International Journal of Contemporary Pediatrics
Cyril JP et al. Int J Contemp Pediatr. 2021 Oct;8(10):1709-1712
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20213735

Original Research Article

Validity of dipstick urinalysis for predicting urinary tract infection in febrile children aged 2-12 years in a tertiary care centre, South Kerala

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Received: 05 September 2021
Accepted: 20 September 2021

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ABSTRACT

Background: Urinary tract infection (UTI) warrants an early accurate diagnosis in children. Use of rapid diagnostic tests like urine dipstick and microscopy was found to be economical and effective. There is lack of sufficient studies on rapid diagnostic tests in developing countries like India. This study looked at the single as well as combination of parameters that provided maximum sensitivity and specificity, providing a better diagnostic criterion in detecting UTI. The objective was to assess the diagnostic validity of urinary dipstick in the diagnosis of UTI in comparison with urinary culture.
Methods: This cross-sectional diagnostic evaluation study was conducted in a tertiary care centre in Southern Kerala. Total of 75 children between the age group of 2 years to 12 years who attended the paediatric OPD with the clinical features of UTI were included in this study. Two urine samples were obtained in sterile containers. The first urine sample was assessed with dipstick and the second sample was sent for culture to confirm the UTI. The results obtained were analysed using SPSS software.
Results: Using culture as gold standard, the results for nitrate alone had lower sensitivity at 69.69%, specificity at 90.4%. The results for LE (LE) alone had higher sensitivity at 81.8%, specificity at 80.95% and the results for combined urine dipstick had higher sensitivity at 84.8% than individual nitrite and LE. The combined positive predictive value (PPV) was lower than individual nitrite and LE 75.6%. The combined negative predictive value (NPV) was higher than individual LE and nitrite at 86.8%.
Conclusions: Dipstick urinalysis alone may not be a completely adequate screening tool for UTI. Since urine dipstick test has high sensitivity it can be used as a bedside tool in detecting UTI in children.

Keywords: Urinary tract infection, Dipstick urine analysis, Urine culture

INTRODUCTION

UTIs are the most common bacterial infections seen in the general population. In hospitalized patients, the second most common cause of bacteraemia is UTI.[1] UTIs are the most common source of serious bacterial infection in young children. Overall, 3% to 5% of young febrile children have UTIs including 5% to7% of those without a source of fever.[2] Beyond the diagnosis and treatment, the identification of a UTI in a young child prompts investigation for vesicoureteral reflux and other urinary tract anomalies that may predispose patients to long-term renal complications.[3] Though urine culture is the gold standard for the diagnosis of UTI, it is expensive and time consuming, requiring at least 48 hours to produce results. Urine analysis is a quick and inexpensive screening method requiring limited expertise. Physical, performed only in the presence of abnormalities in urine dipstick tests. Specific gravity, pH, urobilinogen, glucose, chemical and microscopic examination constitutes a complete urine analysis. In some hospitals urine culture is

ketones, blood, LE and nitrite are tested in dipstick analysis. Negative urine dipstick analysis was found to be valuable in ruling out UTI by a few studies.[4] However, a meta-analysis has shown that a negative dipstick analysis was insufficient to rule out UTI.[5]

Use of rapid diagnostic tests like urine dipstick and microscopy, over the recent past was found to be economical and effective in avoiding unnecessary sampling or urine cultures. These tests guided in selectively performing urine culture based on urine analysis reports, unless there was a strong clinical suspicion or if the patient had received antibiotics. These tests were also helpful in initiating an empirical treatment in children with strong suspicion of UTI, while the urine culture reports were awaited. Many studies have reported high specificity and sensitivity of dipstick tests and these tests aided in early therapeutic intervention, thereby preventing complications. Although extensive paediatric studies have been done to evaluate the performance characteristics of these rapid diagnostic tests in rightly diagnosing a UTI, there was lack of sufficient studies and paucity of data on these in developing countries like India.[6]

This study focused on validity of urine dipstick in early detection of childhood urinary tract infection as an effective screening tool in a South Indian set up. This study looked at the single as well as combination of parameters that provided maximum sensitivity and specificity, providing a better diagnostic criterion in detecting an underlying urinary infection.

Objective

The objective was to assess the diagnostic validity of urinary dipstick test in the diagnosis of UTI in comparison with urinary culture.

METHODS

This hospital based cross-sectional diagnostic evaluation study was conducted at Dr. SM CSI medical college and hospital, Karakonam, Trivandrum, a tertiary care centre in Southern Kerala, during November 2018 to 2020 with the permission of institutional ethics committee. After getting written informed consent from the parents and assent from children, a total of 75 children between the age group of 2 years to 12 years who attended the paediatric OPD with the clinical features of UTI (dysuria, burning micturition, urgency, frequency, suprapubic pain, urinary incontinence, haematuria, abdominal pain, back pain, flank pain, malaise, nausea or vomiting) were included in this study.[7] The children who received antibiotics 48 hours prior to hospital visit, having acute respiratory tract infection with fever, indwelling Foleys catheter, immunodeficiency disorders, nephritic syndrome and urinary tract anomalies with UTI were excluded from the study. A semi structured proforma was used to enter the sociographic and clinical variables. The clean mid-stream catch urine collection technique was explained by the principal investigator in the OPD to the parents as well as the child with video demonstration. Two urine samples were obtained under strict aseptic precautions sterile containers. The presence of UTI was assessed with dipstick urinalysis test (ACON mission urinalysis strips) by the principal investigator in the OPD itself with the sample one and the second sample was sent to the microbiology lab for urine culture to confirm the UTI. The results obtained from urine analysis by urine dipstick test and urine culture was entered in the MS excel and was analysed using SPSS trial version software. The true positive, true negative, false positive, false negative values were obtained and specificity, sensitivity, PPV, NPV were calculated.

RESULTS

A total of 75 children between 2 to 12 years of age were included in this study. The mean age of the study population was 6.7±2.8 years, in those males were having higher mean age of 6.87±2.4 years when compared to 6.56±3.1 years for females. Urine dipstick test showed LE present in 35 children (46.7%) and nitrite present in 27 children (36%).

Urine culture was done in all subjects, of which 33 were positive (44%) and the rest were negative (56%). Using culture as gold standard, the results for nitrate alone had lower sensitivity at 69.69% (95% CI=54.0 to 85.3) and specificity at 90.4% (95% CI=81.5 to 99.3). PPV and NPV for nitrite alone was 85.10% (95% CI=71.7 to 98.5) and 79.16 % (95% CI=67.6 to 90.6), respectively.

Table 1: Comparison of nitrite levels and urine culture.

Urine dipstick nitrite	Urine culture			Chi-square test
	Positive	Negative	Total	
	n	n	N	
Positive	True positive	False positive	27	Test value=3.98; p=0.04
n	23	4		
Negative	False negative	True negative	48	
n	10	38		
Total (N)	33	42	75	

Table 2: Comparison of LE levels and urine culture.

LE	Urine culture			Chi-square test
	Positive	Negative	Total	
	n	n	N	
Positive	True positive	False positive	35	Test value=29.256; p<0.001
n	27	8		
Negative	False negative	True negative	40	
n	6	34		
Total (N)	33	42	75	

Table 3: Comparison of nitrate and LE levels with urine culture.

Combined urine dipstick	Urine culture			Chi-square test
	Positive	Negative	Total	
	n	n	N	
Positive	True positive	False positive	37	Test value=29.737; p<0.001
n	28	9		
Negative	False negative	True negative	38	
n	5	33		
Total (N)	33	42	75	

Table 4: Urine dipstick validity.

Validity	Nitrite % (95% CI)	LE % (95% CI)	Combined % (95% CI)
Sensitivity (true positive/true positive+false negative)×100	69.69 (54.0 to 85.3)	81.80 (68.6 to 94.9)	84.8 (72.6 to 97.0)
Specificity (true negative/true negative+false positive)×100	90.47 (81.5 to 99.3)	80.95 (69.0 to 92.8)	78.5 (66.1 to 90.9)
PPV (true positive/true positive+false positive)×100	85.10 (71.7 to 98.5)	77.10 (63.2 to 91.0)	75.6 (61.8 to 89.5)
NPV (true negative/true negative+false negative)×100	79.16 (67.6 to 90.6)	85.00 (73.9 to 96.0)	86.8 (76.1 to 97.5)

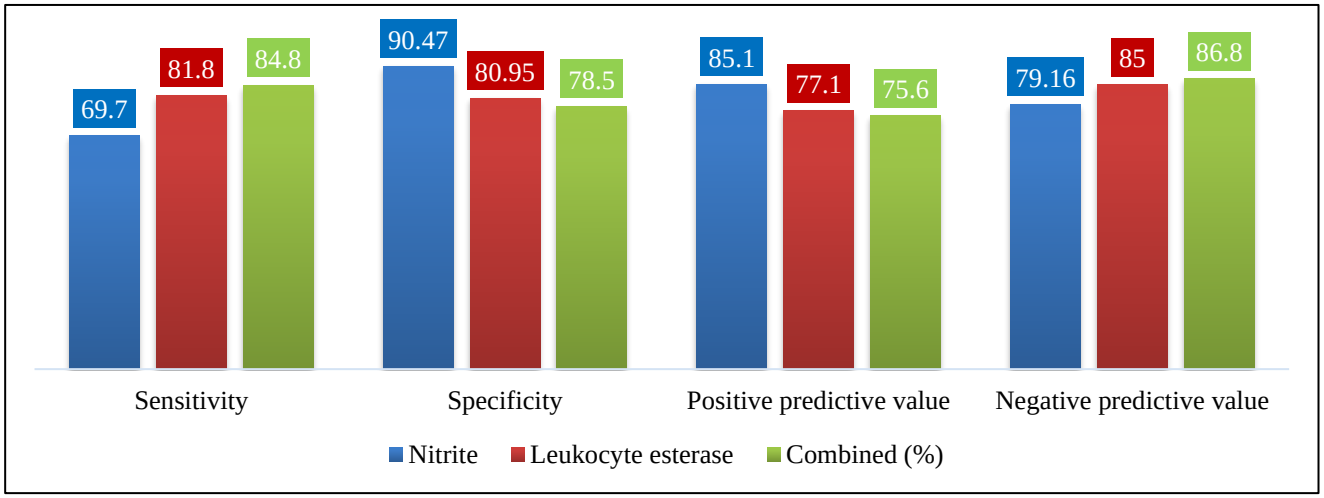

Figure 1: Urine dipstick validity.

The results for LE alone had higher sensitivity at 81.8% (95% CI=68.6 to 94.9). PPV was lower than nitrite 77.1% (95% CI=63.2 to 91.0) and NPV for LE alone was higher than nitrite at 85.0% (95% CI=73.9 to 96.0).

Combined urine dipstick (nitrite and LE) had higher sensitivity at 84.8% (95% CI=72.6 to 97.0) than individual nitrite and LE. PPV at 75.6% (95% CI=61.8 to 89.5) was lower than nitrite and LE alone and NPV was higher than LE and nitrite alone at 86.8% (95% CI=76.1 to 97.5).

DISCUSSION

In this study using culture as gold standard, the results for nitrate alone had lower sensitivity at 69.69 (95% CI=54.0 to 85.3) and specificity at 90.4 (95% CI=81.5 to 99.3). PPV and NPV for nitrite alone was 85.10 (95% CI=71.7 to 98.5) and 79.16 (95% CI=67.6 to 90.6) respectively. According to Roberts et al urinary nitrite was not a sensitive marker for UTI in children, particularly infants, because of their frequent bladder emptying.[8] Most urinary pathogens except *Enterococci* can reduce nitrate to nitrite and the nitrite in the urine indicates bacteriuria. The nitrite dipstick test may be falsely negative if the urine was held for too short a time in the bladder, usually <4 hours and this may be the reason for the low sensitivity (69.7%) in this study.[9] A study by Mambatta et al in Tamil Nadu, reported that the sensitivity of nitrite and LE alone were 23.31% and 48.5%, respectively, which were lower to our findings (69.7% and 81.8%) in both tests.[10] The reason for low sensitivity of nitrite test could be false negative test due to lack of dietary nitrate, dilution of urine or non-reducing bacteria in the urine. Moreover, first voided urine sample which was more accurate for nitrate was not always possible in all the patients. The nitrite in the urine had been shown to increase the PPV in our study and it was also observed in earlier studies.

Using culture as gold standard, the results for LE alone had higher sensitivity at 81.8 (95% CI=68.6 to 94.9). PPV was lower than nitrite 77.1 (95% CI=63.2 to 91.0) and NPV for LE alone was higher than nitrite at 85.0 (95% CI=73.9 to 96.0). Findings from other studies have showed sensitivity of LE from 48.5% to 77%.[10] Therefore, it was reasonable to propose that a positive LE was indirectly a strong predictor for UTI. In several studies, nitrites and LE were shown to have good sensitivity and specificity for the detection of UTI in older children but were less reliable in infants.[9] Ramlakhan et al differed as they found dipstick urinalysis useful in the diagnosis of UTI in children below 2 years of age. Wilson et al reported the combination of positive nitrite or positive LE tests had improved sensitivity (85%) and specificity (84%), which was comparable with the present study (84.8% and 78.5%).[11]

CONCLUSION

Dipstick urinalysis alone may not be a completely adequate screening tool for UTI. However, analysis of results of urine culture in the light of a positive dipstick urinalysis would be useful in making a reasonably prompt decision on UTI treatment. Since urine dipstick has high sensitivity (LE+nitrate) it can even be used as a bedside tool in detecting UTI in children. Also, it can be used in outpatient to start with empirical antibiotic before getting culture and sensitivity reports.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Cyril JP, Baburaj S, Kuruvilla TA, Christy DB, Das LB, Baby YVS. Validity of dipstick urinalysis for predicting urinary tract infection in febrile children aged 2-12 years in a tertiary care centre, South Kerala. Int J Contemp Pediatr 2021;8:1709-12.