

Original Research Article

Evaluation of modified nitrite test for diagnosing urinary tract infection in pediatrics

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Received: 15 June 2021

Revised: 16 July 2021

Accepted: 17 July 2021

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ABSTRACT

Background: Urinary tract infection (UTI) is a common bacterial infection causing illness in children. It may be difficult to recognize UTI in children because the presenting symptoms and signs are non-specific, particularly in younger children. In addition, urine collection and interpretation of urine tests in children are not easy, and therefore, it may not always be possible to confirm the diagnosis unequivocally. The study was conducted to evaluate the value of the modified nitrite test in diagnosing urinary tract infection (UTI) in children.

Methods: The study included 150 children of both sexes, aged below 5 years, who were examined due to suspicion of UTI. The efficacy of the modified nitrite test to predict culture positivity was studied.

Results: Modified nitrite test was positive in 14 out of the 26 culture-positive urine samples (sensitivity 53.85%). The specificity, positive predictive value, and negative predictive value were 96.77%, 77.78%, and 90.91%. The overall diagnostic accuracy was 89.33%.

Conclusions: Modified nitrite test is an effective rapid screening test for diagnosing pediatric UTI.

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

INTRODUCTION

Fever is a common manifestation of various infectious diseases, which have a wide range of severity. Fever without localizing signs or symptoms is a common diagnostic dilemma for clinicians caring for infants.^{1,2} Urinary tract infection (UTI) is recognized increasingly as a common cause of fever in young children.³⁻⁶ Urinary tract infections (UTI) occur relatively frequently in infants and children. The major significance of UTI in children is the accompanying morbidity and the possible association with anatomic abnormalities (obstruction and vesicoureteric reflux). This may lead to renal damage and progressive renal failure and may be amenable to medical therapy or surgical repair if detected early.^{1,2}

UTI can be reliably diagnosed only by culture, and it is the gold standard test. On the one hand, identifying very low-risk children would be desirable to reduce unnecessary urine culture costs. Conversely, clinicians would like to be able to identify those children with a sufficiently high likelihood of UTI to begin presumptive treatment while waiting for the results of the urine culture.³⁻⁶

Several rapid screening tests are commonly used to make a presumptive diagnosis of UTI, including dipstick biochemical analysis of urine for nitrites or leukocyte esterase (LE), as well as microscopic examination of urine for formed elements including white blood cells (WBC) or

bacteria. Numerous studies have been published concerning the use of these tests in diagnosing UTI.^{3,7,8}

Aim

The study was undertaken to evaluate the value of the modified nitrite test in diagnosing UTI in children.

METHODS

The study included 150 children of both sexes, aged below 5 years, who were examined due to suspicion of UTIs in the department of pediatrics in Virudhunagar Government Headquarters hospital from January 2020 to December 2020. A cross-sectional study was used to analyze the modified nitrite test compared to urine culture results in terms of the existence of the UTI.

Inclusion criteria

Children who are having suspicious UTI with symptoms like fever, nausea/vomiting, dysuria, foul smell in urine, urgency, cloudy urine, abdominal pain and failure to thrive.

Exclusion criteria

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

Parents were instructed regarding the cleaning of the genitalia and proper collection of midstream urine in sterile bottles. The time of the previous emptying of the bladder was noted. The time of collection of the urine specimen was also noted. Thus, the duration of the incubation period in the bladder was calculated. Urine samples were immediately transported to the microbiology laboratory and tested. Urine culture was prepared by the standardized loop method. 4 mm calibrated loop designed to deliver a known volume of 0.01 ml of urine was used. The urine sample was mixed thoroughly. The loop was inserted vertically into the urine to allow it to adhere to the loop. The loop full of urine was spread over the surface of the MacConkey agar plate. Incubation of the plate for at least 18 h at 37°C in the incubator was done. Colonies were counted on each plate. The number of colonies was multiplied by 100 to determine the number of microorganisms per ml in the original sample. More than 1,00,000 (10⁵) colonies per ml were taken as significant bacteriuria and considered culture positive.^{2,9}

Modified nitrite test was done by taking 1 ml of urine, 1 drop of sterile 1% NaNO₃ (1 g of sodium nitrate dissolved in 100 ml of sterile water) solution was added, the sample was kept 4 hours in a thermostat at 37 °C, and then the presence of nitrite in the urine was examined using test strips. Test reagent strips were dip in the urine and the result read after 1 min. The presence of a red change

indicates a positive test. No color change indicates a negative test.¹⁰

The result of the modified nitrite test was compared with the urine culture report. The sensitivity, specificity, and predictive value of positive predictive value (PPV), negative predictive value (NPV) and accuracy of the test were statistically analyzed.

Statistical analysis was done with the help of Statistical package for social sciences (SPSS) version 21. Descriptive statistics and chi-square tests were used to infer results.

RESULTS

Of the 150 children included in the study, 86 were male and 64 were female. The age of the children varied from 2 months to 5 years. 26 of the 150 urine samples were culture positive. Escherichia coli was positive in 13 samples, Klebsiella in 12 samples and Proteus in 1 sample.

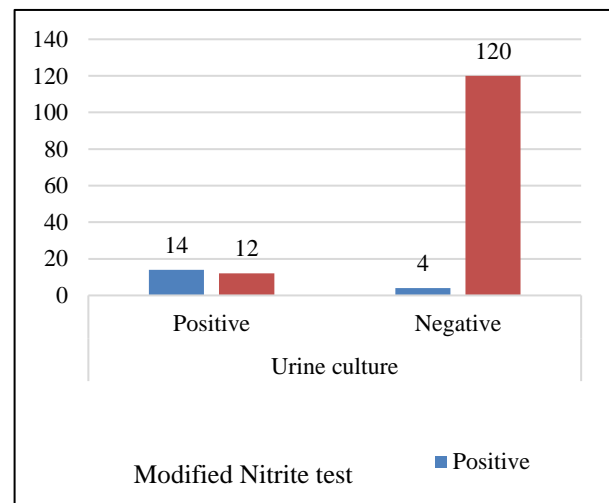


Figure 1: Cross-tabulation of modified nitrite test with urine culture test.

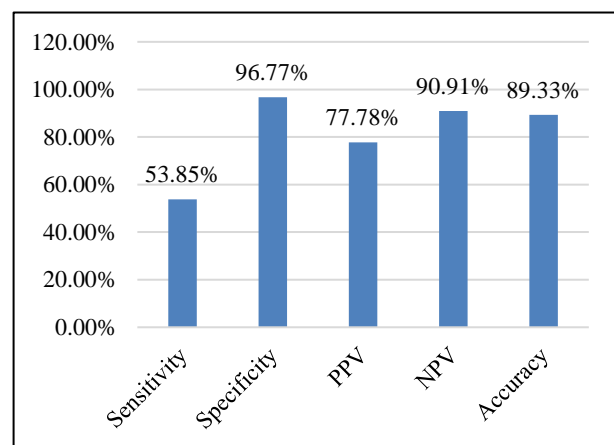


Figure 2: Evaluation of the reliability of the results of modified nitrite test compared to urine culture results.

Figure 1 shows the results and findings of the modified nitrite test compared to urine culture results in 150 patients. The frequency of positive urine culture results for all patients was 26/150 (17.33%). 14/26 (53.84%) had a positive modified nitrite test result and 12/26 (46.15%) had a negative modified nitrite test result, but they had positive urine culture.

Figure 2 shows the indicators of the reliability of the modified nitrite test compared to the urine culture results in diagnosing UTI. In the diagnosis of UTI in children, the modified nitrite test is characterized by high specificity (96.77%), PPV (77.78%), NPV (90.91%) but lower sensitivity (53.85%).

DISCUSSION

Griess nitrite test is by far the most frequently studied and commonly used test for rapid diagnosis. The modified nitrite test in our study had a sensitivity of 53.85% and specificity of 96.77%. In previous studies, the statistical analysis of nitrite tests varied greatly. Goldsmith and Campos study showed sensitivity and specificity for nitrite test as 21% and 99%, respectively.¹¹ Tahirovic and Pasic study showed sensitivity and specificity of 21% and 80%, respectively.¹⁰ Robertson and Duff study gives 43% and 96% as sensitivity and specificity, respectively, for nitrite test.¹³ Zulic et al showed that the nitrite test had sensitivity of 57% and specificity of 98%, while the modified nitrite test showed a sensitivity of 88% and specificity of 93%.¹³ Another study done by the Senthilkumar et al nitrite test showed 10.2% sensitivity and 100% specificity, while the modified nitrite test showed 61.22% sensitivity and 98.80% specificity. Most of the past studies were done in the adult population.²

The results show that false negative nitrite test results can appear due to the insufficient incubation of urine in the bladder and the lack of nitrates from food, resulting in the fact that the nitrite test is not reliable enough to exclude the existence of the UTI. In the pediatric population, because of frequent bladder emptying, the duration of urine stays in the bladder (incubation time) was less.¹⁴ Modification of the test increases the reliability of negative results, especially in children, which is important in diagnosing UTIs. Even if the dietary nitrate is inadequate, bacteria in urine reduce nitrate added to the urine sample during the incubation time of 4 h. This modified method improved sensitivity considerably and especially useful in pediatric patients.¹¹

The advantages of the modified nitrite test are that the test is available in clinical practice, practical and can be used for rapid identification of UTI. Although the shortcomings in sensitivity and NPV are as acceptable as the risk of unnecessary initiation of antibiotic treatment, for the final diagnosis, in addition to nitrite and modified nitrite test, it is mandatory to undertake urine culture tests. This is supported by the claim that the test must have sensitivity

above 92% and specificity of over 99% to have an advantage over urine culture.¹⁴

Limitations

Larger the sample size would have provided accurate results for statistical test to assess significance and correlation.

CONCLUSION

The value of the modified nitrite test in the diagnosis of UTIs is characterized by good reliability to detect UTIs and better reliability than the nitrite test in excluding a UTI, especially in children. Due to its characteristics, it can be very useful in clinical practice. Early diagnosis of asymptomatic children is of great importance in intervention which can reduce mortality and morbidity.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Elder JS. Urinary tract infections. In: Behrman RE, Kliegman RM, Arvin AM, editors. *Nelson Text Book of Pediatrics*. 18th ed. Ch. 538. Philadelphia, USA: Saunders. 2007;2223-4.
2. Senthilkumar KM, Chandrasekaran C, Anandan H, Balaji N, Sivakumar KV. Screening of Pediatric Urinary Tract Infection using Modified Nitrite Test. *Int J Sci Stud*. 2016;4 (3):42-4.
3. Gorelick MH, Shaw KN. Screening Tests for Urinary Tract Infection in Children: A Meta-analysis. *Pediatrics*. 1999;104:e54.
4. Shaw KN, Gorelick MG, McGowan KL, McDaniel Yakscoe M, Schwartz JS. Prevalence of urinary tract infection in febrile young children in the emergency department. *Pediatrics*. 1998;102(2).
5. Hoberman A, Han-Pu C, Keller DM, Hickey R, Davis HW, Ellis D. Prevalence of urinary tract infection in febrile infants. *J Pediatr*. 1993;123:17-23.
6. Bauchner H, Phillipp B, Dashefsky B, Klein JO. Prevalence of bacteriuria in febrile children. *Pediatr Infect Dis J*. 1987;6:239-42.
7. Hurlbut TA, Littenberg B. The diagnostic accuracy of rapid dipstick tests to predict urinary tract infection. *Am J Clin Pathol*. 1991;96:582-88.
8. Lohr JA. Use of routine urinalysis in making a presumptive diagnosis of urinary tract infection in children. *Pediatr Infect Dis J*. 1991;10:646-50.
9. St. John A, Boyd JC, Lowes AJ, Price CP. The use of urinary dipstick tests to exclude urinary tract infection: A systematic review of the literature. *Am J Clin Pathol*. 2006;126:428-36.

10. Tahirovic H, Pasic M. A modified nitrite test as a screening test for significant bacteriuria. *Eur J Pediatr.* 1988;147:632-33.
11. Goldsmith BM, Campos JM. Comparison of urine dipstick, microscopy, and culture for the detection of bacteriuria in children. *Clin Pediatr (Phila).* 1990;29:214-18.
12. Robertson AW, Duff P. The nitrite and leukocyte esterase tests for the evaluation of asymptomatic bacteriuria in obstetric patients. *Obstet Gynecol.* 1988;71:878-81.
13. Zulić S, Tahirović H, Imamović G, Begić H. Evaluation of the value of modified nitrite test in early detection of urinary tract infection in children. *Paediatrics Today.* 2011;7(2):102-09.
14. Downs SM. Technical report: urinary tract infections in febrile infants and young children. The Urinary Tract Subcommittee of the American Academy of Pediatrics Committee on Quality Improvement. *Pediatrics.* 1999;103:e54.

Cite this article as: Babu NA. Evaluation of modified nitrite test for diagnosing urinary tract infection in pediatrics. *Int J Contemp Pediatr* 2021;8:1339-42.