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Profile of Children with Urinary Tract Infection and the Utility of Urine Dipstick as a Diagnostic Tool

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ABSTRACT

Background: Urinary tract infection is a common problem in children and its early diagnosis and treatment is important to prevent long-term complications. Urine dipstick can be an important tool in this respect. The aim of this study is to look at the utility of urine dipstick as a diagnostic tool for UTI and will also see the clinical profile of children with UTI and sensitivity pattern of antibiotics among the isolates of urine culture.

Methods: Urine samples of all children below 14 years of age who were suspected of urinary tract infection were sent for routine microscopic examination and dipstick testing. Urine culture and sensitivity were sent for those samples that were tested positive for nitrite, leucocyte esterase activity or both. For every fifth sample, which is dipstick negative, a culture and sensitivity testing was done.

Results: Among 110 children enrolled, 32(29%) cases had significant bacteriuria. Out of 32 culture positive cases 18(56%) were female. Fever was the main complaint (62.5%)). Escherichia Coli was isolated in 81.25% of cases. Amikacin was sensitive in 93% and amoxicillinwas resistant in 82%. The sensitivity, specificity, positive predictive value, negative predictive value of nitrite test was 65%, 80%, 58%, 85% respectively; those of leucocyte esterase are 84%, 55%, 43%, 89% respectively; those for significant microscopic pyuria >10/hpf were 65%, 74%, 51%, 84% respectively.

Conclusions: E. Coli is the commonest uropathogen in children with UTI. Amikacin is the most sensitive antibiotic against all the isolates. A positive dipstick both for nitrite and leucocyte esterase is associated with high sensitivity and specificity for urinary tract infection as compared to either of them positive alone. In addition, urine WBC ≥10/hpf is associated with high probability of UTI.

Keywords: dipstick; sensitivity; specificity; urinary tract infection.

INTRODUCTION

Urinary tract infection (UTI) is a common problem in children. Incidence of UTI among female is more especially beyond infancy. Timely diagnosis and treatment of UTI is important because of its long-term implications such as renal scarring and hypertension.[1]

Urine culture is regarded as a gold standard for diagnosing UTI.[2] However it takes longer time for the results. In this context urine dipstick can be a useful tool for prompt diagnosis UTI in children. The dipstick contains two different small test blocks in a single strip: one for nitrite and the other for leucocyte esterase. The section for nitrite contains nitrite that changes its color if a Gram-negative bacterium in urine is converted into nitrate. Similarly, the block, in the dipstick, for leucocyte esterase changes its color if there is presence of leucocytes in the urine.[2]

This study aims to look at the clinical profile of children

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with UTI, the utility of urine dipstick as a diagnostic tool for UTI and the sensitivity pattern of antibiotics among the isolates of culture.

METHODS

This is cross-sectional study done in the Pediatric out patient department and ward of Kathmandu Medical College (KMC) from January 2012 to June 2012. Ethical approval was obtained for the study form ethical committee of Kathmandu Medical College. All the children below 14 years of age who were clinically suspected of UTI were enrolled in the study after obtaining verbal consent. During the study period we could collect samples of 110 children. Those children who received antibiotics for more than 24 hours were excluded from the study. Urinary tract infection is suspected if a child had fever without any focus or any of the symptoms like pain abdomen, burning micturition, vomiting, smelly urine, increased frequency of urination. A detailed history and clinical examination was done each child.

Urine sample was collected from the children with suspicion of UTI by catheterization for children who were not toilet trained and by clean catch for older and toilet trained. The samples were sent to laboratory for routine microscopy. At the same time urinary dipstick test was done in the same sample by dipping the strip in the urine specimen. The dipstick soaked with urine was observed for color change after two minutes. If either of them or both of them were tested positive, it was regarded as positive dipstick test indicating urinary tract infection and urine sample was sent for culture and sensitivity. The sterile sample of urine was transported and inoculated in Mac Konkey Agar medium using inoculating loop and incubated for 18 hours at 37° C. If there is a growth, morphology of the growth was observed and biochemical tests were done to identify the pathogen. The growth was again inoculated in Muller Hilton medium for antibiotic susceptibility testing. A colony count of a single pathogen was considered significant if it was $>10^5$. If both leucocyte esterase and nitrite were tested negative, cultures were not sent. However for every fifth negative dipstick test, cultures were sent. This is to cross check if there is any negative dipstick could result in positive urine culture.

All the data were entered in excel and transferred to SPSS version 17. Both descriptive and inferential statistics were used for data analysis. In descriptive statistics, number and percentage presented data. In inferential statistics data were presented by Fischer exact test to measure relationship between urine culture and dipstick test. Moreover sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) were also compared to show the reliability of findings.

RESULTS

During the study period a total of 110 children were enrolled. Age ranged from 2 months to 13 years. There were total of 32(29%) cases of culture confirmed UTI with significant bacteriuria. 56%(18) of the culture positive cases were female. The following table shows the distribution of cases in both sexes in different age groups among culture positive cases.

Table 1. Distribution of children with culture proven UTI in different age groups.

Symptoms	Male			Female		
	14 (44%)			18 (56%)		
	<1 year	1-5 year	>5 year	<1 year	1-5 year	>5 year
Positive urine culture	4	8	2	3	7	8

There are several symptoms in children with confirmed UTI. These symptoms are shown in figure 1. Fever was the most frequent symptoms associated with UTI accounting 62.5%.

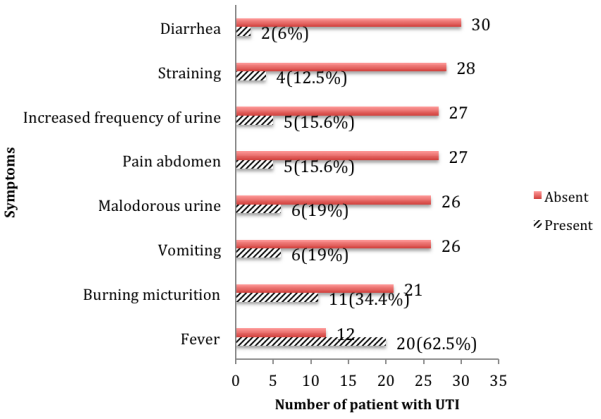

Figure 1. Frequency distribution of symptoms of children with UTI.

All the children suspected with UTI were tested for nitrite and leucocyte esterase in urine using dipstick. Nitrite is positive in 36 (32.7%), leucocyte esterase is positive in 62 (56.4%) and both were positive in 26 (23%) children. The following table 2 shows the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of different tests to diagnose UTI

Table 2. Comparison of different diagnostic tools for UTI with urine culture.

		Urine culture		p-value	Sensitivity (95%CI)	Specificity (95%CI)	PPV(95%CI)	NPP (95%CI)
		Growth	Sterile					
Nitrite (Nit)	Positive	21	15	<0.0001	65.62% (46.81-81.41)	80.77% (70.27-88.81)	58.33% (40.76-74.47)	85.14% (74.95-92.33)
	Negative	11	63					
Leucocyte esterase (LE)	Positive	27	35	<0.0001	84.38% (67.2-94.67)	55.13% (43.44-66.41)	43.55% (30.99-56.74)	89.58% (77.33-96.49)
	Negative	5	43					
Leucocyte esterase + nitrite	Positive	19	7	<0.0001	86.36% (65.06-96.94)	83.33% (68.63-93)	73.08% (52.21-88.38)	92.11% (78.6-98.25)
	Negative	3	35					
WBC in urine	<10/hpf	11	58	0.001	65.62% (46.81-81.41)	74.36% (63.21-83.58)	51.22% (35.14-67.12)	84.06% (73.26-91.75)
	≥10/hpf	21	20					

Among the 32 culture positive cases, Escherichia Coli was isolated in 26(81.25%). The following figure 2 shows the frequency distribution of different isolates among the 32 cultures proven UTI.

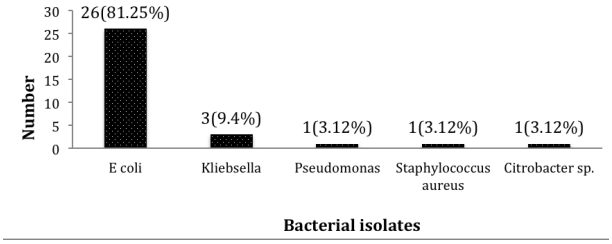

Figure 2. Isolates of urine culture.

The sensitivity pattern of these isolates is shown below in table 3.

Table 3. Sensitivity pattern of antibiotics in isolates of urine culture.

Antibiotics	Number of isolates tested	Number of isolates sensitive (%)	Number of isolates resistant (%)
Amikacin	28	26 (93%)	2 (7%)
Nitrofurantoin	27	25 (93%)	2 (7%)
Ofloxacin	17	13 (76%)	4 (24%)
Ciprofloxacin	14	10 (71%)	4 (29%)
Gentamycin	9	6(66%)	3 (34%)
Norfloxacin	25	15 (60%)	10 (40%)
Ceftriaxone	21	12 (57%)	9 (43%)
Cotrimoxazole	20	7 (35%)	13 (65%)
Nalidixic acid	15	3 (20%)	12 (80%)
Amoxicillin	17	3 (18%)	14 (82%)

DISCUSSION

Urinary tract is a common problem in females. In our study 56% of children with UTI were female and the male to female ratio was 1:1.28. In a similar study by Rai GK et al at Kanti Children hospital 48.3% of children suspected with UTI were female.[3] This is comparable to our study. However other studies showed higher proportion of UTI among females.[4, 5, 6, 7]

In our study fever was present in about two third of the cases, followed by burning micturition in about one third of the patients of UTI which is comparable to other studies.[6, 8]

In our study, among those who were suspected of urinary tract infection, 29% had significant bacteriuria. This is comparable to study done by Taneja N et al[9] and Al Daghistani HI et al[10]whose studies accounted 21.8% and 23.2% respectively.

In those children who had significant bacteriuria, E.coli (81.25%) was the most frequently isolated uropathogen isolated from urine. In a study done by Gallegos A et al 96.1% of cases had E. coli isolation in urine culture.[11]Similarly Ipek IO et al[7, 12] and Jackowska T et al in their study had 81.7% and 74% respectively had growth of E. coli. These results are comparable to our study.

In all the isolates in this study, sensitivity pattern to different antibiotics were observed. Amikacin and nitrofurantoin were the most sensitive antimicrobials against all uropathogens accounting 93% each. This is followed by ofloxacin (76.5%), ciprofloxacin (71%), gentamycin (66%) and norflocacin (60%). Study by

Gallegos J et al[11] had E. coli was sensitive to Amikacin and nitrofurantoin in 100% of the uropathogens. Rai GK et al[3] in their study found amikacin, chloramphenicol, nitrorurantoin and amikacin were the most sensitive.

In contrary, amoxicillin (82%), nalidixic acid (80%) and cotrimoxazole (65%) were the commonly resistant drugs identified in this study. Ceftriaxone was resistant in 43% of all isolates. In a study by Ipek IO et al among the isolated uropathogens, resistance to ampicillin (85.0%), amoxicillin-clavulanate (73.8%) and trimethoprim-sulfamethoxazole (42.9%) was remarkable. This illustrates an emerging resistance of uropathogens to antibiotics we commonly use in daily practice.

A positive test for nitrite, leucocyte esterase or urinary WBC ≥10/hpf is associated with high risk of urinary tract infection as statistical testing shows high level of significance (p-value <0.0001). In our study the sensitivity, specificity, PPV, NPP of nitrite test was 65%, 80%, 58%, 85% respectively; those of leucocyte esterase is 84%, 55%, 43%, 89% respectively; those for significant microscopic pyuria were 65%, 74%, 51%, 84% respectively. The sensitivity and specificity was even higher when both were positive. In a study by Taneja N et al the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of the dip-stick leucocyte esterase test were 73.5%, 58.5%, 33.0%, 88.8% respectively; those of the dip-stick nitrite were 57.1%, 78.7%, 42.7% and 86.8% respectively; and those for microscopic significant pyuria detection were 68.4%, 60.8%, 32.7% and 87.3%, respectively.[9] Similar study by Joseph J Zorc et al[13] the sensitivity and specificity of nitrite, leucocyte esterase and urine WBC ≥10/hpf were 50% and 90%, 83% and 84%, 77% and 89% respectively. Similarly, in a study by Al Daghistani HI et al.[10] The dipstick leukocyte esterase and nitrite testing had a sensitivity of 68.5% and 59% for detecting bacteriuria in UTI and specificity of 73.5% and 78%, respectively. The positive predictive value of the tests was 44% and 60%, and the negative predictive value 88.5% and 86.2%, respectively. Microscopic WBC showed 86.5% specificity but low sensitivity. These values of sensitivity, specificity, positive predictive values and negative predictive value are comparable to our study.

CONCLUSIONS

A positive dipstick both for nitrite and leucocyte esterase is associated with high sensitivity and specificity for urinary tract infection as compared to either of them positive alone. In addition, urine WBC ≥10/hpf is associated with high probability of UTI. Fever is the main symptom of UTI and E. Coli is the commonest uropathogen in these children which is highly sensitive to nitrofurantoin and amikacin.

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