Research Paper

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Serum Albumin: A Prognostic Marker in Critically Ill Patients

Medical Science

KEYWORDS : APACHE II Score, Critically Ill Patients, Morbidity, Mortality, Serum Albumin

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ABSTRACT

Introduction: In resource limited settings, there is a great need to predict the prognosis and outcome in critically ill patients. Currently the most commonly utilized scoring systems is the APACHE II. But, it does not include serum albumin concentration as an independent predictor. Serum albumin appears to be a reliable prognostic indicator in various contexts and is a simple and less time consuming test. The present study analysed the role of serum albumin as an independent prognostic marker in critically ill patients and compare the results with APACHE II.

Materials & Methods: A Prospective observational study was conducted at a tertiary care institute including 300 critically ill patients. Routine investigations like Hb, WBC, platelet count, RFT, LFT, electrolytes and Serum albumin level were measured on day of admission to MICU. Serum albumin and APACHE II score were compared with each other with respect to mortality and morbidity indicators (need for ventilator support, complications and duration of hospital stay). Data was analysed using SPSS software ver. 21 using appropriate statistical tests. P-value of less than 0.05 was taken as level of significance

Results: The mean Serum albumin on day of admission to MICU in survivors and non survivors was 3.06 gm% (+/-0.54) and 2.45 gm% (+/- 0.50) respectively (p< 0.01). The mean APACHE II score in survivors and non survivors was 11.7 (+/- 5.65) and 19.18 (+/- 6.76) respectively (p< 0.01).On comparing these parameters as morbidity predictors, serum albumin levels in survivors with requirement of ventilation, having complications and those with prolonged hospital stay (>21 days) was significantly low, while no difference was observed with respect to APACHE II scores (p> 0.05).

Conclusions: Serum albumin level measurement can be used as a prognostic marker in critically ill patients for predicting mortality and morbidity, in addition to APACHE II Score along with clinical judgment.

INTRODUCTION

Critically ill patients are those that by dysfunction or failure of one or more organs/system depend on survival from advanced instruments of monitoring and therapy [1]. In Indian scenario, where there is scarcity of good ICU, low patient to doctor ratio and limitation of money and material, there is need for a good indicator to predict the risk of mortality and morbidity in such patient.

There are many scoring systems developed to predict the prognosis and outcome in critically ill patients. Currently, the commonly utilized scoring systems are the APACHE (acute physiology and chronic health evaluation) system, the Glasgow coma score (GCS), MPM (mortality probability model), SAPS (simplified acute physiology score), SOFA (sequential organ failure assessment) systems. These were all designed to predict outcomes in critical illness and use severity-of-illness scoring systems with common variables. These include: age, vital signs, assessments of respiratory, renal, and neurologic function; and an evaluation of chronic medical illnesses. But most of them are more time consuming and cumbersome and includes many clinical and lab parameters [2].

Serum albumin appears to be a reliable prognostic indicator in various contexts. A recent review suggests that serum albumin could be an independent predictor of mortality in a wide range of clinical and research settings [3]. Albumin concentrations may be a marker for subclinical disease in elderly patients. In studies of hospitalized patients, hypoalbuminemia is associated with increased length of stay, higher complication rates and higher mortality [4-8]. Serum albumin level measurement is simple, less time consuming and easily available.

Currently the most commonly utilized scoring systems is the APACHE II. But, it does not include serum albumin concentration as an independent predictor, and it has been found to be poorly predictive in hypoalbuminemia [9]. The APACHE III is more predictive of mortality in critical illness [10].

Hence we studied the role of serum albumin as an independent prognostic marker in critically ill patients and compare the results with APACHE II.

MATERIALS & METHODS

Study Design & Duration: A Prospective observational study was conducted at a tertiary care institute of Mumbai for duration of 1 year (2013-14).

Sample Size: 300 (Sample size was calculated by period prevalence in our MICU after applying exclusion and inclusion criteria)

Inclusion Criteria

1. Critically ill Patients [failure of one or more organs/system or depend on survival from advanced instruments of monitoring and therapy] admitted in MICU
2. Age > 18 years

Exclusion Criteria

1. Surgically ill [post-operative]
2. Nephrotic / nephritic syndromes
3. Cirrhosis of liver.

Methodology

Written informed consent was taken from each patient / relative of patient (if patient was not in state to give consent) and study explained. Appropriate history was taken and patients were assessed clinically on day of admission to MICU. Routine investigations like Hb, WBC, platelet count, RFT, LFT, electrolytes and Serum albumin level measured on day of admission to MICU. Radiological investigations like X ray, USG, CT Scan were carried according to need without any cost to patient. Serum albumin was compared to following parameters:

A. Mortality rate
B. Morbidity indicators:
1. Need for ventilator support
2. Complications

3. Duration of hospital stay

Also APACHE II score calculated on same day of admission to MICU and Serum albumin was compared to APACHE II with respect to above mentioned mortality and morbidity indicator.

Statistical Methods

Statistical analysis was done using SPSS software ver. 21.0. Analysis of qualitative data was done using chi-square tests and quantitative data was done using unpaired t-test if data passes 'normality test' or else by Mann-Whitney Test. Relationship between quantitative variables was assessed by using Pearson's Correlation if data passes 'normality test' or else by Sperman's correlation. Binary Logistic Regression analysis was used to find the efficacy of S. albumin and APACH II as screening test to predict mortality. A p-value of < 0.05 was taken as level of significance.

RESULTS

A total of 300 critically ill patients were included in the study, out of which 152 (50.7 %) patients were discharged from hospital (survivors) while 148 (49.3 %) died (non survivors). No significant difference was observed in mortality rate between males and females (p-0.54) while higher age (> 65 years) was associated with higher mortality (p-0.03). The mean S. albumin on day of admission in survivors and non-survivors was 3.06 gm% (+/-0.54) and 2.45 gm% (+/-0.50) (p< 0.01). Similarly mean APACHE II score in survivors and non-survivors was 11.7 (+/- 5.65) and 19.18 (+/- 6.76) (p< 0.01) (table 1). On comparing these parameters by binary logistic regression, we found that both S. albumin and APACHE II are good screening parameters for predicting mortality (table 3). So, low serum albumin and high APACHE II on admission indicates a poor prognosis in terms of mortality. On comparing these parameters as morbidity predictors, serum albumin levels in survivors with requirement of ventilation, having complications and those with prolonged hospital stay (>21 days) was significantly low, while no difference was observed with respect to APACHE II scores (p> 0.05) (table 2).So, in present study, we observed that serum albumin was a better predictor of morbidity than APACHE II score.

DISCUSSION

The present study was conducted on 300 patients who were critically ill and admitted in MICU. APACHE II score and Serum albumin concentrations were measured on day 1, as a prognostic marker to predict their outcome as either death or discharge from the hospital. Our study also compared these markers in patient's requiring mechanical ventilation, having prolonged hospital stay or developed complications.

In our study, we observed that older age (>65 years) was associated with higher mortality (p-0.03), suggesting that age is the significant factor for predicting outcome. In another study by Esteban A et al. [11], older age group has more mortality than young, which is comparable to our study.

APACHE II score has a proven role in predicting mortality. Higher APACHE II score indicates poor outcome. So, we compared APACHE II with serum albumin on day of admission in predicting mortality. In present study, we observed that, both S. albumin and APACHE II score are good screening parameters for predicting mortality.

A study by Rajnish Gupta & V.K. Arora, found mean APACHE II score in survivors and non-survivors as 11.34 ± 6.75 and 23.09 ± 10.01 respectively (p < 0.01) which is comparable to our study [12].Another study by Amr Elhadidy et al. found that APACHE II score is a good predictor of mortality [13]. In a study by Banga A et al. [14], mean serum albumin level on day of admission in survivors and non-survivors was 3.06 gm% (+/-0.54) and 2.45 gm% (+/-0.50) respectively (p< 0.05). Yap FM et al. also reported significantly low mean serum albumin in non-survivors than survivors (2.1 vs 2.57; p< 0.01) [15]. In another study, a serum albumin concentration of less than 3.4 gm% was associated with a 30-day mortality rate of 24.6% which increased to 62% if the serum albumin concentration was 20 gm% or less [16].

On comparing S. Albumin and APACHE II score as morbidity predictors; serum albumin levels in survivors with requirement of ventilation, having complications and with prolonged hospital stay (>21 days) was significantly low (p< 0.05). While, no difference was observed in these patients with respect to APACHE II scores (p> 0.05).

In one study by Chao-Hsiu Chen et al. [17], low serum albumin (<2.8 gm %) was associated with need of prolonged ventilator support. Another study by Ruben D Restrepo et al.,suggests that the presence of hypoalbuminaemia (<2.5 gm%) upon initiation of mechanical ventilation in patients was correlated with a longer ventilator length of stay [18].In another study by Rich MW, Keller AJet al., low serum albumin <3.5 gm% was associated with more complication rate and more hospital stay [19].Study by Dubois MJ et al. conclude that hypoalbuminemia was a potent, dose-dependent independent predictor of poor outcome. Each 10-g/L decline in serum albumin concentration significantly raised the odds of mortality by 137%, morbidity by 89%, prolonged intensive care unit and hospital stay respectively by 28% and 71%, and increased resource utilization by 66% [20]. Various other studies [4,6,21] also corroborated that, low serum albumin concentration correlates with increased length of stay in the intensive care unit (ICU) and with complication rates, such as ventilator dependency and the development of new infection.

CONCLUSION

Low serum albumin level on day of admission appears to be a significant marker in predicting outcome of critically ill patients in the form of mortality and morbidity. Thus serum albumin level measurement can be used as a prognostic marker in critically ill patients in addition to APACHE II Score along with clinical judgment.

TABLES

Table 1. Comparison of various parameters among survivors and non-survivors

Variables (n-300)	Outcome		p- value
	Survivors (n-152)	Non Survivors (n-148)	
Males (n-193)	95 (49.2%)	98 (50.8%)	0.54
Age > 65 years (n-48)	18 (37.5%)	30 (62.5%)	< 0.01
S. Albumin (mg %)	3.06 +/- 0.54	2.45 +/- 0.5	< 0.01
APACHE II	11.7 +/- 5.65	19.18 +/- 6.76	< 0.01

Table 2. Comparison of S. Albumin and APACHE II as morbidity indicators

Survivors			
	Need for Ventilation		p- value
	Yes (n-34)	No (n-118)	
S. Albumin	2.8 +/- 0.4	3.1 +/- 0.5	< 0.01
APACHE II	12.6 +/- 5.7	11.4 +/- 5.6	0.28
	Complications		
	Yes (n-21)	No (n-131)	
S. Albumin	2.7 +/- 0.4	3.1 +/- 0.5	< 0.01
APACHE II	13.1 +/- 7.7	11.5 +/- 5.3	0.21
	Prolonged Hospitalization (> 21 days)		
	Yes (n-18)	No (n-134)	
S. Albumin	2.8 +/- 0.4	3.2 +/- 0.5	< 0.01
APACHE II	12.68 +/- 5.83	11.13 +/- 5.48	0.21

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Table 3. Binary logistic regression analysis for prediction of mortality

Binary Logistic Regression Analysis						
Variables	B	S.E.	Wald	df	p- value	OR
S. Albumin	-1.79	0.3	34.37	1	< 0.01	0.16
APACHE	0.15	0.03	36.64	1	< 0.01	1.16
Constant	2.58	0.95	7.34	1	0.01	

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