

Original Article

Reliability of Rapid Dipstick Test in Detecting Urinary Tract Infection in Symptomatic Children

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ABSTRACT

Objective: Urinary tract infection (UTI) is common in children. Early diagnosis and treatment is important to save permanent renal damage. The present study is designed to assess the reliability of rapid dipstick test in detecting UTI.

Setting: Al-Adan Hospital, Kuwait

Patients and methods: One hundred and thirty-two pediatric patients admitted with clinical suspicion of UTI were studied prospectively. The urine samples were screened by a dipstick test for nitrite (N) and leukocyte esterase (LE) and simultaneously subjected to bacterial culture. Sensitivity, specificity, positive and negative predictive values for each of these tests were assessed by comparison with culture results.

Results: Urine culture was positive in 89 specimens (67.4%). The calculated sensitivity, specificity, positive

and negative predictive values for N alone was 38.2%, 88.4%, 87.2% and 40.9%, respectively, and for LE test were 85.4%, 58.1%, 80.9% and 65.8%. When the positive results of both the tests were combined, the specificity and positive predictive value (PPV) were higher (88.0% and 91.0% respectively) but the sensitivity and negative predictive value (NPV) were lower (74.0% and 67.0% respectively). However, when either of the two tests was positive alone, the specificity (57.5%) and the positive predictive value (73.0%) dropped significantly.

Conclusion: Our study shows that dipstick test has a high PPV for UTI in symptomatic children when both N and LE are positive. However, negative dipstick test does not exclude UTI due to its low NPV. Therefore, this test is not entirely reliable in diagnosing UTI.

KEYWORDS: leukocyte esterase, nitrite, urinary tract infection

INTRODUCTION

Urinary tract infection (UTI) is common among infants and children. The incidence varies with age and sex and is reported as 1-1.4 % in neonates^[1], with a male - female ratio of 2.8:1 to 4:1^[2]. In infants one month to one year of age, UTI occurs in 1.2% of boys and 1.1% of girls; in children one to seven years of age, the incidence is 7.8% in girls and 1.6% in boys^[3]. Early diagnosis and initiation of treatment is crucial for preventing renal scarring, hypertension and chronic renal failure^[4].

Definitive diagnosis of UTI depends on a positive bacterial culture of urine, but the culture results usually take 24 - 48 hours to be available for clinicians to take appropriate action. Several rapid tests for early detection of UTI have been studied for their reliability. Leukocyte esterase (LE) is an enzyme found in neutrophils and is not normally found in urine. Its presence in urine indicates pyuria that may occur with a UTI. Dietary nitrates, ordinarily present in urine, are reduced to nitrites (N) by urinary bacteria^[5]. Most

urinary pathogens reduce nitrates to nitrites except *Pseudomonas* and group B *Streptococci*^[6]. We present the results of one such rapid dipstick test, which depends on detecting N and LE as indicators of UTI in pediatric patients clinically suspected to have UTI.

PATIENTS AND METHODS

A prospective study was done on 132 pediatric patients less than 12 years of age who were admitted with a clinical suspicion of UTI but had not been exposed to any antibiotic therapy. Urine specimens were collected either by urethral catheterization, suprapubic aspiration or midstream clean-catch collection. Dipstick test was done using Boehringer Mannheim reagent strips and read by automated photometer. Quantitative and qualitative bacterial cultures were done on simultaneously collected urine samples.

The N result was read as positive or negative. For LE test, presence of trace amount was considered positive. The culture results were

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Table 1: Criteria for positive urine culture result

Method of collection	Colony count per millilitre
Suprapubic aspiration	Any count
Urethral catheterization	>10 ⁴
Midstream clean catch	>10 ⁵

Table 3: Sensitivity, specificity and predictive values of dipstick test

	Sensitivity* (%)	Specificity† (%)	PPV‡ (%)	NPV§ (%)
Nitrite (N)	38.2	88.4	87.2	40.9
Leukocyte esterase (LE)	85.4	58.1	80.9	65.8
N/ LE both positive	74	88.0	91.0	67.0
N / LE either positive	80.7	57.5	73.0	67.7

* Sensitivity: True positive tests / True positive tests + False negative tests
 † Specificity: True negative tests / True negative tests + False positive tests
 ‡ PPV: Positive predictive value: True positive tests / True positive tests + False positive tests
 § NPV: Negative predictive value: True negative tests / True negative tests + False negative tests

interpreted on the basis of the criteria listed in Table 1. Sensitivity, specificity and predictive values were calculated using the method described by Lohr^[5].

RESULTS

Out of 132 subjects studied, 51 (38.6%) were male and 81 (61.4%) female, with their ages ranging from three days to 11 years (Mean: 26 months). Positive urine culture was observed in 89 (67.4 %) patients out of which 50 (56.2%) were female and 39 (43.8%) were male. Twelve children (13.48 %) had urological anomalies that are known to predispose to recurrent UTI. Vesico-ureteric reflux was observed in four patients, hydronephrosis in four and neurogenic bladder secondary to myelomeningocele in three. One had operated ectopia vesica. Recurrent UTI was also observed in 10 (11.23 %) patients with normal anatomy of the genito-urinary tract.

Bacterial growth yielded *E.coli* in 76 (85.4%) cases, *Klebsiella pneumoniae* in 10 (11.2%), *Enterococci* in two (2.2%), and *Pseudomonas* in one (1.1%) urine specimen.

The results of N test and LE test along with their relationship to the results of urine culture are shown in Table 2. The sensitivity of LE test was higher (85.4%) than the N test (38.2%), while its specificity was lower (58.1%) as compared to N test (88.4%). The positive and negative predictive value for N test was 87.2% and 40.9% respectively, and for the LE test was 80.9% and 65.8% respectively (Table 3).

When both N test and LE were positive, their combined outcome for specificity and positive predictive value was high (88.0% and 91.0% respectively). However, when either test was

Table 2: Results of urine culture compared with dipstick test

Urine culture	N* test		LE* test		N and LE tests		
	Positive	Negative	Positive	Negative	Both positive	Either positive	Both negative
Positive	34	55	76	13	32	46	11
Negative	5	38	18	25	3	17	23
Total	39	93	94	38	35	63	34

*N = nitrite, LE = leukocyte esterase

positive alone, these values dropped to 57.5% and 73.0% respectively. The sensitivity of combined test positivity was 74.0%, and with single test positivity, it was 80.7%. The negative predictive value, on the other hand, was similar (67.0% and 67.7% respectively) for the combined and solitary test positivity. Comparison of the positive culture results of our study with those of other workers^[7-11] is shown in Table 4.

DISCUSSION

Our results are comparable for sensitivity and specificity of the N test with other studies^[7-11] (Table 4). The LE test, however, showed lower specificity. Sensitivity of the combined N and LE tests when, either of them was positive, was consistent with the results of studies conducted by Weinberg *et al*^[8] and Lohr *et al*^[9] but had comparatively lower specificity.

The positive predictive values of the N test and the LE test were high either alone or combined. Our data supports the results of Woodward *et al*^[12] who have reported 100% positive predictive value for the combined positive results of these tests in children with acute abdominal pain. Lejuene *et al*^[13] have also shown high positive predictive value (87.2%) for the combined test in febrile newborn babies and infants less than 18 months old. Unlike other studies^[7-11] our data showed low negative predictive value.

The higher incidence of UTI among our patients (67.4%) can be attributed to the fact that a significant proportion (24.71 %) had predisposing factors for UTI, in the form of abnormal anatomy of the genito-urinary tract or recurrent UTI with a normal genito-urinary tract. The high positive predictive value of the tests in our study is a reflection of the high incidence of UTI^[5].

The lower sensitivity of N test compared to LE test can be explained by the fact that a minimum of four hours is required for the pathogenic bacteria to reduce dietary nitrate to nitrite. Hence, the N test is less likely to be positive in a random urine sample than first voided morning specimen^[5]. Moreover, *Pseudomonas*^[6] and most of the Gram-positive bacteria do not reduce nitrate to nitrite^[5].

Table 4: Comparison of results of the present study with those of other workers

Study	Incidence %	Nitrite (N)				Leukocyte esterase (LE)				N /LE either positive			
		Sensiti- vity %	Specifi- city %	PPV† %	NPV† %	Sensiti- vity %	Specifi- city %	PPV %	NPV %	Sensiti- vity %	Specifi- city %	PPV† %	NPV %
Present study	67.4	38.2	88.4	87.2	40.9	85.4	58.1	80.9	65.8	80.7	57.5	73.0	67.7
Sharief <i>et al</i> ^[7]	5.2	54.6	96.8	37.5	98.4	100	78.1	13.9	100	54.6	98.7	60.0	90.9
Weinberg & Gan ^[8]	4.0	56.0	98.1	54.7	98.1	85.4	92.7	33.7	99.3	90.2	91.6	31.1	99.6
Lohr <i>et al</i> ^[9]	14.8	37.3	100	100	90.2	79.4	72.7	33.6	95.3	83.3	72.4	34.4	96.2
Wammanda <i>et al</i> ^[10]	4.3	28.9	-	72.2	80.8	-	-	-	-	-	-	-	-
Cannon <i>et al</i> ^[11]	14.4	72.7	99.6	96.8	94.6	84.6	71.4	33.6	96.9	91.0	-	-	-

† PPV: Positive predictive value, NPV: Negative predictive value

CONCLUSION

We conclude that when the dipstick test is positive for both N and LE, it has a high positive predictive value for presence of UTI. However, due to the low negative predictive value of these tests, a negative result of dipstick test does not exclude UTI in a population with high incidence of the disease. Therefore, the dipstick test is not a substitute for urine culture, which should be done in all cases in which the dipstick test is positive and /or there is a high index of clinical suspicion of UTI.

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