

Detection of Urinary Tract Infection by Estimating Leukocyte-Esterase in Urine Using Dipsticks

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ABSTRACT

Background: Urine tract infections (UTI) are very common among general population. Successful treatment requires prompt and rapid diagnosis to avoid complications particularly in females who are more prone to develop UTI due to close proximity of genitourinary and anal openings.

Aim: To determine the sensitivity, specificity, positive and negative predictive values and efficacy of dipsticks to estimate presence of Leukocyte-Esterase (LE) in urine which indicates UTI.

Methods: A descriptive study was carried out at Department of Microbiology, Armed Forces Institute of Pathology, Rawalpindi from 1st Jan to 30th June 2015. All the urine samples received in the Microbiology Department for urine culture were included in the study. All specimens were subjected to urine dipstick analysis for leukocyte esterase. All the urine samples were also used for culture on Cysteine Lactose Electrolyte Deficient (CLED) agar.

Results: Out of 1100 urine specimens included in the study, 342 (31.09%) were LE positive and 282 (25.64%) were culture positive. Among LE- positive isolates 218(63.74%) were culture positive and 124 (36.26%) were culture negative. Similarly LE negative (n=758) revealed 64 (8.44%) culture positive and 694 (91.56%) culture negative results. Sensitivity (77.31%), Specificity (84.84%), Positive (56.77%) and Negative Predictive values (91.6%) and over all efficacy (82.91%) of LE Test using dipsticks were noted.

Conclusion: Leukocyte esterase dipstick test is a rapid screening and cost effective test which can be used in areas with limited resources. It is very useful to detect presence of urinary tract infection. However, negative test provides better indication of absence of UTI.

Keywords: Leukocyte esterase dipsticks, Urinary Tract Infection, Urine culture

INTRODUCTION

One of the most prevalent disease entities worldwide is urinary tract infection (UTI). UTI are the most common hospital and community acquired infections associated with complications resulting in end stage renal disease. Prompt diagnosis result in successful treatment and can avoid complications¹. Women are more at risk of developing UTI due to short urethra and close proximity of genitourinary and anal openings². Delaying treatment can lead to severe morbidity and mortality especially in high risk patients. UTI results when microorganisms infect usually sterile sites within the urinary tract. Infection may occur in the lower urinary tract (cystitis), or ascend into the upper tract to include the ureters and kidney (pyelonephritis). UTI remains asymptomatic in some patients and sometimes vary with age and gender. Symptoms include fever, frequency of urination, dysuria, foul smelling urine and enuresis etc³. The presentation in infants and young children with UTI is often nonspecific, making the diagnosis difficult³. Urinary tract infections are also common in pregnancy². Pregnant ladies with positive leukocyte esterase test and significant pyuria can be referred for urine culture to save the time⁴. It is a significant risk factor for developing pyelonephritis in pregnant women⁵ Therefore bacteriuria should be properly screened during

pregnancy to avoid complications⁵. Furthermore, these infections can lead to morbidities and mortalities which could have been prevented through effective laboratory surveillance and screening mechanisms^{4,5}. UTI can be detected in laboratory by urine culture and infection is indicated by dipstick urinalysis and microscopy. Diagnosing UTI clinically is sometimes very difficult due to nonspecific symptoms. The standard test for diagnosis of UTI is urine culture which is costly and requires incubation period of 24-48 hours⁵. An ideal and cost effective test with high accuracy is required to provide early diagnosis without delay in high-risk patients. There are many rapid diagnostic methods available, Urine dipstick and microscopy are good substitution as these are less expensive and less time consuming. Urine dipstick is readily available test which can give results within minutes. Leukocyte esterase dipstick test was introduced by Perry et al in 1982⁶. Leukocyte esterase enzyme is produced by granulocytes, mostly neutrophils and is being used in urine routine examination for the presence of white blood cells and other abnormalities associated with infection. Normally a few or no white blood cells are present in urine and test is negative. When the number of WBCs in urine increases significantly, this screening test becomes positive indicating UTI⁷. The principle of this test is based on the enzymatic cleavage of an indoxyl ester contained in the test pad by esterase from leukocytes. The indoxyl released reacts with

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a diazonium salt to form a violet dye and gives color intensity proportional to the amount of leukocyte in the urine^{5,7}. It is a more reliable indicator of pyuria because it detects both the lysed and intact granulocytes. False positive results may be due to contamination of urine. This test is important to help clinicians in screening for urine culture specimens, monitoring of patients at high risk for UTI, evaluation of antibiotic therapy, and screening of bacterial and non-bacterial urinary tract infection. This study was conducted to compare the performance of leukocytes esterase dipstick with urine culture to evaluate the use of a urine dipstick in detecting UTI. This would be useful in poor resource setting where there is a dearth of trained personnel and equipment for urine culture.

MATERIALS AND METHODS

The study was conducted at Armed Forces Institute of Pathology (AFIP), Rawalpindi from January 2015 to June 2015. Approval of this research was granted by our institutional Ethical Committee. All the urine samples received in the Microbiology Department of AFIP for Culture from patients without discrimination of age and sex were included in the study. All Patients who had indwelling catheters, symptomatic vaginal discharge, or taking any antibiotic since 48 hours before submitting specimens were excluded from the study.

All samples were completely processed within one hour after arrival, to avoid overgrowth of any contaminating bacteria. All specimens subjected to urine dipstick analysis for leukocyte esterase using CYBOW™10M stripes. Change in colour in 60 seconds from white to purple in the test pad area impregnated with indoxyl ester was considered as positive.

All the urine samples were also used for culture. For culture sterile paper strip were dipped into urine container to pick up precise amount of urine (0.2µl), which are streaked using aseptic technique onto Cysteine Lactose Electrolyte Deficient (CLED) agar to give a count after incubation indicating the number of bacteria in the original sample. The plates were incubated at 35°C for 18 to 24 hours. The isolated colonies were counted and total number of Colony Forming Units (CFU)/ ml of urine were calculated. Colonies obtained were tested using Gram stain and biochemical methods to identify the species. Urine culture with isolation of 2 or more different species with a colony count in the range of 10⁴ to 10⁵ was reported as genital contaminants. For reporting negative growth urine specimens were incubated for 48 hours.

Sensitivity, Specificity, Positive and Negative predictive values and overall efficacy of dipstick test in determining the UTI keeping in view the culture result in relation with dipstick test were SPSS 21 was used to determine the descriptive statistical values.

RESULTS

Out of eleven hundred (1100) urine specimens included in the study, 342 (31.09%) were LE positive and 282 (25.64%) were culture positive. The culture revealed various Enterobacteriaceae including *Escherichia coli*, *Klebsiella pneumoniae*, *Citrobacter freundii*, *Enterobacter cloacae*, *Proteus mirabilis* and *Pseudomonas aeruginosa*,

Burkholderia cepacea and *Acinetobacter baumannii*. Among LE- positive isolates 218(63.74%) were culture positive and 124 (36.26%) were culture negative. Similarly LE negative (n=758) revealed 64 (8.44%) culture positive and 694 (91.56%) culture negative results (Table 1). Sensitivity, Specificity, Positive and Negative Predictive value and over all efficacy of Leukocyte Esterase Test using dipsticks are described in Table 2. Dipsticks showed significant good values in detecting UTI. The Negative predictive values (91.6%) are better than positive predictive values (56.77%) indicating negative result with dipsticks more important in assessing the absence of UTI than Positive-predictive-values.

Table1: Leukocyte esterase test and culture results of Urine specimens

Leukocyte Esterase test	Culture		Total
	Positive	Negative	
Positive	218	124	342
Negative	64	694	758
Total	282	818	1100

Table 2: Sensitivity, Specificity, Positive and Negative Predictive value and over all efficacy of Leukocyte Esterase Test using dipsticks

Sensitivity	77.31%
Specificity	84.84%
Positive Predictive Value	56.77%
Negative predictive value	91.6%
Efficacy	82.91%

DISCUSSION

Urinary Tract Infection (UTI) is a common infection with nonspecific presentation most of the time. Due to these atypical symptoms missed diagnosis is very frequent, which can cause severe renal damage especially in the high-risk population. The successful management of these patients depends upon timely and accurate diagnosis. The next step to clinical assessment is to perform suitable urine test for the diagnosis of infection. The diagnosis of UTI is mainly made by dipstick and microscopy. Culture is the reference standard for UTI diagnosis. But it takes at least 48-72 hours to give a result. To get urgent result dipstick tests is the quick and easy alternative to culture and can be carried out in primary care. The present study demonstrates that bedside urine dipsticks can substitute rapid urinalysis for diagnosis of urinary tract infections. Using dipsticks instead of urine culture may decrease patient time and the cost of testing. In this study, the sensitivity and specificity of dipstick Leukocyte Esterase (LE) test was found to be significantly good (about 77% and 85% respectively). The high negative predictive values (91.6%) indicate that negative test results are more useful in excluding UTI. Different studies of the dipstick LE test in adults have shown that the test is both sensitive and specific in detecting pyuria⁸ The dipstick test of leukocyte esterase is a reasonable and rapid screening which does not require highly trained personnel for diagnosis of urinary tract infections⁸. Al-Daqhistani and Abdel-Dayem in 2002 found the sensitivity and specificity of dipstick LE test as 68.5% and 73.5% respectively. PPV and NPV as 44% and

88.5% respectively⁹ Panagamuwa *et al.*, compared the accuracy of dipstick urinalysis with the standard microbiological test for excluding UTI. He calculated the sensitivity as 72.7%, specificity 88.0%, PPV was 37.2% and NPV was 97.1 %. They concluded that there was 90% reduction in the number of samples sent for culture in Laboratory¹⁰. One study from Utah suggested that Dipstick alone can screen UTI in febrile infants (age 1-90 days) before getting culture report¹¹ Fernandes DJ *et al.*, in 2017 stated out of 104 children evaluated for suspicion of UTI the nitrite specificity alone was 93.94%, leucocyte esterase specificity was 75.76% while urine dipstick test (nitrite and leucocyte esterase) was 96.97% and urine microscopy found to be 50% when compared with urine culture. They concluded that urine dipstick and microscopy are very useful screening tests exclude UTI¹². This Whiting *et al.*, reported a systematic review for determining the diagnostic accuracy of rapid tests or detecting UTI in children less than five years of age. Their results also support the use of dipstick positive for both NT and LE tests to rule in UTI¹³. One study from Brazil confirmed that negative dipstick could be a good predictor for negative culture of urine specimen. They also proposed leucocyte esterase as reliable parameter as compared to nitrite¹⁴. Walter LJM Deville¹ in 2004 conducted a meta-analysis to demonstrate the usefulness of dipstick urinalysis alone in all populations to rule out UTI if NT or LE tests are negative¹. Another study from Thailand suggested that combined leucocyte esterase and nitrite urine dipstick test can show high level specificity and sensitivity¹⁵. Mambatta A *et al.*, in 2015 suggested that urine dipstick can be used as first-level screening test of urine in outpatient settings¹⁶. Laboratory diagnosis of UTI by LE dipstick urinalysis in remote areas where technical laboratory staff and services are not accessible is veritable fall back tool for doctors and clinicians. Midstream urine samples with Negative leucocyte esterase can guide whether culture is required or not.

CONCLUSIONS

Leucocyte esterase dipstick test is a rapid screening and cost effective test which can be used in areas with limited resources. It is easy to perform and requires less time and cost without the need of highly trained personnel. It is very useful to detect presence of urinary tract infection. However, negative test provide better indication of absence of UTI.

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