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Diagnostic Correlation of Urine Microscopy with Urine Culture in the Detection of Urinary Tract Infection: A Cross-Sectional Study from A Tertiary Care Hospital in Rajasthan

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ABSTRACT

Background: Urinary tract infection (UTI) is among the most common bacterial infections encountered in clinical practice and contributes substantially to patient morbidity and healthcare burden. Urine culture is considered the gold standard for diagnosis; however, it is time-consuming and resource-intensive. Urine microscopy is frequently used as a rapid and economical screening tool, especially in resource-limited settings. The present study was conducted to evaluate the correlation between urine microscopy and urine culture in the detection of urinary tract infection.

Objectives: To assess the correlation between urine microscopy findings and urine culture results in patients suspected of urinary tract infection and to determine the diagnostic utility of urine microscopy in predicting culture-positive UTI.

Methods: A hospital-based observational cross-sectional study was conducted in a tertiary care hospital in Rajasthan from February 2026 to April 2026 among 380 patients clinically suspected of urinary tract infection. Demographic and clinical details were recorded using a predesigned proforma. Clean-catch midstream urine samples were subjected to routine urine microscopy and urine culture examination in the Department of Pathology using standard laboratory procedures. Significant pyuria was defined as more than 5 pus cells per high-power field, while significant bacteriuria on culture was considered at $\geq 10^5$ CFU/mL. Statistical analysis was performed using SPSS version 26.0. Chi-square test was used to assess association, and diagnostic validity parameters were calculated using urine culture as the reference standard. A p-value <0.05 was considered statistically significant.

Results: Among 380 participants, females constituted 62.6% of cases, and the majority belonged to the 21–40 years age group. Dysuria was the most common presenting complaint (66.8%). Pyuria on urine microscopy was observed in 56.3% participants, while urine culture positivity was detected in 42.6% cases. A statistically significant association was found between pyuria and urine culture positivity ($\chi^2 = 72.4$, $p < 0.001$). Urine microscopy demonstrated a sensitivity of 84.0%, specificity of 64.2%, positive predictive value of 63.6%, and negative predictive value of 84.3% for detection of culture-positive urinary tract infection.

Conclusion: Urine microscopy showed significant correlation with urine culture and demonstrated good sensitivity for screening urinary tract infection. It can serve as a rapid, economical, and useful preliminary diagnostic tool in tertiary healthcare settings. However, urine culture remains essential for definitive diagnosis and antimicrobial susceptibility testing.

Keywords*: Urinary Tract Infection; urine microscopy; urine culture; pyuria; bacteriuria; diagnostic correlation; tertiary care hospital.*

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections encountered in clinical practice and contributes significantly to morbidity across all age groups worldwide. It affects nearly 150 million individuals annually and imposes a considerable economic burden on healthcare systems due to diagnostic investigations, antimicrobial therapy, and recurrent infections.[1] UTIs are more common among females because of anatomical predisposition, although males, children, elderly individuals, pregnant women, and catheterized patients also constitute important high-risk groups.[2] Clinical manifestations range from asymptomatic bacteriuria and uncomplicated cystitis to severe pyelonephritis and urosepsis, making early and accurate diagnosis essential for timely treatment and prevention of complications.[3]

The gold standard for diagnosis of UTI is urine culture, which identifies the causative organism and determines antimicrobial susceptibility patterns.[4] However, urine culture is time-consuming, requires laboratory infrastructure, and may delay initiation of treatment in symptomatic patients. In resource-limited settings, especially in developing countries, clinicians often rely on rapid screening methods such as urine microscopy for preliminary diagnosis.[5] Microscopic examination of urine for pyuria, bacteriuria, epithelial cells, and casts is inexpensive, readily available, and can provide rapid results that assist in clinical decision-making.[6]

Urine microscopy has therefore become an important adjunctive diagnostic tool in tertiary healthcare centers where a large number of patients present with symptoms suggestive of UTI. The presence of significant pyuria and bacteriuria on microscopy is generally considered suggestive of infection, but its diagnostic accuracy varies depending on patient population, sample collection technique, observer variability, and laboratory standards.[7] False-positive findings may occur due to contamination, while false-negative results can be seen in partially treated infections or dilute urine samples. Consequently, understanding the correlation between urine microscopy and urine culture is clinically important for determining the reliability of microscopy as a screening modality.[8]

In India, UTIs constitute a major proportion of outpatient visits and hospital admissions, particularly among women and elderly patients. Increasing antimicrobial resistance among uropathogens has further highlighted the need for accurate laboratory diagnosis before initiation of empirical therapy.[9] In tertiary care hospitals of Rajasthan, heavy patient load and limited turnaround time for culture reports often necessitate reliance on urine microscopy for early therapeutic decisions. Despite widespread use of microscopy, variations in laboratory practices and patient characteristics may influence its predictive value in different settings.[10]

Several studies conducted globally and within India have evaluated the sensitivity and specificity of urine microscopy in detecting culture-positive UTI, but findings have been inconsistent. Some studies have demonstrated strong correlation between pyuria and significant bacteriuria, whereas others have reported limited diagnostic utility of microscopy alone.[5,7] Furthermore, regional data from Rajasthan regarding the correlation of urine microscopy with urine culture remain limited. Local epidemiological evidence is important because prevalence of infection, bacterial spectrum, and healthcare practices may differ across regions and institutions.

Therefore, the present study was undertaken in a tertiary care hospital in Rajasthan to evaluate the correlation between urine microscopy findings and urine culture results in patients suspected of urinary tract infection. The objectives of the study were to determine the diagnostic utility of urine microscopy in predicting culture-positive UTI and to assess the association between microscopic parameters and urine culture findings.

METHODOLOGY

Study Design: This hospital-based observational cross-sectional analytical study was conducted to assess the correlation between urine microscopy findings and urine culture results in the detection of urinary tract infection among patients attending a tertiary care hospital in Rajasthan.

Study Setting: The study was conducted in the Department of Pathology in collaboration with allied clinical departments of a tertiary care teaching hospital in Rajasthan, India. The institution caters to both urban and rural populations and receives a large number of patients with symptoms suggestive of urinary tract infection.

Study Duration: The study was conducted over a period of three months from February 2026 to April 2026.

Study Population: The study population included patients of all age groups and both sexes presenting with clinical suspicion of urinary tract infection and advised urine routine microscopy and urine culture examination by the treating physician during the study period.

Inclusion Criteria

- Patients presenting with symptoms suggestive of urinary tract infection such as dysuria, frequency, urgency, suprapubic pain, flank pain, or fever.
- Patients who provided a clean-catch midstream urine sample for laboratory analysis.

- Patients willing to participate and provide informed consent.
- For participants below 18 years of age, consent was obtained from parents or legal guardians.

Exclusion Criteria
- Patients already receiving antibiotic therapy within the preceding 48–72 hours.
- Patients with inadequate, contaminated, or improperly collected urine samples.
- Patients unwilling to participate in the study.
- Samples with incomplete laboratory or clinical data.

Sample Size: The sample size was calculated using the formula for estimation of proportion in cross-sectional studies:

$$n = \frac{Z_{1-\alpha/2}^2 \times p \times q}{d^2}$$

Where:
- (n) = required sample size
- ($Z_{1-\alpha/2}$) = standard normal variate at 95% confidence interval = 1.96
- (p) = expected prevalence of culture-positive urinary tract infection among suspected cases
- (q = 1-p)
- (d) = allowable error

Assuming prevalence (p) of culture-positive UTI among suspected patients as 44% based on previously published literature, with 5% absolute precision and 95% confidence interval:

$$n = \frac{(1.96)^2 \times 0.44 \times 0.56}{(0.05)^2}$$

The calculated sample size was approximately 379. Considering feasibility and completeness of data collection, a final sample size of 380 participants was included in the study.

Sampling Technique: A consecutive sampling technique was employed. All eligible patients meeting the inclusion criteria during the study period were enrolled consecutively until the required sample size of 380 was achieved.

Data Collection Tools & Procedure: After obtaining informed consent, demographic and clinical details including age, sex, presenting symptoms, relevant medical history, and antibiotic use were recorded using a predesigned semi-structured data collection form. Participants were instructed regarding proper clean-catch midstream urine collection technique to minimize contamination. Urine samples were collected in sterile wide-mouthed containers and transported promptly to the central clinical pathology laboratory for processing. Urine microscopy was performed on freshly collected samples. Centrifuged urine sediment was examined microscopically for the presence of pus cells, red blood cells, epithelial cells, casts, crystals, and bacteria. Significant pyuria was defined as more than 5 pus cells per high-power field. Simultaneously, urine culture examination was carried out in accordance with standard laboratory protocols under aseptic conditions by inoculation on culture media such as CLED agar and MacConkey agar using a calibrated loop method. Samples showing significant bacteriuria (≥10^5 colony-forming units/mL) were considered culture positive. Identification of isolates and antimicrobial susceptibility testing were carried out according to standard laboratory protocols.

Study Variables: The independent variables included demographic characteristics such as age and sex, clinical symptoms suggestive of urinary tract infection, and urine microscopy parameters including pyuria, bacteriuria, epithelial cells, and casts. The dependent variable was urine culture positivity indicating confirmed urinary tract infection. Correlation between microscopy findings and culture positivity was assessed to determine the diagnostic utility of urine microscopy.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) software version 26.0. Continuous variables were expressed as mean and standard deviation, while categorical variables were expressed as frequency and percentage. Association between urine microscopy findings and urine culture positivity was assessed using Chi-square test or Fisher's exact test wherever appropriate. Diagnostic validity measures including sensitivity, specificity, positive predictive value, and negative predictive value of urine microscopy were calculated using urine culture as the reference standard. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: Written informed consent was obtained from all participants prior to enrollment, and assent with parental consent was obtained for minors where applicable. Confidentiality and anonymity of participant information were strictly maintained throughout the study. The study adhered to the ethical principles outlined in the Declaration of Helsinki for research involving human participants.

RESULTS

A total of 380 patients with suspected urinary tract infection were included in the study. The majority of participants belonged to the 21–40 years age group (44.2%), and females constituted 62.6% of the study population (Table 1).

Table 1: Distribution of Study Participants According to Demographic Characteristics (n = 380)

Variable	Category	Frequency (n)	Percentage (%)
Age group (years)	<20	42	11.1
	21–40	168	44.2
	41–60	112	29.5
	>60	58	15.2
Sex	Male	142	37.4
	Female	238	62.6

Dysuria was the most common presenting complaint observed among 66.8% of participants, followed by increased frequency of micturition (58.2%) and burning micturition (52.9%) (Table 2).

Table 2: Clinical Presentation Among Patients Suspected of Urinary Tract Infection (n = 380)

Clinical symptom*	Frequency (n)	Percentage (%)
Dysuria	254	66.8
Increased frequency of micturition	221	58.2
Fever	146	38.4
Suprapubic pain	118	31.1
Flank pain	84	22.1
Burning micturition	201	52.9

*Multiple responses possible

On urine microscopy, pyuria was detected in 56.3% of cases, while bacteriuria was observed in 46.3% participants. Urine culture demonstrated significant bacteriuria in 42.6% of samples (Table 3).

Table 3: Distribution of Urine Microscopy Findings and Urine Culture Results (n = 380)

Laboratory parameter	Category	Frequency (n)	Percentage (%)
Pyuria (>5 pus cells/HPF)	Present	214	56.3
	Absent	166	43.7
Bacteriuria on microscopy	Present	176	46.3
	Absent	204	53.7
Urine culture result	Positive	162	42.6
	Negative	218	57.4

A statistically significant association was observed between pyuria on urine microscopy and urine culture positivity (χ^2 = 72.4, p <0.001). Culture positivity was substantially higher among patients with pyuria compared to those without pyuria (Table 4).

Table 4: Association Between Pyuria on Urine Microscopy and Urine Culture Positivity (n = 380)

Pyuria on microscopy	Culture Positive n (%)	Culture Negative n (%)	Total	Chi-square value	p-value
Present	136 (63.6)	78 (36.4)	214	72.4	<0.001
Absent	26 (15.7)	140 (84.3)	166		
Total	162	218	380		

Diagnostic validity analysis showed that urine microscopy had a sensitivity of 84.0% and specificity of 64.2% for detection of culture-positive urinary tract infection. The negative predictive value was relatively high (84.3%), indicating usefulness of urine microscopy as a screening tool to exclude infection in suspected cases (Table 5).

Table 5: Diagnostic Validity of Urine Microscopy for Detection of Culture-Positive UTI (n = 380)

Diagnostic parameter	Value (%)
Sensitivity	84.0

Specificity	64.2
Positive Predictive Value	63.6
Negative Predictive Value	84.3
Overall Diagnostic Accuracy	72.6

DISCUSSION

The present hospital-based cross-sectional study evaluated the correlation between urine microscopy and urine culture in the detection of urinary tract infection among patients attending a tertiary care hospital in Rajasthan. The study demonstrated a significant association between microscopic pyuria and culture positivity, with urine microscopy showing good sensitivity and moderate specificity for predicting culture-confirmed UTI. These findings suggest that urine microscopy may serve as a useful preliminary screening tool, particularly in resource-constrained settings where immediate culture reports are not available.

In the present study, females constituted the majority of participants, and the highest proportion of patients belonged to the 21–40 years age group. This observation is consistent with the established epidemiology of UTI, wherein females are more predisposed because of shorter urethral length, anatomical proximity of the urethra to the anal region, and hormonal influences.[1,2] Similar demographic trends have been reported in previous Indian and international studies evaluating urinary tract infections.[9,11]

Dysuria and increased frequency of micturition were the most common presenting symptoms in the current study. Comparable findings were reported by Hooton et al., who observed that lower urinary tract symptoms remain the predominant clinical manifestations among patients with uncomplicated UTI.[3] Clinical symptoms alone, however, may lack adequate specificity, thereby necessitating laboratory confirmation through urine examination and culture.

The present study observed urine culture positivity in 42.6% of suspected cases, which is comparable to findings reported in previous hospital-based studies from developing countries.[12,13] Variability in culture positivity rates across studies may be attributed to differences in patient selection criteria, prior antibiotic exposure, sample collection methods, and diagnostic thresholds used for defining significant bacteriuria.

Pyuria on urine microscopy showed a statistically significant association with urine culture positivity in the current study. Patients with significant pyuria demonstrated markedly higher rates of culture-confirmed infection compared to those without pyuria. Similar findings have been documented by Stamm et al., who reported that pyuria correlates strongly with bacteriuria and reflects underlying inflammatory response within the urinary tract.[8] Manoni et al. also demonstrated that microscopic examination of urine sediment has substantial diagnostic utility in screening for UTI, particularly when pyuria and bacteriuria are assessed together.[7]

The sensitivity of urine microscopy in the present study was 84.0%, indicating that microscopy was able to identify a large proportion of culture-positive cases. The specificity, however, was comparatively moderate at 64.2%, suggesting the possibility of false-positive findings due to contamination or noninfectious inflammatory conditions. Similar diagnostic performance has been reported in previous studies evaluating urine microscopy as a screening modality.[5,14] Simerville et al. noted that while urinalysis and microscopy are useful rapid tests, they cannot completely replace urine culture because of variability in interpretation and inability to identify causative organisms accurately.[6]

The relatively high negative predictive value observed in this study suggests that absence of pyuria on microscopy may help in ruling out infection in a considerable number of patients. This finding has important clinical implications in tertiary healthcare settings with heavy patient load, where rapid preliminary screening may reduce unnecessary antibiotic usage and optimize laboratory workload. In resource-limited settings, microscopy can therefore aid in early clinical decision-making while awaiting confirmatory culture reports.

The findings of the present study support the continued use of urine microscopy as an adjunctive diagnostic tool for suspected UTI; however, urine culture remains indispensable for definitive diagnosis and antimicrobial susceptibility testing. With rising antimicrobial resistance among uropathogens, dependence solely on microscopy may lead to inappropriate empirical therapy.[9] Therefore, integration of rapid screening methods with standard microbiological culture remains essential for rational patient management.

The strengths of the present study include adequate sample size, standardized microbiological procedures, and assessment of diagnostic validity parameters using urine culture as the reference standard. The study also provides regional data from Rajasthan, where limited literature exists regarding correlation between urine microscopy and culture findings.

However, certain limitations should be acknowledged. Being a single-center study, generalizability of findings may be limited. The study duration was relatively short, and follow-up assessment of clinical outcomes was not performed.

Interobserver variability in microscopic examination could not be completely eliminated. Additionally, prior undocumented antibiotic exposure among some participants may have influenced culture positivity rates.

Overall, the study highlights the significant correlation between urine microscopy and urine culture in the diagnosis of urinary tract infection and emphasizes the role of microscopy as an effective screening tool in tertiary healthcare settings.

CONCLUSION

The present study demonstrated a significant correlation between urine microscopy findings and urine culture positivity in patients with suspected urinary tract infection. Pyuria on microscopy was strongly associated with culture-confirmed infection, indicating that urine microscopy is a useful preliminary screening modality in routine clinical practice. The study also showed that urine microscopy possesses good sensitivity and a high negative predictive value, making it valuable for early identification and exclusion of urinary tract infection, particularly in high-volume tertiary healthcare settings. Although urine microscopy provides rapid and cost-effective results, its moderate specificity highlights the possibility of false-positive findings and emphasizes that it should not replace urine culture. Urine culture continues to remain the gold standard for definitive diagnosis and antimicrobial susceptibility testing. Integration of urine microscopy with culture-based confirmation may improve diagnostic efficiency, promote rational antibiotic use, and reduce unnecessary treatment. Further multicentric studies with larger populations are recommended to validate these findings and optimize screening protocols for urinary tract infection in diverse healthcare settings.

DECLARATIONS

Funding: No external funding was received for this study.
Conflict of Interest: The authors declare no conflict of interest.
Consent: Written informed consent was obtained from all participants prior to enrollment in the study.
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REFERENCES

1. Flores-Mireles AL, Walker JN, Caparon M, Hultgren SJ. Urinary tract infections: epidemiology, mechanisms of infection and treatment options. Nature reviews microbiology. 2015 May;13(5):269-84.
2. Foxman B. Epidemiology of urinary tract infections: incidence, morbidity, and economic costs. The American journal of medicine. 2002 Jul 8;113(1):5-13.
3. Hooton TM. Uncomplicated urinary tract infection. New England Journal of Medicine. 2012 Mar 15;366(11):1028-37.
4. Wilson ML, Gaido L. Laboratory diagnosis of urinary tract infections in adult patients. Clinical infectious diseases. 2004 Apr 15;38(8):1150-8.
5. Devillé WL, Yzermans JC, Van Duijn NP, Bezemer PD, Van Der Windt DA, Bouter LM. The urine dipstick test useful to rule out infections. A meta-analysis of the accuracy. BMC urology. 2004 Jun 2;4(1):4.
6. Simerville JA, Maxted WC, Pahira JJ. Urinalysis: a comprehensive review. American family physician. 2005 Mar 15;71(6):1153-62.
7. Karacan C, Erkek N, Senel S, Akin Gunduz S, Catli G, Tavil B. Evaluation of urine collection methods for the diagnosis of urinary tract infection in children. Med Princ Pract. 2010;19(3):188-91.
8. Stamm WE. Measurement of pyuria and its relation to bacteriuria. The American journal of medicine. 1983 Jul 28;75(1):53-8.
9. Das RN, Chandrashekhar TS, Joshi HS, Gurung M, Shrestha N, Shivananda PG. Frequency and susceptibility profile of pathogens causing urinary tract infections at a tertiary care hospital in western Nepal. Singapore medical journal. 2006 Apr 1;47(4):281.
10. Collee JG, Fraser AG, Marmion BP, Simmons A. Mackie and McCartney Practical Medical Microbiology. 14th ed. New York: Churchill Livingstone; 1996.
11. Kasper DL, Fauci AS, Hauser SL, Longo DL, Jameson JL, Loscalzo J. Urinary tract infections, pyelonephritis, and prostatitis. Harrison's principles of internal medicine, 20th edn. McGraw-Hill Education, New York. 2018.
12. Taneja N, Chatterjee SS, Singh M, Singh S, Sharma M. Pediatric urinary tract infections in a tertiary care center from north India. Indian journal of medical research. 2010 Jan 1;131(1):101-5.
13. Dash M, Padhi S, Mohanty I, Panda P, Parida B. Antimicrobial resistance in pathogens causing urinary tract infections in a rural community of Odisha, India. Journal of Family and Community Medicine. 2013 Jan 1;20(1):20-6.
14. Semeniuk H, Church D. Evaluation of the leukocyte esterase and nitrite urine dipstick screening tests for detection of bacteriuria in women with suspected uncomplicated urinary tract infections. Journal of clinical microbiology. 1999 Sep 1;37(9):3051-2.