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Original Article

Urinary Tract Infections in Children

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ABSTRACT

Background and Aim: *Urinary tract infection (UTI) causes significant illness in children. The diagnosis in most developing countries is often overlooked due to difficulties in obtaining urine from children especially those who would not void voluntarily. Misdiagnosis often leads to renal damage and hypertension, which could be avoidable with early diagnosis and proper management. Empirical antibiotic treatment in UTI, especially if based on the epidemiology and resistance patterns of common uropathogens, plays an important role in prevention of renal damage. The aim of this study was to evaluate the prevalence of clinical symptoms, laboratory findings, renal ultrasonography, Dimercaptosuccinic acid (DMSA) renal scanning and antimicrobial sensitivity of uropathogens.*

Materials and Methods: *This retrospective study was conducted on 136 patients hospitalized in Qods hospital of Qazvin with positive urine culture during 2006 (from March through October).*

Results: *One hundred and thirty five children were included in the study. Of the total, 108 (80%) were females and 27 (20%) were males with a female to male ratio of 5.4:1. The median age of the patients was 24.4 months. Ninety eight (72.6%) patients were from cities and 37 (27.4%) were from rural areas. Of 135 patients, 17 (11.1%) had past history of hospitalization with UTI. Fever was the most common clinical presentation (68.1%) followed by dysuria (37%) and vomiting (29.6%). Normal white blood cell count was found in 113 cases (83.7%) and 22 patients (16.3%) had leukocytosis. Increase erythrocyte sedimentation rate (ESR) was found in 64 cases (55.6%) and positive C-reactive protein (CRP) in 54.8% of patients. Escherichia coli (E.coli) caused 67.4% of the infections followed by Klebsiella species (14.1%). The majority of the E.coli isolates (90.1%) were from females, while the remaining were from males. Among the gram negative enteric bacilli high prevalence of resistance was observed against ampicillin (86.9%) and co-trimoxazole (78.3%). E.coli isolates had the most sensitivity to amikacin (90.1%), ciprofloxacin (83%), nitrofurantoin (81.2%), ceftriaxon (78.5%), gentamycin (77.8%) and ceftizoxime (74%). Sonography of the kidney and bladder showed abnormality in 15.3% of patients, while the DMSA renal scan was abnormal in 46.5%.*

Conclusion: *UTI is one of the most common infections diagnosed in hospitalized children, particularly in females. Since in the young children specific clinical signs and symptoms of UTI are uncommon, the presence of other potential signs and symptoms are not reliable in excluding UTI. This study revealed that enterobacteriaceae were the predominant bacterial pathogen of hospitalized children with UTI. It also represents high level resistant of E.coli isolates to ampicillin and co-trimoxazole. Thus, continued local surveillance studies are urged to monitor emerging antimicrobial resistance and to guide interventions to minimize its occurrence. This study is useful to improve the empiric treatment.*

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Keywords: *Antibiotic resistance pattern, Children, DMSA renal scanning, Sonography, Urinary tract infection, Urine culture*

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INTRODUCTION

The morbidity of the urinary tract infection (UTI) in the infancy is very high resulting in permanent renal damage which causes hypertension or end stage renal failure (1-3). UTI occurs in 3-5% of the girls and 1% of the boys. In childhood, UTI is 2 to 4 fold more prevalent in girls than in boys, and 5% of school girls have UTI during their school years (4,5).

Fever remains a more common presentation in the neonates, infants and younger children whereas older children present with other symptoms (1,5). Eighty percent of the infants with culture proven UTI present with fever (1,6). Dysuria can also be the main symptom of UTI in younger children, but most of the time, it indicates cystitis (2). Dysuria may be associated with enuresis and foul smelling turbid urine (1,2,7). Urinalysis is also recommended in infants presenting with jaundice (1,8).

Some newborns and infants may show nonspecific symptoms such as jaundice, poor feeding, irritability and weight loss (2). Pediatric investigators have identified the risk factors associated with an increased risk of UTI in children with less than 2 years of age. They include temperature higher that 39°C, fever longer than two days, white race, age less than one year and no other obvious source of fever. The presence of two or more of the above risk factors yielded a sensitivity of >99% and specificity of 71% for detection of UTI in this age group (1,9).

The purpose of this study was to analyze the clinical symptoms, laboratory findings and antimicrobial sensitivity of uropathogens at Qods teaching hospital with an idea to expedite diagnosis and thus reduce the morbidity associated with it.

MATERIALS AND METHODS

During a 6 month period from March 2006 through October 2006, 135 children with UTI (positive urine culture) were admitted to the hospital from the Emergency department of Qods hospital, Qazvin, Iran. Signs, symptoms, laboratory findings, roentgenographic studies, sonography and DMSA renal scan were retrospectively analyzed. We extracted the information on age, gender and place of living from the medical records.

Information on clinical signs and symptoms (fever, dysuria, nausea, vomiting, diarrhea, urgency, malodorous urine, jaundice, abdominal or flank pain, altered color of urine, convulsion, failure to thrive and urinary incontinence) was extracted, too. In addition to above data, information on laboratory findings (WBC, ESR, CRP, leukocyturia, nitrite test, urine culture and antibiogram) were collected from the medical records.

Information on sonography and DMSA renal scan were considered, too.

RESULTS

From March 2006 through October 2006, there were 135 patients (age ≤ 12 years) diagnosed with UTI (with positive urine culture) at our hospital.

Among 135 patients with UTI, 80% were females and 20% were males (Table 1), with a female to male ratio of 5.4:1. The median age of the patients was 24.4 months. One hundred eighteen (87.4%) had no past history of hospitalization with UTI, but 17 patients (12.6%) had history of hospitalization with UTI. Ninety eight patients (72.6%) were from cities and 37(27.4%) were from rural areas. The most common clinical presentation was fever (68.1%) followed by dysuria (37%) and

Table 1. Distribution of the patients according to age and sex

Age \ Sex	Female	Male	Total
<2 months	9	11	20
2 months to 2 years	62	9	71
>2 years	37	7	44
Total	108	27	135

Table 2. Clinical presentation of UTI in children (n=135)

Presentation	No.	%
Fever	92	68.1
Dysuria	50	37
Vomiting	40	29.6
Diarrhea	31	23
Urgency	31	23
Malodorous Urine	29	21.5
Refusal of Feeding	26	19.3
Irritability	22	16.3
Abnormal or flank pain	15	11.1
Seizure	11	8.1
Failure to thrive	10	7.4
Urinary incontinence	9	6.6

vomiting (29.6%). The detail is given in table 2.

ESR was increased in 64 cases (55.6%) and 51 patients (44.6%) had normal ESR; in 20 patients there was no record of ESR. CRP was positive in 63 cases (54.8%) and negative in 52(45.2%); in 20 patients it was not measured.

Urine contained more than 5 WBCs/High Power Field (HPF) in 101(74.8%) of the 135 specimens examined; 34(25.2%) specimens had less than 5 WBCs/HPF. Meanwhile all the urine cultures were positive. Nitrite test was positive in 31(35.2%) of the 88 specimens, while 57(64.8%) specimens had negative nitrite test.

Urine culture from 135 patients grew ≥ 100,000 colony-forming units/ml of a single bacterial species. E.coli was identified in 91(67.4%) patients. The pathogens from the other patients were Klebsiella pneumonia 19(14.1%), Enterobacter 6 (4.4%) and Proteus mirabilis 5(3.7%). The detail is given in table 3. Antimicrobial susceptibility testing was determined by disk agar diffusion method. The overall rate of susceptibility to amikacin, gentamycin, ciprofloxacin, nitrofurantoin, ceftriaxon, nalidixic acid, co-trimoxazole and ampicillin were 93%, 89%, 89%, 88%, 71%, 65%, 34% and 11%, respectively. E.coli was found to be most susceptible to amikacin (90.1%) followed by ciprofloxacin (83%), nitrofurantoin (81.2%),

Table 3. Frequency of the patients according to age and microorganism

Microorganism \ Age	<2Mo	2M-2yr	>2yr	Total
Escherichia coli	3	52	36	91
Klebsiella pneumonia	12	4	3	19
Enterobacter	1	2	3	6
Proteus mirabilis	1	4	-	5
Streptococcus non hemolytic	1	3	-	4
Staphylococcus coagulase negative	1	2	1	4
Staphylococcus coagulase positive	-	2	1	3
Enterococcus	1	1	-	2
Citrobacter	-	1	-	1
Total	20	71	44	135

ceftriaxon (78.5%), gentamycin (77.8%), ceftizoxime (74.1%), nalidixic acid (57.3%), co-trimoxazole (21.7%) and ampicillin (13.1%).

In our study, renal ultrasonography was normal in 111 patients (84.7%) and abnormal in 20 cases (15.3%). Renal cortical scintigraphy by Dimercaptosuccinic acid (DMSA) was normal in 46 cases (53.5%) of 86 patients, while 40 patients (46.5%) had abnormal DMSA renal scan.

DISCUSSION

Urinary tract infection (UTI) is an important cause of morbidity and mortality in the first 2 years of life (10). In our studied patients, there was an obvious preponderance of female (Table 1), and this is in accordance with other studies performed in Iran as well as in other countries (2,3,11).

Majority of the patients (52.6%) belonged to the 2 to 24 months age group and this coincides with other studies (1,12,13). As reported by other studies the reason might be that this age group (especially older than one year of age) is more susceptible to infections due to their toilet training problems (14).

The number of the patients was less in the neonatal period and the cases increased with increasing age; a fact which is also reported by

many other studies (1,15). Fever was the most common symptom in the 135 enrolled cases; 68.1% of the patients had history of fever. Other studies also indicate the high association between the fever and urinary tract infection (1,5,6,8,16).

Dysuria was common in our study (37%). Although it is a common presentation in older children, it can be a presenting symptom in infants (1,17,18). The difference seen in various studies (4 to 60.8%) is due to the difference in the patients' age groups. Dysuria was reported in 4% of the neonates, (18) and in up to 60.8% of the cases (17) beyond neonatal period.

Failure to thrive (FTT) was found in 10 patients (7.4%) in our study as compared to studies from different countries (1,14,18). In one research it was reported to be as high as 80% and in another study it was 31% (1); the difference seen in various studies is due to the difference in the patients' age groups. If only infants were included in the study, FTT would be as high as 80% (1).

Abdominal or flank pain was also a non specific finding in patients having UTI; 88.9% of our patients did not have any pain, which was not similar to other studies. In Qureshi's evaluation, about 48% of the patients were free of any pain (1), which was in accordance with another study (14).

Similar to the previous research (19), absence of significant pyuria did not rule out UTI. Less than 5 WBCs/HPF were found in 25.2% of the urine samples. Bacteria were present on stained smears of 81.5% of the cases, which was in accordance with another study (19).

The nitrite test was disappointing in diagnosing infection as it was positive in only 35.2% of the urines with positive cultures. In one study, nitrite test was positive in 81.4% of the urine samples (20) and in another study it was 59% (21). There are several potential explanations for the observed differences. More frequent voiding in non-toilet-trained infants leads to decreased time for production of nitrites by nitrites-reducing organisms, while such infants might tend to have a less vigorous inflammatory response to infection, which may explain the lower sensitivity of the dipstick test for nitrites (22). Other factors such as differences in the techniques of the test performance, characteristic of the patient population and differences in disease prevalence can cause such a differences (22). Thus, nitrite test alone can not accurately predict urinary tract infection.

The high prevalence of gram negative bacteria with E.coli as the predominant organism in this study is in agreement with previous reports (10-23). The pattern of antibiotic susceptibility in some cases differed from other reports. While Rabasa and Shattima (24) reported less than 30% sensitivity to nitrofurantoin, more than 81.2% of our isolates were susceptible to this antibiotic. The most striking observation in this study is the poor sensitivity shown by both gram-negative and positive bacteria against co-trimoxazole and ampicillin, the two most common antibiotics used in our community in treating UTI. The improper use of antibiotics often facilitates the selection of resistant strains of bacteria (10). The more antibiotics are used in community, the more likely it is that resistant strains will be selected and maintained in the environment (10). Self-medication with ampicillin and co-trimoxazole is very common in our community, as it is in other communities (10). The inadequate dosage of these two antibiotics used during self-medication is likely to be a contributing factor to the development of resistant strains to these drugs (10).

Ataei et al found a high incidence of renal involvement (78.8%) in children with their first-time documented pyelonephritis by DMSA renal scan (25). According to them cortical scintigraphy is more sensitive than ultrasonography (39%) in detecting these renal changes. Findings in our study

showed that DMSA renal scan is more sensitive than ultrasonography in detecting these renal changes, which is in agreement with previous studies (10,25). Acute phase reactants (ESR, CRP) in children with febrile UTI have been previously reported (26-29). These studies have shown statistically significant increased levels of ESR and CRP in patients with acute pyelonephritis when compared with those with acute cystitis (30). These findings have led to the practice of obtaining these tests to differentiate between upper and lower UTIs (30). However, of the quoted studies, only a few addressed the issue of specificity of these tests (27-29,31). Our study elaborates further on the use of acute phase reactant tests and demonstrates that they are not specific enough to confirm the diagnosis of acute pyelonephritis. Although comparing with other studies (30), the specificity of ESR (47%) and CRP (50%) in our study was higher. In addition, comparing our report with the earlier studies revealed different results (27-29,31). In these studies, sensitivity of CRP and ESR tests varied from 72 to 93%, whereas specificity varied from 25 to 57%; while in our study sensitivity of CRP and ESR tests was 72.5% and 65%, and specificity of CRP and ESR tests was 50% and 47%, respectively.

CONCLUSION

The present findings emphasize the need to include the diagnosis of urinary tract infection in children, especially in all febrile infants on admission. The long established position of co-trimoxazole and ampicillin as drug of choice in the treatment of UTI needs to be reviewed. There is the need to undertake regular surveillance of urinary tract pathogens and their antibiotic susceptibility patterns and to find effective methods to control the misuse of antibiotics in the community.

In addition, our study shows that neither clinical nor laboratory data will allow an accurate diagnosis of acute pyelonephritis. Using the available laboratory criteria, the diagnosis will be missed in a large number of patients. Given the low specificity of clinical findings and available laboratory tests to define the site of urine infection in this age group, we recommend DMSA renal scintigram as the test of choice to make the diagnosis of acute pyelonephritis in these patients.

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