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ORIGINAL RESEARCH

Outcomes of Obese Intensive Care Patients with Acute Respiratory Failure

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Introduction

Obesity is a growing general health problem involving more than one third of the United States adult population. While obesity is considered a major risk factor for the development of a number of respiratory diseases, its effect in the critical care setting is not clear with a paucity of studies with conflicted results.

Methods

We conducted a retrospective study of patients admitted to the intensive care unit of our institution between September 2015 and September 2017 with acute respiratory failure requiring intubation. At admission patient's demographic information with height and weight were collected along with an APACHE II Score. Patients were followed until discharge with data collected on length of stay, intubation days, re-intubation, mortality, tracheostomy, and PEG placement. IRB approval was obtained #17108.

The initial dataset included 231 patients. Of the original 231 patients, 51 were excluded; 48 did not have APACHE II Scores and 3 patients did not have information to calculate BMI. Obesity was defined as BMI ≥ 30 and <70 . An additional 14 patients were excluded with BMI > 70 and one patient with extremely high APACHE II score. The remaining 161 patients were further stratified into obesity classes I, II, and III.

Univariate logistic regression was employed to identify relationships between variables of interest and ROC analysis identified threshold values for continuous variables. Those thresholds were then used to generate indicator variables for logistic regression. Odds ratios were calculated to interpret results.

Results

The cohort of 166 patients included, 59 females, and 107 males, with 119 (71.68%) patient survivors and 47 (28.31%) died. Univariate logistic regression showed a very strong relationship between APACHE II Score and mortality ($p=0.0056$, odds ratio 1.0442, 95% confidence interval 1.0127 - 1.0766). The probability of death increased by 51.08% for increasing APACHE II scores compared to previously calculated lower score. Gender

was not found to be statistically significant as a predictor of mortality ($p=0.539$). ROC analysis showed a weak (0.6448) area under the curve with threshold of 21.5 as APACHE II Score. Apache II Score itself was found to be statistically significant in logic regression ($p=0.0020$) with an odds ratio of 2.9919, 95% (CI of 1.4910, 6.0035). The probability of death was 74% greater for patients with calculated APACHE II scores ≥ 21.5 as compared to those patients with APACHE II scores ≤ 21.5 . BMI was not significantly related to mortality ($p=0.983$), in the logistic regression analysis. There was no relationship between mortality and degree of obesity, categorized by Class I (BMI 30-34.9), Class II (BMI 35-39.9), Class III (BMI >40), and Fisher's Exact Test $p = 0.35$ (Table 1). Further categorization by high and low APACHE II scores ≥ 21.5 as compared to those patients with APACHE II scores ≤ 21.5 also showed no statistical difference, Fisher's Exact Test $p = 0.66$ (Table 2).

Discussion

The aim of our retrospective study of was to evaluate the risk of mortality in obese patients due to acute respiratory failure requiring intubation in the Intensive Care Unit (ICU). Admission, APACHE II Score and Body Mass Index (BMI) were calculated. Prior studies examined APACHE II score to obese patient's outcomes. Studies examined outcomes in patients with extreme obesity,¹ severe acute pancreatitis,² sepsis,³ and common comorbidities related to obesity.⁴ Our results suggest obese ICU patients with acute respiratory failure requiring intubation do not have increased mortality. Because our sample did not include normal weight patients, our study is limited. Stratifying the patients' obesity classes (Class I, II, III), also showed no significant increase in mortality.

Patients with a BMI over 30 kg/m² are considered to be obese. Furthermore, a study of the obesity rate in the county is 39.3%, which is significantly higher than the California State obesity rate of 25.1%. Our county's is very near to the United States average BMI of 39.8%.⁵

Obesity is correlated to an increase in all-cause mortality. These patients are at an increased risk for developing a myriad of medical diseases including but not limited to: diabetes mellitus, hypertension, dyslipidemia, cardiovascular disease, and various

cancers.⁶ Adipose tissue deposition itself may lead to respiratory complications such as sleep apnea and obesity hypoventilation syndrome. Additionally, obese patients have an underlying ventilation-perfusion mismatch that causes hypoxia, decreased compliance of the lung, a high incidence of post-extubation wheezing, and an increased risk of aspiration.⁷

The mortality risk of patients under ICU management is measured by the APACHE II Score. APACHE II is a point-based system, range 0 to 71, that can be used for risk stratification of critical illness and to compare the care received by patients with similar risk characteristics. APACHE II is based upon values of 12 routine physiologic measurements, age, and previous health status of the patient upon initial presentation. An increasing score is closely correlated with the subsequent risk of hospital death. The original study that established APACHE II used a sample size of 5790 all-cause ICU admissions from 13 hospitals,⁸ this makes it a powerful scoring index. This scoring system is one of the most commonly used in research for its simplicity and effectiveness.

In our study we found that the probability of death is 74.95% greater for those patients with calculated APACHE II scores ≥ 21.5 as compared to those patients with APACHE II scores ≤ 21.5 . BMI was found to not be related to mortality ($p=0.983$),

based on logistic regression analysis. In patients with BMI ≥ 30 , data failed to show any relationship between mortality and degree of obesity ($p=0.848$).

Our results demonstrate that higher APACHE II score on admission was strongly correlated with a poorer patient prognosis. However, obesity was not shown to have an impact on mortality regardless of obesity class and gender. To our knowledge, this is the first study that suggests that increasing body mass index in patients with acute respiratory failure does not have significant impact on mortality.

Limitations

The limitations of this study, include retrospective, single community hospital and single ICU with limited power.

Conclusion

Our study suggests there is no correlation between degree of obesity or increasing body mass index and mortality in obese patients with acute respiratory failure requiring intubation. Larger prospective multi-institutional studies are needed to validate this finding.

Figure 1:

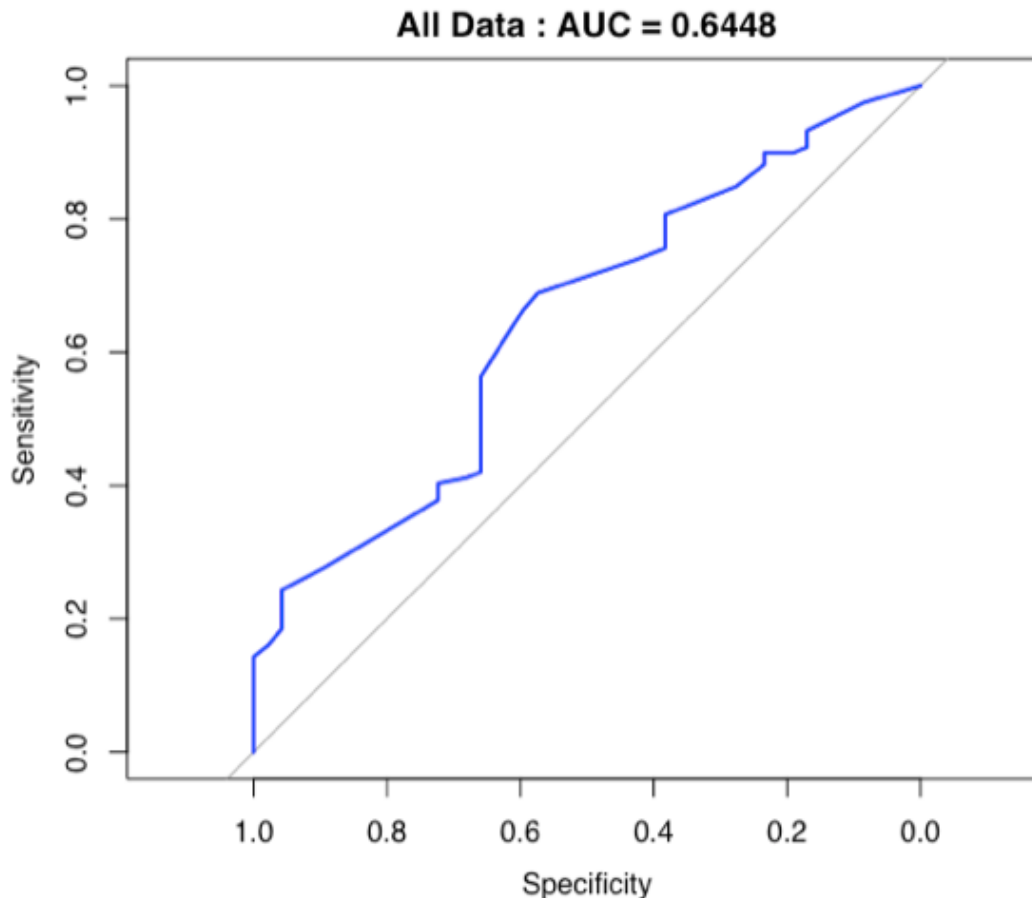


Table 1:

| | Class I (14) | Class II (29) | Class III (118) |
|----------|--------------|---------------|-----------------|
| Survived | 10 | 24 | 82 |
| | 8.62% | 20.69% | 70.69% |
| Died | 4 | 5 | 36 |
| | 8.89% | 11.11% | 80.00% |

Table 2:

| | Class I | Class II | Class III |
|------------------|---------|----------|-----------|
| APACHE II > 21.5 | 6 | 9 | 46 |
| | 9.84% | 14.75% | 75.41% |
| APACHE II ≤ 21.5 | 8 | 20 | 72 |
| | 8.00% | 20.00% | 72.00% |

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