

EVALUATION OF MODIFIED NITRITE TEST AS A DIAGNOSTIC TEST IN URINARY TRACT INFECTION OF CHILDRENPUNEET JAIN¹, SUNNY MALVIA¹, NIHA KHAN^{2*}¹Department of Pediatrics, Pacific Medical College and Hospital, Udaipur, Rajasthan, India. ²Department of Pediatrics, Pacific Institute of Medical Science, Udaipur, Rajasthan, India. Email: dr.nihakhan@gmail.com

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ABSTRACT

Objective: Urinary tract infection (UTI) is common infection in children. Urine culture is the gold standard method for diagnosing urine infection but it takes more than 48 h to give results. The objective is to evaluate the diagnostic ability of modified nitrite test as a rapid diagnostic screening test for diagnosis of UTI in children.

Methods: An observational and cross-sectional study was conducted in a tertiary care hospital in Udaipur over a period of 1 year. Children aged up to 60 months with suspected UTI were enrolled in the study. Children with congenital urogenital anomalies and prior antibiotic treatment were excluded from the study. Urine culture and modified nitrite test was done for every children.

Results: Ninety children with suspected UTI were enrolled in the study. Urine culture was positive in 14 (15.55%) out of 90 urine samples. When modified nitrite test was compared to positive urine culture, true positives were 9 and 1 was false positive. Sensitivity, Specificity, PPV, NPV, and Accuracy was 64.29%, 98.68%, 90%, 93.75%, and 93.33%, respectively.

Conclusion: Sensitivity and specificity of modified nitrite test are good enough as a diagnostic test for detection of UTI. It can be used as a point of care test for rapid screening and identifying the cases.

Keywords: Modified nitrite test, Urinary tract infection, Urine culture.

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INTRODUCTION

The most common manifestation of any infectious diseases is fever and its duration and grade depends on the severity of disease. Fever without localizing sign or symptom is a common diagnostic dilemma for most pediatrician which leads to battery of investigations both invasive and non-invasive. Urinary tract infection (UTI) is one of the most common bacterial infections. It can be found in both community and hospital settings. The incidence of UTI is more in females as compared to males beyond infancy period.

The frequency of UTI in infants and children is common. The major importance of UTI in children is morbidity associated with it. In most of the cases in children, there can be associate anatomic abnormalities (obstruction and vesicoureteric reflux). This may cause damage to kidneys and it may ultimately lead to progressive renal failure requiring intensive medical and surgical care [1].

One of the most effective and common way to detect UTI is urine analysis [2]. There are many diagnostic methods such as Gram stain, the wet mount microscopy, dipstick, and automated assays. However, urine culture is the gold standard method for diagnosis of UTI. Urine culture helps in diagnosing the pathogen and its antimicrobial susceptibility pattern but it can take up to 48 h thus leading to delay in the treatment [3].

There are certain urine markers that are present in urine during urine infection such as leucocyte esterase and nitrites. Reagent strips have been designed detection of these markers which allow early detection of infection in the emergency department. These tests can be considered as point of care tests and may help in earlier initiation of the treatment [4,5].

The objective of this study is to evaluate the diagnostic ability of modified nitrite test as a rapid diagnostic screening test for diagnosis of UTI in children.

METHODS

An observational and cross-sectional study was conducted in a tertiary care hospital in Udaipur over a period of 1 year from January 2021 to December 2021.

The study included 90 children of both sexes, aged below 60 months, who were examined due to suspicion of UTIs in the Department of Paediatrics, Pacific Medical College and Hospital. Institutional ethical clearance was taken. Consent from caretaker/parent/guardian was taken.

Those children who had symptoms such as fever, nausea/vomiting, dysuria, foul smell in urine, urgency, cloudy urine, abdominal pain, and failure to thrive were suspected to be having UTI. These children were included in the study.

Patients who were already on antibiotic therapy, having congenital urogenital anomalies and non-consenting were excluded from the study.

The standard method of urine collection was adopted by mid stream clean catch in previously sterilized culture bottles. Cleaning of the genitalia and proper collection of urine in sterile bottles was explained to each and every parent. The time of the previous emptying of the bladder was noted. Time of collection of the urine specimen was also noted. Thus, the duration of the incubation period in the bladder was calculated. Urine culture was prepared by the standardized loop method. More than 10⁵ colonies per ml were taken as significant bacteriuria and considered culture positive [2].

Nitrite test was done by dipping the reagent strips in urine. The results were read after 1 min. Presence of a color change to red indicates positive test. Negative test is indicated by no color change.

Modified nitrite test: If the initial nitrite test was negative, one drop of 1% of sodium nitrate solution was added to the urine. This was incubated for 4 h at 37° centigrade. Nitrite test was again repeated and result interpreted as for nitrite test. The result of nitrite test modified nitrite test compared with urine culture report. Data were analyzed using Statistical Package for the Social Sciences version 22. Diagnostic measures, that is, sensitivity, specificity, positive predictive value, and negative predictive value were calculated by standard formulas using culture as gold standard.

Sensitivity is calculated as the percentage of sick people who are correctly identified as having the disease. It is the ability of the test to identify the number of true positives.

Specificity is the percentage of healthy people who are correctly identified as not having the disease. It is the ability of the test to identify the number of true negatives.

Positive predictive value is the probability that subjects with a positive screening test are truly having the disease.

Negative predictive value is the probability that subjects with a negative screening test are not having the disease

RESULTS

Over the period of 1 year, 90 children with suspected UTI were enrolled in the study. Out of 90 children, 37 were male children and 43 were female children. The smallest child with suspected UTI was 4 month old female child and the eldest was 60 month old female child.

Most common presenting complaint was fever in 59 (65.55%) followed by pain abdomen in 41 (45.55%). Other significant complaints were vomiting (23.33%) and increased frequency of micturation (44.4%).

Urine culture was positive in 14 (15.55%) out of 90 urine samples. Most common causative organism was *Escherichia coli* which was present in 8 (57.14%) culture positive urine sample, followed by *Kleibsell* in 4(28.57%), proteus in 1 (7.14%), and coagulase negative staphylococcus in 1 (7.14%).

Modified nitrite test was positive in 10 urine samples. When modified nitrite test was compared to positive urine culture, true positives were nine and one was false positive. Modified nitrite test was negative in 80 urine samples. Out of which 76 were true negative and four were false negative.

Sensitivity, specificity, positive predictive value, negative predictive value, and accuracy are been tabulated in Table 1.

DISCUSSION

Our study was observational and prospective study where we enrolled 90 children under the age of 60 months who were suspected to be having UTI on the basis of symptoms. The fever was most common presenting feature followed by pain abdomen. This was similar to the findings of Kavitha *et al.* [6] where the author found fever as common presenting symptom.

We performed modified nitrite test in all 90 children enrolled and at the same time, urine culture was sent. In our study, we found that modified nitrite test was positive for 71.42%. The sensitivity and specificity of

modified nitrite test were 64.29% and 98.68%. Tahirovic and Pasic [7] study showed sensitivity and specificity of 93% and 80%, respectively, for modified nitrite test. Senthilkumar *et al.* [8] did the same study where the age group was 2 months to 12 years. Moreover, he found 61.22% sensitivity and 98.80% specificity for modified nitrite test. In studies done in past, nitrite test was evaluated and compared with urine culture. The study done by Goldsmith and Campos [9] had sensitivity and specificity for nitrite test as 21% and 99%. Robertson and Duff [10] study for nitrite test had 43% sensitivity and 96% specificity. Nitrite test for diagnosing urinary test infection had low sensitivity and it varied from study to study. While modified nitrite test had improved sensitivity and it is evident in not only our study but some other studies too. For an ideal screening test, it should be rapid, inexpensive, simple to use, and accurate. Modified nitrite test is available in clinical practice, practical, and can be used for rapid identification of UTI. The disadvantage is that it has lower sensitivity and negative predictive value but it can be accepted as the risk of unnecessary initiation of antibiotic treatment can be lowered. Urine culture should always be done for final diagnosis as any test must have sensitivity above 92% and specificity of over 99% to have an advantage over urine culture [11].

CONCLUSION

Sensitivity and specificity of modified nitrite test are good enough as a diagnostic test for detection of UTI. In the rural set up where resources are not adequate and facility of culture is not available, modified nitrite test can help detecting the UTI readily. It can be used as a point of care test for rapid screening and identifying the cases.

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AUTHORS' CONTRIBUTIONS

Dr Sunny malvia: Contributed to formulating the question, designing the study, carrying it out, and analyzing the data. Dr Puneet Jain: Contributed to formulating the question, designing the study, carrying it out, and proofreading. Dr Niha Khan: Contributed to designing the study, data Analysis, and writing the article.

CONFLICTS OF INTEREST

There are no conflicts of interest.

AUTHORS FUNDING

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Table 1: Different measures for reliability of modified nitrite test

Sensitivity	64.29%
Specificity	98.68
Positive predictive value	90
Negative predictive value	93.75
Accuracy	93.33

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