for some organ dysfunctions, its current predictive power is not expected to be as strong as that of APACHE III.

The development of organ failure in critically ill patients is associated with increased mortality rate (7). The major risk factor for hospital death in critically ill patients with COPD is the development of nonrespiratory organ system dysfunction (13). Although respiratory system dysfunction plays a significant role in the long-term outcome of patients with COPD, nonrespiratory organ dysfunctions have more of an effect on the hospital mortality rate of patients with acute exacerbation of COPD (13). The development of renal and cardiac failure has been associated with poor outcome in critically ill patients with COPD (38). Nonpulmonary organ failure developed in 20% of our patients, and it was the most significant risk factor for hospital death. Moreover, there was a strong association between the development of sepsis and nonpulmonary organ failure, highlighting the importance of preventing infection to improve patient outcome.

This study has several weaknesses. The study population was relatively small. Potentially important prognostic data were not obtained, including patients' activities of daily living, number of episodes of respiratory failure before the study, outpatient medications, and pulmonary function values. No information was available after the survivors were dismissed from the hospital. Because the study was performed in one inner-city, tertiary medical center, our findings may not apply to other patient populations. Moreover, the exact timing of sepsis and organ failure in relationship to ICU admission and death was not determined in the present study. Despite these weaknesses, our study adds new information to the medical literature in that we have described the incidence of nonrespiratory organ failure and sepsis and the impact of these complications on hospital mortality rate.

CONCLUSION

Our study describes the prognostic factors, complications, and outcomes of patients with COPD admitted to an inner-city ICU for acute respiratory failure. The hospital mortality rate was lower than predicted. Physiologic abnormalities at admission to an ICU measured by the APACHE II prognostic system and development of nonrespiratory organ dysfunction were associated with a lower survival rate.

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