

Comparison of urine culture and urine dipstick nitrite test in diagnosis of Urinary Tract Infection

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ABSTRACT

UTI is one of the most frequent bacterial diseases in all group of the age. The most widespread reference method for UTI is conventional urine culture. Dipsticks nitrite test is commonly used in primary care to predict the subsequent diagnosis of urinary tract infection also it helps in early detection of UTI by avoiding the complication of UTI in causing other diseases. The current study was carried out to determine the sensitivity, specificity of Nitrite (NIT) testing in relation to urine culture. A total of 1043 mid stream urine samples from patients who attend KFH, Kigali, at the microbiology service for bacteriological analysis of urine from January 2014 to March 2014 were included in the study. Urine culture and dipstick tests were carried out on urine samples of all patients. Urinalysis and nitrite were performed in fresh and uncentrifuged urine by using urine dip stick. The urine culture was considered as gold standard. Urine cultures were positive in 165 (15.8%) patients. Dipstick tests of urine were positive in 61(5.8%) patients. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of Dipstick test were 36.6%, 99.9%, 98.3% and 87.8% respectively. The results suggest that any method of urine screening shouldn't be substituted for a urine culture in patient with suspicion of UTI.

Keywords: UTI, Dipstick tests

RESUME

L'infection urinaire est l'une des plus fréquentes maladies bactériennes dans tous les groupes d'âge. La méthode de référence la plus répandue pour le diagnostic de l'infection urinaire est la classique uroculture. Le test utilisant les bandelettes réactives de nitrites est couramment utilisé dans les soins primaires pour prédire le diagnostic subséquent de l'infection des voies urinaires. Elle contribue aussi à la détection précoce de l'infection urinaire, évitant ainsi des complications pouvant provoquer d'autres maladies. La présente étude a été effectuée afin de déterminer la sensibilité, la spécificité du test nitrite (NIT) en relation avec la culture de l'urine.

1043 échantillons d'urines des patients qui ont fréquenté le service de microbiologie de KFH, Kigali, de janvier 2014 à mars 2014 ont été inclus dans l'étude. La culture des urines et le test de nitrite ont été effectués sur des échantillons d'urine de tous les patients. La culture d'urine était considérée comme étalon. L'uroculture était positive dans 165 (15,8%) cas. Le test de nitrite a été positif dans 61 d'entre eux (5,8 %). La sensibilité, la spécificité, la valeur prédictive positive (VPP) et la valeur prédictive négative (VPN) de bandelettes réactives étaient de 36,6 %, 99,9 %, 98,3 % et 87,8 % respectivement. Les résultats suggèrent qu'aucune méthode de dépistage urinaire ne devrait être substituée à la culture d'urine chez les patients suspects d'infection des voies urinaires.

Mots clés: Infections urinaires, Bandelettes réactives

INTRODUCTION

Urinary tract infection (UTI) is one of the most common bacterial infections encountered in clinical practice both in community and hospital settings in all age groups. Clean-catch, mid stream urine for culture and sensitivity testing is considered the best method to diagnose UTI [1, 2]. Urinalysis can reveal diseases that have gone unnoticed because such diseases may not produce striking signs or symptoms. The most widespread reference method for UTI diagnosis is the conventional urine culture in which a finding of 100,000 colony forming units per milliliter (CFU/mL) of urine is considered as significant. [3].

Several rapid screening techniques such as urinalysis (microscopic Pyuria), enhanced urinalysis (white blood cell [WBC] count per cubic millimeter) plus gram stain, urine dipstick (leukocyte esterase or nitrate) and uriscreen (catalase test) tests have been used in diagnosis of UTI [3, 4]. A nitrite test is a standard component of a urinary test strip. This test is commonly used in diagnosing urinary tract infections. A positive nitrite test indicates that bacteria may be present in significant numbers in urine [5]. A positive nitrite test also indicates that nitrite has been produced from reduction of nitrate by enteric

bacteria, most commonly by the Enterobacteriaceae family. However false-negative assays are also common with this test [6]. Use of dipsticks instead of culture may decrease patient time and the cost of testing. However basic treatment decision based on either dipsticks or urinalysis is questionable [6]. The objective of the study was to compare dipstick urinalysis (nitrite) with culture by calculating performance characteristics of these tests.

METHODS

The study was including 1043 mid stream urine received in KFH, Kigali, at the microbiology service for bacteriological analysis from January 2014 to March 2014. In this number, 879 were culture negatives, culture and nitrites were analyzed from 165 positive culture. Given that the number of samples (specimens) was small, there was no need of sampling. Criteria of inclusion were: All midstream urine received in microbiology for urine culture was taken within the period of our study. Exclusion criteria were: Patients who had taken antibiotics in the past 72 hours, or had indwelling Foley catheters.

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Culture: Semi-quantitative culture on cysteine lactose electrolyte deficient (CLED, Hi-Media, Mumbai) media was used as the gold standard for diagnosing UTI. Semi-quantitative culture is done by plating 1µl urine using a

calibrated bacteriological loop on CLED agar, and colonies are counted after overnight incubation at 37°C. Cut off for significant bacteriuria was taken as 10⁵cfu/ml [7]. Samples showing growth of 2 or more bacterial species ($\geq 10^3$ cfu/ml) of doubtful significance were noted and repeat cultures asked for. MSU samples showing scanty bacterial growth (<10³cfu/ml) were reported as no significant growth.

Dipstick test: Dip-stick nitrite test (NT) was evaluated using the Urine 10 parameters (Cyress Diagnostics, Belgium). Manufacture methodology was followed to perform the test and read the results. Briefly, the test strip was dipped in the urine sample and taken out immediately. The strips were blotted with a blotting paper to remove excess urine and compared the colors of the reagent pad within 60 seconds with the color chart on the vial label under good light.

Calculation of sensitivity, specificity, and predictive values Sensitivity, specificity, and predictive values were calculated for nitrite test on urine culture of more than 100,000 pure growth organisms per milliliter as the validating standard. Sensitivity, specificity, and predictive values were calculated as follows [8]:

Sensitivity = True positive / (True positive + False negative)

Specificity = True negative / (True negative + False positive)

Positive Predictive Value = True positive / (True positive + False positive)

Negative Predictive Value = True negative / (True negative + False negative)

RESULTS

A total of 1043 were analysed. Culture was considered positive if the culture showed greater than 100,000 colonies of single or two pathogen(s). As shown in table: 1 below, E.coli (135 isolates) is the predominant followed by klebsiella (28 isolates) among the gram negative bacilli and Enterococci species (18 isolates) among the gram positive cocci.

Table 1: Comparison of bacteria isolated from urine culture and Nitrite test by using dipstick.

Bacteria isolated	Number isolated	Number of nitrite positive	Number of nitrite negative
Escherchia coli	135	50	63
Klebsiella species	28	10	18
Proteus species	2	0	2
Morganella morganii	7	0	7
Citrobacter species	5	0	5
Enterobacter species	4	0	4
Serratia species	2	0	2
Acinetobacter species	3	0	3
Pseudomonas aeruginosa	2	0	2
Enterococci species	18	0	18
Streptococci species	6	0	6

As shown in table 2, 164 samples were culture positive, 60 were nitrite positive and culture positive and 104 were nitrite negative and culture positive. 61 were nitrite positive and 1 was culture negative and nitrite positive and 878 were both culture and nitrite negative.

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Table 2: Sensitivity, specificity, predictive values positive and negative values for dipstick (nitrite positive)

	Positive culture	Culture Negative	Total
Nitrite positive	60	1	61
Nitrite negative	104	878	982
Total	164	879	1043

Sensitivity: 36.6%

Specificity: 99.9%

Positive predictive value: 98.3%

Negative predictive value: 87.8%

DISCUSSION

Several rapid screening tests are used commonly to make a presumptive diagnosis of UTI, including dipstick biochemical analysis of urine for nitrites or leukocyte esterase, as well as microscopic examination of urine for formed elements including white blood cells or bacteria. Numerous studies have been published concerning the usefulness of these tests in diagnosing UTI [9].

Of the 165 culture positive, Escherichia coli is the predominate one followed by Klebsiella species, Enterococci species is the predominate one among gram positive organisms. Similar finding were seen in the study conducted by Muvunyi from Rwanda [10].

Table 3: Sensitivity, specificity, predictive values positive and negative values for dipstick (nitrite positive) in various studies

Study	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Ayazi P & et al [4]	76	12	72	14
Muna M & Rajab S [11]	27.3	100		
Eidelman Y & et al [12]	39			
Semeniuk H & Church D [13]	43.6	99.6	75	88.2
Jeanne J.A & et al [14]	36.6	99.9	98.3	87.8
Kacmaz B & et al [15]	60			
Gorelick GM [16]	88	93		
Yehezkel W & et al [17]	97.1	82.5	69.4	98.6
In current study	36.6	99.9	98.3	87.8

As shown in table 3, the sensitivity and the specificity of nitrite dipstick was different in different studies when compare to urine culture. In current study the sensitivity was low and specificity of urine nitrite dipstick was high. Muna M and Rajab S from Libya, Eidelman Y and et al and Semeniuk H and Church D from Canada were also reported the same with low sensitivity between 27.3% to 43.6% and high specificity 99.6% to 100% as shown in the table 3.

In a recent meta-analysis, the sensitivity of the nitrite test (45%–60%) among most female populations, whereas the specificity of the nitrite test was higher (85%–98% vs. 17%–93%). The positive predictive value of the nitrite test has been reported to be nearly 96% [14] but in the current study the sensitivity is low with an acceptable specificity.

In contrast, Ayazi P and et al from Iran, Kacmaz B et al, Gorelick et al and Yehezkel W et al from Israel, found that high sensitivity between 60% and 97.1% and specificity ranges from 12% to 93% as shown in the table 3.

The PPV ranges from 69.4% to 75% from different studies which is shown in the table: 3 but in the current study the PPV was 98.3%. The NPV value ranges from 14% to 88.2% which is shown in the table: 3, in current study the NPV is with acceptable range.

This difference may be because of different sample population in different studies like high risk population, Gender, Children [12, 14, 17] or because of different brands of strips used for dipstick biochemical analysis. It may be due to improper techniques for collection or transportation to the laboratory, allowing the colonizing bacteria to multiply, which result in false positive nitrite test which may result in under treatment and as consequences could cause real damage or sepsis to the urinary tract system. Nitrite negative may occur due to a low colony forming unit count or dilute urine. In addition, a nitrite test does not detect organisms unable to reduce nitrate to nitrite, such as Enterococci, Staphylococci species, Acinetobacter or Adenovirus etc. Another disadvantage of the nitrite test is that the causative microorganism and its antibiotic susceptibility are not known.

CONCLUSION

A positive nitrite test result should be considered to be indicative of a UTI, and the patient should be treated empirically according to local antibiotic sensitivity guidelines before culture results. However, when the nitrite test yields negative results, a UTI cannot be excluded, and urine samples should be further investigated by culture (Gold standard), without start of empirical therapy. However the of nitrite tests can be used in empirical diagnosis and treatment because of its high specificity. Furthermore, the nitrite tests suits the district hospitals in developing countries where no culture facilities are available.

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