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The effect of race on long term mortality in mechanically ventilated patients

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ABSTRACT

Objective: Determine the impact of race on one-year mortality following mechanical ventilation.
Background: There is a lack of prospective studies on the effect of race on survival following mechanical ventilation.
Methods: Observational study of adult patients on ventilatory support for <24 h prior to enrollment. Socioeconomic factors, laboratory and clinical data were recorded. Primary outcome was one-year mortality.
Results: We enrolled 178 patients; 100 African American (AA), 78 other races (OTH). One-year mortality for AA was 49% and 33% for OTH ($p = 0.035$). After correcting for covariates, race was not significantly associated with mortality ($p = 0.42$). AA patients had higher mean arterial blood pressure, serum creatinine, heart rate, and peak ($p < 0.01$) and mean ($p = 0.05$) airway pressures.
Conclusions: AA patients who underwent mechanical ventilation had greater one-year mortality, although race per se was not a significant factor. It remains to be determined if strict blood pressure control and lower airway pressures may improve survival in this racial group.

Introduction

Conflicting evidence has emerged over the past few decades regarding health outcomes among individuals of different racial and ethnic backgrounds in the United States.[1,2] It is well established that there is a disparity in mortality rates between African Americans (AA) and Whites that starts at birth, peaks in early adulthood and slowly narrows thereafter.[2–6]

On the other hand, little is known about the association of race with the long-term survival of patients who undergo treatment with mechanical ventilation in the intensive care setting. Most studies on the subject derive from retrospective analyses of large databases, again yielding contradictory results. For example, data from three Acute Respiratory Distress Syndrome (ARDS) network trials found AA race not to be a significant factor in determining the 60-day mortality rates when adjusted for severity of illness.[7] On the other hand, the annual age-adjusted mortality rate for ARDS in the

Abbreviations: AA, African American; F_iO_2, Fraction inspired oxygen; HIV, Human immunodeficiency virus; ICU, Intensive Care Unit; LOS, Length of stay; MAP, Mean arterial pressure; OTH, Other Races; $(Paw)_{mean}$, Mean airway pressure; $(Paw)_{peak}$, Peak airway pressure; PEEP, Positive end-expiratory pressure; SAPS II, Simplified Acute Physiology Score II; SES, Social-economic status; SOFA, Sequential Organ Failure Assessment score.

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United States, culled from over 300,000 decedents from 1979 to 1996, was higher for AA than for Whites.[8] In a prospective study by Erickson et al, higher 60-day crude mortality was noted among mechanically ventilated AA patients.[9] They also showed that AA race was not independently associated with mortality. To our knowledge, these data have not been reproduced by subsequent prospective studies.

Here we present results from a prospective, observational study on the association of race and long-term survival in critically ill patients who underwent ventilatory support. We also examined the effect on outcome of several socioeconomic and demographic variables that have been shown to affect mortality in the general population, among them marital status and annual income.[10–17]

Methods

This was a prospective, longitudinal, observational, cohort study of mechanically ventilated adult patients, conducted in a mixed, multidisciplinary ICU at The George Washington University Hospital, between March 2011 and January 2013. The study was approved by the Institutional Review Board (IRB No. 110910), who determined that informed consent could be waived, provided that patients or their surrogates were allowed to opt out from the study.

Patients 18 years of age or older, mechanically ventilated for less than 24 h, were considered for enrollment. Patients were excluded from analysis if they died or were extubated less than 12 h from enrollment, or if they voluntarily withdrew from the study.

Given the observational nature of the study, physicians not taking part in the study determined all treatment modalities, including ventilatory parameters.

Patient's self-reported race, marital status, whether or not they were currently employed, and their mail addresses were recorded in the medical chart at the time of enrollment. Average household income, home price and percent below poverty were determined based on the patient's zip code, as reported in the 2010 US Census.[18]

Quintiles were calculated for mean home value, mean income and percent below poverty, and the mean quintile score was calculated as a substitute for socioeconomic status (SES), as patients' occupation, education and household income were not available.[19] Medical insurance information was recorded from the medical chart and classified as: uninsured, private insurance, Medicaid, Medicare, and Medicare with private co-payment or with Medigap.

Type of admission (medical, scheduled or emergency surgery), admission diagnoses, Simplified Acute Physiology Score II (SAPS II), Sequential Organ Failure Assessment score (SOFA), Glasgow Coma Scale score modified for intubated patients (verbal score = 1), hemodynamic data, laboratory values and ventilator settings were recorded upon enrollment.[20–22] Patients' hospital and outpatient clinic charts were used to determine comorbid conditions. These included use of alcohol, tobacco or illicit drugs, human immunodeficiency virus (HIV) infection, malignancy, chronic lung disease, diabetes mellitus, systemic hypertension, chronic kidney disease, cardiac disease, anemia (defined as hemoglobin <10 g/dL) and morbid obesity (body mass index > 40 kg/m^2).

The immediate indication for mechanical ventilation was recorded as respiratory failure, post-operative complication or airway protection. Mechanical ventilator data were recorded in real time, with a software written specifically for this purpose, from the time of enrollment until the patient died, was weaned from the mechanical ventilator or was transferred to a long-term care ventilator facility. The recorded airway pressures were characterized as the average pressure (Paw mean) as well as the highest pressure developed in one breath (Paw peak). Hourly measurements of mean arterial pressure (MAP), heart rate, and the dosage of intravenous (I.V.) medications administered, were transcribed from the ICU chart.

We divided the patients according to their self-reported race into an AA group and a group comprised of all other races (OTH). This classification followed the National Institutes of Health (NIH) policy on reporting race and ethnicity data.[23] The OTH group encompassed patients of White, Asian, Native American, and of more than one race.

The primary outcome was one-year all-cause mortality, measured from the date of enrollment. The subject's vital status was initially obtained from the hospital or the outpatient clinic chart. Telephone interviews were conducted in those instances where the subject had not been seen in the outpatient clinic or readmitted to the hospital. Secondary outcomes were duration of ventilatory support, ICU and hospital length of stay (LOS).

Data analysis

A sample size of 164 patients was projected to detect a 20% difference in mortality rates between the groups, with 90% power and a two-sided p value of 0.05. Student's t-test or the Mann–Whitney test was used to determine significant differences between independent samples as deemed appropriate. Pearson's chi square test was used to compare medication-use.[24] Kaplan–Meier analysis was used to compare the groups from the time of enrollment to death. Patients who remained alive were censored at one year; patients lost to follow-up were censored at their last follow-up date. A worse-case sensitivity analysis of primary outcome variables was performed to account for missing data.

Logistic regression was used to investigate the independent association of race with death, after controlling for covariates that were found to be significantly associated with mortality in the univariate analysis. These included sex, SES, reason for mechanical ventilation, admission type, medical insurance type, marital status, age, enrollment values for partial arterial oxygen pressure, diastolic blood pressure and serum creatinine >1.5 mg/dL, and average values for heart rate and mean airway pressure ($(Paw)_{Mean}$) measured during the course of ventilatory support. A stepwise logistic regression model was used with a cutoff for model entry and exit of $p < 0.10$, except that race was included in all models. The CKD-EPI formula, which adjusts serum creatinine values based on sex, age, and race, was used in a sensitivity analysis to determine whether serum creatinine might have functioned as an indicator for race in the logistic regression model.[25,26] Cox Regression was used to examine time to death by race, after controlling for the covariates that remained in the final logistic regression model. Unless otherwise specified, data are shown as median (interquartile range). All reported p values are two-tailed with $p < 0.05$ considered significant.

Results

Demographics

Of 212 patients enrolled, 34 died or were extubated within 12 h from enrollment. Five patients voluntarily withdrew from the study and were excluded from data analysis. Of the remaining 178 patients, 100 were AA (56.2%) and 78 were OTH (43.8%). The percentage of patients who were either unemployed or retired was similar for both groups (65% for AA and 55% for OTH; $p = 0.22$). Fewer AA patients were married (16% v. 44%; $p < 0.001$). The AA group lived in areas with a lower average household income ($59,994 v. $86,503; $p < 0.0001$) and home price ($348,188 v.