Utility of simple urinary screening tests to rule out UTI in Pediatric population

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Abstract
Context: UTI is one of the important infection among pediatric population. Rapid screening test to rule out UTI can save time and it is very useful in areas where laboratory facilities are lacking. Aims: The study was carried out to find out the prevalent bacteria causing pediatric UTI and utility of different screening tests to rule out UTI in this population. Settings and Design: It was a hospital based, observational and cross sectional study. Methods and Materials: For every cases of suspected UTI, urine culture was done by standard protocol. Uncentrifused urine samples were examined by wet mount microscopy for pus cells per high power field of microscope. All the samples were screened by dipstick for detection of leukocyte esterase and presence of nitrite in them. Combur 10 Test UX test strips from Roche Diagnostics was used to screen the urine samples. Result: Culture positivity rate was found to be 17.5%. E. coli was the commonest uropathogen isolated from this population. UTI was found to be more common in Hindus. Negative predictive value of Microscopic pyuria, Leucocyte esterase, Nitrite tests were 89.4%, 91.6%, 88.7% respectively to rule out UTI. Conclusion Using different screening methods (microscopic pyuria, dipstick leukocyte esterase, nitrite test) with either of them found positive, seems to be a effective, cost saving method to rule out UTI
Keywords: UTI, Pediatric, screening test

I. Introduction

Urinary tract infection is considered to be the third most common bacterial infection in developing countries after gastrointestinal and respiratory tract infection.[1] Many cases of UTI under two years of age group remains undiagnosed due to its various non specific clinical presentations[2] and sometimes UTI may present without any obvious symptom in younger children. Because of the fact it becomes sometime difficult to diagnose UTI in an early stage and treatment is delayed. Thus various complications can arise like hypertension, renal insufficiency, renal scarring etc [1,3] in long term in untreated cases. In girls, 75-90% of UTI is caused by *Escherichia coli* followed by *Klebsiella* and *Proteus* spp[2]. There are emergence of other microorganisms like *Enterococcus* spp, *Staphylococcus aureus* in recent years and many of them are resistant to commonly used antibiotics thus creating a therapeutic challenge for the clinicians.[4,5,6] Many rapid screening methods are available which includes urine microscopy for pus cell detection, Gram staining of urine, dipstick tests for detection of leukocyte esterase and nitrite in urine etc to rule out UTI. Several studies have been conducted to observe the validity and reliability of above mentioned screening tests to rule out UTI especially in adult population[7]and also in pediatric age group[8].There is still a paucity of data in Indian literature regarding the validity of urine screening tests in pediatric population. The present study was carried out to find the prevalent bacteria causing UTI in pediatric population and in the present study we also looked for the efficacy of different screening tests like pus cell detection by microscopy, leukocyte esterase and nitrite detection by dipstick method to rule out UTI in pediatric population.

II. Material And Methods

Aims: The study was carried out to find out the prevalent bacteria causing pediatric UTI and utility of different screening methods to rule out UTI in pediatric population.

The present study was carried out in the Department of Microbiology, College of Medicine and JNM Hospital, WBUHS in collaboration with the Department of Pediatric Medicine of the same institution. It was a hospital based, observational and cross sectional study. After getting ethical clearance from institutional ethical

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committee the study was conducted during the period of 6 months. Children under 12 years of age showing sign and or symptom of UTI from both inpatient (IPD) and outpatient (OPD) department of Pediatrics were included in the present study as study population. During the study period 188 urine samples were collected from different pediatric patients from OPD and IPD. Consent was taken from the parents or relatives of the patients and the purpose of the study was explained to them. For every cases of suspected UTI, urine samples were collected by aseptic procedure in sterile plastic disposable containers. In case of clean catch mid stream urine sample, colony count greater than 10^5 colony forming unit (CFU)/ml of urine of a single type bacteria indicates 'significant bacteriuria.[22] Uncentrifused urine samples were examined by wet mount microscopy for pus cells per high power field of microscope. All the samples were screened by dipstick for detection of leukocyte esterase and presence of nitrite in them. Combur10 Test UX test strip from Roche Diagnostics was used to screen the urine samples. Nitrate reducing enzymes that are produced by most of the urinary pathogen reduce nitrate to nitrite and the inflammatory cells in urine produce leukocyte esterase. These two can be detected by the above mentioned dipstick screening tests by observing its change of color after contact with urine sample. Urine culture was done by semi-quantitative method using standard loop technique.

III. Result

In the present study urine samples of 188 children with suspected UTI were examined. IPD and OPD ratio of suspected cases were 118:70 (1.6:1), among them 33 samples were found to be culture positive. Culture positivity rate was 17.5% (33/188) among the suspected UTI cases. Among the 33 culture positive cases IPD and OPD ratio of cases were found to be 21:12 (1.7:1). Overall UTI was found to be more common in female 21.9 % (20/91) as compared to male 13.4% (13/97). Male and female distribution of cases according to the age group is shown in tables.

Table: 1   Age and sex wise distribution of UTI

Age	Culture	Female	Male	Total	P Value
<1 yrs	N	6(28.6)	15(71.4)	21	
	P	1(100)	0(0)	1	0.32
	Total	7	15	22	
1-5 yrs	N	24(38.7)	38(61.3)	62	
	P	8(50)	8(50)	16	0.29
	Total	32(41)	46 (59)	78	
>5 yrs	N	41(59.9)	31(43.1)	72	
	P	11(68.8)	5(31.3)	16	0.28
	Total	52	36	88	
Total	N	71 (45.8)	84(54.2)	155	
	P	20(60.6)	13 (39.4)	33	0.09
	Total	91	97	188	

Table 2. Distribution of cases between religion

Urine sample	Religion		Total
	Hindu	Muslim	
Culture Negative	129 (80.1)	26 (96.2)	155 (82.4)
Culture Positive	32 (19.8)	1 (3.7)	33 (17.5)
Total	161	27	188

The culture result was significantly more positive in Hindus (19.8%) as compare to Muslims (3.7%), with p value 0.04

 In the present study *E. coli* was the commonest isolated bacteria 48.4% (16), followed by *Klebsiella pneumoniae* 24.2% (8), *Enterococcus spp* 9% (3), *Proteus mirabilis* 6% (2), *Coagulase negative Staphylococcus* 6% (2), *Pseudomonas spp* 3% (1) *and Staphylococcus aureus 3%(1).*
Ratio of Gram negative and Gram positive organism isolated from urine was 4.5:1(27:6). Among Gram positive group *Enterococcs spp* is more prevalent pathogen 50% (3/6) .

Table 3: Result of urine Wet mount microscopy and Dipstick leukocyte esterase (LET) and   Nitrite test (NT)

		CULTURE					CULTURE		
		+ ve	- ve	Total			+ ve	- ve	Total
Microscopic pyuria	+ ve	`21	53	74	LET and or NT	+ ve	26	60	86
	- ve	12	102	114		- ve	7	95	102
		33	155	188			33	155	188
LET	+ ve	24	56	80	Any one of 3 tests	+ ve	30	68	98
	- ve	9	99	108		- ve	3	87	90
		33	155	188			33	155	188
NT	+ ve	17	29	46	Pyuria + (either of LET or NT)	+ ve	23	51	74
	- ve	16	126	142		- ve	10	104	114
		33	155	188			33	155	188

Table 4: Usefulness of urine screening by Microscopic pyuria, LET and NT by Dipstick test

	Microscopic pyuria	LET +ve	NT +ve	LET and or NT +ve	Any one of three tests positive	Microscopic Pyuria + ve (either of LET or NT+ve)
Culture Positive(n=33)	21	24	17	26	30	23
Sensitivity(%)	63.6	72.7	51.5	78.7	90.9	69.6
Specificity (%)	65.8	63.8	81.2	61.2	56.1	67
PPV (%)	28.3	30	36.9	30.2	30.6	31
NPV (%)	89.4	91.6	88.7	93.1	96.6	91.2

The data were analyzed with IBM SPSS version 22.0 software. Chi-square test was applied to see the difference in proportion. All tests were two tailed and the significance level of 0.05 was taken. Other statistical formulas were applied whenever applicable.

IV. Discussion:

In this present study among 188 clinically suspected pediatric UTI cases, 17.5% were found to be culture positive. Similar culture positivity rate of 18.18% was found among suspected pediatric UTI cases in a study from western India[9.] In the present study there was no male preponderance of UTI in infants as seen in the above mentioned study. In another study[3] from north India we found 28.3% children had culture proven UTI. The present study showed that overall culture positivity is higher in females (21.9%) compared to males (13.4%) and this finding is supported by many other studies[3,9,10]. Shorter length of female urethra and closeness of the urethral meatus to anus is responsible higher prevalence of UTI in female[11]. In the present study it is seen that UTI is significantly more common in Hindu children(19.8%) , circumcision seems to reduce the incidence of UTI in Muslim community (3.7%). Same finding was confirmed by another study[10] where 90% of cases were Hindu and only 10% of UTI is seen in Muslims. Colonization of fore skin with bacteria may likely increase the incidence of UTI among male Hindu.

Fever was the commonest presentation (65.0%) followed by abdominal pain (42.5%) in the present study as seen in a study by Shukla *et al*[12]. Similar findings was found in a different study where commonest presentation of UTI was fever (88%)[11].UTI in pediatric age group is very difficult to diagnose because of the fact that patients present with non specific symptoms commonly than urinary symptoms. This may lead to wrong diagnosis or delay in appropriate treatment leading to various complications.

E. coli followed by *Klebsiella* spp are the most common causes of UTI as seen in various studies[3] worldwide. In the present study also most common isolated bacteria was *E. coli* (48.4%) followed by *Klebsiella* (24.2%).In another study[13] high prevalence rate (63.6%) of pediatric UTI was found, and commonest isolates were *Escherichia coli (42.76%)* followed by *Klebsiella pneumoniae (38.46%).*

Over the past few decades, a good number of studies have been performed to assess the validity and utility of different urine screening tests for adult but the number of studies regarding this matter in pediatric age group is limited. In the present study it was found that dip stick leukocyte esterase was more sensitive (72.7% vs. 51.5%) and had higher negative predictive value (91.6% vs. 88.7%) than that of dipstick nitrite test. On the other hand among all the screening tests dip stick nitrite test is more specific (81.2%). It was found that sensitivity of microscopic pyuria (63.6% vs. 51.5%) was better than dipstick nitrite test. Similar type of finding can be seen by different authors[7,8]. Nayak *et al* [14] in their study depicted that sensitivity and PPV of LE were

61% and 69% respectively. In their study they found a very low specificity of LE, microscopic pyuria compared to the present study. Waisman Y *et al[15]* while comparing accuracy of three different screening tests they found sensitivity and negative predictive value of dip stick test was of 93.1% and 98.6% respectively[16]. On the other hand, in a different study it was mentioned that the dipstick negative predictive value is too low rule out while the positive predictive value is too low to confirm UTI[17] . It was found in the dipstick test manufacturer's instruction that medication with imipenem, meropenem, and clavulanic acid may cause false positive reactions while testing for leukocyte esterase while urine protein excretions in excess of 500ml/dL and urine glucose excretions in excess of 1 gm /dL may diminish the intensity of the reaction color. Prolonged urinary retention in the bladder of 4 to 8 hours is essential in order to obtain an accurate result of dipstick nitrite test. These could be the contributors of false positive and false negative reactions of the tests. In the present study here also positive predictive values were low compared to their negative predictive values. When positive result of any one of three the screening tests were considered ,sensitivity and negative predictive values were increased up to 90.9% and 96.6% respectively. It can be stated from above mentioned discussion that screening tests can be more effective specially in ruling out UTI than to diagnose it.

The dip sticks are cheap, and to screen each sample the cost of the test is around 11 rupees, it is much less compared to urine culture, costs more than 50 rupees per sample. So the financial benefits cannot be overlooked. Though screening tests can rule out UTI in a good number of cases, urine culture should always be performed to determine drug sensitivities to guide treatment and to detect false negatives. The antibiotic sensitivity pattern of bacteria changes rapidly over last few years, so knowledge of local etiologic agents and their antibiotic susceptibility is needed for proper management of patient. This study gives an idea of prevalent bacteria causing UTI in pediatric age group in this hospital, and would help the physician to choose appropriate antibiotic in patient management. By using simple screening tests UTI can be ruled out in number of patients within a short time thus sample load and the cost of diagnosis can be minimized. This type of screening test may be an effective tool to rule out UTI in rural setting as well as in a hospital where huge patient load is there. These are time saving, cost effective way to screen the urine samples. Regular microbiological surveillance by hospital infection committee and careful performance of in vitro susceptibility testing and formation of own antibiotic policy can help to prevent the infection caused by different multidrug resistant pathogens.

V. Conclusion

From the study we can conclude that among the suspected cases of UTI 17.5% were culture positive. Overall UTI is more common in girls than boys. Fever is the most common presenting symptom in pediatric UTI. E. coli is the most common isolated organism which shows resistance to commonly used antibiotics like cotrimoxazole, ceftriaxone and they have a very good sensitivity to imipenem, meropenem, and nitrofurantoin. Among Gram positive isolates, *Enterococci* is more prevalent and they have a good sensitivity to nitrofurantoin, linezolid, vancomycin . Using different screening methods (microscopic pyuria, dipstick leukocyte esterase, nitrite test) with either of them found positive, seems to be a effective, cost saving method to rule out UTI. The major limitation of our study is the lower number of culture positivity due to the small sample size. Various risk factor of pediatric UTI could not be studied properly due to insufficient information from relatives of the patients. If further study can be done with larger population a better conclusion can be made in all these regards.

References:
[1]. Srivastava RN, Bagga A. Urinary tract infection. In, Bagga A. Paediatric Nephrology, 4th Ed, New Delhi, Jaypee, 2005; 235-264.
[2]. Elder J.S .Urinary tract infections. In Nelson Textbook of Pediatrics *,* vol 2. 19th edition. Elsevier Inc. 2012; p.1829-34.
[3]. Taneja N, Chatterjee S.S, Singh M, Singh S, Sharma M. Pediatric urinary tract infections in a tertiary care centre from North India. *Indian J Med Res 2010*;131: 101-5.
[4]. Narasimhan KL,Chowdhary SK, Kaur B, Mittal BR, Bhattacharya A. Factors affecting renal scarring in posterior urethral valves. *J Pediatr Urol* .2006; *2*: 569-74.
[5]. Narasimhan KL, Mahajan JK, Kaur B, Mittal BR, Bhattacharya A. The vesicoureteral reflux dysplasia syndrome in patients with posterior urethral valves. *J Urol* 2005; 174: 1433-5.
[6]. Chandrasekharam V V, Srinivas M, Charles AR, Agarwala S, Mitra DK, Bal CS, *et al*. Urinary-tract infection affects somatic growth in unilateral symptomatic hydronephrosis. *Pediatr Surg Int* 2002; *18* : 451-4.
[7]. Taneja N, Chatterjee SS, Singh M, Sivapriya S. Validity of quantitative Unspun urine microscopy, Dipstick Test Leucocyte Esterase and Nitrite tests in rapidly diagnosing urinary tract infections. *J Assoc Physicians India* . 2010; 58: 485-7.
[8]. Fadil Y. Anad, FRCPCH . A simple method for selecting urines samples that need culturing. *Annals of saudi medicine.*2001; (21):1-2.
[9]. Kulkarni VL, Kulkarni DM ,. Nilekar SL. Bacteriological evaluation of urinary tract infection (UTI) in pediatric patients. *Int j pharm bio sci*. 2014 July; 5(3): 699 – 704.

[10]. Maurya SK and Singh AK. Clinical Efficacy of Moringa oleifera Lam. Stems Bark in Urinary Tract Infections. International Scholarly Research Notices, 2014, 7 pages.
[11]. Omoregie R, Erebor JO, Ahonkhai I, Isobor JO, and Ogefere HO, Observed changes in the prevalence of uropathogens in Benin City, Nigeria, New Zealand Journal of Medical Laboratory Science. 2008; 62: 26
[12]. Shukla OS, Singh SN. Urinary tract infection in 1-12 years age group; a cross section study of 100 cases. *International Archives of integrated Medicine (IAIM)*. 2015; 6:192-196.
[13]. Gupta S, Agarwal R, Bhooshan S, Diwakar MK, Goyal A, Agrawal A. Changing trends in resistance pattern as an alarm by bacteria before it's too late to treat. *IOSR Journal of Dental and Medical Sciences* (IOSR-JDMS). 2013 Nov- Dec; 6:55-60.
[14]. Nayak U.S, Solanki H. Patva P. Utility of dipstick versus urine culture in diagnosis of urinary tract infection in children. *Gujarat medical journal*. 2010;65(1):20-22.
[15]. Waisman Y, Zerem E, Amir L, and Mimouni M, The Validity of the Uriscreen Test for Early Detection of Urinary Tract Infection in Children. Pediatrics. 1999 ;104(4)
[16]. Sharma A, Shrestha S, Upadhyay S and Rijal P. Clinical and Bacteriological profile of urinary tract infection in children at Nepal Medical College Teaching Hospital. *Nepal Med Coll J*. 2011 Mar; 13(1): 24-26
[17]. Van Nostrand JD, Junkins AD, BartholdiRK . Poor Predictive Ability of Urinalysis and Microscopic Examination to Detect Urinary Tract Infection**. Am J Clin Pathol. 2000 May; 113(5):709-13.