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Original Research Article

Serum Albumin as a Prognostic Marker in Critically Ill Patients in Intensive Care Unit in a Tertiary Care Centre

Sagar Saha[1], Atul Debbarma[2], Saru Kumar Debbarma[3], Sandipan Debbarma[4], Subrata Bhowmik[5]

[1]Post Graduate Trainee, Department of Medicine, Agartala Government Medical College & GBP Hospital, Agartala, Tripura, India.
[2]Associate professor, Department of Medicine, Agartala Government Medical College & GBP Hospital, Agartala, Tripura, India.
[3]Associate professor, Department of Medicine, Agartala Government Medical College & GBP Hospital, Agartala, Tripura, India.
[4]Post Graduate Trainee, Department of Medicine, Agartala Government Medical College & GBP Hospital, Agartala, Tripura, India
[5]Senior Resident, Department of Medicine, Government Medical College & GBP Hospital, Agartala, Tripura, India.

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Corresponding author: Dr. Sagar Saha
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Abstract

Introduction: Albumin is the most abundant plasma protein and contributes to 50-60% of total protein of the body. Serum albumin is a useful marker of nutritional status of an individual. Besides maintaining colloidal osmotic pressure, it has important anti-inflammatory, anti-oxidant, ligand binding and anticoagulation properties**.** Serum albumin can be used as a good independent prognostic marker in critically ill patients in comparison with APACHE 2.

Materials and Methods: This study is a single centre observational study conducted in the ICU, Agartala Government Medical College, GB Pant Hospital for 1- and 1/2-years study periods. 322 patients are studied Serial albumin levels were estimated on admission, 24hrs, 48hrs and 72hrs.All the patient were be followed up till discharge or death and these 2 groups were termed as 'survivors' and 'nonsurvivors'. APACHE 2 scoring was done in all patients and compared with mean albumin level.

Results: Receiver operating characteristics curve was plotted using S Albumin at admission, S Albumin at 24 hrs, S Albumin at 48 hrs, S Albumin at 72 hrs and APACHE II scores to predict the mortality.

The area under the curve was 0.64, 95% CI (0.56-0.72) for APACHE II scores, 0.94, 95% CI (0.87-0.97) for S Albumin at admission, 0.91, (0.87-0.95) for S Albumin at 24 hrs, 0.90, 95% CI (0.86-0.93) for S Albumin at 48hrs and, S Albumin at 72 hours. All these AUCs were significant with the p value of <0.001 for predicting mortality. Among the survivors, no one had serum albumin level of <2.5 g/dL at 72 hours, 21 (8.4%) had (2.5- 3.0) g/dL, 112 (44.8%) had a level of (3.0-3.5) g/dL and 117 (46.8%) had >3.5g/dL. Among non-survivors, nearly half (51.4%) had a serum albumin level of (3.0-3.5)g/dL and 27 (37.5%) had albumin level in the range of (2.5-3.0)g/dL and only one patient had >3.5g/dL, 7(9.7%) had albumin <2.5g/dL.

There was a significant difference in serum albumin level at 72 hours and the status of survival with the p value of <0.001.

Conclusion: Serum albumin on 72 hrs correlated directly with higher mortality in Critically ill patients. Serum albumin on 72hrs and the level of change, during the hospital stay, had an impact on morbidity. At 72hrs serum albumin <2.5 mg/dl served as a poor prognostic marker. Serum albumin measured after 72 hrs was as accurate as the admission APACHE II score in correctly classifying patients according to outcome. Serial assessment of serum albumin provides useful prognostic information in critically ill patients. Serum albumin thus serves as a simple but powerful prognostic tool for critically ill patients.

Keywords: Serum albumin, APACHE 2, Critically il.

Introduction

Albumin is the most abundant plasma protein and contributes to 50-60% of total protein of the body [1]. Serum albumin is a useful marker of nutritional status of an individual. Besides maintaining colloidal osmotic pressure, it has important anti-inflammatory, anti-oxidant, ligand binding and anticoagulation properties. It also helps in microvascular integrity. It is possible that albumin has a role in limiting the leakage from capillary beds during stress-induced increases in capillary permeability. Endothelial cells seem to be able to control the permeability properties of the capillary membrane, possibly by altering the nature and distribution of glycoproteins in the vessel wall [2].

Under physiological conditions, albumin may have significant antioxidant potential. It is involved in the scavenging of oxygen free radicals, which have been implicated in the pathogenesis of inflammatory diseases. Physiological solutions of human serum albumin have been shown to inhibit the production of oxygen free radicals by polymorphonuclear leukocytes.

This may be related to the abundance of sulfhydryl (-SH) groups on the albumin molecule [3].

It serves as an indicator of overall clinical status in critically ill patients. Critically ill patients, ie, those who because of dysfunction of one or more organs or sepsis are at increased risk of mortality [4]. Albumin being a negative acute phase reactant, its concentration decreases often dramatically early in the course of illness and often does not increase till the recovery phase starts [5].

Hypoalbuminemia is associated with increased mortality and morbidity in critical illness [6-9]. It is cheap and effective way to stratify the patients and take required emergency measures.

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 [10]. 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. 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 [11].

There are many scoring systems developed to predict the prognosis and outcome in critically ill patients. 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 [12]. Currently the most commonly utilized scoring systems is APACHE 2 [13].

As most of scoring systems are more time consuming and cumbersome and includes many clinical and lab parameters, we need a simple and good outcome predictor in critically ill patient. Hence, serum albumin can be used as a good independent prognostic marker in critically ill patients in comparison with APACHE 2.

APACHE II score is a general measure of disease severity based on current physiologic measurements, age & previous health conditions. The score can help in the assessment of patients to determine the level & degree of diagnostic & therapeutic intervention.

Interpretation of APACHE II: minimum 0 and maximum 71; increasing score is associated with an increasing risk of hospital death. The advantage of the APACHE is that it can be used throughout the patient's hospital course in monitoring the patient's response to therapy. The accuracy of the APACHE II at admission as an early prognostic indicator of disease severity is about 75%; it is comparable with Ranson score in distinguishing mild from severe

Pancreatitis [14].

Aim & Objectives

Aim

The aim of the study is to evaluate serial serum albumin level as a prognostic marker in critically ill patients in intensive care unit in a tertiary care centre.

Objectives

1.To estimate serial serum albumin level in critically ill patient in intensive care unit.

2.To compare the serum albumin level with APACHE 2 scoring system as a predictor of mortality.

Materials and Methods

Study Type: Observational Study.

Study Design: A cross-sectional study.

Study Setting: This study will be conducted in the ICU, Agartala Government Medical College, GB Pant Hospital.

Study period: 1 and 1/2 years study periods.

Sample size = 322

Methodology

Key features of the critically ill patient are severe respiratory, cardiovascular or neurological derangement, often in combination, reflected in abnormal physiological observations53. 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 [11].

Written informed consent have to take from each patient / relative of patient (if patient was not in state to give consent) and study explained. Appropriate history has to be taken and patients have to be assessed clinically on day of admission to MICU. Serial albumin level will be estimated on admission,24hrs,48hrs and 72hrs24.All the patient will be followed up till discharge or death and these 2 groups shall be termed as 'survivors' and 'nonsurvivors'. APACHE 2 scoring will be done in all patients and will be compared with mean albumin level. Routine investigations like Hb, WBC, platelet count, RFT, LFT, electrolytes level have to measure on day of admission to MICU. Radiological investigations like X ray, USG, CT scan are carried according to need without any cost to patient.

Data Management:

After completion of data collection, the data will be summarized in terms of pie

charts, tables, columns, figures, and bar diagrams. For Categorical data chi-square test and for continuous data T-test will be applied.

Statistical package for social sciences (SPSS) software will be used for analysis of the data and Microsoft Word and Excel will be used to generate tables and figures.

Serum albumin estimation by BCG method:

Principle: Albumin binds with Bromo Cresol Green (BCG) at ph 4.2 causing a shift of the yellow BCG dye. The blue green colour is formed is proportional to the concentration of albumin, when measured photometrically between 580-630 nm with maximum absorbance at 624 nm. Estimation of serum albumin, potassium by ion selective electrode (I.S.E) Method[15].

Inclusion criteria:

1. Critically ill patients admitted in MICU.
2. Age>18 years.

Exclusion criteria:

1. Chronic liver disease. 2. Nephrotic Syndrome. 3. Nephritic Syndrome. 4. Malnutrition. 5. Patient not giving consent.

Results and Analysis:

Table 1: Survivors and non-survivors

Status	Number	Percentage
Survived	250	77.7
Not survived	72	22.4
Total	**322**	**100.0**

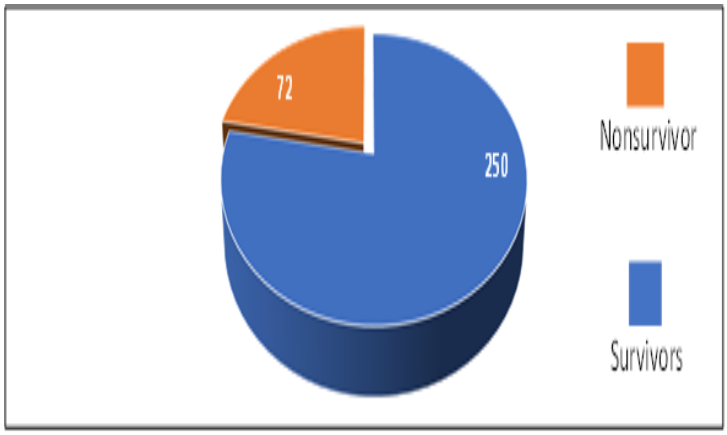

Figure 1: Survivors and Non-survivors.

We had recruited 322 participants for the purpose of our study. Out of 322 patients, 72 (22.4%) had not survived and 250 (77.7%) was alive.

Table 2: Gender distribution

Gender	Survivors			Non-survivors
	n	%	n	%
Male	133	53.2	43	59.7
Female	117	46.8	29	40.3
Total	**250**	**100**	**72**	**100**
Chi square p value=0.327 (Not significant)				

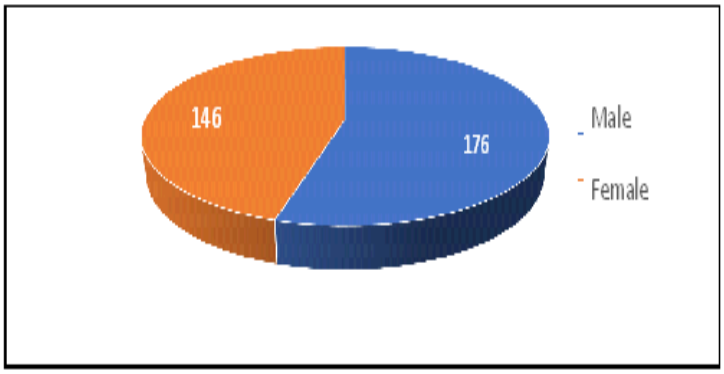

Figure 2: Gender Distribution

Among the survivors nearly half of them (53.2%) were men and the rest of 46% were women. Among the non survivors, 43 (59.7%) were men and 29 (40.3%) were women. There was no significant difference observed between the groups in terms of gender.

Table 3: Comparison of APACHE II score

Parameter	Survivors		Non-survivors		P value
	Mean	SD	Mean	SD	
APACHE II	10.7	3.2	12.7	4.0	**<0.001**

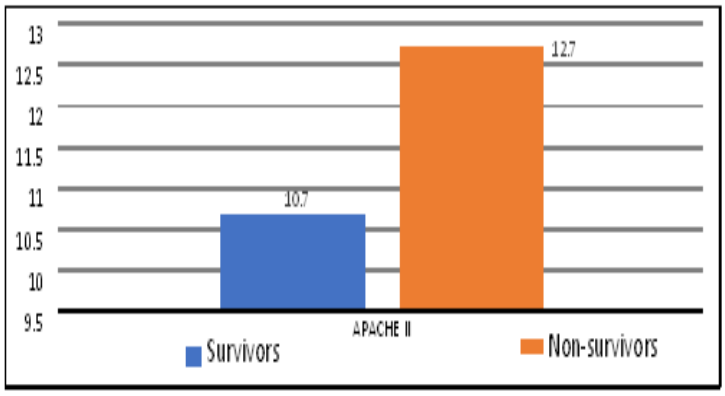

Figure 3: APACHE II Score among Survivors and Non-survivors

The mean (SD) APACHE II score among survivors was 10.7 (3.2) and the same was 12.7 (4.0) in the patients who were not survived. The mean APACHE II score was less among survivors compared to non-survivors. The difference of 2 in mean APACHE II scores was statistically significant with the p value of <0.001.

Table 4: Comparison of Serum albumin levels at different time points

Serum albumin	Survivors		Non-survivors		P value
	Mean	SD	Mean	SD	
Admission	3.2	0.3	2.5	0.3	**<0.001**
24 hours	3.2	0.4	2.6	0.3	**<0.001**
48 hours	3.3	0.4	2.8	0.3	**<0.001**
72 hours	3.4	0.4	2.9	0.3	**<0.001**

The above table shows the mean (SD) of serum albumin at admission, 24, 48 and 72 hours between survivors and non-survivors. In all the time points the albumin level was higher among

survivors than non-survivors. In all the times the difference in albumin level between the groups was statistically significant with the p value of <0.001.

Table 5: Area under the curve (ROC analysis) for the Outcome-Mortality

Parameter	Area under the curve	95 % CI for AUC	P value
APACHE II	0.64	0.56-0.72	<0.001
S Albumin at admission	0.94	0.87-0.97	<0.001
S Albumin at 24 hrs	0.91	0.87-0.95	<0.001
S Albumin at 48 hrs	0.90	0.86-0.93	<0.001
S Albumin at 72 hrs	0.90	0.86-0.93	<0.001

Receiver operating characteristics curve was plotted using S Albumin at admission, S Albumin at 24 hrs, S Albumin at 48 hrs, S Albumin at 72 hrs and APACHE II scores to predict the mortality.

The area under the curve was 0.64, 95%CI (0.56-0.72) for APACHE II scores, 0.94, 95% CI (0.87-0.97) for S Albumin at admission, 0.91, (0.87-0.95) for S Albumin at 24 hrs, 0.90, 95% CI (0.86-0.93) for S Albumin at 48hrs and, S Albumin at 72 hours. All these AUCs were significant with the p value of <0.001 for predicting mortality.

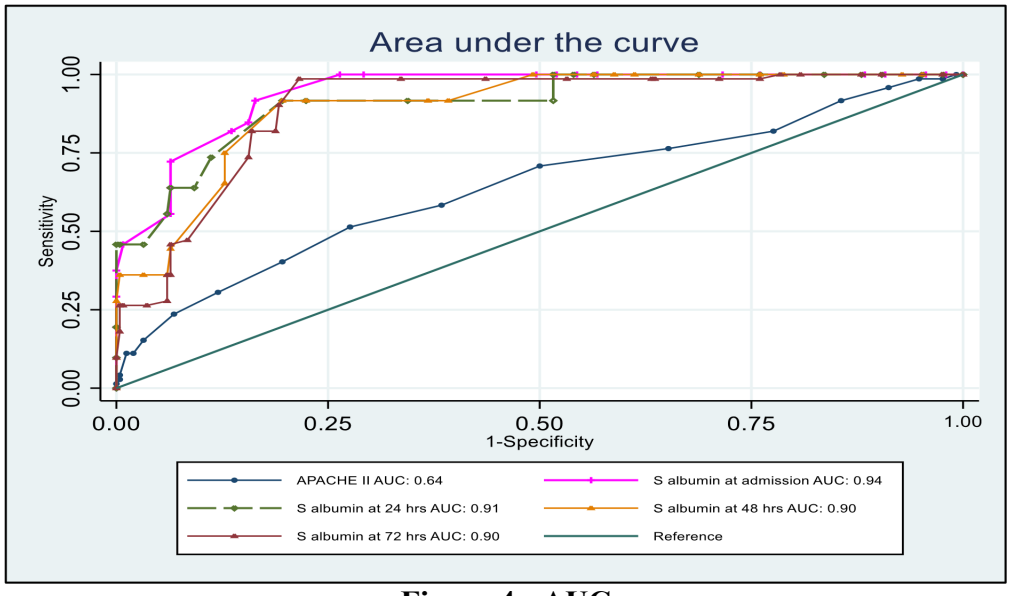

Figure 4: AUC

Table 6: Serum albumin levels (at 72 hours) and mortality

Serum albumin levels (at 72 hours)	Survivors		Non-survivors	
	n	%	n	%
<2.5	0	0	7	9.7
2.5-3	21	8.4	27	37.5
3.0-3.5	112	44.8	37	51.4
>3.5	117	46.8	1	1.4
Total	**250**	**100**	**72**	**100**
Chi square p value=<0.001 **(Significant)**				

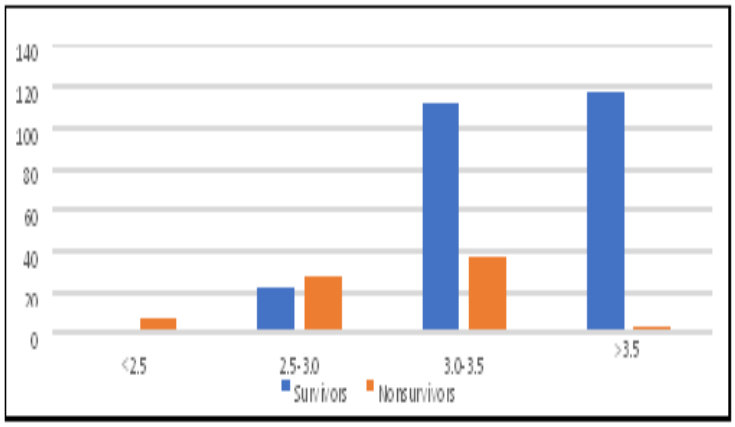

Figure 5: Serum Albumin level at 72hrs among survivors and nonsurvivors.

Among the survivors, no one had serum albumin level of <2.5 g/dL at 72 hours, 21 (8.4%) had (2.5- 3.0) g/dL, 112 (44.8%) had a level of (3.0-3.5) g/dL and 117 (46.8%) had >3.5g/dL. Among non-survivors, nearly half (51.4%) had a serum albumin level of (3.0-3.5) g/dL and 27 (37.5%) had albumin level in the range of (2.5-3.0) g/dL and only one patient had >3.5g/dL, 7(9.7%) had albumin <2.5g/dL. There was a significant difference in serum albumin level at 72 hours and the status of survival with the p value of <0.001

Discussion

A cross-sectional study was conducted in the ICU, Agartala Government Medical College, GB Pant Hospital.

Serial measurements of serum albumin concentration during the first 72 hrs. after admission to a general adult intensive care unit was retrospectively reviewed in 322 consecutive critically ill patients over a one & half year period.

All the patients were followed up till discharge or death and these 2 groups were termed as 'survivors' and 'nonsurvivors'. [15]

In our study, we had recruited 322 participants for the purpose of our study. Out of 322 patients, 72 (22.4%) had not survived and 250 (77.7%) was alive. Among the survivors nearly half of them (53.2%) were men and the rest of 46% were women. Among the non survivors, 43 (59.7%) were men and 29 (40.3%) were women. There was no significant difference observed between the groups in terms of gender. [16]

We found that the mean (SD) APACHE II score among survivors was 10.7 (3.2) and the same was 12.7 (4.0) in the patients who were not survived. The mean APACHE II score was less among survivors compared to non-survivors. The difference of 2 in mean APACHE II scores was statistically significant with the p value of <0.001.

In our study the albumin level was higher among survivors than non-survivors. In all the times the difference in albumin level between the groups was statistically significant with the p value of <0.001.

In our study, among the survivors, no one had serum albumin level of <2.5 g/dL at 72 hours, 21 (8.4%) had (2.5- 3.0) g/dL, 112 (44.8%) had a level of (3.0-3.5) g/dL and 117 (46.8%) had >3.5g/dL. Among non-survivors, nearly half (51.4%) had a serum albumin level of (3.03.5) g/dL and 27 (37.5%) had albumin level in the range of (2.5-3.0) g/dL and only one patient had >3.5g/dL, 7(9.7%) had albumin <2.5g/dL. There was a significant difference in serum albumin level at 72 hours and the status of survival with the p value of <0.001.

The area under the curve was 0.64, 95%CI (0.56-0.72) for APACHE II scores, 0.94, 95% CI (0.87-0.97) for S Albumin at admission, 0.91, (0.87-0.95) for S Albumin

at 24 hrs, 0.90, 95% CI (0.86-0.93) for S Albumin at 48hrs and, S Albumin at 72 hours. All these AUCs were significant with the p value of <0.001 for predicting mortality.

Conclusions

In our study, we found the mean APACHE II score was less among survivors compared to nonsurvivors. The difference of 2 in mean APACHE II scores was statistically significant with the p value of <0.001.

Non-survivors had less Serum Albumin compared to survivors. We also found those who had less serum albumin required more ionotropes and ventilation support than those had higher serum albumin level. Critically ill patients have higher mortality rates. Early recognition of patients at high risk of poor outcome can prompt more aggressive management to improve their survival. Serum albumin is a cheap and cost effective and is routinely measured in all Critically ill patients.

Serum albumin on 72 hrs correlated directly with higher mortality in Critically ill patients. Serum albumin on 72hrs and the level of change, during the hospital stay, had an impact on morbidity. At 72hrs serum albumin <2.5 mg/dl served as a poor prognostic marker. Serum albumin measured after 72 hrs was as accurate as the admission APACHE II score in correctly classifying patients according to outcome. Serial assessment of serum albumin provides useful prognostic information in critically ill patients. Serum albumin thus serves as a simple but powerful prognostic tool for critically ill patients.

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