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VALIDATION OF SIMPLIFIED ACUTE PHYSIOLOGY SCORE 3 (SAPS 3), FOR PREDICTING MORTALITY IN THE RESPIRATORY INTENSIVE CARE UNIT

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INTRODUCTION: Several scoring systems have been developed over the years to predict ICU outcome. Of all the models developed, SAPS 3 is a recent one and has gained in popularity due to its large and varied developmental cohort.[1] Most of the outcome prediction models do not perform equally well in other geographical settings. In this prospective study, we sought to validate SAPS 3 in a respiratory intensive care unit (ICU) in a tertiary care university-based hospital in South India.

METHODS: The sample size was calculated by standard methods using the odds ratio and was estimated to be 150 with a power of >0.8. Outcome of interest was ICU mortality. SAPS 3 data within 24 hours was collected in 150 adult patients admitted in ICU over a period of 12 months. Multivariate logistic regression analysis was applied after univariate analysis of the data. The data were validated using Hosmer-Lemeshow Goodness of Fit tests for calibration and ROC analysis for discrimination.

RESULTS: The ICU mortality was 24.67% (35/150). The median (interquartile range) of SAPS 3 score in ICU survivors was 50 (41 to 59) and 69 (59 to 83). SAPS 3 was found to predict ICU mortality on logistic regression analysis with good calibration (p=0.173) and discrimination (AUC=0.821 with 95% CI=0.74 to 0.89). Analysis also found that the ideal cut-off was 57 at which the sensitivity and specificity would be 84% and 71% respectively. Results of logistic regression analysis are depicted in the Table. Mortality predicted from our model for some SAPS 3 scores found in our sample are as follows: score (% mortality): 20 (1%), 40 (5.7%), 57 (21%), 60 (26%), 80 (66%), 100 (92%).

DISCUSSION: Risk prediction models developed in another country require validation and recalibration before being used to provide risk-adjusted outcomes within a new country setting.[2] SAPS 3 score was validated in Central and Western Europe.[3] Whereas, in another study,in a cohort of 28,357 patients from 147 Italian intensive care units, although discrimination was good, calibration turned out to be poor.[4] Our findings indicate consistency in both calibration and discrimination of SAPS 3 scoring in predicting ICU mortality in our setting that consists of medical and surgical cases in need for ventilatory support.

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Logistic Regression Analysis for SAPS 3 Score

Predictor	Co-efficient	P value	Odds ratio	95% CIs for Odds ratio
Constant	-6.31276	0.000		
SAPS 3 Score	0.08747	0.000	1.09	1.06 to 1.13

P value for overall predictive ability of SAPS 3 score for ICU mortality is 0.000 (Log-Likelihood = -64.181). Goodness-of-fit testing with Hosmer-Lemeshow method revealed P value of 0.173

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AMONG NUTRITION CRITERIA, ADMISSION DAY HYPOALBUMINEMIA PREDICTS ICU MORTALITY

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INTRODUCTION: The role of nutrition criteria in influencing mortality in intensive care units (ICUs) is controversial.[1-3] In this prospective study, we sought to evaluate nutrition criteria in predicting mortality in a respiratory intensive care unit (ICU) in a tertiary care University-based hospital in South India. The ICU setting consists of medical and surgical patients requiring ventilatory support.

Methods: During a prospective observational study related to validation of SAPS 3 scoring system, nutrition criteria were collected in 150 adult patients admitted in ICU over a period of 12 months. Outcome of interest was ICU mortality. The data included body mass index (BMI), mid-arm circumference, triceps skin-fold thickness, abdominal girth, serum albumin, albumin/globulin (A/G) ratio, and hemoglobin. Data were collected in the first 24 hours of admission. For BMI, possible influence of malnutrition and obesity was studied. Multivariate logistic regression was applied after univariate analysis of the data. ROC analysis was done for discrimination.

RESULTS: The ICU mortality was 24.67% (35/150). Of the variables studied, albumin/globulin ratio and serum albumin were found to be significant on univariate analysis. Multivariate analysis by logistic regression analysis identified serum albumin as the sole independent predictor of ICU mortality. The results of logistic regression are depicted in the Table. The area under the ROC curve was 0.686 with 95% CI=0.594 to 0.778). Analysis also found that the ideal cut-off was 2.6 gm/dl at which the sensitivity and specificity would be 68% and 66% respectively.

DISCUSSION: Nutritional status of an individual can affect the ICU outcome in several ways. Both Low BMI (malnutrition)[4] and high BMI (obesity) are equally important. Low serum albumin is an indicator for pre-existing malnutrition and liver disease.[5] Obesity with its adverse affects on respiratory physiology complicates the ICU course especially in those requiring ventilatory support. Paradoxically, obesity may improve outcome related to increased fat reserves to sustain the metabolic stress.[2] In the present study, among the nutrition criteria, we could identify only the admission day serum albumin as the sole independent predictor of ICU mortality. Further studies are required to verify whether therapy targeted to correct hypoalbuminemia in the ICU improves the outcome.

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Results of Logistic Regression Analysis

Predictor	Co-efficient	P value	Odds ratio	95% CIs
Constant	1.73916	0.045		
Albumin	-0.85788	0.007	0.42	0.23 to 0.79
A/G ratio	-0.55893	0.396	0.57	0.16 to 2.08

The P value for overall predictive ability of the model is 0.002 (Log-likelihood = -77.506). Goodness-of-fit testing with Hosmer-Lemeshow method revealed P value of 0.499. Mortality predicted from our model for some serum albumin values (gm/dl) found in our sample are as follows: albumin (% mortality): 1.0 (71%), 2.0 (51%), 2.6 (48%), 3.0 (30%), 4.0 (16%), 5.0 (7%).

AMONG NUTRITION CRITERIA, ADMISSION DAY HYPOALBUMINEMIA PREDICTS ICU MORTALITY

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Abstract

Introduction: The role of nutrition criteria in influencing mortality in intensive care units (ICUs) is controversial (1-3). In this prospective study, we sought to evaluate nutrition criteria in predicting mortality in a respiratory intensive care unit (ICU) in a tertiary care University-based hospital in South India. The ICU setting consists of medical and surgical patients requiring ventilatory support.

Methods: During a prospective observational study related to validation of SAPS 3 scoring system, nutrition criteria were collected in 150 adult patients admitted in ICU over a period of 12 months. Outcome of interest was ICU mortality. The data included body mass index (BMI), mid-arm circumference, triceps skin-fold thickness, abdominal girth, serum albumin, albumin/globulin (A/G) ratio, and hemoglobin. Data were collected in the first 24 hours of admission. For BMI, possible influence of malnutrition and obesity was studied. Multivariate logistic regression was applied after univariate analysis of the data. ROC analysis was done for discrimination.

Results: The ICU mortality was 24.67% (35/150). Of the variables studied, albumin/globulin ratio and serum albumin were found to be significant on univariate analysis. Multivariate analysis by logistic regression analysis identified serum albumin as the sole independent predictor of ICU mortality. The results of logistic regression are depicted in the Table. The area under the ROC curve was 0.686 with 95% CI=0.594 to 0.778). Analysis also found that the ideal cut-off was 2.6 gm/dl at which the sensitivity and specificity would be 68% and 66% respectively.

Discussion: Nutritional status of an individual can affect the ICU outcome in several ways. Both Low BMI (malnutrition) (4) and high BMI (obesity) are equally important. Low serum albumin is an indicator for preexisting malnutrition and liver disease (5). Obesity with its adverse affects on respiratory physiology complicates the ICU course especially in those requiring ventilatory support. Paradoxically, obesity may improve outcome related to increased fat reserves to sustain the metabolic stress (2). In the present study, among the nutrition criteria, we could identify only the admission day serum albumin as the sole independent predictor of ICU mortality. Further studies are required to verify whether therapy targeted to correct hypoalbuminemia in the ICU improves the outcome.

References:

1. Garrouste-Orgeas, M., et al., Intensive Care Med, 2004; 30:437-43.
2. Hogue, C.W., Jr., et al. Intensive Care Med, 2009; 35: 1152-70.
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5. Ryan, A.M., et al., J Gastrointest Surg, 2007;11:1355-60.

Table: Results of logistic regression analysis

Predictor	Co-efficient	P value	Odds Ratio	95% CIs
Constant	1.73916	0.045		
Albumin	-0.85788	0.007	0.42	0.23 to 0.79
A/G ratio	-0.55893	0.396	0.57	0.16 to 2.08

The P value for overall predictive ability of the model is 0.002 (Log-likelihood = -77.506). Goodness-of-fit testing with Hosmer-Lemeshow method revealed P value of 0.499. Mortality predicted from our model for some serum albumin values (gm/dl) found in our sample are as follows: albumin (% mortality): 1 (71%), 2 (51%), 2.6 (48%), 3 (30%), 4 (16%), 5 (7%).

Introduction and Methods

Introduction

The role of nutrition criteria in influencing mortality in intensive care units (ICUs) is controversial [1-3].

While there have been some studies that have hinted at a very poor nutritional status being responsible for poor outcomes [1], others have shown inconclusive results [2-3].

Some studies have concluded that obesity is associated with increased morbidity but not increased mortality [4].

In this prospective study, we sought to evaluate nutrition criteria in predicting mortality in a respiratory intensive care unit (ICU) in a tertiary care University-based hospital in South India. The ICU setting consists of medical and surgical patients requiring ventilatory support.

Methods:

During a prospective observational study related to validation of SAPS 3 scoring system, nutrition criteria were collected in 150 adult patients admitted in ICU over a period of 12 months. Outcome of interest was ICU mortality.

The data included

✓ body mass index (BMI), Kg/Sq.m

✓ mid-arm circumference (MAC): cm

✓ triceps skin-fold thickness, (TST); mm

✓ abdominal girth, (Abd. Girth): cm

✓ serum albumin (Alb): gm/dL

✓ albumin/globulin (A/G) ratio

✓ hemoglobin. Gm/dL

Data were collected in the first 24 hours of admission. For BMI, possible influence of malnutrition and obesity was studied.

For univariate analysis, the continuous data between the survivors and non-survivors were analyzed by Mann-Whitney U test and categorical data were analyzed by chi-square test. A P value < 0.05 was considered significant.

The data found significant were subjected to multivariate logistic regression analysis. Hosmer and Lemeshow's Goodness-of-Fit was used to test the calibration [5].

For discrimination, the continuous data was separated for survivors and non-survivors and ROC analysis was performed. Area under the ROC curve was computed using nonparametric method described earlier [6].

Results

Results: The ICU mortality was 24.67% (35/150).

Table 1: Univariate Analysis

Variable Median (IQR)	Survivors (n=113)	Non-survivors (n=37)	P value
BMI	22.76 (21.5 to 24.54)	23.19 (21.03 to 24.82)	0.94
MAC	21.00 (17.85 to 24.75)	22.00 (18.80 to 27.00)	0.19
TST	13.50 (11.90 to 16.00)	13.70 (12.05 to 16.25)	0.56
Abd Girth	86.00 (79.00 to 92.00)	88.00 (81.00 to 93.00)	0.33
Alb	2.90 (2.34 to 3.40)	2.3 (2.05 to 2.90)	0.000
A/G ratio	1.09 (0.90 to 1.26)	0.9 0 (0.70 to 1.10)	0.007
Hb	10.10 (8.75 to 11.90)	9.40 (7.15 to 11.55)	0.235

The proportion of patients with malnutrition and obesity in survivors and non-survivors were similar (chi-squared test)

Table 2: Results of multi-variate logistic regression analysis

Predictor	Co-efficient	P value	Odds Ratio	95% CIs
Constant	1.73916	0.045		
Albumin	-0.85788	0.007	0.42	0.23 to 0.79
A/G ratio	-0.55893	0.396	0.57	0.16 to 2.08

Log-Likelihood = -77.506
Test that all slopes are zero: G = 12.580, DF = 2, P-Value = 0.002

Table 3: Goodness-of-Fit Tests

	Chi-square	DF	P value
Hosmer-Lemeshow	7.352	8	0.499

General Logistic Regression Equation

$$z = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k$$

$$z = \alpha + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k$$

$$f(z) = \frac{1}{1 + e^{-z}} = \frac{1}{1 + e^{-(\alpha + \Sigma \beta_i X_i)}}$$

Results and Discussion

Logistic Regression Equation for the Present Model

Z= 1.7396 + (-0.85788 x Serum albumin gm/dL)

Based on our model, the area under the ROC curve (**Figure 1**) was 0.686 with 95% CI=0.594 to 0.778. Analysis also found that the ideal cut-off was 2.6 gm/dl at which the sensitivity and specificity would be 68% and 66% respectively.

Figure 1: ROC Curve analysis

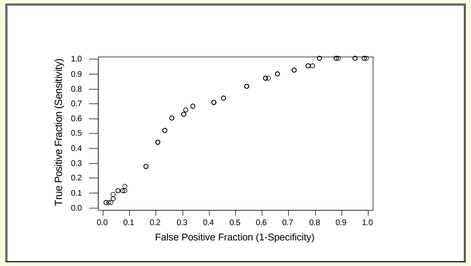

Table 4: ICU Mortality prediction from admission day serum albumin

Serum albumin (gm/dL)	Probability (%) ICU Mortality
1 gm/dL	71%
2 gm/dL	51%
2.6 gm/dL	48%
3.0 gm/dL	30%
4.0 gm/dL	16%
5.0 gm/dL	7%

Discussion:

Nutritional status of an individual can affect the ICU outcome in several ways. Both Low BMI (malnutrition) (7) and high BMI (obesity) are equally important. Low serum albumin is an indicator for preexisting malnutrition and liver disease (8). Obesity with its adverse affects on respiratory physiology complicates the ICU course especially in those requiring ventilatory support. Paradoxically, obesity may improve outcome related to increased fat reserves to sustain the metabolic stress (2). In the present study, among the nutrition criteria, we could identify only the admission day serum albumin as the sole independent predictor of ICU mortality. Our results concur with a recent study on outcomes in critically ill surgical patients with serum albumin levels associated with poor prognosis. The association between serum albumin levels (g/dL) and mortality were as follows: 0 to 2.5 (29.92%), 2.5 to 3.5 (10.42%), and > 3.5 (9.88%). Slight differences with regard to serum albumin values and actual mortality may reflect differences in gentic, socio-economic and dietary habits between patient sample in south India and that of north America. Further studies are required to verify whether therapy targeted to correct hypoalbuminemia in the ICU improves the outcome.

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