Section: General Medicine

Original Research Article

A STUDY OF PROGNOSTIC VALUE OF SERUM ALBUMIN LEVELS IN PATIENTS WITH COMMUNITY-ACQUIRED PNEUMONIA AND CORRELATION WITH CURB-65 AND PSI SCORING

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ABSTRACT

Background: Community-acquired pneumonia (CAP) is one of the most important public health problems worldwide. The assessment of disease severity and outcome prediction is necessary for the allocation of health resources and therapeutic options in the management of CAP. The aim is to study the prognostic value of serum albumin levels in hospitalised patients with community-acquired pneumonia in terms of patient outcome and correlate it with CURB-65 and PSI score.

Materials and Methods: It was an observational study. 97 individuals with community-acquired pneumonia were included. CURB-65 and PSI scoring were calculated and compared with serum albumin levels. Serum albumin was also correlated with patient outcome in terms of mortality or duration to clinical stability, ventilator requirement, complications and duration of hospital stay.

Results: The study's demographic data showed that most participants were aged 51-60 and 61-70 years, with a male predominance (59.8%). Serum albumin levels, measured at admission, Day 3, and Day 5, showed significant associations with complications like sepsis and respiratory failure. A negative correlation was observed between serum albumin levels and the number of days to reach clinical stability. There was a significant difference between patients who required mechanical ventilation vs those who did not in terms of serum albumin levels ($p = 0.012$). There was a strong negative correlation between the number of days of hospital Stay and S. Albumin (g/dL) (Day 3), and this correlation was statistically significant ($p = <0.001$). There was no statistically significant correlation between CURB 65 and S. Albumin. There was a weak negative correlation between PSI and S. Albumin (g/dL) (at admission), and this correlation was statistically significant ($p = 0.012$). Patients discharged had a higher mean albumin level (2.90) compared to patients who died (2.10), with a statistically significant p-value of 0.018.

Conclusion: Serum albumin levels correlated significantly with complications, clinical outcomes, and scoring systems, indicating its potential as a prognostic biomarker. Future research could further explore the therapeutic implications of these findings in improving outcomes for CAP patients.

Keywords: CAP, CURB65, Serum Albumin, PSI scoring system.

INTRODUCTION

Community-acquired pneumonia (CAP) is one of the most important public health problems worldwide.[1] The assessment of disease severity and outcome prediction is necessary for the allocation of health resources and therapeutic options in the management of CAP.[2,3] The reported mortality of adults admitted

to hospital with CAP has varied widely (4%–21%).[2] The knowledge of relevant prognostic factors would be useful for the early identification of patients at high risk of requiring intensive care treatment.

The two prominent tools for this purpose are the pneumonia severity index (PSI), developed in the USA after Pneumonia Outcome Research Trial (PORT), and the British Thoracic Society (BTS) rule, which has recently been modified to CURB-65 "confusion, elevated blood urea nitrogen, elevated respiratory rate, low systolic or diastolic blood pressure (BP), and age over 65 years (CURB-65)".[4,5] The two scoring approaches are viewed as being complementary, as each has different strengths and weaknesses. The use of CURB-65 and the Pneumonia severity index have limitations.

Recent studies have found that certain biomarkers like pro calcitonin, Serum albumin, C reactive protein, and pro-inflammatory cytokines have additional information on the severity of CAP, can distinguish between bacterial and viral etiology, and may predict complications.[5] However, most of the biomarkers are expensive and are not easily available in emergencies. Low serum albumin within 24 hours of admission has been independently associated with poor outcomes.[6]

The mechanisms underlying the cause are diverse. The rate of albumin synthesis is decreased in the acute phase of inflammation. Hence, serum albumin is an indirect and easily available biomarker, which can be correlated with the severity of CAP.

Serum albumin, readily measurable upon hospital admission, has been associated with outcomes in various disease states due to its role in inflammation and immune response modulation. Low levels of serum albumin have been independently linked to worse outcomes in CAP, likely reflecting underlying physiological stress and inflammation.

This study aims to assess the prognostic value of serum albumin levels in hospitalized patients with community-acquired pneumonia by correlating them with patient outcomes, CURB-65, and PSI scores. It also investigates the relationship between albumin levels and the severity of illness, including complications, the need for mechanical ventilation, vasopressor support, and length of hospital stay.

MATERIAL AND METHODS

This prospective observational study was conducted over 1 year after receiving IEC approval. The study comprised 97 individuals presenting with symptoms and signs indicative of community-acquired pneumonia, as defined by the inclusion criteria. They were admitted under the Department of General Medicine and Pulmonology at NIZAM'S INSTITUTE OF MEDICAL SCIENCES.

The study included participants over 18 years of age with community-acquired pneumonia who exhibit at least two symptoms such as productive cough, purulent sputum, dyspnoea or tachypnoea, fever with rigors or chills, pleuritic chest pain, and a new chest radiograph opacity. It excluded individuals under 18, those with chronic liver disease, burns, mal-absorption syndromes, malnutrition, HIV, organ transplants, immunosuppressant or steroid use, pregnancy, lactation, and symptoms developing more than 48 hours after hospitalization.

The study included patients after the diagnosis was confirmed through clinical examinations and chest X-rays. PSI and CURB-65 scores were calculated, and routine haematological tests, including serum albumin levels on admission and days 3 and 5, were conducted. Serum albumin levels were measured using bromocresol green dye binding and spectrophotometry and were analysed with relation to clinical outcomes like time to clinical stability, length of hospital stay, need for mechanical ventilation or vasopressor support, and complications. Data analysis was performed using SPSS v23 with various statistical methods, including Pearson's or Spearman's correlation, paired t-tests, Wilcoxon Signed Rank tests, and ANOVA/Friedman tests, with statistical significance set at $p < 0.05$.

RESULTS

Majority of the study participants (51%) belonged to the age group of 50-70 years, followed by 18-30 years of age (13.4%). The study population was male predominant (59.8%).

Fever was the most common presenting complaint (93.8%), followed by dyspnea (91.8%). Diabetes (47.3%) and hypertension (47.3%) were the most common co-morbidities.

The mortality rate observed in present study was 3.1%. Rest of the 96.9% patients got discharged. Mean serum albumin levels at admission, Day 3 and Day 5 are depicted below in Table 1. Table 2 summarises the correlation of serum albumin levels with complications. Those with complications such as sepsis, MODS and respiratory failure had significantly lower mean serum albumin values than those who did not have any complications.

Correlation	Spearman Correlation Coefficient	P Value
Number of Days to Reach Clinical Stability vs S. Albumin (mg/dL) (At Admission)	-0.58 (95%CI: -0.72 to -0.4)	<0.001
Number of Days to Reach Clinical Stability vs S. Albumin (g/dL) (Day 3)	-0.61 (95%CI: -0.73 to -0.46)	<0.001
Number of Days to Reach Clinical Stability vs S. Albumin (g/dL) (Day 5)	-0.54 (95%CI: -0.69 to -0.37)	<0.001

Figure 1.

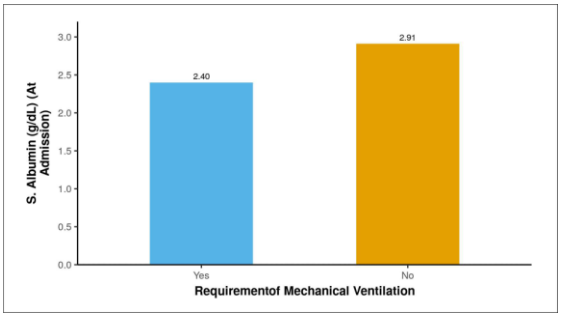
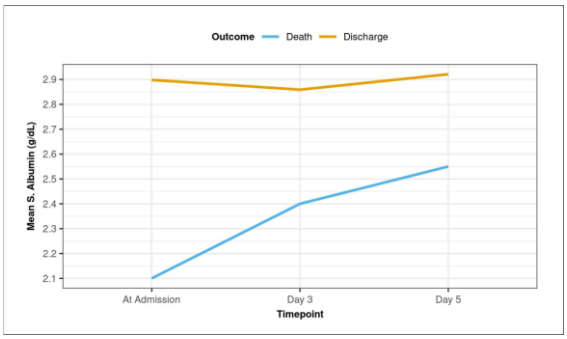


Figure 2.



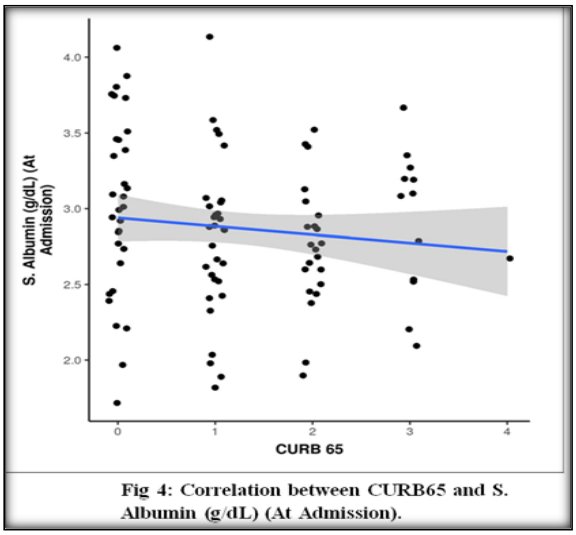


Figure 3.

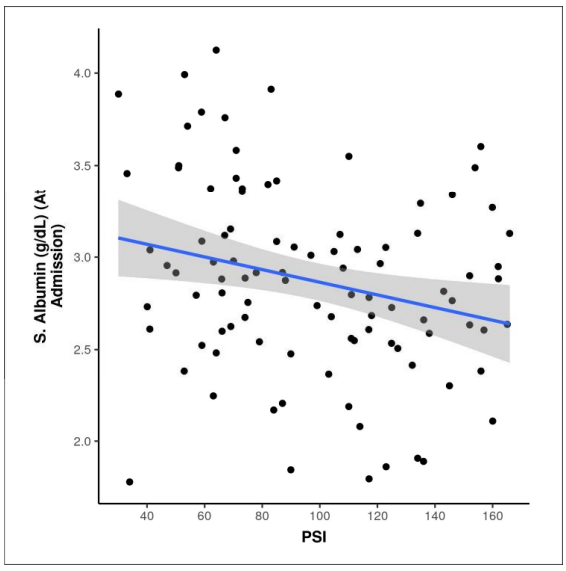


Figure 4.

A moderate to strong negative correlation was found between the number of days to reach clinical stability and S. Albumin (g/dL) at various time points (admission, Day 3, and Day 5), all statistically significant (rho ranging from -0.54 to -0.61, $p < 0.001$) (Figure 1). There was a significant difference between patients who required mechanical ventilation and those who did not in terms of S. Albumin (g/dL) (At Admission) ($W = 134.500$, $p = 0.012$), with the median S. Albumin (g/dL) (At Admission) being highest in the group not requiring Mechanical Ventilation (Figure 2). There was a moderate negative correlation between the Number of Days of Hospital Stay and S. Albumin (g/dL) (At Admission), and this correlation was statistically significant (rho = -0.44, p = <0.001).

No significant correlation was observed between CURB 65 and S. Albumin at admission (rho = -0.13, p = 0.188) (Figure 3), but a weak negative correlation was identified between PSI and S. Albumin at admission (rho = -0.25, p = 0.012). (Figure 4.)

The mean S. Albumin level was significantly lower in patients who died (2.10 g/dL) compared to those discharged (2.90 g/dL) with a statistically significant p-value of 0.018. Figure 5 depicts the trend of serum albumin in patients who died vs those who were discharged.

Table 2: Association of serum albumin with complications at admission, on day 3 and day 5

	Mean albumin at admission	p value	Mean albumin at day3	P value	Mean albumin at day 5	P value
Sepsis	2.74	<0.001	2.71	<0.001	2.81	0.003
Respiratory failure	2.76	0.038	2.71	0.005	2.82	0.05
Pleural effusion	2.76	0.178	2.81	0.555	2.90	0.852
MODS	2.57	0.047	0.047	0.132	2.77	0.433
ARDS	2.53	0.145	3.10	0.407	3.14	0.366
No complication	3.24	0.002	3.25	0.001	3.23	0.096

Table 3: Correlation between different variables

Correlation	Spearman Correlation Coefficient	P- Value
Number of days to reach clinical stability versus S. Albumin (mg/dL) (At Admission)	-0.58 (95%CI:-0.72to-0.4)	<0.001 (statistically significant)
Number of Days to Reach Clinical Stability versus S. Albumin (g/dL) (Day 3)	-0.61 (95%CI:-0.73to-0.46)	<0.001 (statistically significant)
Number of Days to Reach Clinical Stability versus S. Albumin (g/dL) (Day 5)	-0.54 (95%CI:-0.69to-0.37)	<0.001 (statistically significant)
CURB65 versus S. Albumin (g/dL)(At Admission)	-0.13(95%CI:-0.33to -0.07)	0.188(statistically significant)
PSI versus S. Albumin (g/dL)(At Admission)	-0.25 (95%CI:-0.45to-0.05)	0.012(statistically significant)
Number of Days to Reach Clinical Stability versus CURB 65	0.29(95%CI:0.07to0.47)	0.007(statistically significant)
Number of Days of Hospital Stay versus CURB65	0.26(95%CI:0.06to0.45)	0.010(statistically significant)

DISCUSSION

Our study involved 97 participants with a mean age of 52.13 years (SD±16.15). Age distribution revealed significant representation in the 51–70 years range (51.6% of participants). Our study aligns with studies done by Jain et al[7] and Almirall et al[8]who found that adults aged 65 years and older constitute a significant proportion of CAP hospitalizations in the U.S.

In our study, males accounted for 59.8% of participants while females constituted 40.2%, indicating a male predominance. This gender distribution aligns with findings from studies by Mandell et al[9] and Waterer et al.[10]

In present study fever (93.8%) followed by shortness of breath (SOB,91.8%), and cough (89.7%) were the most common clinical symptoms. These findings are consistent with other studies such as those by Mandell et al,[9] and File Jr et al,[11] which also highlight fever, SOB, and cough as hallmark symptoms.

This study identified prevalent comorbidities among CAP patients, notably diabetes (47.3%) and hypertension (47.3%), These findings are supported by studies by Mandell et al,[9] File Jr et al.[11] Torres et al,[12] Welte et al,[13] and Chalmers et al,[14] which underscore the impact of these comorbidities on CAP severity and clinical outcomes.

The serum albumin levels presented across admission (mean2.87g/dL), day 3 (mean2.85g/dL), and day 5 (mean2.91g/dL) show relatively stable values with slight variation over time in this cohort. The median values (2.8g/Dl at admission, 2.9g/dL on day3, and 2.9g/dL on day5) and inter quartile ranges suggest consistency in central tendency across the sampling periods, despite the ranges indicating some variability from 1.8 to 4.2g/ dL at admission, 1.7to4g/dL on day3,and 1.7to 4.4 g/dL on day 5. Comparatively, studies by Waterer et al[10] have reported similar findings in CAP patients.

Sepsis was prevalent in 64.9% of cases, while pleural effusion developed in 48.5% and 28.9% presented with multi-organ dysfunction. These rates of complications are consistent with studies by Mandell et al.[9]

Patients diagnosed with sepsis in our study consistently exhibited lower mean albumin levels at admission (2.74 g/dL), day 3 (2.71 g/dL), and day 5 (2.81 g/dL). Similarly, patients who developed respiratory failure showed significantly lower albumin levels at admission (2.76 g/dL), day 3 (2.71 g/dL), and day 5 (2.82 g/dL). These findings suggest that albumin may play a critical role in respiratory function and the progression to respiratory compromise in pneumonia cases, reflecting its potential utility as a prognostic marker in this context. Wang et al,[15] observed that lower albumin levels on admission predicted worse outcomes and prolonged mechanical ventilation in patients with respiratory failure, underscoring albumin's potential utility as a prognostic indicator in this context. Patients with multiple organ dysfunction syndrome (MODS) in our study presented with significantly lower albumin levels at admission (2.57 g/dL). O'Brien et al[16]. (2003) have demonstrated similar associations between lower albumin levels and increased risk of developing MODS in critically ill patients.

In our study, patients who did not develop complications during their pneumonia course exhibited significantly higher albumin levels at admission (3.24g/dL), day 3 (3.25g/dL), and day 5 (3.23g/dL) compared to those who experienced various complications. This observation underscores the potential protective role of adequate serum albumin levels against the development of severe outcomes in pneumonia patients. Research by Zhang et al,[17] and Liu et al,[18] supports these findings, demonstrating associations between higher albumin levels and favorable clinical outcomes in critically ill patients.

In our study, we observed significant negative correlations between serum albumin levels at various time points (admission, day 3, and day 5) and the number of days required to reach clinical stability in pneumonia patients. A lower serum albumin level at admission was moderately correlated with a longer time to achieve clinical stability (rho = -0.58, $p < 0.001$), suggesting that hypoalbuminemia upon admission may delay recovery or resolution of pneumonia symptoms. Similarly, lower albumin levels on day 3 (rho = -0.61, $p < 0.001$) and day 5 (rho = -0.54, $p < 0.001$) were strongly and moderately correlated, respectively, with prolonged time to clinical stability. These findings are consistent with previous literature that has explored the relationship between serum albumin levels and clinical outcomes in pneumonia and other critical illnesses. For

instance, a study by Jiang et al (2017) [19] reported similar correlations, highlighting that lower albumin levels were associated with delayed recovery and longer hospital stays in patients with pneumonia.

In our study, patients who required mechanical ventilation exhibited significantly lower serum albumin levels at admission (mean 2.40 g/dL) compared to those who did not require mechanical ventilation (mean 2.91 g/dL). Research by Lee et al. (2018) [20] and Wang et al. (2019)[15] has similarly demonstrated associations between lower albumin levels and increased likelihood of mechanical ventilation in critically ill patients.

In our study, we found significant negative correlations between serum albumin levels at admission, day 3, and day 5 and the number of days of hospital stay in pneumonia patients. A lower serum albumin level at admission was moderately correlated with a longer hospital stay (rho = -0.44, $p < 0.001$), indicating that hypoalbuminemia upon admission may prolong the duration of hospitalization. Similarly, stronger negative correlations were observed for albumin levels on day 3 (rho = -0.6, $p < 0.001$) and day 5 (rho = -0.57, $p < 0.001$), suggesting that lower albumin levels during hospitalization are associated with extended hospital stays.

Research by Zhang et al. (2020) [17] has indicated that maintaining or improving albumin levels during hospitalization is associated with shorter hospital stays and improved recovery rates in patients with severe infections and respiratory diseases.

In our study, we did not find a statistically significant correlation between serum albumin levels at admission and the CURB 65 score in pneumonia patients (rho = -0.13, p = 0.188). The CURB 65 score primarily focuses on acute physiological parameters and age, whereas serum albumin reflects nutritional status and inflammation, which may not always directly correlate with acute illness severity metrics.

In our study, we observed a statistically significant weak negative correlation between serum albumin levels at admission and the Pneumonia Severity Index (PSI) score in pneumonia patients.

Comparing our findings with existing literature, similar studies have reported varying degrees of correlation between serum albumin levels and pneumonia severity indices. For instance, a study by Renaud et al. (2018) (21) found a comparable weak negative correlation between serum albumin levels and PSI scores in elderly patients with CAP, suggesting that hypoalbuminemia may serve as a marker of disease severity and prognosis.

In our study, we found a statistically significant association between serum albumin levels at admission and patient outcomes in pneumonia. Specifically, patients who were discharged had a higher mean albumin level at admission (2.90 g/dL) compared to those who died (2.10 g/dL), with a p-value of 0.018. This suggests that lower albumin levels at admission may be associated with poorer outcomes, including increased mortality in pneumonia patients.

Comparing our findings with existing literature, similar studies have also reported associations between hypoalbuminemia and adverse outcomes in pneumonia and other critical illnesses. For example, a study by Song et al. (2019) (22) demonstrated that lower serum albumin levels at admission were independently associated with increased mortality and prolonged hospital stays in patients with severe pneumonia. This underscores the prognostic value of serum albumin as a biomarker reflecting nutritional status, systemic inflammation, and overall health status in pneumonia patients

The clinical implications of our findings suggest that assessing serum albumin levels at admission could provide additional insight into pneumonia severity beyond traditional clinical parameters. Lower albumin levels may reflect systemic inflammation, malnutrition, and impaired immune response, all of which contribute to the severity of pneumonia and subsequent outcomes. Clinicians could potentially use albumin levels alongside PSI scores to refine risk stratification, guide treatment decisions, and monitor patient progress during hospitalization.

Limitations: The small sample size of 97 participants and single- center design may limit the generalizability of findings to broader populations or different healthcare settings. The study's focus on clinical outcomes, such as mortality, complications, and hospital stay, does not capture patient-reported outcomes, long-term effects, or quality-of-life measures. Potential confounding variables, such as socioeconomic and environmental factors, may also influence outcomes but were not fully addressed. Addressing these limitations could enhance the study's applicability, providing a more comprehensive understanding of CAP and guiding future research.

CONCLUSION

Serum albumin is an inexpensive, rapid and easily available test. In the present study, serum albumin levels correlated significantly with complications, clinical outcomes, and scoring systems. Hence, it is a useful prognostic biomarker for community acquired pneumonia in resource limited settings.

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