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Procalcitonin albumin ratio: A useful predictor in intervention of urosepsis from febrile urinary tract infection

Nikunj Kishore Rout
Associate Professor, Department of Nephrology, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, India

Sujit Kumar Pradhan
Associate Professor, Department of Critical Care Medicine, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, India

Subranshu Patro
Professor, Department of General Medicine, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, India

Ashwini Prasad Pattanaik*
Senior Consultant, Department of Nephrology, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, India

***Abstract*---**Because procalcitonin has been recommended as a bacterial infection marker, this study was conducted to investigate the utility of serum PCT as an early marker to decide on intervention for urinary tract infection. We did a one-year retrospective analysis with 200 individuals who had febrile urinary tract infections. The independent risk variables for distinguishing urosepsis from febrile urinary tract infection were identified using univariate and multivariate logistic analysis. To examine the prediction accuracy of the procalcitonin/albumin ratio, a receiver operating characteristic (ROC) curve analysis was performed. The procalcitonin/albumin ratios in the urosepsis group were greater than those in the febrile urinary tract infection group were 84.62 percent and 96.00 percent, respectively. Furthermore, in the subset of 65 patients with urosepsis, the procalcitonin/albumin ratio in the uroseptic shock group was higher than in the non-urosepsis group. Our findings show that the procalcitonin/albumin ratio can distinguish between urosepsis and febrile urinary tract infection early in the diagnostic process. Furthermore, patients with urosepsis who had greater procalcitonin/albumin ratios were more likely to develop uroseptic

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shock. Our findings show that the procalcitonin/albumin ratio can be employed in clinical practise as a quick and low-cost biomarker.

***Keywords*---**albumin, diagnostic, febrile urinary tractinfection, procalcitonin, urosepsis.

Introduction

Urinary tract infection (UTI) is one of the most common diseases encountered by urologists. Febrile UTI (fUTI) typically represents acute pyelonephritis or acute prostatitis, but it may also represent urosepsis [1, 2]. Urosepsis is life-threatening organ dysfunctions caused by dysregulated host responses to infections originating in the urinary tract and/or male genital organs [3, 4]. The overall mortality rate for urosepsis can range from 7.5% to 30% [5, 6]. Moreover, this condition can prolong the length of hospital stays, increase costs and worsen a patient's overall prognosis, however, these adverse consequences can be alleviated by early diagnosis and treatment [7]. The ability to immediately discriminate urosepsis from fUTI is important in therapeutic decision-making and provides these patients with suitable treatments that can avoid sepsis-related organ failure. However, the response to urosepsis is complex and not all patients with fUTI display similar signs or symptoms. The diagnosis of urosepsis is time-consuming and can only be confirmed with blood and urine culture results [8]. The process of diagnosing these infections can take anywhere from 24 to 72 hours, based on the time required to obtain the culture results. Additionally, there may be false positive results because of contamination. Therefore, rapid and efficient diagnostic methods for discriminating urosepsis from fUTI are necessary.

Procalcitonin (PCT) was recently introduced as a novel predictor for systemic infection. PCT is induced in the plasma of patients with severe bacterial or fungal infections or sepsis. PCT concentrations up to 1000ng/ml and above are observed during severe sepsis and septic shock. PCT concentrations are associated with the severity of multiple organ dysfunction syndrome secondary to systemic inflammation of infectious origin [9, 10]. Randomized controlled trails had demonstrated efficacy in reduction of antibiotics usage [11, 12, 13], and FDA approved its use to assess the risk of critically ill patients progressing to severe sepsis. However, PCT levels may vary early during the development of sepsis. Also, it had been reported that the test's predictive power is only significant later in the patient's course [6, 9, 14, 15]. Moreover, most studies about the link between PCT and septic shock focused on generally ill patients with heterogeneous clinical conditions rather than a specific disease, compromising the predictability of PCT. The aim of this study was to investigate the use of the PCT/albumin ratio as an early diagnostic predictor for discriminating between urosepsis and fUTI. We compared the PCT/albumin ratio to currently available biomarkers such as blood leucocyte counts and C-reactive protein (CRP) levels.

Materials and Methods

Sample selection

We did a one-year retrospective study of patients with febrile urinary tract infections who were hospitalised to Pradyumna Bal Memorial Hospital in Bhubaneswar. Fever (38.0°C), age 18 years, a history of fever or shaking chills within 24 hours of presentation, at least 1 symptom of UTI (flank pain or dysuria), and leucocyturia or a positive urine culture were the inclusion criteria. Patients over the age of 18, pregnancy, a history of kidney transplantation, hemodialysis or peritoneal dialysis, patients with missing data, and patients with an illness that could alter the PCT level were all excluded (such as thyroid disease). Urosepsis was characterised as sepsis caused by a urinary tract infection and/or male genital organ infection [5]. Patients with fUTI were considered to have urosepsis if they had a bacterial infection proven by blood cultures or clinically diagnosed, and exhibited at least two of the following four criteria: fever (>38°C) or hypothermia (90 bpm); tachypnea (>20 respirations/minute); or leucopoenia (leucocyte count 12.0 109 / L) or a left-ward shift (>10 percent immature gran Patients were divided into two groups based on whether or not they had urosepsis. On admission, blood samples for CRP, leucocytes, platelets, albumin, and PCT were obtained. Demographic information, diagnoses, and clinical and laboratory data were all documented. All patients' medical records were reviewed, and clinical and biochemical data were collected as needed. Basic characteristics were obtained, including demographic information and pre-existing comorbidities such as diabetes, chronic lung illness, and renal failure.

Laboratory procedures

Upon admission to the hospital, the complete blood count (CBC), serum albumin, CRP, and PCT levels were also examined. PCT levels were determined using the manufacturer's instructions and the automatic analyzer VIDAS BRAHMS PCT package insert (BIOMÉ RIEUX). The assay's lower limit of detection was 0.05 ng/mL, while the functional assay sensitivity was 0.09 ng/mL. An automatic nephelometer was used to measure CBC, serum albumin, and CRP (Beckman Coulter, Pasadena, CA). CRP normal ranges were 0 to 6mg/L and albumin normal ranges were 35.0 to 53.0 g/L.

Statistical analysis

We used the independent samples t-test and Mann–Whitney U test for continuous data, and the x2 test for categorical variables, to compare the general information of each group. For the description of basic features, categorical variables are expressed as numbers and percentages, and continuous variables are expressed as means, standard deviations, or medians (upper and lower quartile). Positive and negative predictive values, as well as sensitivity and specificity, were computed. SPSS version 17.0 was used for the statistical analysis (SPSS, Chicago, IL). Unconditional logistic regression analysis was done to establish whether each variable in urosepsis was an independent factor. A P-value of < .05 in a univariate analysis was used to identify covariates for the multivariate logistic regression study. P< .05 was judged significant for variables, and the results are presented

as odds ratios with 95 percent confidence intervals (CIs). The area under the receiver operating characteristic (ROC) curve was used to assess prediction accuracy. The most accurate cut-off values were obtained using sensitivity/specificity.

Results

In our study, 115 (57%) of the patients were male, whereas 85 (43%) were female. There was a male predominance, with a M:F ratio of 1.35:1.

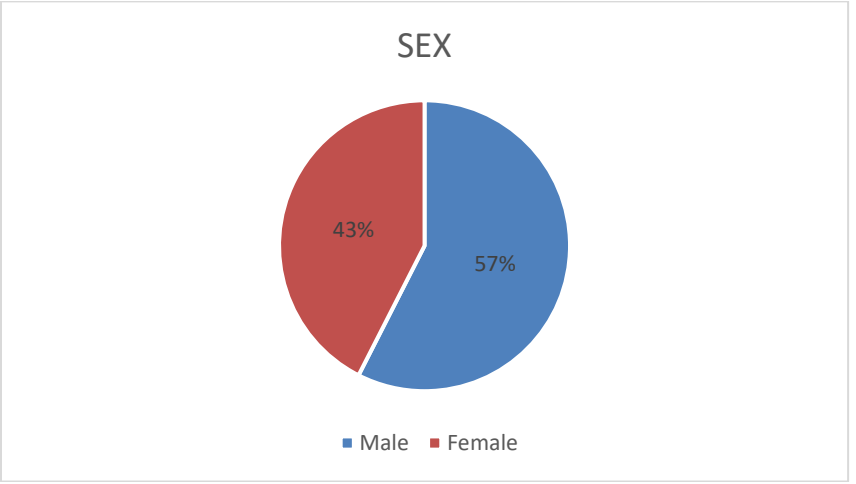

Figure 1. Patients' Distribution according to sex

The majority of patients (30%) were 61-70 years old, followed by 51-60 years (21 percent), 71-80 years (20 percent), 41-50 years (11 percent), 81-90 years (10 percent), 21-30 years (4.5 percent), and 31-40 years (3.5 percent).

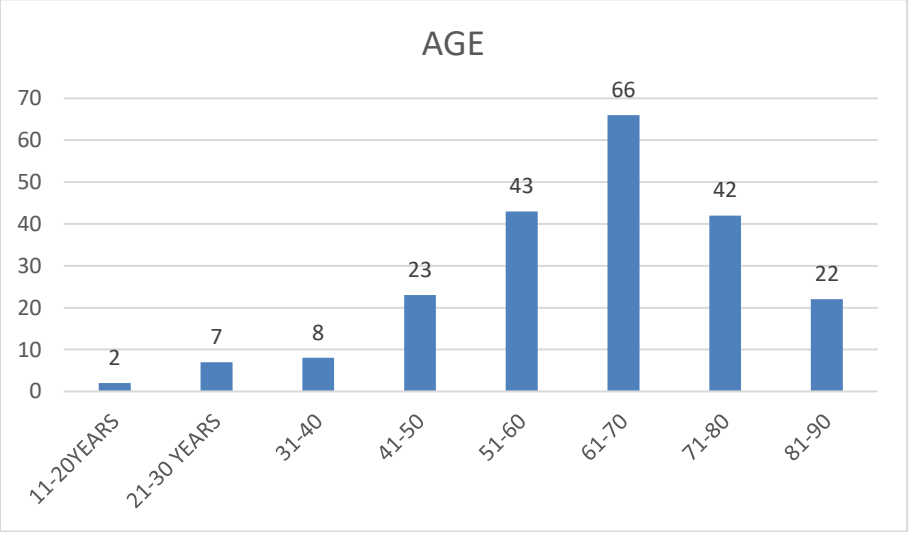

Figure 2. Patients' Distribution according to age

Out of 200 patients, 125 got sepsis, with 69 (55 percent) being male and 56 (45 percent) being female.

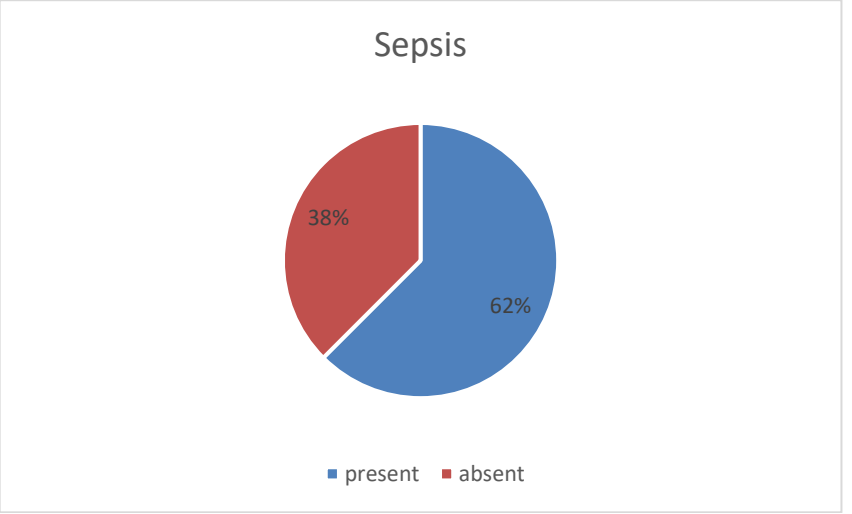

Figure 3. Patients' Distribution according to sepsis

Eighty-three individuals showed positive urine cultures, with 42 (51%) having E. coli and 41 having other bacteria.

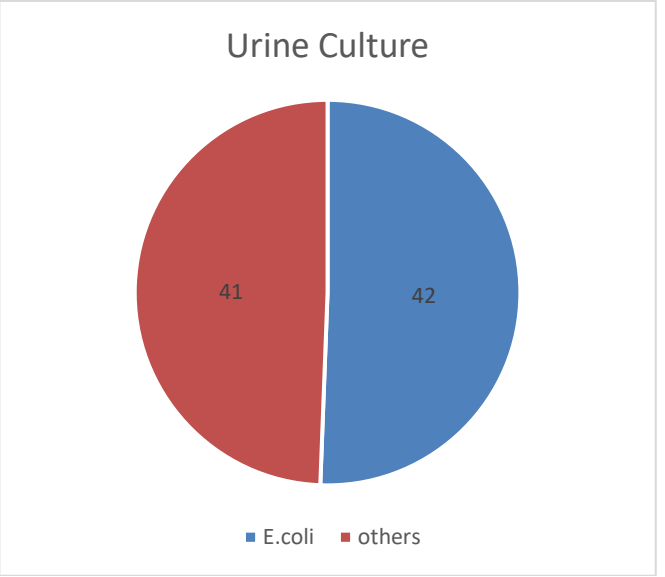

Figure 4. Patients' Distribution according to urine culture

Diabetes affected 105 (53%) of the patients, while hypertension affected 104 (52%) of the patients.

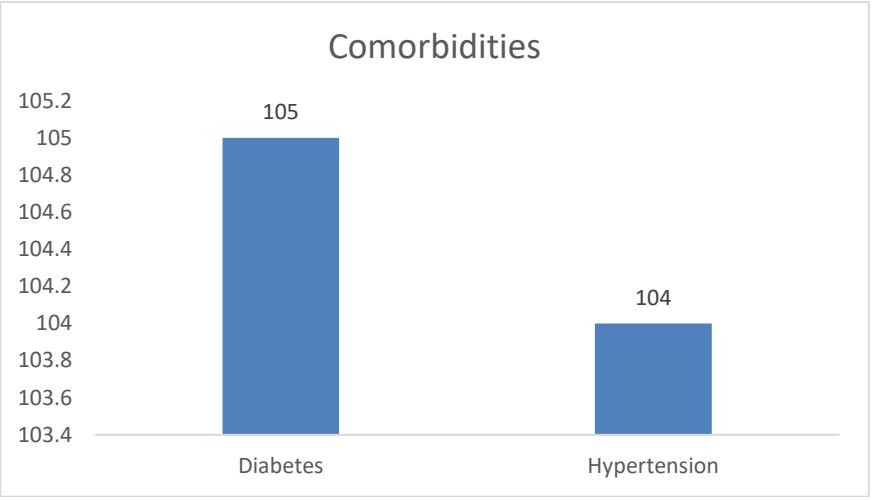

Figure 5. Patients' Distribution according to comorbidities

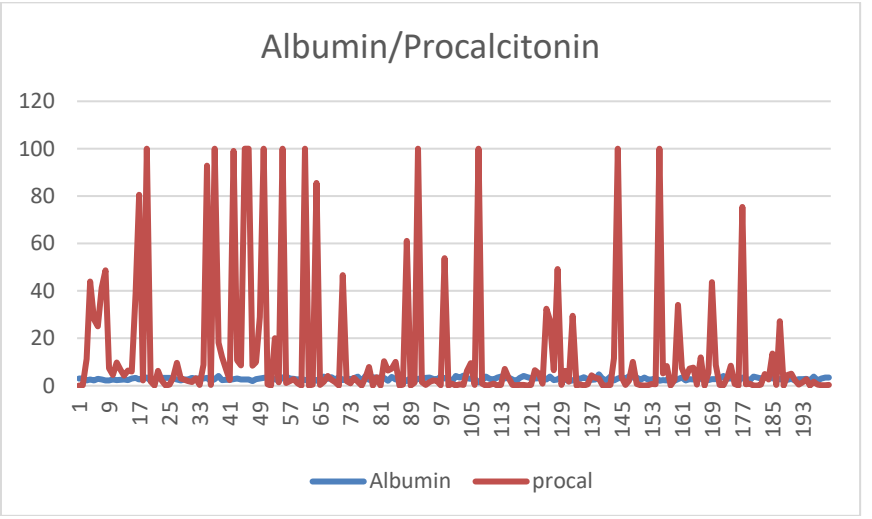

Figure 6. Patients' Distribution according to procalcitonin/albumin ratio

The area under the ROC curve (AUC) was used to examine the predictability of distinguishing urosepsis from fUTI (Fig. 6). At admission, the AUC for the PCT/albumin ratio was 84.62 percent and 96.00 percent, respectively, while the CRP and leucocyte cut-off values were less specific (sensitivity and specificity of 87.50 percent and 50.77 percent, and sensitivity and specificity of 64.62 percent and 74.32 percent, respectively) (Figure 6). The PCT/albumin ratio was found to be an early diagnostic predictor in distinguishing urosepsis from fUTI, with an elevated PCT/albumin ratio of 0.44.

Discussion

The key conclusion of our study was that the PCT/albumin ratio at the time of admission can be utilised as an early diagnostic predictor for distinguishing urosepsis from fUTI, which is an improvement over traditional and widely used

systemic infection biomarkers such as CRP and leucocyte count [15]. The AUC value for CRP and leucocytes was substantially higher in our study. To the best of our knowledge, this is the first study to look at the efficacy of the PCT/albumin ratio in distinguishing between urosepsis and fUTI. In patients with febrile UTI, PCT reliably predicts the existence of bacteraemia and bacterial load [16]. Some investigations have found that PCT levels greater than 2 ng/mL had a greater than 90% specificity for sepsis or the progression to sepsis, but PCT levels less than 0.5 ng/mL are not linked with sepsis [17]. We also discovered that CRP, leukocyte count, and PCT were considerably greater in patients with urosepsis than in those with fUTI upon admission. With regard to PCT levels, 26.2 percent of urosepsis patients (n=17) exceeded the 200 ng/mL threshold, which was much higher than the values required to suggest urosepsis. [18] This conclusion was most likely due to the fact that patients with urosepsis had fewer fundamental disorders and were younger in general.

The PCT levels were greater in our study for the following reasons: the majority of patients with UTI were infected with gram-negative organisms, which causes higher peak PCT values than infections caused by gram-positive organisms [19]. Different observation times could have led to different PCT optimum cut-off levels for diagnosing sepsis [20]. Various test procedures and reagents may have been utilised [21]. However, in our hospital, all of the patients' PCT levels were obtained upon arrival, reducing bias. The superiority of procalcitonin levels in the diagnosis of sepsis over C-reactive protein has already been shown [22]. In a study that compared PCT to CRP, the diagnostic sensitivity was 77% and the specificity was 79%. The receiver's operational characteristic was 85%. Despite having a limited sample size, our findings were comparable to those of a large-scale meta-analysis [18]. Procalcitonin can be a helpful biomarker that should be measured on a regular basis when deciding whether urinary intervention is necessary.

In conclusion, we discovered a considerably higher value for procalcitonin in patients with blocked UTI by comparing two groups of patients. As a result, we propose that procalcitonin levels could be utilised as a potential biomarker to help clinicians decide whether to proceed with urinary intervention in patients with blocked UTI. There were some drawbacks to this study as well. First, because it was a retrospective study, bias was likely. Second, the information was gathered from a single location. As a result, the results may differ from those of other centres, and the predictive likelihood may have been overstated when compared to a prospective study. Additional prospective studies with larger populations and multiple centres are required to corroborate our findings.

Conclusion

A procalcitonin/albumin ratio greater than 0.44 is useful for distinguishing urosepsis from fUTI and may outperform established indicators such as CRP levels and leucocyte counts. Our findings show that the procalcitonin/albumin ratio is a quick and low-cost biomarker in clinical practise. Prospective research with larger populations and multiple centres could validate these findings.

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