

The prognostic implication of serum albumin and BUN/Albumin ratio in assessing severity and mortality in community acquired pneumonia (CAP)

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Abstract

Introduction and Aim: Community Acquired Pneumonia (CAP) is one of the most important causes of death in pneumonia patients. Most of the CAP patients hospitalized end up with severe complications. So the requirement of ICU in CAP patients is the most challenging decision to be taken on the part of physicians. This study was carried out to evaluate the necessity of serum albumin level and Blood Urea Nitrogen (BUN)/Albumin ratio in the assessment of ICU need and death within one month of admission in CAP patients.

Materials and Methods: Patients who were suffering and hospitalized for CAP were taken into the study. Venous blood samples were collected to determine albumin levels and to calculate BUN/Alb ratio. The levels of these parameters were correlated with the need of ICU and death within one month in these patients.

Results: 63 patients diagnosed and hospitalized with community acquired pneumonia were taken into the in the study. Patients who had lower serum albumin and higher BUN/Albumin ratio, had the necessity of ICU treatment. The level of BUN/Albumin ratio in determining ICU necessity was found to be ≥ 12.94 . The sensitivity was 91.30% and the specificity 65.79%. Decreased albumin level was an independent risk factor for the necessity of ICU management (OR: 4.152, 95% CI: 0.814 to 0.971, $p < 0.001$). The level of albumin in assessing the necessity of ICU management was found to be ≤ 3.2 g/dl.

Conclusion: Patients who had decreased serum albumin and increased BUN/Albumin ratio had the necessity of ICU management. Decreased level of albumin is a self-determining biochemical parameter for determining ICU requirement and assessing prognosis in CAP.

Keywords: Blood urea nitrogen, Albumin level, Community acquired pneumonia.

Introduction

Community acquired pneumonia is one among the most frequently seen pneumonia in medical wards. It affects people of all age groups. It is a common respiratory disease that leads to severe complications. It is an important cause of death worldwide.¹ The American Thoracic Society/ Infectious Diseases Society of America has established some scoring methods to determine the disease progression of pneumonia. CURB-65 (confusion, urea nitrogen, respiratory rate, blood pressure, ≥ 65 years) and Pneumonia Severity Index (PSI) are commonly used scoring methods to determine the disease complication.⁴ But, these scoring methods are affected by subjective decision of individual clinicians. So to determine the need of ICU requirement in these patients is a real challenge for clinicians.^{2,3} So, clinicians are in need of simple blood parameters to take crucial decision on requirement of ICU in these patients during the course of treatment. In recent years many studies have undertaken on the use of certain serum biomarkers in CAP patients. Some of the serum analytes studied included, atrial natriuretic peptide and pro-calcitonin. The levels of these inflammatory markers correlated with mortality and severity of CAP.^{5,6} Blood urea and serum albumin are among the routinely analyzed laboratory biomarkers which are implicated in the disease progression of pneumonia. Many studies have shown that the patients who ended up with complications had lower serum albumin levels than the patients who were successfully treated.⁷⁻¹⁰ The present study is under taken to evaluate the role of BUN and albumin in

assessing the requirement of ICU and death within one month of admission in these patients.

Materials and Methods

This study was done in Mac Gann teaching hospital, Shivamogga, Karnataka. This study was prospective observational. Ethical committee permission was taken. Informed approval was also obtained from all the subjects who were taken into the study. The study was comprised of 63 consecutive patients admitted for CAP between January 2016 to December 2017. Patients of both the sex between 18-65 years, from the community were taken into the study. The subjects who were considered in the study presented with at least two demark able features suggesting the diagnosis of pneumonia. Patients suffering from DM, AIDS, organ failure and other immunocompromized patients were excluded. We estimated serum parameters by Erba XL -640 auto-analyzer. Albumin was analyzed by colorimetric assay with Bromo-Cresol-Green method. Urea was analyzed by colorimetric kinetic test with Urease and glutamate dehydrogenase method. BUN was calculated by urea using the factor $BUN (mg/dl) = \text{urea}(mg/dl) / 2.1428$.

Results

In total 63 patients (46 men and 17 female) between the age group 18-65 years were included in the study. Demographic characteristic of the patients are given in Table 1. 28 among the 63 patients admitted had to be treated in ICU. Only one patient treated in ICU died within 28 days

of admission. The age, sex and other factors were not found to be associated with the need of ICU (all $p > 0.05$). Patients who required ICU management had one common feature, i.e low serum albumin and high BUN/ Albumin ratio. The p-value was less than 0.0001. The level of BUN/Albumin to establish the necessity for ICU management was ≥ 12.94 . The sensitivity 91.30% and specificity being 65.79%. The ROC curve analysis was found to be 0.777. The 95% confident interval was 0.653 to 0.874. The p-value was 0.5 and is depicted in Fig. 1. The level of albumin to expect the necessity of ICU management was ≤ 3.2 g/dl. The sensitivity was 91.30% and specificity 78.95%. The ROC curve analysis was 0.914. The 95% confident interval was 0.814 to 0.971 and p-value is 0.0001. This is shown in Fig. 2. Logistic regression analysis showed that the decreased albumin level was an independent serum biomarker for the necessity of ICU management. The Odds ratio is 0.137, 95% Confident interval is 0.0497 to 0.224, and p-value is 0.0021. The factors related to death within one month of admission were also analyzed. The demographic characteristics such as age, sex, other chronic lung and other metabolic disorders like diabetes mellitus did not seem to affect the death within one month of admission in these patients. Patients in whom CURB-65 was >2 , PS I was >3 and who required ICU treatment, had a higher rate of death; ($p = 0.029$, $p = 0.003$, $p = 0.001$). Because the number of patients included in the study were less, statistical significance and logistic regression analysis could not be done for death within one month in these patients.

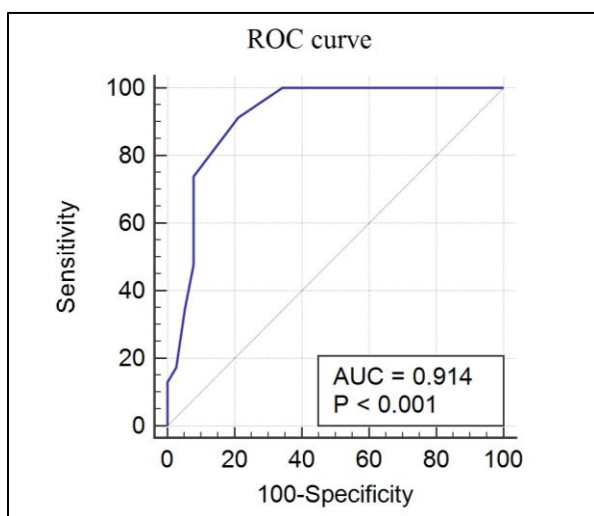


Fig. 1: The receiver operating characteristic (ROC) curve constructed from albumin measurements as a predictor of ICU need in patients with community acquired pneumonia. The area under the curve is 0.914(95% CI: 0.814 to 0.971)($p < 0.001$)

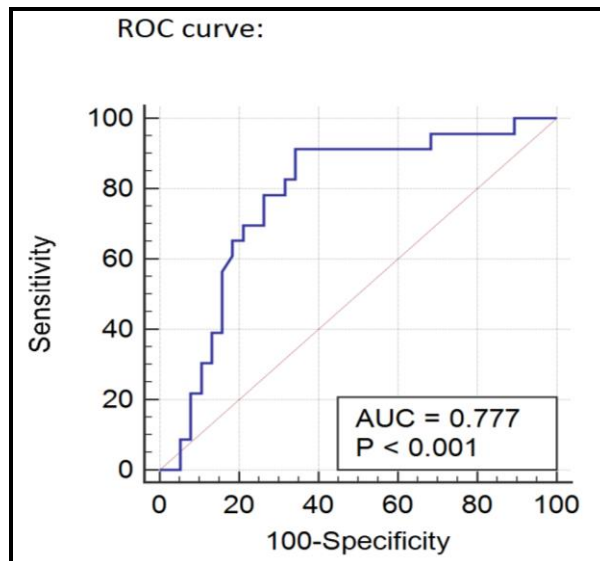


Fig. 2: The Receiver operating characteristic curve (ROC) constructed from calculations of BUN/Alb ratio as predictor of ICU need inpatients with CAP. The area under the ROC curve: 0.777 (95% CI: 0.653 to 0.874) ($p < 0.001$)

Table 1: Demographic properties and laboratory findings of CAP patients

Characteristics	Values
Gender	n%
Male	74.19%
Female	25.80%
Age, years	(n=63)
mean±SD	42.3±11.11
Blood urea nitrogen (mg/dl)	n=63
mean±SD	43.41±10.11
Serum albumin(g/dl)	n =63
mean±SD	3.28±0.30
BUN/Albumin ratio	n=63
mean±SD	13.74±4.48

Discussion

This study showed the CAP patients with decreased albumin and increased BUN/Albumin ratio were more prone for the requirement of ICU management. Decreased albumin level was found to be the independent predictor for the necessity of ICU treatment. There are numerous biochemical parameters, including procalcitonin and B-type natriuretic peptide. The levels of these parameters are correlated with the disease progression in these CAP.^{5,6} However the estimation of these biochemical parameters is not always available in all hospitals and may cost more for the patient. Conversely albumin and BUN are constantly tested serum biomarkers in all hospitals for CAP patients.

Nutritional status of the hospitalized patients is usually assessed with the level of serum albumin. Decreased albumin level was observed as a poor outcome in many patients, as also in CAP. The quantity of albumin production is markedly less in the acute phase of

inflammation. Most of the patients of pneumonia are infected with gram negative bacteria. These bacteria liberate cytokines, interleukins and chemokines as mediators of inflammation. These mediators increase the membrane permeability and lead to escape of albumin from the capillary vessels. Low level of albumin is constantly linked with poorer outcome in all admitted and seriously sick patients.⁷ In the study carried out by Lee et al, concluded that low albumin was constantly found in death within one month of admission due to CAP. Likewise patients who had decreased albumin level at the time of admission, were found to be more prone for death among CAP patients.⁸⁻¹⁰ In the present study, decreased albumin level was in strong association with the need of ICU management.

Earlier conducted research works have observed that the patients with CAP with higher level of BUN had comparatively increased death rates than patients with lower BUN level.¹¹ The determination of serum BUN currently is the most widely used screening test for the evaluation of kidney function. Hydration status of the patient must be considered during the evaluation of many biochemical parameters. Pneumonia patients are generally dehydrated because of high fever. During dehydration, reabsorption of urea is increased by the kidneys. This results in increase of BUN level in pneumonia patients. Thus high BUN levels make clear that there is diminish in renal perfusion due to dehydration and thus ultimately leading to further progression of pneumonia.

This research work had few limitations. This study did not consisted enough pneumonia patients. Moreover the study considered pneumonia patients from single hospital. This small patient group may fail to generalize for the whole CAP patients group. Moreover most of the patients admitted did not have severe pneumonia.

Conclusion

Community acquired pneumonia patients, who had low albumin and high BUN/Albumin ratio had the necessity of ICU management. Serum albumin and BUN/Albumin ratio are most commonly done biochemical parameters, which are simple, but more valuable parameters in assessing the prognosis of CAP. Serum albumin alone can be used as independent factor in assessing the necessity of ICU management in these patients. Many more studies are required to analyze the precise role and the lower limit of albumin and BUN /Albumin relation in assessing the complication and death in CAP patients.

Conflict of Interest: None.

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