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**Research Article**

# Analysis of Role of Haematological Parameters in diagnosis of Urinary Tract Infection in a Tertiary Care Centre: A Case Control Study

**Dr Anjali P V[1], Dr Arun Gopinath[2], Dr Vivek A B[3].**

*[1]Assistant Professor, Department of Pathology, Srinivas Institute of Medical Sciences & Research Centre, Mukka, Manglore, Karnataka*
*[2]Associate Professor, Department of Pathology, MelmaruvathurAdhiparasakthi Institute of Medical Sciences & Research Centre, Melmaruvathur, Tamil Nadu*
*[3]Assistant Professor, Department of Pharmacology, Srinivas Institute of Medical Sciences & Research Centre, Mukka, Manglore, Karnataka*

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**Corresponding Author:**

**Dr Anjali P V**
Assistant Professor, Department of Pathology, Srinivas Institute of Medical Sciences & Research Centre, Mukka, Manglore, Karnataka.

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## ABSTRACT

**Background:** UTI is one of the common bacterial infections and may lead to serious morbidity and mortality. In the present study, a systematic evaluation of haematological parameters was done to analyse the role of these markers in early diagnosis of UTI. These findings were further compared with the microbiological culture results to demonstrate a link between the haematological indices and the type of organism, whether gram positive or gram negative to allow proper selection of the empiric antibiotic regimen.
**Objective:** To evaluate the diagnostic significance of haematological parameters in the diagnosis of urinary tract infection in a tertiary care centre **.**
**Materials and Methods:** A prospective case-control study was conducted at Srinivas Hospital, Srinivas Institute of Medical Sciences and Research Centre(tertiary care centre), Mukka from September 2025 to February 2026.The study analysed haematological data from 145 culture-confirmed UTI cases and compared it with 145 culture-negative non UTI controls. Haematological parameters such as Haemoglobin, WBC count, Platelet count, MPV,RDW and PDW were analysed using an automated haematology analyser. Urine culture results were correlated with above haematological parameters.
**Results:** The UTI patients exhibited lower Hb and higher WBC, platelet count, MPV, RDW and PDW compared to controls. Gram-positive UTI infections showed higher WBC count, platelet counts, RDW and PDW , but lower MPV compared to gram-negative UTI infections.
**Conclusion:** Haematological parameters could serve as potential biomarkers in diagnosis of UTI's. It was also useful in differentiating gram positive and gram negative UTI's.

***Keywords****: UTI, MPV, RDW, PDW.*

## INTRODUCTION

Urinary tract infection (UTI) is one of the common bacterial infections and may lead to serious morbidity and mortality.[1]Upper urinary tract infections (i.e., pyelonephritis) may lead to renal scarring and end-stage renal disease.[2] Early diagnosis and prompt antimicrobial treatment are required to minimize risk of renal scarring and progressive kidney damage.[2]

Although urine culture is regarded as the gold standard of diagnosis, it takes at least 48 hours to obtain confirmative results.[2]Initial treatment of the UTI is often experimental and is guided by clinical manifestations.[3]To improve diagnosis and treatment, alternative more rapid, more reliable and cost effective diagnostic methods are required.[3]

Complete blood count is routinely ordered in most patients with UTI, and this information along with blood indices such as RDW, PDW and MPV are available and easily accessible, without added cost. Studies have shown that inflammation and infection affect some blood indices that could be used by physicians as diagnostic markers in diagnosing infectious diseases. However, their roles in the diagnosis and management of diseases are not known completely.[3]

In the present study, a systematic evaluation of haematological parameters was done to analyse the role of these markers in early diagnosis of UTI. These findings were further compared with the microbiological culture results to demonstrate a link between the haematological indices and the type of organism, whether gram positive or gram negative to allow proper selection of the empiric antibiotic regimen.

**OBJECTIVES**

1. To analyse variations in haematological parameters in patients with confirmed urinary tract infections.
2. To compare haematological profiles of UTI patients with those of non-UTI individuals.
3. To assess the correlation between haematological parameters and gram-positive and gram-negative urinary tract infection.
4. To explore the role of haematological parameters in aiding early diagnosis of urinary tract infection.

**MATERIALS & METHODS**

A prospective case-control study was conducted at Srinivas Hospital, Srinivas Institute of Medical Sciences and Research Centre (tertiary care centre), Mukka, Karnataka, India from September 2025 to February 2026, after obtaining ethics approval from our Institutional Ethics Committee (SIEC/SIMSRC/ST2/08/2025). This prospective case-control study analysed haematological data from 145 culture-confirmed UTI cases and was compared with 145 confirmed culture-negative non UTI controls. The 145 culture-confirmed UTI patients in our tertiary care centre were classified as cases. Haematological parameters such as Haemoglobin, WBC count, Platelet count, Mean Platelet Volume(MPV),Red Cell Distribution Width(RDW) and Platelet Distribution Width(PDW) were analysed using an automated haematology analyser. Urine culture results on blood and MacConkey agar were obtained and correlated with above haematological parameters.

**INCLUSION CRITERIA**

All UTI- culture positive cases aged over 18 years

**EXCLUSION CRITERIA**

1. Pregnant females
2. Children under 18 years of age
3. Patients with known haematological disorders such as Leukaemia, Thalassemia, Sickle cell disease and bone marrow disorders.
4. Patients with other infections
5. Patients with autoimmune diseases

**DETAILS OF ANALYSIS**

Statistical analysis was performed using SPSS software version 26.0.

- Descriptive statistics- Mean and Standard deviation was calculated.
- Inferential statistics-
  Comparison between UTI and Non-UTI groups was performed with t-test. p-value was calculated and p value of <0.05 was considered statistically significant.

**Table 1: The normal reference ranges for haematological parameters are as follows[4]**

| PARAMETER | REFERENCE RANGE |
|---|---|
| HEMOGLOBIN | 12-14gm/dl- females, 13-16 gm/dl- males |
| TOTAL WBC COUNT | 4000-10,000/cu.mm |
| PLATELET COUNT | 1.5-4.5 lakhs /cu.mm |
| RDW- CV | 11.5-14.5% |
| PDW | 9-17% |
| MPV | 7.5 -12 fL |

**RESULTS**

The study analysed the haematological parameters of 145 culture confirmed UTI patients and were compared to 145 non-UTI controls, revealing statistically significant differences across multiple parameters . Additionally, parameters were evaluated between UTI patients infected with gram-positive and gram-negative bacilli.

The mean age of both the cases and the controls was 55 years. Each group included 46 males and 99 females.

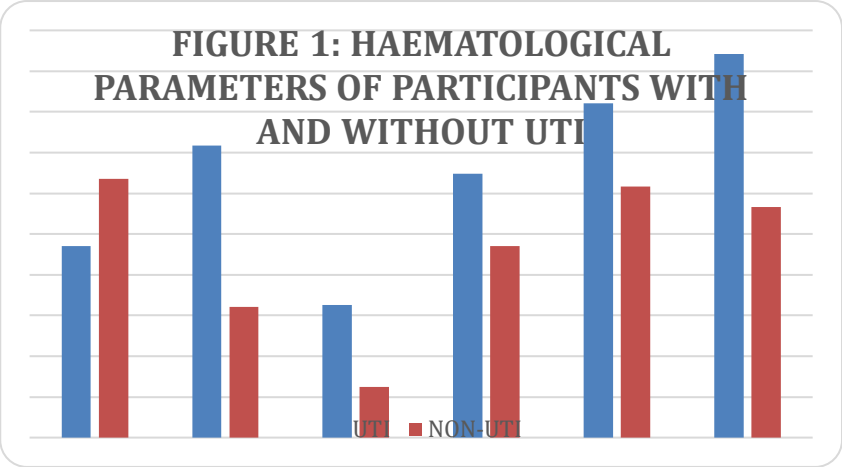


**Figure 1: Haematological parameters of participants with and without UTI**

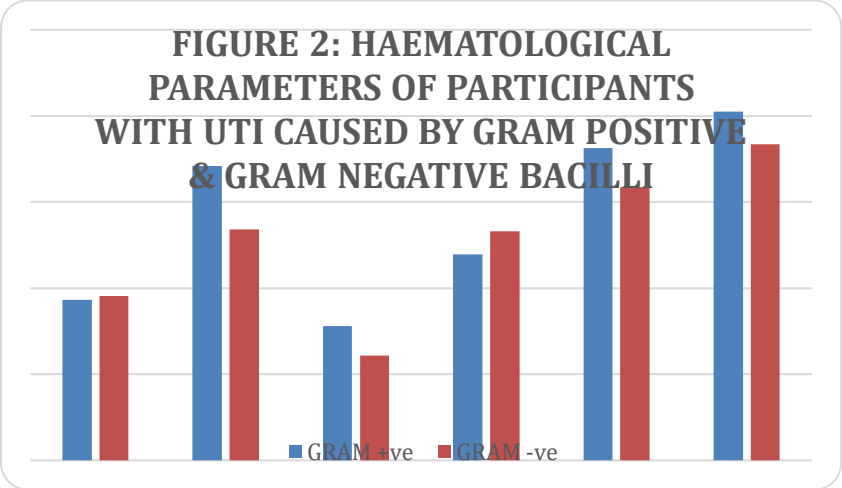


**Figure 2: Haematological parameters of participants with UTI caused by Gram-positive &Gram-negative bacilli**

**UTI and RBC Parameters**

UTI patients had a lower mean Hb level (9.4 g/dL) compared to non-UTI controls (12.7 g/dL), with a statistically significant p-value of <0.001. Mean RDW was higher in UTI patients (16.43%) compared to non-UTI controls (12.33%), with a p-value of<0.001. (Table 2, Figure 1)

**Table 2: Haematological parameters of participants with and without UTI**

| PARAMETER | MEAN VALUE IN UTI | MEAN VALUE IN NON-UTI | p VALUE |
|---|---|---|---|
| Haemoglobin | 9.4 | 12.7 | <0.001 |
| WBC | 14.33 | 6.42 | <0.001 |
| Platelet | 6.52 | 2.49 | <0.001 |
| MPV | 12.97 | 9.4 | <0.001 |
| RDW | 16.43 | 12.33 | <0.001 |
| PDW | 18.83 | 11.32 | <0.001 |

Hb levels, however, showed no significant difference between gram-positive and gram-negative UTI patients with p-value of 0.31.Mean RDW was higher in gram-positive UTI patients(18.14%) than in gram-negative UTI patients(15.87%) with statistically significant p-value of <0.001. (Table 3, Figure 2)

**Table 3: Haematological parameters of participants with UTI caused by gram-positive & gram-negative bacilli**

| PARAMETER | MEAN VALUE IN Gram positive UTI | MEAN VALUE IN Gram negative UTI | p VALUE |
|---|---|---|---|
| Haemoglobin | 9.33 | 9.53 | 0.31 |
| WBC | 17.09 | 13.42 | <0.001 |
| Platelet | 7.81 | 6.1 | <0.001 |

| | | | |
|---|---|---|---|
| MPV | 11.96 | 13.31 | <0.001 |
| RDW | 18.14 | 15.87 | <0.001 |
| PDW | 20.25 | 18.36 | <0.001 |

**UTI and WBC Parameters**

The mean WBC count in UTI patients (14,330/cu.mm) was significantly higher than in non- UTI controls (6420/cu.mm), with a p-value of <0.001. (Table 2, Figure 1)

Mean WBC count was also significantly higher in gram-positive infections (17,000/cu.mm) compared to gram negative infections (13,420/cu.mm), with a p-value of <0.001. (Table 3, Figure 2)

**UTI and Platelet Parameters**

UTI patients exhibited a higher mean platelet count (6.5 lakhs/cu.mm) than non-UTI controls (2.49lakhs/cu.mm), with a p-value of <0.001. (Table 1, Figure 1). Among UTI cases, gram-positive infections showed a higher platelet count (7.8 lakhs/cu.mm) compared to gram-negative infections (6 lakhs/cu.mm), with a statistically significant p-value of <0.001. (Table 2, Figure 2)

MPV was significantly higher in UTI patients (12.97 fL) compared to non-UTI controls (9.4 fL), with a p-value of <0.001. (Table 1, Figure 1) However, MPV was lower in gram-positive infections (11.96 fL) compared to gram-negative infections (13.31 fL), with a p-value of <0.001. (Table 3, Figure 2)

The UTI patients had a significantly higher PDW (18.83 %) compared to non-UTI controls (11.32%), with a p-value of <0.001. (Table 2, Figure 1)PDW was also higher in gram-positive infections (20.25%) compared to gram-negative infections (18.36%), with a p-value of <0.001. (Table 3, Figure 2)

**Microbiological Findings**

Gram-negative organisms accounted for 75% of UTI cases (109 cases), with Escherichia coli 80 (55.2%) cases being the most common pathogen, followed by Klebsiella pneumoniae 16 (11%) cases, Proteus mirabilis 5(3.4%), Enterobacter 4(2.7%) and Pseudomonas aeruginosa 4(2.7%).(Table 4, Figure 3)

**Table 4: Urine culture findings of UTI patients**

| Urine Culture | No of cases | Percentage |
|---|---|---|
| GRAM POSITIVE BACILLI | 36 | 24% |
| 1. Staphylococcus aureus | 6 | 4% |
| 2. Streptococcus | 2 | 1% |
| 3. Enterococcus faecalis | 22 | 15% |
| 4. Streptococcus saprophyticus | 3 | 2% |
| 5. Streptococcus agalactia | 3 | 2% |
| GRAM NEGATIVE BACILLI | 109 | 75% |
| 6. Escherichia coli | 80 | 55.2% |
| 7. Klebsiella pneumoniae | 16 | 11% |
| 8. Proteus mirabilis | 5 | 3.4% |
| 9. Enterobacter | 4 | 2.7% |
| 10. Pseudomonas aeruginosa | 4 | 2.7% |

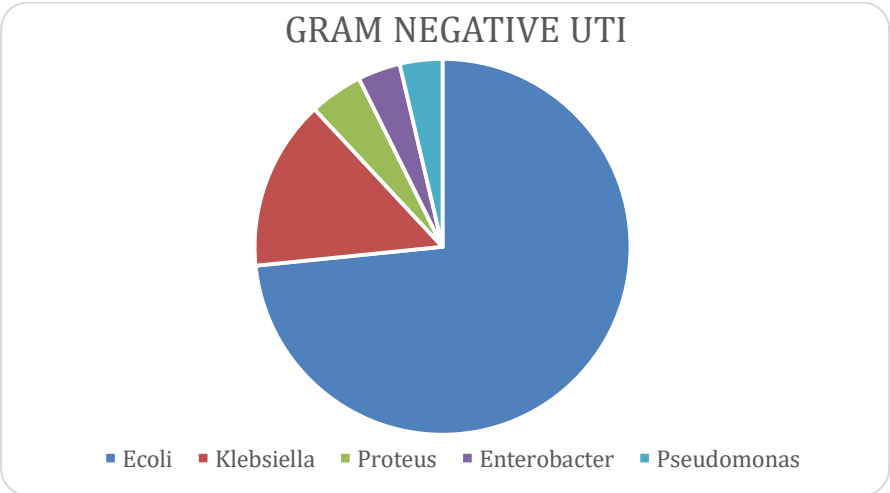


**Figure 3: Percentage of gram-negative bacilli causing UTI**

Gram-positive organisms accounted for 24% of UTI cases (36 cases), with Enterococcus faecalis 22 (15%) cases being the most frequent, followed by Staphylococcus aureus 6 (4%) cases ,Staphylococcus saprophyticus3(2%) cases, Staphylococcus agalactiae 3 (2%) and Streptococci 2 (1%) cases.(Table 4, Figure 4 )

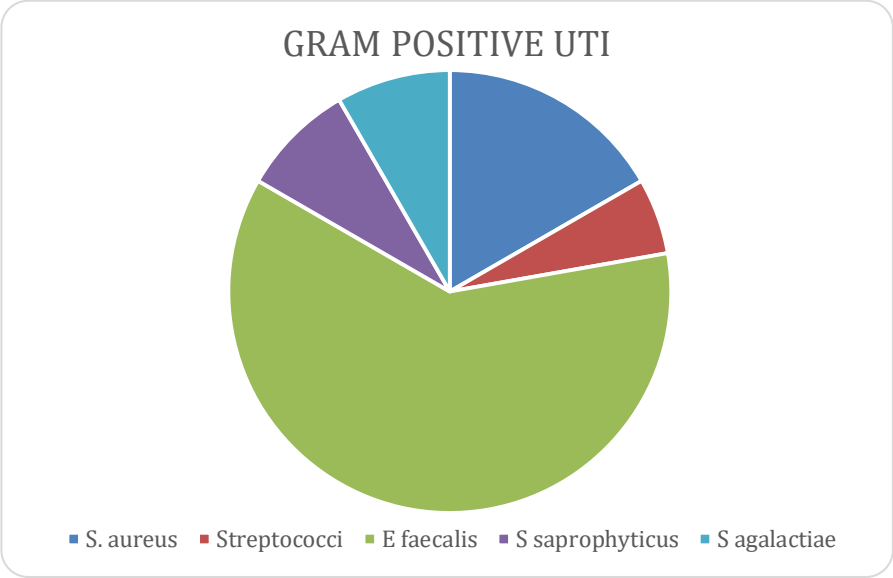


**Figure 4: Percentage of Gram-positive bacilli causing UTI**

## DISCUSSION

Our study compared the haematological parameters of UTI cases with age and gender matched controls. These parameters were correlated with the urine culture results of UTI cases.

Similar to the present study, Akya A et al[5] found that UTI's are highly prevalent in women and affect them in all age groups. Mean age of the cases was 55 years ,similar to study done by Srinivasan S et al[6] who reported mean age as 50.3 years.

### UTI and Red Blood Cell (RBC) Parameters

In the present study, the mean Hb level was lower in UTI patients (9.4 g/dL) compared to non- UTI controls (12.7 g/dL) .Similar findings were observed by study done by Alaaraji K et al[7] and Srinivasan S et al[6]. Alaaraji K et al[7] reported significantly lower values of Hb levels in UTI patients (11.3±1.6 g/dL) compared to non-UTI controls. Srinivasan S et al[6] obtained a lower mean Haemoglobin level in UTI cases (11.91±1.88 g/dL) compared to non-UTI controls (12.29±1.86 g/dL) . This reduction in Haemoglobin value in UTI cases can be due to inflammation resulting in impaired erythropoiesis.

However, the Hb levels showed no statistically significant difference between gram-positive and gram-negative organisms in this study (9.33 g/dL vs. 9.53 g/dL, p-value=0.31).Similar findings were observed in study done by Srinivasan S et al[6] and Watkins RR et al[8].

Red Cell Distribution Width (RDW): The RDW was significantly elevated in UTI cases (16.43%) compared to non-UTI controls (12.33%).Similar findings are observed in the studies done by Majidpour A et al[3] and Srinivasan S et al[6]. Mean RDW of 14.9 ± 1.8% and 15.13±2.07 was observed in UTI cases by Majidpour A et al[3] and Srinivasan S et al[6] respectively. This was attributed to the increased anisocytosis in UTI cases due to inflammation.

RDW values showed statistically significant difference between culture-positive and culture-negative organisms in this study ( 18.14% vs 15.87 %,p value <0.001) . Similar findings were observed by Watkins RR et al[8] and Srinivasan S et al[6]. This may be due to stronger inflammatory response mechanisms in gram positive infections compared to gram negative infections.

### UTI and WBC Parameters

In the present study, UTI patients exhibited a significantly elevated WBC count (14,330/ cu.mm) compared to non-UTI controls (6420/ cu.mm) with a p value of <0.001.Similar findings were observed by Ayazi P et al[9] and Srinivasan S et al[6] with a raised mean WBC count of 13.1±3.9×103/µL and 12.82±4.88×103/µL respectively in UTI cases.

Correlation with microbiological culture results suggest that, WBC counts were significantly higher for gram-positive organisms (17.09/ µL) compared to gram-negative organisms (13.42/µL). Similar results were observed by Watkins RR

et al[8] and Srinivasan S et al[6]. Watkins RR et al[8] suggest that this variation could be due to stronger immune responses induced by thicker peptidoglycan layers in gram-positive bacilli.

**UTI and Platelet Parameters**

Platelet count: The UTI patients exhibited a higher mean platelet count (6.52 lakhs/cu. mm) compared to non-UTI controls (2.49 lakhs/cu. mm, p-value=0.001). Similar findings was observed by Srinivasan S et al[6] and Catal F et al[10]. They suggested that, increased platelet count observed during UTI episodes may be due to direct utilisation of platelets in these immune processes. Platelet count was significantly higher in gram positive UTI than gram negative UTI similar to above studies.

Mean Platelet Volume(MPV):The MPV was significantly higher in UTI patients (Mean MPV= 12.97 fL) compared to controls (9.4 fL, p-value = <0/001).Similar findings was observed by Srinivasan S et al[6] and Lee IR et al[1] with Mean MPV of 10.6±0.8 fL and 10.12±1.58 fL respectively. MPV was found to be significantly higher in gram-negative UTI than gram-positive UTI similar to study done by Srinivasan S et al[6].

Platelet Distribution Width (PDW): The PDW was significantly higher in UTI patients (18.83) than in non-UTI controls (11.32, p-value<0.001).Similar findings were observed by Srinivasan S et al[6] and Majidpour A et al[3]. They suggested that elevated PDW indicates increased platelet size variability, which can be attributed to inflammation. The PDW was higher in gram positive infections (20.25) than in gram-negative infections (18.36, p-value=<0.001). Kotha DVS et al[11]and Srinivasan S et al[6] found similar results. They suggested that significant increase in PDW in gram-positive infections may be due to more intense platelet response induced by bacilli.

## CONCLUSION

Haematological parameters could serve as potential biomarkers in diagnosis of UTI's. It was also useful in differentiating gram positive and gram negative UTI's.

The UTI patients exhibited lower Hb and higher WBC, platelet count, MPV, RDW and PDW compared to controls. Gram-positive UTI infections showed higher WBC count, platelet counts, RDW and PDW , but lower MPV compared to gram-negative UTI infections. E. coli and Enterococcus faecalis were the predominant gram-negative and gram-positive pathogens, respectively. These results reflect distinct haematological profiles in UTI patients, depending on the infecting organism.

## LIMITATIONS OF THE STUDY

1. Smaller sample size.
2. Study did not differentiate between upper and lower UTI.
3. Follow up of haematological parameters of the UTI patients in response to treatment was not done as it was invasive to do CBC for such patients regularly during the course of therapy to evaluate the response.

## RECOMMENDATIONS

1. Further studies are needed to better understand the basis for the observed effects of different infectious organisms on haematological parameters.
2. Studies with larger sample size and longer duration are highly suggested to compare these indices before and after treatment to get more precise results.

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