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**Original Research Article**

# Utility of dipstick test (nitrite and leukocyte esterase) and microscopic analysis of urine when compared to culture in the diagnosis of urinary tract infection in children

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## ABSTRACT

**Background:** Urine culture is the gold standard in the diagnosis of urinary tract infection (UTI), but usually takes at least 48 hours and is expensive. Urine dipstick test and microscopy are useful for early diagnosis and initiation of treatment. The current study aims to assess the diagnostic value of dipstick and microscopy of urine in the diagnosis of UTI in comparison with culture.
**Methods:** Children aged between 3 months-15 years of age, in whom UTI was suspected clinically were included in the study. Dipstick and microscopic examination of urine were done and compared with the urine culture. Results were analyzed using sensitivity, specificity, positive predictive value and negative predictive values.
**Results:** Total of 104 children with clinical suspicion of UTI were evaluated in the study. The specificity of nitrite is 93.94%, leucocyte esterase 75.76%, urine dipstick test (nitrite and leukocyte esterase) 96.97% and urine microscopy is 50% when compared to urine culture.
**Conclusions:** Urine dipstick test (nitrite and leukocyte esterase) and urine microscopy can be used as screening tests to rule out or rule in UTI. This would be useful clinically as treatment could be commenced in children pending culture reports.

**Keywords:** Nitrite and leukocyte esterase, UTI, Urine dipstick test

## INTRODUCTION

Urinary tract infection (UTI) is a common disease in childhood and approximately 3 to 5 percent of girls, and 1 percent of boys develop UTI.[1]

Early and prompt treatment is essential because UTI has been considered as an important risk factor for the development of renal insufficiency or end-stage renal disease.[2]

Early detection of urinary tract infection by dipstick, microscopy or culture is important as non-specific symptoms make the clinical diagnosis of UTI challenging especially in younger children.[3]

This prospective observational study was done in children between 3 months and 15 years of age in whom UTI was suspected clinically during the period between November 2016 to August 2017 to assess the accuracy of urine dipstick and urine microscopy in the diagnosis of UTI.

Objective of study of this study was to analyse the diagnostic accuracy of urinary dipstick test (nitrite and leukocyte esterase) and microscopy when compared to

culture in the diagnosis of urinary tract infection in children between 3 months -15 years of age.

## METHODS

Urine sample was collected in three separate containers, from each patient for dipstick, microscopy, and culture.

### *Urine dipstick chemical analysis*

Fresh uncentrifuged urine sample was examined for urine nitrite and leucocyte esterase by using urine dipstick (combur 10 Test M). Nitrite was considered as positive if there was a change in colour of dipstick from colourless to pink. Leukocyte esterase was considered as positive if there was a change in colour of dipstick from off-white to purple.[4-7]

### *Urine microscopy*

Microscopic examination of the centrifuged urine sample was done for bacteria and pyuria.

More than 5 leukocytes per high power field in a centrifuged sample is suggestive of UTI.[8] When the urine sample is freshly collected and uncontaminated, the presence of bacilli is suggestive of UTI.[9]

### *Urine culture*

Urine culture was considered positive if there was $\geq 10^5$ colony forming unit of a single organism.[8]

### Definitions

*Urinary tract infection*

Infection of the urinary tract is identified by growth of significant number of organism of a single species in the urine in the presence of symptoms as below.[8]

**Table 1: Symptoms and signs of UTI in children.**

| Age group | Symptoms and signs |
|---|---|
| Infants and young children | Fever |
| | Vomiting |
| | Abdominal pain |
| | Poor weight gain |
| Older children and adolescents | Frequency |
| | Dysuria |
| | Urgency |
| | Frequency |
| | Abdominal or flank pain |

*Significant bacteriuria*

Colony count of $>10^5$/ml of a single species in a midstream clean-catch sample.[8]

### *Inclusion criteria*

All children suspected to have UTI clinically in between 3 months-15 years of age were included in the study.

### *Exclusion criteria*

Children who have received antibiotics in the last 48 hours were excluded from the study.

The study was approved by the institutional ethics committee. All relevant details were recorded in the predesigned proforma

## RESULTS

There was a total of 104 children in whom UTI was suspected clinically. In 40 (38.5%) children urine dipstick test was positive [22 (21.2%) were nitrite positive and 32 (30.8%) were leukocyte esterase positive] and 61 (58.7%) children were positive for urine microscopy. Urine culture was positive in 38 (36.5%) children (Table 2).

**Table 2: Results of urine dipstick test, microscopy and urine culture.**

| | Positive | |
|---|---|---|
| | N | % |
| Urine dipstick (n=104) | 40 | 38.46 |
| Nitrite only | 22 | 21.15 |
| Leukocyte Esterase only | 32 | 30.76 |
| Both nitrite and leukocyte esterase | 14 | 13.46 |
| Urine microscopy (n=104) | 61 | 58.65 |
| Urine culture (n=104) | 38 | 36.53 |

Out of the 38-urine culture positive cases, 14 (36.84%) were males and 24 (63.15%) were females (Figure 1).

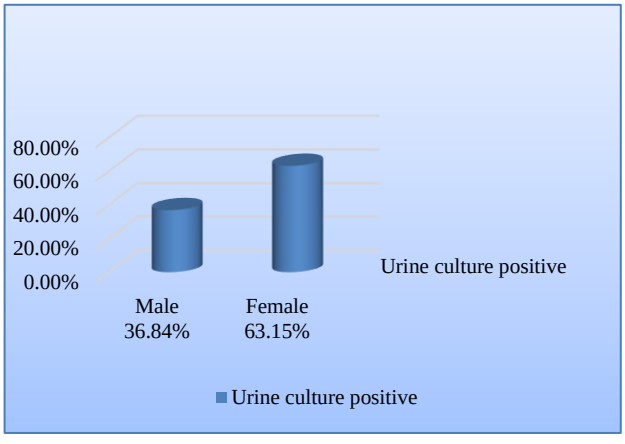


**Figure 1: Sex distribution of culture positive cases.**

Out of the 38-urine culture positive cases, 25 (65.80%) were positive for *E coli*, 4 (10.50%) for *Klebsiella*, 2 (5.3%) for *Proteus*, 2 (5.3%) *Enterobacter*, 1 (2.60%) *Citrobacter* and 4 (10.50%) were other bacteria.

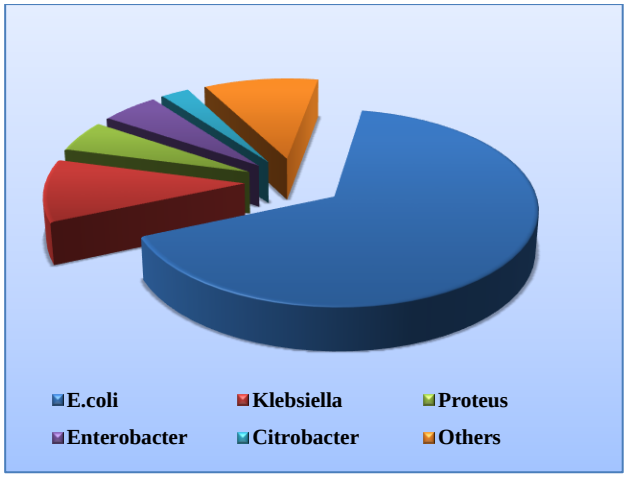


**Figure 2: Organism in urine culture positive cases.**

Sensitivity and specificity of urine dipstick for nitrite alone was 47.37% and 93.94% respectively with a highly significant p-value of 0.000001, when compared to urine culture generating a PPV and NPV of 81.82% and 75.61% respectively.

Sensitivity and specificity of urine dipstick for leukocyte esterase alone was 42.11% and 75.76% respectively with a p-value of 0.06 which is not statistically significant, when compared to urine culture generating a PPV and NPV of 50.00% and 69.44% respectively.

Sensitivity and specificity of urine dipstick for combined nitrite and leukocyte esterase was 31.58% and 96.97% respectively, when compared to urine culture generating a PPV and NPV of 85.71% and 71.11% respectively (Table 3).

**Table 2: Urine dipstick in comparison with urine culture.**

| Screening test | Urine culture positive (n = 38) | Urine culture negative (n = 66) | Total | |
|---|---|---|---|---|
| Nitrite-positive | 18 | 4 | 22 | PPV=81.82% |
| Nitrite negative | 20 | 62 | 82 | NPV=75.61% |
| Total | 38 | 66 | 104 | |
| | Sensitivity - 47.37% | Specificity - 93.94% | | p - 0.000001 |
| Leucocyte esterase positive | 16 | 16 | 32 | PPV=50.00% |
| Leucocyte esterase negative | 22 | 50 | 72 | NPV=69.44% |
| Total | 38 | 66 | 104 | |
| | Sensitivity - 42.11% | Specificity-75.76% | | p-0.06 |
| Nitrite and leukocyte esterase positive | 12 | 2 | 14 | PPV=85.71% |
| Nitrite and leukocyte esterase negative | 26 | 64 | 90 | NPV=71.11% |
| Total | 38 | 66 | 104 | |
| | Sensitivity - 31.58% | Specificity - 96.97% | | p - 0.00004 |

**Table 3: Urine microscopy in comparison with urine culture.**

| Urine microscopy | Urine culture positive (n=38) | Urine culture negative (n=66) | Total | |
|---|---|---|---|---|
| Positive | 28 | 33 | 61 | PPV = 45.90% |
| Negative | 10 | 33 | 43 | NPV = 76.74% |
| Total | 38 | 66 | 104 | |
| | Sensitivity = 73.68% | Specificity = 50.00% | | p = 0.018 |

Sensitivity and specificity of urine microscopy was 73.68% and 50.00% respectively when compared to urine culture with a p-value of 0.018, generating a PPV and NPV of 45.90% and 76.74% respectively.

Specificity and positive predictive value of microscopic urinalysis were 50% and 45.90% respectively, which is lower than that of urine dipstick test for nitrite 93.94% and 81.82% respectively (Table 3).

## DISCUSSION

There are many studies which have evaluated the use of urinary dipstick test and microscopy in the diagnosis of UTI in children, but the results obtained from these studies are inconsistent.

In the present study, we have evaluated the diagnostic value of urine dipstick for nitrite and leucocyte esterase

and urine for microscopy when compared with gold standard urine culture for the diagnosis of UTI.

Among all the urine culture positive (n=38) children in present study, we found females 24 (63.15%) had more culture positive results than males 14 (36.84%). The most frequent organism isolated were (65.80%) *E coli*, (10.5%) *Klebsiella*, (5.30%) *Proteus* which was similar to the results observed in other studies by Sharma A et al and Taneja N et al.[11,12]

The sensitivity and positive predictive value of urinary dipstick test for nitrite alone when compared to urine culture in the diagnosis of UTI was 47.37% and 81.82% respectively, while specificity and negative predictive value were 93.94% and 75.61% with a highly significant p-value (0.000001) These results were comparable with the findings reported by Ali MM.[2]

In contrast to present study results, Carias MJB et al in their studies found that the sensitivity of nitrite was high.[13] Low sensitivity for nitrite in present study may be due to the random collection of urine specimen for urine dipstick test, as a minimum of 4 hours is required for pathogenic bacteria to reduce nitrate to nitrite.

The sensitivity and positive predictive value of urinary dipstick test for leukocyte esterase alone when compared to urine culture in the diagnosis of UTI was 42.11% and 50.00% respectively, while specificity and negative predictive value were 75.76% and 69.44% with a p-value of 0.06 which is not significant. These results were similar to study done by Najeeb S et al.[7]

The sensitivity and positive predictive value of urine dipstick for nitrite and leucocyte esterase together when compared to urine culture in the diagnosis of UTI was 31.58% and 85.71% respectively, while specificity and negative predictive value were 96.97% and 71.11%. In contrast, Nayak US in his study concluded that the sensitivity, specificity, PPV and NPV of the urine dipstick test were 68%, 25%, 71.4% and 22% respectively.[3]

The sensitivity and positive predictive value of urine microscopy when compared to urine culture in the diagnosis of UTI was 73.68% and 45.90% respectively, while specificity and negative predictive value were 50.00% and 76.74% with a significant p-value of 0.018. In comparison Baral R in their study showed that the sensitivity, specificity, PPV and NPV of urine microscopy were 36%, 60%, 68% and 55% respectively.[15] This disparity in the study results may be due to the inappropriate technique for collection and storage of urine sample.

As the sensitivity of urine microscopy is better than urine dipstick test for nitrite or leukocyte esterase, a positive urine microscopy is more helpful in ruling in UTI in children. Since the specificity of nitrite dipstick test is better than leukocyte esterase dipstick test and urine microscopy, a negative nitrite in urine dipstick test is more helpful in ruling out UTI in children. Further studies with large numbers are required to confirm the results of the same.

## CONCLUSION

In the present study, we found that urine dipstick test (nitrite and leukocyte esterase) and urine microscopy can be used as screening tests to rule out or rule in UTI. This would be useful clinically as treatment could be commenced in children pending culture reports.

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