



## Role of C-Reactive Protein levels in Differentiating Upper Urinary Tract Infection and Lower Urinary Tract Infection in Adults

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### Abstract

**Background:** Urinary Tract Infection (UTI) is common infection in everyday practice. Mortality and morbidity is increased in UTI complicated with bacteremia. UTI above bladder is considered as upper UTI and below as lower UTI. Distinction between upper UTI and lower UTI is more important because it has a therapeutic and prognostic significance. Elevated CRP levels are often seen in acute pyelonephritis and rarely in cystitis.

**Methods:** Present study was a cross sectional study in King George Hospital from October 2017 to May 2018 in patients having culture positive UTI. Patients were categorised into upper and lower UTI based on clinical features. Patients having suprapubic pain, dysuria, frequency, urgency are considered as having lower urinary tract infection. Patients having loin pain, renal angle tenderness, temperature equal or more than 38.5 c, and features of sepsis are considered as having upper urinary tract infection.

**Results:** Out of 65 cases 43 were females and 22 were males, 26 were upper UTI and 39 were lower UTI. On urine culture E.coli was grown in 64.6% klebsiella in 13.8% Proteus in 6.15%, staph. aureus and streptococcus in 2 cases each, pseudomonas in one case and others 6.15%. Mean value of CRP upper UTI is 126.6mg/L and lower UTI is 5.1 mg/L which is statistically significant ( $p < 0.01$ ).

**Conclusions:** C-reactive protein is a good diagnostic tool in differentiating upper UTI and lower UTI as it is significantly raised in upper UTI and it is a non invasive diagnostic tool. Longer follow of CRP up may point to high risk cases which are likely to develop chronic parenchymal renal disease.

### Introduction and Background

Urinary tract infection (UTI) is one of the common infection seen in everyday practice<sup>1</sup>. UTI has various clinical manifestations ranging from simple fever and lower urinary tract symptoms to dreadful form of sepsis with septic shock causing prolonged morbidity and mortality depending on underlying host and pathogen risk factors<sup>2</sup>. The

most common organism causing urinary tract infection is Escherichia coli.<sup>1,2,3</sup> Mortality and morbidity is usually increased in UTI complicated with bacteremia.<sup>4,5</sup>

UTI above the urinary bladder is considered as Upper UTI and below is Lower UTI. The distinction between Upper and Lower UTI is more important because it has a therapeutic and

prognostic significance.<sup>6</sup> Upper UTI may be associated with parenchymal scarring secondary to renal involvement that may lead to arterial hypertension and chronic renal failure.<sup>7,8</sup>

Various diagnostic approaches such as clinical history, physical examination and laboratory data including urine and blood analysis are often inconclusive in localizing site of UTI. More specific examinations such as determination of antibody coated bacteria in urine, evidence of serum antibodies against bacteria, ureteral catheterization bladder wash out test, gallium scans contribute to localization of UTI but because of their time consuming and partly invasive character they cannot and should not be used routinely. One of the indirect, non-invasive methods of localizing UTI to the upper tract and lower tract is C-reactive protein (CRP) in blood<sup>9</sup>.

Plasma CRP is produced only by hepatocytes, predominantly under transcriptional control by the cytokine IL-6, although other sites of local CRP synthesis and possibly secretion have been suggested. De novo hepatic synthesis starts very rapidly after a single stimulus, serum concentrations rising above 5 mg/l by about 6 hours and peaking around 48 hours. The plasma half-life of CRP is about 19 hours and is constant under all conditions of health and disease, so that the sole determinant of circulating CRP concentration is the synthesis rate, which thus directly reflects the intensity of the pathological processes stimulating CRP production. In most, though not in all diseases the circulating value of CRP reflects ongoing inflammation and/or tissue damage much more accurately than do other laboratory parameters of the acute-phase/response, such as plasma viscosity and the erythrocyte sedimentation rate.<sup>10</sup>

Present study is to evaluate the role of CRP in differentiating upper UTI from lower UTI.

### Aim of the Study

To determine the role of blood C-reactive protein levels in differentiating upper urinary tract infection from lower urinary tract infection.

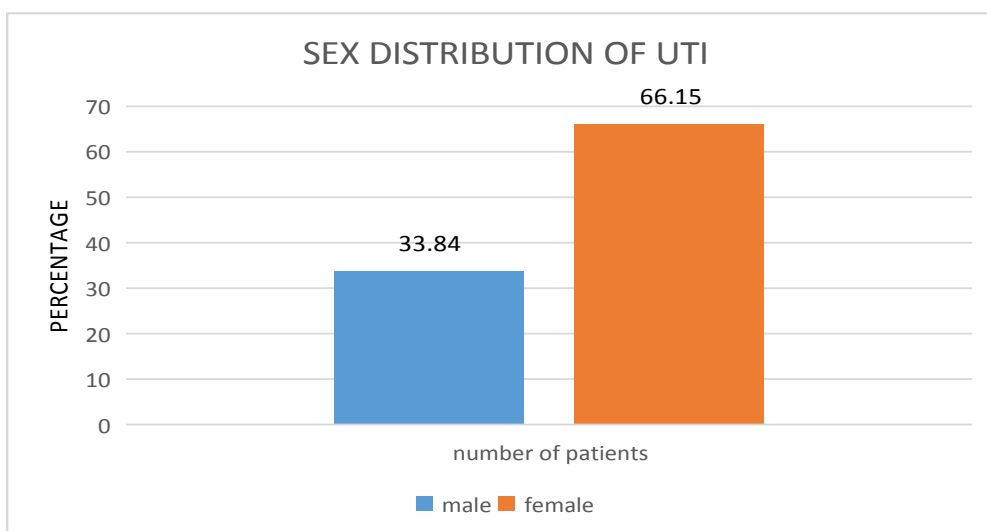
### Materials and Methods

Present study was a cross sectional study in King George Hospital from October 2017 to May 2018 in patients having culture positive UTI. Adult patients whose age is >16 years are included in the study. Patients having suprapubic pain, dysuria, frequency, urgency are considered as having lower urinary tract infection. Patients having loin pain, renal angle tenderness, temperature equal or more than 38.5 c, and features of sepsis are considered as having upper urinary tract infection. Patients having other inflammatory conditions, tissue injury and necrosis, Malignancies, Autoimmune disorders, Urine culture negative urinary tract infection, Pregnancy and Chronic kidney disease have been excluded from the study. Detailed clinical history is taken and following investigations are done: Complete blood picture, Plasma C-reactive protein levels, Renal function tests, Blood culture, Urine routine and culture sensitivity (clean catch mid stream samples are collected for culture), Ultrasound abdomen and pelvis/CT abdomen.

### Observations and Results

**Table 1** Sex distribution of UTI

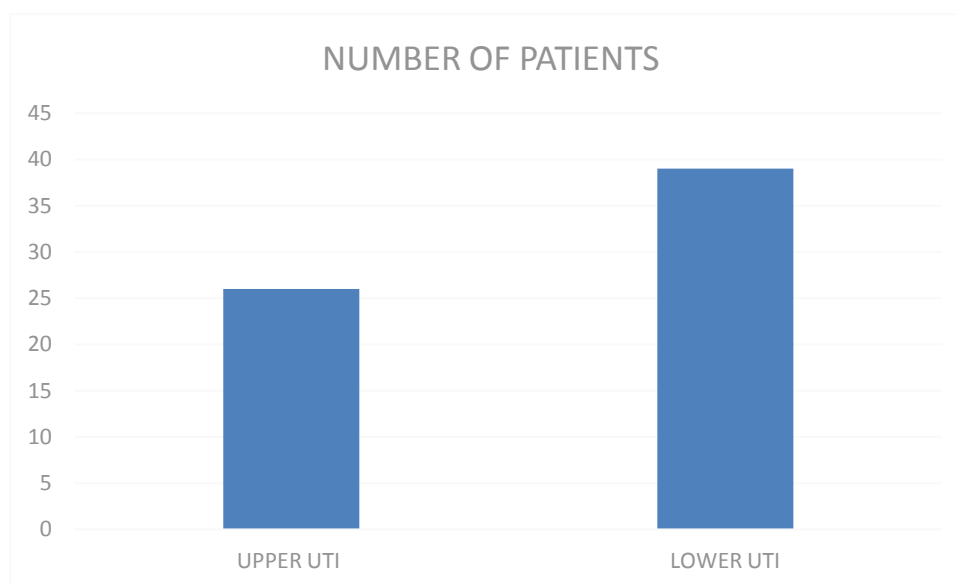
SEX	NUMBER	PERCENTAGE
MALE	22	33.84
FEMALE	43	66.15



Among the 65 patients 43 are females and 22 are males

**Table 2:** No of Patients in Upper and Lower UTI

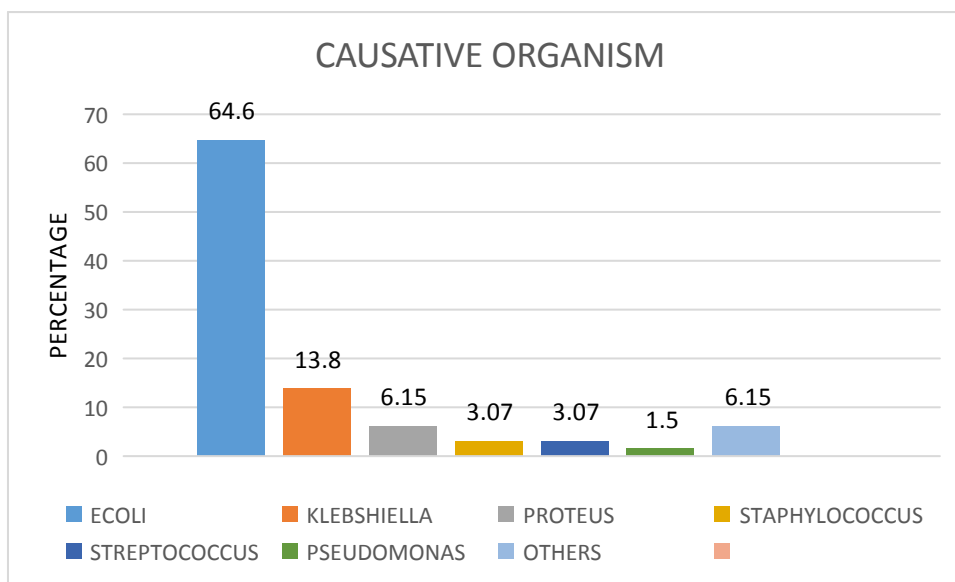
	NUMBER OF CASES	PERCENTAGE
UPPER UTI	26	40
LOWER UTI	39	60



Among patients 60 % had Lower UTI and 40% had Upper UTI

**Table 3:** Causative Organism

Causative organism	Number of cases	Percentage
E.Coli	42	64.66
Klebsiella	9	13.8
Proteus	4	6.15
Staphylococcus	2	3.07
Streptococcus	2	3.07
Pseudomonas	1	1.5
Others	4	6.15



Most common causative organism E.Coli is most common followed by Proteus

**Table 4:** CRP in Upper UTI and Lower UTI

	CRP[MEAN] MG/L	SD
UPPER UTI	126.6	12.12
LOWER UTI	5.10	1.98

Mean CRP in Upper UTI patients was 126.6 mg/l whereas in Lower UTI it was 5.10 mg/l which was statistically significant [p value<0.01]

**Discussion**

The present study is a cross sectional study including inpatients coming to King George hospital having culture positive urinary tract

infection. Among 65 patients 26 patients had Upper UTI and 39 patients had lower UTI.

In the present study mean CRP in Upper UTI patients was 126.6 mg/l whereas in lower UTI it was 5.10mg/l which was statistically significant [p value<0.01] which is similar to other studies<sup>9,11,12</sup>. This shows that CRP is significantly raised in Upper UTI. Elevated CRP signifies more inflammation in Upper UTI.

**Table 5:** Comparison with Other Studies

	CRP inUpper UTI[mg/l]	CRP Lower UTI[mg/l]	P value
P Agarwal et al <sup>11</sup>	127.33	4.7	<0.01
Present study	126.6	5.10	<0.01

P Agarwal et al (2013) reported the role of blood CRP levels in upper urinary tract infection and lower urinary tract infection in adult patients (>16 years). The mean value of CRP in the cases of Upper UTI was 127.33 mg/L whereas in Lower UTI it was 4.7 which was statistically significant<sup>11</sup>. In a study done by Ahmed J AI – Sayyad et al [2011] which included 83 patients with UTI CRP >35 mg/l classifies Upper UTI and

Lower UTI with sensitivity and specificity of 95.9 and 88.2 respectively.<sup>13</sup>. A study of Chieh-Wei Yen et al showed that longer febrile period and high C-reactive protein level are good indicators of prediction of the risk of pyelonephritis in urinary tract infection patients. Fever or an elevated C-reactive protein level often accompanies acute pyelonephritis and is found in

rare cases of cystitis but also occurs in infections other than pyelonephritis.<sup>14</sup>

In the present study Ecoli is the most common organism (64.6%) followed by klebsiella (13.8%) which is similar to other studies<sup>9,11</sup>. E coli and klebsiella continue to be most common organisms for both UTI and urosepsis.<sup>15,16,17</sup>

### Limitations

This is a time bound study hence sample size is less. Large number of UTI cases are to be studied to improve authenticity.

Follow up CRP after antibiotic therapy was not done in the present study in view of financial constraints.

### Conclusion

C-reactive protein is a good diagnostic tool in differentiating upper urinary tract infection from lower urinary tract infection, as it is significantly raised in upper urinary tract infection with comparison to lower urinary tract infection (p<0.01). It is a non-invasive test and is not associated with morbidity and also economically feasible in tertiary and peripheral setting.

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