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ESTIMATION OF SERIAL SERUM ALBUMIN LEVELS AS PROGNOSTIC MARKER IN CRITICALLY ILL PATIENTS ADMITTED IN ICU: A CROSS-SECTIONAL STUDY

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ABSTRACT:

Albumin is the most abundant plasma protein in human body. It is important to identify patients at the time of admission who are likely to have a poor outcome, so that such patients can be managed aggressively. Serum albumin is one of the simplest, reliable, inexpensive and easily available prognostic markers in patients on ventilator support. Therefore, the present study was conducted to study the use of serial serum albumin as a prognostic factor in deciding the outcome in critically ill patients on ventilator**.** The present study was observational cross-sectional study carried out at Department of Medicine of tertiary care centre during November 2021 to October 2022. A total of 50 patients who were admitted in ICU and requiring mechanical ventilatory support for 5 days or more were included in the study. Each patient was subjected to detailed history and physical examination. Serum albumin estimation was done on the day of admission when they were put on mechanical ventilator and subsequently on day three, day five and day 10 of their hospital stay. The statistical software namely SPSS 22.0 used for the analysis of the data. **Results:** Among 50 patients, majority of the patients survived 31 (62%) patients while 19 (38%) patients died. The total decline in serum albumin in the survivors from admission to day 10 is 0.86 g/dl. And in non-survivors it is 1.09 g/dl over a period of 10 days. The present study concludes that in critically ill patients, serial serum albumin levels can be used as a guide for weaning the patients from ventilator support.

KEY WORDS: Serum albumin, Prognostic, Critically Ill, Cross-sectional

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INTRODUCTION:

Patients who are admitted in Intensive Care Unit (ICU) are at an increased risk of mortality due to the severity of their illness.[1] It is important to identify patients at the time of admission who are likely to have a poor outcome, so that such patients can be managed aggressively.[2]

Current outcome prediction in critically ill patients relies on the art of clinical judgment and/or the science of prognostication using illness severity scores. For prediction of outcome in intensive care unit, several scoring systems (APACHE, SAPS, MPM, MOF score and SOFA) have been developed. They assist the physician to predict mortality and/or severity of illness, but the results of combined scores are not 100% reliable. [3]

Although none of these systems is perfect at predicting mortality, there is overall a strong relationship between the patient's age and chronic health status, acute physiologic upset, sequential organ failure and death. As we can see, there is an almost linear relationship between extent of organ dysfunction and mortality. Organ preservation thus is a fundamental objective of critical care. [4]

The biochemical processes underlying critical illness have increasingly been unraveled. Several biochemical markers reflecting the process of inflammation, immune dysfunction, impaired tissue oxygenation and endocrine alterations have been evaluated for their predictive power in small subpopulations of critically ill patients. [5]

There is no ideal method of predicting outcome, but resource limited setting it is important to decide which of these patients will benefit from ICU admission.

Albumin is the most abundant plasma protein in human body. It has been the subject of extensive studies. We now know the amino acid sequences of albumin, the complete gene sequence of human albumin, and the location of mutations in the gene sequence.[1] Serum albumin is one of the simplest, reliable, inexpensive and easily available prognostic markers in patients on ventilator support.[6]

This study intends to determine the use of serial serum albumin as a prognostic factor in deciding the outcome in critically ill patients on ventilator.

OBJECTIVE:

1. To correlate Serum albumin and clinical outcome in critically ill patient.

METHODOLOGY:

The present study was observational cross-sectional study. The study was carried out at intensive care unit attached to Department of Medicine Dr. D. Y. PATIL Medical College Hospital & Research Institute, Kadamwadi, Kolhapur during November 2021 to October 2022. The study was conducted after obtaining clearance from the Ethical Committee of the institute. A total of 50 patients who were admitted in ICU and requiring mechanical ventilatory support for 5 days or more were included in the study. Patient on ventilatory support who dies within 5 days of admission to ICU, patient who weaned from ventilatory support within 5 days of being put on ventilatory support, chronic liver disease, nephrotic Syndrome and malabsorption syndrome were excluded.

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The study included patients with all etiologies who were intubated and were put on mechanical ventilation. The decision for mechanical ventilation was taken by the treating physician. Clinical and demographic profile at the time of admission to ICU including age, sex, smoking status, history of previous hospital admissions, associated chronic illnesses like hypertension, diabetes mellitus, chronic obstructive pulmonary disease was recorded. A careful and detailed history was recorded and thorough clinical examination was conducted. All the points mentioned in the proforma were recorded. Additional information if any was recorded. For patients who were included in the study, serum albumin estimation was done on the day of admission when they were put on mechanical ventilator and subsequently on day three, day five and day 10 of their hospital stay. Serum albumin was assayed using an automated bromocresol purple (BCP) specific dye binding method. The outcome of the patient was recorded either as discharge of the patient from the hospital (survivor) or patient's death in hospital (non-survivor). The statistical analysis was done using SPSS 22.0.

RESULTS:

A total of 50 patients who were admitted in ICU and requiring mechanical ventilatory support for 5 days or more were included among which majority of the patients survived 31 (62%) patients while 19 (38%) patients died.

Table 1: Distribution according to demographic profile among patients:

Demographic profile	Survivors (n=31)	Non-survivors (n=19)	P value
Age (Mean ±SD) years	47.8 ±21.7	62.3 ±13.0	0.011
Male	19 (61.3%)	11 (57.9%)	0.321
Female	12 (38.7%)	8 (42.1%)	

It was seen that mean age in survivors was 47.8 ±21.7 years and non-survivors was 62.3 ±13.0 years. There was a significant difference (p=0.011) between the two groups indicating a higher age at admission for non-survivors. Amongst survivors 19 (61.3%) were males and 12 (38.7%) were females. In non-survivors (19), 11 (57.9%) were males and 8 (42.1%) were females.

Table 2: Serum Albumin levels in two groups on day one

S.albumin in g/dl		Survivors (n=31)	Non-survivors (n=19)	P value
Day 1	< 3.5	17 (54.8%)	17 (89.5%)	0.005
	≥ 3.5	14 (45.2%)	2 (10.5%)	
Day 3	< 3.5	23 (74.2%)	19 (100%)	0.007

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	≥ 3.5	8 (25.8%)	0 (0%)	
Day 5	< 3.5	26 (83.9%)	19 (100%)	0.03
	≥ 3.5	5 (16.1%)	0 (0%)	
Day 10	< 3.5	29 (93.6%)	19 (100%)	0.129
	≥ 3.5	2(6.4%)	0 (0%)	

In the survivor group, 45.2% patients have normal serum albumin levels on admission as compared to just 10% in the non-survivor group, suggesting hypoalbuminemia at admission indicates a poorer prognosis in terms of increased mortality. Similarly, on day 3, 5 and 10 hypoalbuminemia were more prevalent in non-survivors. (Table 2)

Table 3: Comparative levels of mean serum albumin on different days between the two groups

Day of estimation	Mean Serum albumin levels in g/dl	
	Survivors	Non-survivors
Day 1	3.43	3.12
Day 3	3.04	2.75
Day 5	2.76	2.37
Day 10	2.57	2.03

The total decline in serum albumin in the survivors from admission to day 10 is 0.86 g/dl. In non-survivors it is 1.09 g/dl over a period of 10 days. The results show that there is a steady fall in serum albumin in both groups. However, the fall in non-survivors is steeper than survivors. It suggests that the rapidity with which serum albumin level falls influences the prognosis of the patient in terms of mortality. A steep decline in serum albumin indicates a poor prognosis. (Table 3)

Table 4: Strength of association between serum albumin and outcome of patients:

Serum albumin	Odds ratio
Day 1	0.0150
Day 3	53.0177
Day 5	0.2256
Day 10	0.0595

The above table 4 indicates that the strongest predictor of outcome of the patient is serum albumin on day three with highest odds ratio. Outcome of the patient is poorly correlated with serum albumin level on day one which has the lowest odds ratio.

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Table 5: Accuracy of prediction of outcome after logistic regression Equation:

S. Albumin	Sensitivity	Specificity	Accuracy	NPV	PPV
S. Albumin levels	83.87%	78.95%	82%	86.67%	75%

Using the logistic regression equation derived from the study, it was found that it correctly identified 83.87% patients to survive and 78.95% patients to die. Overall, it was 82% accurate in the prediction of the outcome of the patient. It was also found that the probability that this equation will predict the outcome of survivors correctly is 86.67%. Also, the probability that this equation will correctly predict the outcome of non-survivors correctly is slightly lower at 75%. (Table 5)

DISCUSSION:

The present study was conducted on patients who were critically ill and required mechanical ventilation for five days or more. Serial serum albumin concentrations were measured as a prognostic marker to predict their outcome as either death in the hospital or discharge from the hospital.

In present study, there was a significant difference (p=0.011) between the 2 groups indicating a higher age at admission for non-survivors. Esteban A et al[7] study published in JAMA 2002 reported the mean age of patients managed on mechanical ventilator to be 59.2 years (±17.3 years). Blunt MC et al [8] study reported in Anaesthesia 1998, the age of non-survivors as 58 years (±3.8 years) which is significantly more ($p<0.05$) than survivors as 49 years (±4.1 years). This was similar to results in study population.

The study shows that males are more likely to suffer from a critical illness than females. Earlier published study by Esteban A et al, this was found to be 59.3% males and 38.7% females.[7] Study carried out by Blunt MC et al shows it to be 57% males and 43% females.[8] Our study matches to these studies.

The present study shows that the serum albumin levels decreased more rapidly in non-survivors. The total decline in serum albumin in the survivors from admission to day 10 is 0.86 g/dl. In non-survivors it is 1.09 g/dl over a period of 10 days. This is similar to McCluskey A, et al [9] study which reports that serum albumin levels decreased more steeply in non-survivors. This suggests that patients who have a rapid decline in the serum albumin level have a poor prognosis in terms of increased mortality.

In the study, overall, it was able to predict the outcome correctly in 82% of the all cases. Amongst survivors the predictability of outcome reaches to 86.67% while non-survivors it is slightly lower level of 75%. However, McCluskey A, et al [9] study compared the outcome of the patients based on serum albumin measurements at admission, at 12-24 hours, at 24-48 hours and at 48-72 hours, reported 48-72 hours serum albumin to be 53.7% sensitive and 84.8% specific with accuracy of 74.2 %. This difference is observed because of the larger sample size of 348 patients with difference in the time of serial measurement of serum albumin from the time of admission in this study.

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The study indicates that the strongest predictor of outcome of the patient is serum albumin on day three with highest odds ratio. In Banga A et al [10] study reports day five albumin levels to be the strongest predictor of mortality. This difference is noted because of the method of analysis of data and the use of different kind of statistical test to predict the outcome.

Serum albumin is routinely measured in all critically ill patients. It is a cheap and easily available test in all laboratories. Its value as an important prognostic marker has been well established. The serial estimation of serum albumin provides the treating doctor an insight in the prognosis of the patient so that they can be managed aggressively.

CONCLUSION:

The present study concludes that in critically ill patients, serial serum albumin levels can be used as a guide for weaning the patients from ventilator support, which is the key survival factor. The serum albumin can be used to predict outcome of critically ill patients.

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