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Study of Serum Albumin as a Prognostic Marker in Critically ILL Patients

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Abstract

Introduction: Serum albumin is an important parameter in the assessment of the nutritional status of both acute and chronically ill patients(1), Low albumin levels have been associated with morbidity and mortality in critically ill patients. It is thus, important to identify the patients at the time of admission who are likely to have a poor outcome, so that such patients can be managed aggressively.

AIM: Study Of Serum Albumin As a Prognostic Marker in Critically ill patients.

Materials and Methods: After approval from the Institutional Ethical committee all patients were selected as per inclusion and exclusion criteria. The patients, who are critically ill was selected from MICU and Serum albumin level was measured by BECKMAN COULTER ANALYZER. The statistical analysis was performed by statistical software SPSS version 21.0.

Result: The present cross- sectional study was conducted in the department of medicine, among 100 critically ill Patients The results show that there is a steady fall in serum albumin in both groups. However, the fall in non-survivors was more steep than survivors. When mean albumin was compared statistically at different intervals, it was found to be statistically significant.

Conclusion: Serum albumin is a cheap and cost effective and is routinely measured in all critically ill patients. Thus serum albumin serves as a powerful prognostic tool for critically ill patients.

Keywords: serum albumin, critically ill, survivors, non survivors.

Introduction

Albumin is the most abundant plasma proteins in humans. It helps to maintain the colloid osmotic pressure, acts as a carrier protein, and is involved in metabolic, antioxidant and various other functions. Patients who are admitted in Intensive Care Unit (I.C.U.) are at an increased risk of mortality due to the severity of their illness. It is thus, important to identify the patients at the time of admission who are likely to have a poor outcome, so that such patients

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can be managed aggressively. Serum Albumin appears to be one such prognostic indicator. Its utility as a prognostic indicator has been studied in various contexts including critically ill patients.[2] A low serum albumin (SA) concentration correlates with increase in length of stay in ICU increases the risk of death and even readmission to hospital sooner and more frequently. The daily trend of serum albumin can be useful tool in predicting the weaning capability of patients needing mechanical ventilation. It has been used by many investigators as an index of the nutritional and metabolic status of the patients.

Albumin, a major component of plasma protein, is required to maintain oncotic pressure, micro vascular permeability, acid–base function, and to prevent platelet aggregation.[2] Albumin is the most important contributor to the osmotic colloid pressure. Infact, given its negative charge at normal pH, it retains sodium cations, and therefore water, in the intravascular compartment. It also plays central roles in cellular physiology, including intravascular transport of molecules (like hormones) and lipid metabolism. A dye-binding method is used to measure serum albumin. Once bound to bromocresol, the complex absorbs light at a different wavelength than unbound bromocresol. Bromocresol can also bind to other proteins and thus can lead to an overestimation of albumin levels.[1]

Total daily albumin degradation in a 70 kg adult is around 14 g day^{-1} or 5% of daily whole-body protein turnover. Albumin is broken down in most organs of the body. Muscle and skin break down 40–60% of a dose of labelled albumin. The liver, despite its high rate of protein metabolism, degrades 15% or less of the total. The kidneys are responsible for about 10%, while another 10% leaks through the stomach wall into the gastrointestinal tract.

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.[3] Albumin level is a strong predictor of many diseases and surgeries, particularly in some critical illnesses, such as sepsis and acute myocardial infarction, and also in critically ill children. Moreover, low serum albumin concentrations in critical illness have been associated with poor outcomes. A meta-analysis of 90 cohort studies with acutely ill patients by Vincent et al. showed that for each 1 g/dL decline in serum albumin concentration there was a significant rise in the odds of mortality by 137%, morbidity by 87%, and prolonged hospital stay by 71%.

Serum albumin is a part of the hepatic function test and is routinely assessed at admission in critical patients. Serum albumin level measurement is simple, less time consuming and easily available. In Indian scenario where there is scarcity of good intensive care units, low doctors to patient's ratio and limitation of financial resources, there is a need for good cost-effective indicator to predict risk of mortality and morbidity.

Materials and Methods

This Hospital based prospective study entitled "**STUDY OF SERUM ALBUMIN AS A PROGNOSTIC MARKER IN CRITICALLY ILL PATIENTS**" was conducted after clearance from Board of Studies and Ethical committee in Muzaffarnagar Medical College, Muzaffarnagar during the period 2019-21. The study population was calculated using G-power software with 80% of power and 5% of significance level. The total sample size was determined to be 100 patients.

Inclusion Criteria:

1. Age > 18 years
2. Critically ill Patients [failure of one or more organs/system or depend on survival from advanced instruments of monitoring and therapy] admitted in MICU of Muzaffarnagar medical college.
3. Patients ready to give and sign informed written consent

Exclusion Criteria:

1. Nephrotic / Nephritic Syndrome
2. Cirrhosis of Liver.
3. Malnutrition
4. Protein losing enteropathy
5. Patients not willing to give informed consent

Methodology

1. Written informed consent was taken from each patient/relative of patient (if pt was not in state to give consent) and study explained.
2. Patients were selected on basis of inclusion and exclusion criterias.
3. Detailed history was taken.
4. Patients assessed clinically on day of admission to MICU.
5. Routine investigations like Hb, WBC, platelet count, RFT, LFT, electrolytes and Serum albumin.
6. Serum albumin level was measured by BECKMAN COULTER ANALYZER using reagents{BROMOCRESOL GREEN AND SUCCINATE BUFFER} on day 1,3,5,7.
7. Radiological investigations like X ray, USG, CT Scan were carried according to need without any cost to patient.

The data was entered into the Microsoft excel and the statistical analysis was performed by statistical software SPSS version 21.0. The Quantitative (Numerical variables) were present in the form of mean and SD and the Qualitative (Categorical variables) were present in the form of frequency and percentage.

The student t-test was used for comparing the mean values (continuous data) between the 2 groups whereas chi-square test was applied for comparing the categorical data (frequency). The p-value was considered to be significant when less than 0.05.

Observations and Results

The present cross- sectional study was conducted in the department of medicine, among 100 critically ill Patients [failure of one or more organs/system or depend on survival from advanced instruments of monitoring and therapy] admitted in MICU.

Table 1: Distribution of the patients based on outcome at the end of the study

Outcome	Number	%
Survivors	80	80
Non survivors	20	20
Total	100	100

Out of 100 subjects, 80 survived while 20 were expired (Table 1)

The mean age of study population was 51.55±16.79 years with a rage of 18-90 years.

The mean age among survivors was 50.91±16.66 years with range of 18-85 years. The mean age among non-survivors was 54.10±17.51 years with range of 21-90 years. There was a significant difference (p = 0.047) between the two groups with higher mean age among non-survivors.

In our study 58% of the subjects were males and 42% were females.

Mortality was reported to be more among males compared to females.

Table 2: Comparison of Serum Albumin (g/dl) Survivors and Non-Survivors

Serum Albumin (g/dl)	Survivors		Non survivors		p value
	Mean	SD	Mean	SD	
Day 1	3.95	0.53	2.88	0.26	0.008*
Day 3	3.51	0.48	2.57	0.21	0.003*
Day 5	3.18	0.37	2.28	0.28	0.003*
Day 7	2.96	0.39	1.98	0.24	<0.01*

When mean albumin was compared statistically at different intervals, it was found to be statistically significant (table 10, graph 10). The results show that there is a steady fall in serum albumin in both groups. However, the fall in non-survivors was more steep than survivors. It suggests that the rapidity with which serum albumin level falls has an effect on the prognosis of the patient in terms of mortality. A steep decline in serum albumin indicates a poor prognosis.

Critically ill patients after have reduced albumin levels due to malnutrition or the Metabolic stress or both. 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 & research settings. Large community based studies have shown a link between low serum albumin and an increase in morbidity and mortality. A low serum albumin concentration correlates with increased length of stay in the intensive care unit and with complication rates, such as ventilator depending and the development of new infection. The daily trend of serum albumin can be a useful tool and predicting the capability of patients needing mechanical ventilation.

Discussion

Critically ill patients after have reduced albumin levels due to malnutrition or the metabolic stress or both. 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 & research settings. Large community bared studies have shown a link between low serum albumin and an increase in morbidity and mortality. A low serum albumin concentration correlates with increased length of stay in the intensive care unit and with complication rates, such as ventilator depending and the development of new infection. The daily trend of serum albumin can be a useful tool and predicting the capability of patients needing mechanical ventilation.[4-8]

In the intensive care setting, serum albumin has long been a predictor of each 10-g/L decrease in the serum albumin concentration significantly raised the odds of mortality by 137%.[9] More recent studies including that of 5894 acutely ill adult medical patients have also shown hypoalbuminemia at admission to be an independent marker of 30-day all-cause mortality.[10] the intensive care setting, serum albumin has long been a predictor of poor clinical and surgical outcomes although it is also a reflection of the acute-phase response.[11].

The mean age of study population was 51.55±16.79 years with a rage of 18-90 years. The mean age in survivors was 50.91±16.66 years with range of 18-85 years. The mean age in non-survivors was 54.10±17.51 years with range of 21-90 years. There was a significant difference (p = 0.047) between the two groups with higher mean age among non-survivors. These results were in accordance with study done by Mahajan S et al[12] i.e. The mean age of survivors was 47.8±21.7 years and that of non-survivors was 62.3±13.1 year.

In present study, among survivor group, 61.3% patients have normal serum albumin levels on admission as compared to just 35.0% in the non-survivor group, suggesting hypoalbuminemia at admission indicates a poorer prognosis in terms of increased mortality. (p=<0.001) In our study, the mean serum albumin level at day 1 was 3.49±0.49, day 3 was 3.42±0.49, day 5 was 2.84±0.49 and day 7 was 2.65±0.49. The mean serum albumin level at day 1 day 3 day 5 and day 7 was significantly more among survivors (3.95±0.53,3.51±0.48,3.18±0.37 and 2.96±0.39 respectively) compared to non survivors (2.88±0.26, 2.57±0.21, 2.28±0.28 and 1.98±0.24 respectively). In the study by *Sarvanakumar et al*,[13] mean level of serum albumin at day 1 was 3.72 g/dl (+ 0.278) in survivor group and in non survivors group, it was 3.11 g/dl (+ 0.247). The difference in mean serum albumin in day 1 was statistically significant In a study by Nirmala *et al (*2015[14], slightly higher serum albumin was detected in Survivors versus non-survivors on day 1 (3.46 ± 0.25 vs. 3.44 ± 0.30), but the variance was statistically not significant. In a study by Sanket Mahajan et al,[12] mean serum albumin level on day of admission (Day 1) for the study group was 3.3 g/dl (± 0.4 g/dl). In survivors, it was 3.4 g/dl (± 0.4 g/dl) and in non-survivors it was 3.1 g/dl (± 0.19 g/dl). It was significantly lower (p = 0.003) in non-survivors. A study done by Gosavi et al [15] also showed the mean Serum 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). In the study by *Sarvanakumar et al*, [13] the mean level of serum albumin at day 3 was 3.17 g/dl (+ 0.248) in survivor group and in non-survivors group, it was 2.65 g/dl (+ 0.172). The difference in mean serum albumin in day 3 was statistically significant.

While the association between low albumin levels and ICU mortality have been demonstrated in this and other studies, a key question for clinicians treating critically ill patients is whether this finding is indicative of causation or association. While albumin

supplementation is used in clinical practice, there is little evidence to support this practice. The Albios trial failed to show a benefit of supplemental albumin in patients with sepsis and septic shock.[16]

Recommendations from *Vincent et al*. [9] stated that albumin administration, although unlikely to cause harm in most patients, should be reserved for use in specific groups of patients in whom there is evidence of benefit. Currently, it is unclear which, if any, groups of patients will benefit from albumin therapy. Future studies need to focus on identifying patients who will benefit from albumin therapy, determining if there are albumin cut-offs that may identify patients who would benefit from albumin therapy, determine the dosage of albumin solution and identify appropriate albumin level targets that are needed to improve outcomes.The performance of serum albumin as an individual biomarker is not adequate to triage patients, and this highlights the complex multifaceted nature of outcome prediction in critical care. Serum albumin may, however, play a role in future outcome prediction models that may be developed in the SA setting, and further research should be conducted to explore this premise. The use of serum albumin at appropriate clinical cut-offs to direct specific therapy (e.g. albumin therapy) should also be explored.

Summary and Conclusion

Out of 100 subjects, 80 survived while 20 were expired..In the survivor group 61.3% patients have normal serum albumin levels on admission as compared to just 35.0% in the non-survivor group, suggesting hypoalbuminemia at admission indicates a poorer prognosis in terms of increased mortality. The results show that there is a steady fall in serum albumin in both groups. However, the fall in non-survivors was more steep than survivors. The strongest predictor of outcome of the patient is serum albumin on day three with highest (odds ratio 35.12).The average duration of hospital stay was significantly longer in survivors as compared to non-survivors (p=0.007).

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. Serial assessment of serum albumin provides useful prognostic information in critically ill patients. Serum albumin on day 3 correlated directly with higher mortality in Critically Ill patients. Serum albumin thus serves as a simple but powerful prognostic tool for critically ill patients.

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