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Research Article

Utility of Serum Procalcitonin and Serum Albumin Ratio as Predictors in Discriminating Urosepsis from Patients with Febrile Urinary Tract Infection

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Abstract

Background: Serum procalcitonin (PCT) is a dependable and effective non-invasive diagnostic test that can assist a physician in determining the appropriate treatment for a urinary tract infection (UTI). this study aimed toassess the utility of serum procalcitonin and serum albumin ratio as predictors in discriminating urosepsis from patients with febrile urinary tract infection

Methods: A Prospective observational study was conducted for 18 months. Study subjects include all cases of urinary tract infection. A total of 80 patients were included in the study. A proforma containing necessary details with baseline demographic data, clinical, and Laboratory data was recorded upon inclusion into the study. Other tests such as C-reactive protein, total leucocyte count, Complete blood count, liver function test, renal function test and USG abdomen and pelvis was done and documented.

Results: Age group of 51-60 years constituted the majority. The levels of serum albumin were <3.5 mg/dl in 72% of the study subjects and >3.5 mg/dl in 28%. The bacterium Escherichia coli (E. coli) was identified in 26 cases, constituting 32.5% of the sample. Among the 80 study subjects with urinary tract infections, 7.5% had mortality. 34.78% of the fUTI cases had procalcitonin levels more than 2ng/mL and 97.1% of the urosepsis cases had procalcitonin levels more than 2ng/mL. PCT levels of > 2.0 ng/mL or ≥ 2.0 ng/mL.

Conclusion: Procalcitonin/albumin ratios greater than 0.44 are useful in differentiating between fUTI and urosepsis, and they may be better than more conventional biomarkers like leucocyte counts and CRP levels. The procalcitonin/albumin ratio is a low-cost and quick biomarker for use in clinical settings.

Keywords: Serum Procalcitonin and Serum Albumin Ratio, Urosepsis, Febrile Urinary Tract Infection, Tertiary Care Centre.

INTRODUCTION

Urinary tract infection (UTI) ranks as the third most common infection, behind gastrointestinal and respiratory tract infections. Among patients admitted to the hospital, it is the most common source of infections acquired in the community or inside the hospital setting. The prognosis and treatment of urinary tract infection (UTI) can be challenging and are influenced by the location of the illness and several risk factors.[1]

Urosepsis is a condition characterised by sepsis that is specifically caused by an infection in the urinary system. Urosepsis constitutes 25% of the total number of sepsis patients. The incidence of Urosepsis is anticipated to increase as the population ages.[1] Sepsis is a prevalent and deadly illness. Sepsis is defined as the malfunction of organs caused by an imbalanced immune response to infection, which can potentially lead to death.[2]

Conventional methods for diagnosing UTIs involve doing urine tests and urine culture. Although urine culture is a time-consuming and expensive process, it remains the most reliable method for diagnosing urinary tract infections (UTIs).[3] Serum leukocyte or neutrophil counts, C-reactive protein (CRP), and interleukins are commonly used to indicate urinary tract infections (UTIs). However, procalcitonin (PCT) has been shown to be more effective in separating acute

pyelonephritis (APN) from lower urinary tract infections (LUTIs). PCT can also aid in distinguishing between bacterial and viral diseases, a particularly crucial task in young individuals. In addition, serum procalcitonin (PCT) is detected 2 hours after tissue invasion, and its levels often increase and reach their highest point 12 hours later.[4,5]

Consequently, serum procalcitonin (PCT) is a dependable and effective non-invasive diagnostic test that can assist a physician in determining the appropriate treatment for a urinary tract infection (UTI).[5] In the absence of infection, elevated procalcitonin (PCT) levels have been observed in various medical contexts, including post major surgeries, transplants, injuries, burn injuries, severe cardiogenic shock, abnormalities in organ perfusion, autoimmune disorders, cancers and metastasis, non-infectious systemic inflammation, chronic kidney disease (CKD), and naturally in neonates. [5,6]

Furthermore, it lacks precision, and distinct thresholds may need to be tailored for various circumstances. Sastre et al.[7] discovered that PCT is not enough dependable to serve as the only indicator of sepsis. However, it might be valuable as a component of a comprehensive sepsis assessment. Currently, neither PCT nor any other biomarker can comprehensively elucidate the complex host response in sepsis or account for patient variability, such as age, comorbidities, surgery, and drugs.[5] the initial emphasis was on the systemic consequences of an imbalanced proinflammatory element, but sepsis also includes an anti-inflammatory reaction. Utilizing additional biomarkers that target other pathways might enhance the sensitivity and specificity of PCT over the whole range of sepsis, hence mitigating its limitations. More than 100 molecules and multi-marker approaches have been investigated with the purpose of detecting sepsis,[8], Procalcitonin (PCT) serves as an indicator of widespread inflammation in the body and, thus, can assist in predicting the presence of bacteria in the bloodstream.

It is considered a diagnostic indicator of sepsis in severely unwell individuals. Presently, PCT levels are extensively utilised and have been verified as indications of urosepsis. The PCT test demonstrates high sensitivity. Multiple studies have noted that procalcitonin (PCT) levels can rise in non-infectious situations and may remain low during genuine infections. Albumin is a strong indicator of outcomes in disorders associated to infection, since its levels often drop during acute phase infections. The relationship between the PCT to albumin ratio and early detection of urosepsis in patients with fUTI remains uncertain since no study has reported on this association. We hypothesized that the ratio of procalcitonin to albumin (PCT/albumin) might serve as a prognostic indicator for the timely detection of urosepsis in patients with febrile urinary tract infections (fUTI). With this background this study aimed toassess the utility of serum procalcitonin and serum albumin ratio as predictor in discriminating urosepsis from patients with febrile urinary tract infection

MATERIALS AND METHODS

This is a Prospective observational study and it was conducted at PES Institute of Medical Sciences & Research (PESIMSR), Kuppam, AP for 18 months. Study subjects includeall cases of urinary tract infection that meet the inclusion and exclusion criteria admitted in PESIMSR.Inclusion Criteriawaspatients aged 18 to 60 years of both gendersandpresenting withat least one symptom of urinary tract infection (flank pain or dysuria) and urine routine showing total leukocyte count > 10 cells/high power field. Pregnant women, patients withhistory of kidney transplantation, haemodialysis or peritoneal dialysis and patients with missing data and patients with an illness that could alter the procalcitonin level, like multiple organ dysfunction syndrome,and all stage 3, stage 4 and stage 5 chronic kidney disease (CKD)cases were excluded from the study.

Sample Size was calculated based on the Rout et al study[9]with precision 0.09 (9%) and expected prevalence 0.2143 (21.43%) at 95% CI. A total of 80 patients were included in the study. A proforma containing necessary details with Baseline demographic data, clinical, and Laboratory data was recorded upon inclusion into the study. Socio demographic detailslike-Age, Gender, occupation, and comorbidities like Hypertension and type 2 diabetes mellitus.

Following Investigations Were Done

Serum Procalcitonin, Serum Albumin, C Reactive Protein (CRP), Total leukocyte count (TLC), Urine routine(U/R), Urine culture and sensitivity (Urine C&S), Complete blood count (CBC), Renal Function Test (RFT), Estimated glomerular filtration rate (EGFR), Liver Function Test (LFT), USG Abdomen and Pelvis measured.

Procedure for Data Collection

All patients who visited the medicine OPD or were admitted in PESIMSR throughout the study period and metthe inclusion and exclusion criteria were included in the study after obtaining written informed consent. Detailed demographic data as well as symptoms at the time of admission, were documented in a pretested organized format. Patients with urinary tract infection were examined in detail and documentation was done as per the proforma designed for the purpose. Urine routine microscopy, urine culture and was submitted to determine a positive diagnosis of UTI. Single, clean-catch voided urine specimen with 1 bacterial species isolated in a quantitative count ⩾105 cfu/mL identifies bacteriuria in men and women.

Collection of Mid-Stream Urine Sample

Patients were asked to clean their external genitalia prior to the collection of urine. Male patients were asked to clean the penis with clean tap water and retract the glans penis, then asked to pass about 50 ml of urine into toilet or bowel and the next stream of 5-10 ml is collected into a clean sterile bottle provided by lab. Female patients were asked to separate their labia by two fingers and clean their vulva twice using front- to-back strokes with swabs soaked in clean tap water, then urine is collected in similar way as male patients, whilst labia are held apart. Samples were labelled and immediately transported to lab. The presence of bacteria or other organisms in typically sterile urine or genitourinary tissues is known as urinary tract infection (UTI). Urosepsis is life-threatening organ dysfunctions caused by dysregulated host response to infections originating in the urinary tract and/or male genital organs.

Blood samples were collected within 24 hrs of admission to determine serum procalcitonin and serum albumin levels. Other tests such as C-reactive protein, total leucocyte count, Complete blood count, liver function test, renal function test and USG abdomen and pelvis was done and documented. EGFR was calculated and documented. Patients were thoroughly assessed to rule out any other possible primary source of illness.

All patients' serum procalcitonin to albumin ratio was calculated and documented at the initial visit and all patients were treated according to standardized hospital protocol were kept under observation and closely monitored for the onset of sepsis using clinical symptoms for 5 days. Correlation of clinical symptoms of sepsis was done with their admission levels of serum procalcitonin to albumin ratio and compared with C C-reactive protein and total leukocyte count.

Ethical Considerations

Prior approval from the Institutional Ethics Committee has been obtained. All the participants in this study are voluntarily involved. Informed consent was obtained from every participant.Participant confidentiality will be maintained.Participants were not subjected to any potential harm.

The statistical analysis was carried out by the statistical software SPSS version 25.0 after the data had been loaded into the Microsoft Excel spreadsheet. The quantitative (numerical variables) information was presented as the mean and standard deviation, while the qualitative (categorical variables) information was presented as the frequency and percentage of each category. When comparing the mean values of the two groups, the student t-test was utilized, whilst the chi-square test was utilized to analyze the frequency differences between the two groups. If the p-value was less than 0.05, then it was regarded to be statistically significant. Sensitivity, specificity, and positive and negative predictive values were calculated.

RESULTS

Table 1: Distribution According to Sociodemographic Variables, Symptoms, Habits and Comorbidities

Variables		Frequency	Percentage
Age	21-30 years	7	8.8
	31-40 years	14	17.5
	41-50 years	24	30.0
	51-60 years	35	43.8
Gender	Female	33	41.3
	Male	47	58.8
Signs and symptoms	Fever	71	88.8
	Vomiting	20	25.0
	Abdominal pain	34	42.5

	Burning micturition Urgency Supra Pubic tenderness	61 25 47	76.3 31.3 58.8
Personal habits	Alcoholism Smoking	16 15	20.0 18.8
Co-morbidities	Hypertension Diabetes	29 37	36.3 46.3

The distribution of the age groups among patients with urinary tract infections showed a significant concentration in the older populations. Specifically, the age group of 51-60 years constituted the majority, with 35 individuals accounting for 43.8% of the total sample size of 80. The overall mean age of the study participants was 57.47 years with a standard deviation of 16.89, further emphasizing the predominance of older adults in the study cohort. The sample comprised 33 females (41.3%) and 47 males (58.8%), indicating male predominance.

Study subjects presented with various signs and symptoms, among which fever (88.8%) was predominant, followed by burning micturition (76.3%), supra pubic tenderness (58.8%), abdominal pain (42.5%), urgency in urination (31.3%) and vomiting (25%). Smoking and alcoholism were present in equal proportion of patients around 20% each.

The prevalence of co-morbid conditions among the 80 participants with urinary tract infections was examined. Diabetes was common co-morbidity, with 37 individuals accounting for 46.3 % of the study group. Hypertension was also present in a significant portion of the cohort, affecting 29 individuals, which corresponds to 36.3% of the sample.

Table 2: Distribution According to Serum Albumin, Urine Culture, Sepsis, Hospital Stay and Outcome

Variables		**Frequency**	**Percentage**
Serum Albumin (g/dl)	<3.5 >3.5	58 22	72.5 27.5
Urine culture	Escherichia coli Klebsiellapneumoniae CONS Pseudomonas aeruginosa No growth	26 11 5 3 35	32.5 13.7 6.3 3.8 43.7
Sepsis	Urosepsis Febrile Urinary tract infections (fUTI)	34 46	42.5 57.5
Outcome	Survived Died	74 6	92.5 7.5
Hospital stay	<7 days 7-14 days >14 days	32 38 10	40 47.5 12.5

The levels of serum albumin were <3.5 mg/dl in 72% of the study subjects and >3.5 mg/dl in 28%. The bacterium Escherichia coli (E. coli) was identified in 26 cases, constituting 32.5% of the sample, other pathogens found were Klebsiella pneumoniae 11(13.75%). This significant predominance of Escherichia coli suggests its major role in UTIs within the study group, reinforcing the need for targeted therapeutic strategies against this specific pathogen in similar clinical settings.

42.5% of the study subjects developed urosepsis. Among the 80 study subjects with urinary tract infections, 7.5% had mortality. Duration of hospital stay was <7 days in 40% of study subjects, 7 to 14 days in 47.5% and >14 days in 12.5% of study subjects.

Table 3: Comparison of fUTI and Urosepsis between Factors

Variable	**fUTI No. (%)**	**Urosepsis No. (%)**	**Total**	**P value**

Age	21-30 years 31-40 years 41-50 years 51-60 years	5 (10.9) 9 (19.6) 10 (21.7) 22 (47.8)	2 (5.9) 5 (14.7) 14 (41.2) 13 (38.2)	7 14 24 35	0.04
Gender	Male	19 (41.3)	14 (41.8)	33	0.841
Serum Albumin (g/dl)	<3.5 g/dl >3.5 g/dl	30 (65.5) 16 (34.8)	28 (82.4) 6 (17.6)	58 22	0.001
CPR (mg/dl)	<6 mg/dl >6 mg/dl	26 (56.6) 20 (43.5)	1 (2.9) 33 (97.1)	27 53	<0.001
WBC in Urine	<5 WBCs/hpf >5 WBCs/hpf	44 (95.7) 2 (4.3)	26 (76.5) 8 (23.5)	70 10	<0.010
USG abdomen	Normal Abnormal	24 (52.2) 22 (47.8)	5 (14.7) 29 (85.3)	29 51	<0.001
Hospital stay	<7 days 7-14 days >14 days	26 (56.5) 10 (21.7) 10 (21.7)	6 (17.6) 10 (29.4) 18 (52.9)	32 20 38	<0.001
Mortality	Died Survived	1 (2.2) 45 (97.8)	5 (14.7) 29 (85.3)	6 74	0.035
Procalcitonin	≤ 2ng/mL ≥ 2ng/mL	30 (65.2) 16 (34.8)	1 (2.9) 33 (97.1)	31 49	<0.001
PAR ratio	<1 >1	32 (69.6) 14 (30.4)	0 (0) 34 (100)	32 48	<0.001
Plenty of WBC in urine		2 (4.3%)	8 (23.5%)	10 (12.5%)	<0.001
DM		10 (21.7%)	18 (52.9%)	28	0.040
HTN		14 (30.4)	15 (44.1)	29	0.64
Mortality		1 (2.2)	5 (14.7)	6	<0.001

Urinary tract infections were observed higher among the age group 51-60 years (43.8%), among which urosepsis was observed in 38.2%, among the age group 41-50 years urosepsis was observed in 41.2% of study subjects. There was a statistically significant association between age group and fUTI**.** The results indicated that the majority of the patients, 28 out of 34 (82.4%), had albumin levels <3.5 g/dl, whereas 6 patients (17.6%) exhibited levels >3.5 g/dl. The distribution of albumin levels showed a statistically significant difference with a p-value of 0.001, suggesting that lower albumin levels might be associated with more severe cases of infection or possibly other underlying health conditions.

The results showed a significant association between increased CRP levels and sepsis. Specifically, 33 out of 34 patients with sepsis (97.1%) had increased CRP levels compared to only 20 out of 46 patients without sepsis (43.5%). Conversely, normal CRP levels were found in 1 patient with sepsis (2.9%) and 26 patients without sepsis (56.5%). This significant difference in CRP levels between the two groups was statistically validated with a p-value of 0.0001**.**

The results showed a significant association between plenty WBC count in fUTI and sepsis. Specifically, 8 out of 34 patients with urosepsis (23.5%) had plenty WBC count (>5 WBCs/hpf) in urine compared to only 2 out of 46 patients without sepsis (23.5%). This significant difference in WBC count in Urine between the two groups was statistically validated with a p-value of 0.01. The results showed a significant association between USG abdomen and sepsis. Specifically, 29 out of 34 patients with sepsis (85.3%) had Abnormal USG findings compared to only 22 out of 46 patients without sepsis (47.8%). This significant difference in USG abdomen between the two groups was statistically validated with a p-value of 0.001.

The data showed distinct differences in hospitalization duration between patients with sepsis (34 participants) and those without sepsis (46 participants). Patients with sepsis demonstrated a longer hospital stay, with 18 of them (52.9%) staying for more than 14 days, compared to only 10 patients (21.7%) without sepsis staying beyond this duration. This comparison yielded a statistically significant p-value of 0.001, indicating that the presence of sepsis significantly affected the length of hospital stay.

The study revealed a significant difference in mortality rates: 5 out of 34 patients with sepsis (14.7%) succumbed to the condition, whereas only 1 out of 46 patients without

sepsis (2.2%) died. This significant disparity yielded a p-value of 0.035, indicating a strong statistical association between sepsis and increased mortality.

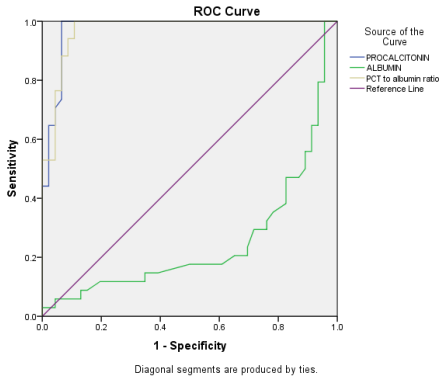
The study revealed a significant difference in procalcitonin levels with disease severity. 34.78% of the fUTI cases had procalcitonin levels more than 2ng/mL and 97.1% of the urosepsis cases had procalcitonin levels more than 2ng/mL. PCT levels of > 2.0 ng/mL or ≥ 2.0 ng/mL indicate the patient has a high probability of a systemic bacterial infection and increased risk that the infection could progress to sepsis or septic shock.

The study revealed that there was no significant difference in occurrence of death in cases with procalcitonin ≤ 2ng/mL with levels with ≥ 2ng/mL. All patients with urosepsis had a PCT/Albumin ratio greater than 1. Only 14 patients (30.4%) presented a ratio greater than 1 in febrile UTI cases. The significant distribution was confirmed by a p-value of 0.001, indicating a strong statistical significance that higher PCT/Albumin ratios might correlate with greater severity of infection or systemic response

Table 4: Mean/ Median Comparison of fUTI and Urosepsis between Factors

Variable	fUTI Mean±SD / Median (IQR)	Urosepsis Mean±SD/Median (IQR)	P value
E GFR	85.80 ± 9.41	50.35 ± 18.74	0.002
Serum Creatinine	1.13 ±0.54	2.3 ± 0.19	0.040
Albumin(g/dL)	3.35 ± 6.0	2.90 ± 6.3	<0.001
Procalcitonin(ng/ml)	0.71 (0.15, 3.37)	63.79 (30.31, 198)	<0.010
PAR ratio	0.021 (0.003, 0.094)	2.201 (0.978, 6.299)	<0.001
CRP (mg/L)	10.48±7.2	16.65±6.79	0.015
Leukocyte (x106/ L)	10985 ± 4719	16617 ± 7067	<0.035
Hospital Stay	6.26 ± 2.84	11.88 ± 3.49	0.040

Figure 1: ROC Curve



Area Under the Curve					
Test Result Variable(s)	Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
				Lower Bound	Upper Bound
Procalcitonin	.974	.016	.000	.943	1.000
Albumin	.251	.059	.000	.135	.367
PCT to albumin ratio (PAR)	.971	.016	.000	.938	1.000

ROC analysis of our study variables showed that Procalcitonin has an AUC of 0.974 with a standard error of 0.016. A p value of 0.000 indicates that the result is statistically significant. Procalcitonin has a Youden index of 0.6217 with a cut-off of ≥ 1.42, a distance to the corner of 0.2764, a PPV of 88.6 percent, a sensitivity of 85.2 percent, and a specificity of 80.6 percent with a cut-off of 1.42.

PAR has an AUC of 0.971, a standard error of 0.016, A p-value of 0.000 indicating that the result is statistically significant. PAR has a Youden index of 0.6941 with cut-off of ≥0.44, with a distance to the corner of 0.2841 and amPPV of 98.1 percent, NPV of 85.3 percent, sensitivity of 96.8 percent, and specificity of 88.3 percent.

Albumin has an AUC of 0.251 with a standard error of 0.059. A p value of 0.000 indicates that the result is statistically significant. It is having AUC which is not acceptable to use this as a prognostic or diagnostic indicator in between fUTI and Urosepsis.

DISCUSSION

The term "urinary tract infection" (UTI) refers to the presence of bacteria or other organisms in genitourinary tissues or urine that is normally sterile. Bacteriuria is the term used to describe any type of bacteria found in the urine.[1]

Urinary tract infection that is febrile might also indicate sepsis. It usually signifies acute prostatitis or acute pyelonephritis. Urosepsis is a potentially fatal organ dysfunction caused by dysregulated host responses to infections that start in the urine system and/or male genital organs. 7.5% to 30% is the range of possible overall death rates from urosepsis. This illness may make hospital stays longer, raise expenses, and impair the outlook for patients as a whole. Early detection and intervention can help to mitigate these negative effects. [2]

It's critical to distinguish between urosepsis and UTI as soon as possible, since this helps with therapeutic decision-making and helps these patients receive appropriate care that can prevent organ failure associated with sepsis. But the reaction to urosepsis is complicated, and not every patient has the same symptoms or indicators. Urosepsis diagnosis is a laborious process that can only be verified by the findings of blood and urine cultures. Diagnosing these infections might take up to 72 hours, depending on how long it takes to get the culture results.[2]

Another reason for false positive results might be contamination. As a result, quick and accurate diagnostic techniques are required to distinguish between urosepsis and UTI. Recently, procalcitonin (PCT) was shown as a potential systemic infection predictor. PCT levels are elevated in the plasma of individuals suffering from sepsis or severe bacterial or fungal infections. Severe sepsis and septic shock can result in PCT values up to 1000ng/ml and higher. The concentration of PCT is determined by the severity of multiple organ dysfunction syndrome resulting from systemic inflammation of viral etiology. One useful biomarker for the early detection of sepsis is procalcitonin (PCT).PCT has a half-life of around 24 hours .[2] Point-of-care tests (PoCTs) that measure blood CRP and procalcitonin (PCT) have the potential to enhance the detection of urinary tract infections (UTTIs) in elderly people and the subsequent administration of antibiotics.[3]

When it comes to bacterial infection, PCT is more sensitive and specific than CRP. PCT can be used to distinguish between urosepsis, UTI, and asymptomatic bacteriuria in individuals with negative nitrite or leukocyte esterase.[4]

In emergency situations, PCT can predict the likelihood that patients may become infected with germs. Research has demonstrated that PCT-based techniques can significantly and safely reduce antibiotic consumption in patients who do not have acute exacerbations of COPD, community-acquired pneumonia, or severe lower respiratory tract infections.[5]

Therefore, the present prospective study was performed to compare the PCT to albumin ratio to other indicators that are already available, such as blood total leucocyte count (TLC) and levels of the protein Creatine (CRP), in order to distinguish between urosepsis and febrile urinary tract infection.

The present study included a total of 80 participants with UTIs. A noteworthy concentration in the senior populations was seen in the age distribution of patients with UTIs, suggesting that the frequency or severity of UTIs that result in fever conditions may be significantly influenced by age.

47 were male (58.8%) and 33 of whom were female (41.3%). Although both males and females can experience symptomatic UTIs, the finding of little bit higher male prevalence in our study is in contrast to previous research which reported that female gender have a greater degree of influence compared to their male counterparts.

The research group consisted of 80 patients, of whom 46.3% had diabetes, making it the most frequent co-morbidity. Of the cohort, hypertension affected 29 (36.3%) of the sample. This was another substantial fraction of the cohort with hypertension. There was discernible variation in the incidence of UTIs between individuals with diabetes and those without the disease in this particular sample, according to the statistical analysis, which

produced a p- value of 0.04 for the diabetes distribution. These results of the current study are in line with the past literature which indicates that UTI group of patients had a higher prevalence of diabetes mellitus and hypertension.

In the present study, The bacterium Escherichia coli (E. coli) was identified in 26 cases, constituting 32.5% of the sample, other pathogens found in higher cases was Klebsiella 11(13.75%). This significant predominance of E. coli suggests its major role in UTIs within the study group, reinforcing the need for targeted therapeutic strategies against this specific pathogen in similar clinical settings. This substantial E. coli predominance indicates that this pathogen plays a key role in UTIs within the study group, which emphasizes the necessity for tailored therapy approaches against this particular bacterium in comparable clinical contexts. Nargis et al.'s research[10] 35.8% of the isolates were Escherichia coli. Seven (9.5%) cases of mixed infection were identified, with Pseudomonas, Acinetobacter, and other microorganisms being more prevalent. This was consistent with the findings of Andreola et al.[11] and Karlsson et al.[12], albeit with a lower positive culture rate than ours. Additionally, Karlsson et al.[12] reported that positive culture cases had significantly higher PCT levels than negative cases.

The current study demonstrated that the duration of hospitalization varied significantly between individuals with sepsis (34 participants) and those without sepsis (46 participants). Sepsis patients exhibited an extended hospital stay; of them, 18 (52.9%) stayed longer than 14 days, whereas only 10 (21.7%) of the non-septic patients stayed longer than 14 days. On the other hand, compared to 10 patients (29.4%) in the same group who had sepsis, and almost same percentage of patients (21.7%) who did not have sepsis had hospital stays of 7-14 days. UTIs can lead to hospitalization and subsequent development of sepsis, a severe condition with high mortality rates. Research has indicated that urinary tract infections (UTIs) can lengthen hospital stays and increase the likelihood of developing sepsis, highlighting the connection between UTIs, sepsis, and extended hospital stays. Therefore, early detection and management of UTIs are crucial in reducing sepsis risk and improving hospitalization outcomes.

The results of the present study showed that 48 out of 80 individuals (60%) had a PAR greater than 1. This represented the large majority of participants. Conversely, only 22 individuals (40%) had a PAR of less than 1. The median Par value was 0.19 (IQR-0.02-1.91). in case of urosepsis cases it was 2.20 (IQR- 0.97, 6.29) and in fUTI cases it was 0.021 (IQR- 0.003,0.094)

The findings of the current research showed that 58 patients (72.5%) had albumin levels below 3.5 gm/dl, whereas the rest of the patients, 22 out of 80 (27.5%), had values over 3.5 gm/dl. The results indicated that the majority of the patients, 28 out of 34 urosepsis cases (82.4%), had albumin levels <3.5 mg/dl, whereas 6 patients (17.6%) exhibited levels >3.5 mg/dl. The albumin level distribution revealed a statistically significant difference, indicating that lower albumin levels may be linked to more serious infections or perhaps other underlying medical issues. Researchers have looked at the potential use of serum albumin as a predictor to distinguish between individuals with feverish UTIs and those with urosepsis. Numerous investigations have looked into how well these markers work as urosepsis predictors. [9,10,13]

The data revealed a significant all patients with urosepsis had a PCT/Albumin ratio greater than 1. Only 14 patients (30.4%) presented a ratio greater than 1 in febrile UTI cases. indicating that higher PCT/Albumin ratios might correlate with greater severity of infection or systemic response.

Our study's primary discovery was that, in contrast to the widely used and conventional biomarkers of systemic infection, such as CRP and leucocyte count, the PCT/albumin ratio at the time of admission can be used as an early diagnostic predictor for differentiating urosepsis from fUTI. Our results showed a significantly higher AUC value compared to leucocytes and CRP. This is the first study that we are aware of that evaluates the PCT/albumin ratio's usefulness in differentiating between fUTI and urosepsis.

CRP and leucocyte are typically used in conjunction with blood cultures and are thought to be helpful markers for the diagnosis of sepsis. However, since it can take up to 72 hours to receive the culture results, these techniques aren't always sufficient for an early diagnosis. The patient's general health may suffer as a result of this diagnosis delay. As a result, quicker and more effective diagnostic techniques were required. It has

previously been reported that the neutrophil lymphocyte count ratio (NLCR) is a good indicator of bacteremia.[14-18] According to Lars Ljungström[19], in less severe septic conditions, NLCR or PCT alone performed comparably in confirming the presence of bacterial sepsis.

In patients with feverish UTIs, PCT reliably predicts the presence of bacteraemia and bacterial load.[20] Research indicates that PCT levels >2 ng/mL have >90% specificity for sepsis or the development of sepsis, while PCT levels <0.5 ng/mL are not linked to sepsis. Additionally, we discovered that patients with urosepsis had significantly higher admission CRP, leukocyte counts, and PCT values than patients with fUTI.[21] 42.5% of patients (n=34) with urosepsis exceeded the 190 ng/mL threshold, which was significantly higher than the values required to suggest urosepsis, especially with the PCT levels. This result was probably brought about by the fact that patients with urosepsis were generally younger and had fewer basic diseases. Our study's PCT levels were higher for the following reasons:[22]

Different observation times may have produced different PCT optimal cut-off values to diagnose sepsis;[23] Different test methods and reagents may have been used[24]; However, these were the same in our hospital, where all patients' PCT levels were taken upon admission, thereby reducing bias. The majority of UTI patients were infected with gram-negative organisms, which causes higher peak PCT values than infections caused by gram-positive organisms.

Only the PCT/albumin ratio at admission, which the ROC curve showed to be significantly higher than both PCT and Albumin, was an independent predictor of urosepsis in a multivariate analysis. Few studies have recently assessed the diagnostic utility of the PCT/albumin ratio in separating patients with fUTI from those who have urosepsis. Additionally, we calculated the ideal PCT/albumin ratio cut-off value to separate patients with fUTI from those at risk for urosepsis, maximizing sensitivity without significantly sacrificing specificity. The creation of a ROC curve provided additional evidence of the statistical models' diagnostic accuracy.

This curve showed that, with 96.8% sensitivity and 88.3% specificity, the ideal cut-off value for the PCT/albumin ratio was >0.44, which allowed for the separation of urosepsis from fUTI. In terms of predicting urosepsis, the PCT/albumin ratio >0.44 exhibited the highest sensitivity and specificity. Moreover, the severity of urosepsis may be indicated by the PCT/albumin ratio. According to our research, the PCT/albumin ratio was substantially higher in uroseptic shock [2.201 (0.978, 6.299) vs 0.021 (0.003, 0.094)); P=.0001] than in urosepsis without shock. Although PCT levels are thought to be associated with infections, they can occasionally rise in non-infectious situations and may stay low during infections. It is well known that individuals with infections typically have lower albumin levels. In order to increase the sensitivity and specificity of early urosepsis diagnosis before the onset of hypotension or thrombocytopenia, we combined the two biomarkers. Our findings demonstrate the utility of the PCT/albumin ratio as a predictor, as it facilitates the timely diagnosis of urosepsis in fUTI patients without requiring the waiting for blood culture results.

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