
Urinary Tract Infection in Children: A hospital Based Study

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Abstract

Background: Urinary tract infection (UTI) is one of the most common diseases in children.

Objective: The aim of this study was to review the clinical, laboratory characteristics and renal ultrasonography (RUS) of urinary tract infection (UTI) cases in children.

Patients & methods: This cross-sectional study was conducted in the Central Teaching Hospital for children in Baghdad. The study sample included 138 children, ranging 1 month to 15 years, presented with presumptive UTI based on history, physical examination, urinalysis findings and urine culture, during the period between 1st of March 2004 and 15th of November 2004.

Cases were grouped according to their age, group 1 (under 2 years), group 2 (2-7 years) and group 3 (>7 to 15 years).

History was taken (data included age, sex, circumcision for males, signs, symptoms and worm infestation), physical examination, and standard laboratory general urinalysis (microscopy, nitrite dipstick), urine culture (the pathogen and its sensitivity) and renal ultrasound (RUS) was performed.

Results: Among the total number of (138) children, group 1 has accounted for the highest percentage (58.7%). According to the sex difference; the females were predominant in three groups, the male: female ratio was 58:80 (P>0.05). Diarrhea & vomiting was the commonest presentation in group 1 (26.1%), while fever was the commonest in group 2 (9.4%) and group 3 (10.1%) (P>0.001). Sixty five patients had urine culture positive (47.1%), *Escherichia coli* was the predominant organism, while 73 (52.9%) were found to have culture negative results.

Urinary tract infection (UTI) was more common in uncircumcised males and when worm infestation was present.

Regarding the culture positive urine samples (65); they were predominantly in group 1, 44/65 (31.9%) with females were predominantly affected in all age groups, male/female was 23/42 (P>0.05).

Regarding ultrasound findings; they were normal in 44.6% and abnormal in 55.4%. Of all ultrasound abnormalities, increased renal echogenicity was the commonest finding and accounted for 16.9% of cases.

Overall Gram-negative organisms cause 98.5% of the UTI in this study. *E coli* are the leading pathogen and the most suitable antibiotic is nitrofurantoin.

Conclusions: In conclusion; female sex and children less than 2 years of age are significant in the occurrence of urinary tract infection. Our findings revealed that the method of urine analysis should not substitute for a urine culture in the symptomatic patients.

Keywords: Urinary tract infection, urine culture, *Escherichia coli* (*E. coli*).

Introduction:

Although the true incidence of urinary tract infections in children is difficult to estimate and it depends on the rates of diagnosis and investigation, they are one of the most common bacterial infections seen by clinicians who care for young children^[1,2,3,4].

At least 8% of girls and 2% of boys will have UTI in childhood, and between 30% and 40% will have another episode within two years^[4, 5, 6].

Except for the first 8-12 weeks of life, when infection of the urinary tract may be secondary to a haematogenous source, UTI is believed to arise by ascending route following the entry of bacteria via the urethra^[1].

The non-specific presentation has implications for misdiagnosis and the potential for long term complications^[3].

Some risk factors for UTI are, female sex, uncircumcised males vesicoureteral reflux, pinworm infestation,

Voiding dysfunction and others^[7].

The diagnosis of UTI in young children is important as it is a marker for urinary tract abnormalities and, in the newborn, may be associated with bacteraemia^[1].

A urine specimen for culture is necessary to document a UTI in young children. Prior to culture, urinalysis may be useful to detect findings supporting a presumptive diagnosis of UTI^[1].

Mainly colonic bacteria cause UTIs. In females, 75-90% of all infections are caused mainly by *E coli*, followed by *Klebsiella* & *Proteus*. Some series report that in males older than 1 year of age, *Proteus* is as common as *E coli*; others report a preponderance of gram-positive organisms in males.

Enterobacteriaceae are the most common bacteria isolated from uncomplicated UTI^[1], viral infections, particularly Adeno virus may also occur^[6, 7].

The non invasive nature of renal ultrasound (RUS), the lack of radiation, and the low cost, have made it an ideal tool for the initial screening investigation in children with UTI^[6, 8, 9, 10,].

A significant proportion of children investigated after a proven UTI will have an underlying renal tract anomaly, including obstructive lesions in 0-4% and vesicoureteric reflux in 8-40% of children^[4, 5, 11, 12]. New uro-radiology imaging techniques like cortical radionuclide scanning and prenatal ultrasonography improve our understanding of the etiology, effect of treatment and outcome of UTIs.

Evidently, most kidneys at risk are those which already sustained intrauterine damage by obstruction or vesicoureteral reflux^[13].

The introduction of new potent oral antimicrobials limits the need for hospitalization only to the very young infant and the very seriously ill child^[13].

Patients & methods:

This cross-sectional study was conducted in the Central Teaching Hospital for children/Baghdad. The study sample included 138 children, 58(42%) were boys and 80(58%) were girls, mean ages were 4.05+/-2.9 & 3.6+/-3.27 years respectively (range 1 month -15 years), presented with presumptive UTI based on history, physical examination, urinalysis findings (microscopy and nitrite dipstick) and urine culture. During the period between 1st of March 2004 and 15th of November 2004.

In practice, the total cases were grouped according to their age; group 1 (under 2 years), group 2 (2-7 years) and group 3 up (>7 to 15 years).

History was taken (the data included age, sex, circumcision [for males], symptoms and worm infestation). Physical examination and standard laboratory general urinalysis (microscopy, nitrite dipstick), urine culture (the pathogen and its sensitivity) and renal ultrasonography (RUS) were performed.

In UTI, pyuria(>5 white blood cells/high-power field) suggested infection^[6], yet pyuria may be absent in young children with UTI^[6].

A bacterial culture of $\geq 10^5$ colony forming units of a single species per ml isolated from a urine specimen was considered to be significant and were considered to have UTI^[4,5,14,15], while the presence of multiple organisms suggested specimen contamination^[6].

The bacteria were identified by standard methods and the antimicrobial susceptibility determined by Bauer-Kirby method (disk diffusion)^[16, 17].

Urine cultures were obtained by the midstream clean-catch urine specimens in children older than 2 years, and by urine bag (non specific test results) in children younger than 2 years^[6, 18].

RUS was performed in all urine culture positive patients during hospitalization using a device with sector or linear 5 and 7.5 MHz transducers.

All results were expressed in numbers and percentages, the statistical analysis was done using t-test and Chi-square and P-value <0.05 was considered as significant and below 0.01 was considered highly significant.

Results:

Among the total number of (138) children with the age range of 1month-15years, group 1 (accounted for 81 cases constituting 58.7%), including (38 boys constituting 27.5%, and 43girls constituting 31.2%), group 2 (accounted for 34 cases constituting 24.6%), including (11 boys constituting 8%, and 23 girls constituting 16.7%) while group 3 (accounted for 23 cases constituting 16.7%), including (9boys constituting 6.5%, and 14girls constituting 10.1%).

So group 1(<2 years) accounted for the highest percentage, and the females were predominant in three groups, the male: female ratio was 58:80 (P>0.05) as shown in table (1).

Table (2) shows that diarrhea & vomiting was the commonest presentation in group 1 (36/81, 26.1%), while fever was the commonest presentation in group 2 (13/34, 9.4%) and group 3 (14/23, 10.1%), so there was a highly significant difference in the presentation among the three groups (P=0.001).

Table 1: shows age and sex distribution in the study sample

Age Groups	Male	Female	Total	P Value
	Count/Percentage	Count/Percentage		
<2years	38/27.53	43/31.15	81/58.69	0.336
2-7years	11/7.97	23/16.66	34/24.63	
>7years	9/6.52	14/10.14	23/16.66	
Total	58/42.02	80/57.97	138/100	

Table 2: shows the chief complain in different age groups of the study group.

Chief Complain	AGE GROUP			Total No./Percentage	P Value
	<2years No./Percentage	2-7years No./Percentage	>7years No./Percentage		
Diarrhea & Vomiting	36/26.1	4/2.89		40/28.98	0.001
Fever	26/18.8	13/9.42	14/10.14	53/38.40	
Dysurea	1/0.7	4/2.89	3/2.17	8/5.79	
Abdominal pain	0	7/5.07	4/2.89	11/7.97	
Swelling	2/1.5	5/53.62	2/1.44	9/6.52	
Vomiting	4/2.9	0	0	4/2.89	
Failure to thrive	12/8.7	1/0.72	0	13/9.42	
Total	81/58.7	34/24.63	23/16.66	138/100	

Table (3) shows that out of the 138 urine samples collected, 65 patients were culture positive (47.1%), while 73(52.9%) were found to have culture negative results.

Among the total number of 65 urine samples, E coli was the most common organism that accounted for 31/65(47.7%), while Klebsiella and Proteus were accounted for 26/65(40%) and 4/65(6.2%) respectively. The remaining pathogens were other Enterobacteriaceae 3/65(4.6%) & staphylococcus aureus 1/65(1.5%).

Circumcised males were 26(9 had positive urine culture and 17 were not) and non-circumcised males were 32(14 had positive urine culture and 18 were not infected) with P value <0.005.

Worm infestation (pin worm) was present in 38 patient and none in 27 patients of proven urine culture positive.

Regarding the culture positive urine samples, they were predominant in group 1(44/65, 31.9%), then group 2(12/65, 8.7%) and group 3(9/65, 6.5%), but there was no significant difference in sex distribution in the culture positive different age groups, with females were predominantly affected, male/female = 23/42 (P>0.05) as shown in table (4). Table (5) shows fever was the commonest presentation in significant leukocyturia (10 to >=25 pus cells / HPF) and urine culture positive patients 40/65 (61.5%), P>0.05.

Of 65 samples, the number of pus cells was: 17 samples with 10-14cell/HPF, 7 patients with fever

8 samples with 15-19cell/HPF, 3 patients with fever 6 samples with 20-24cell/HPF, 3 patients with fever 9 samples with >=25cell/HPF, 5 patients with fever Also in table (5), the nitrite dipstick tests were only positive in 5 samples (P>0.05).

Table 3: shows the bacteriological findings of urine culture

Bacteria isolated from urine culture	No. of patients/Percentage
Escherichia coli	31/47.7
Klebsiella	26/40
Proteus	4/6.2
Other Enterobacteriaceae	3/4.6
Staph. Aureus	1/1.5
Total	65/100

Table 4: shows the sex distribution in the culture positive according to different age groups.

Age groups		No. of culture* positive/Percentage	Male/Female
Group one	<2years	44/31.9	17/23
Group two	2-7years	12/8.7	4/12
Group three	>7years	9/6.5	2/7
Total		65	23/42

* P Value of culture positive with age groups was 0.123

Table 5: shows the correlation of chief complain with the pus cell and nitrite

Chief Complain	Pus cell (No.) groups in urine*							Urine nitrite**	
	<5	5-9	10-14	15-19	20-24	>=25	Total*	Positive	Negative
Diarrhea & Vomiting	5	5	5	1	2	0	8	2	17
Fever	3	5	7	3	3	5	18	2	23
Dysurea	0	2	2	0	1	1	4	0	6
Abdominal pain	0	1	0	1	0	1	2	1	2
Swelling	0	0	1	2	0	0	3	0	3
Vomiting	1	0	0	0	0	1	1	0	2
Failure to thrive	0	3	2	1	0	1	4	0	7
Total	9	16	17	8	6	9	40	5	60

* P Value of Pus cell groups in urine was 0.458

** P Value of Urine nitrite was 0.610

Total significant leukocyturia (10 to >=25 pus cells / HPF)

Regarding ultrasound findings, they were normal in 29/65(44.6%) and abnormal in 36/65(55.4%) of positively culture patients. Of all abnormalities, increased renal echogenicity was accounted for

11/36(16.9%), pyelonephritis for 10/36(15.4%), while pelvocalyceal dilatation and cystitis had accounted for 8/36(12.3%) & 7/36(10.8%) respectively as shown in table (6).

Table 6: ultrasound findings

Ultrasound findings		No.	%
Normal ultrasound findings		29	44.6
Abnormal ultrasound findings	Increased renal echogenicity	11	16.9
	Pyelonephritis	10	15.4
	Pelvocalyceal dilatation(PCD)	8	12.3
	Cystitis	7	10.8
	Total	36	55.4
Total		65	100

E. coli was significantly sensitive to nitrofurantoin (24 out of 31), (P value 0.001).

Klebsiella was significantly sensitive to nitrofurantoin (15 out of 26), (P value 0.001).

Proteus was significantly sensitive to gentamycin (3 out of 4), (P value 0.001).

Discussion:

The incidence of UTI during infancy and childhood is high and influenced by the age & sex of the patient, in other words the age & sex differences are common in UTI^[7, 19, 20].

We found that the rate of UTI varied with age groups, the higher rate in group 1 (under 2 years), a finding similar to Larcombe J and Jack S. Elder^[4, 7].

In general; this study shows that positive urine cultures (in the three age groups) were mainly recorded in females (n=42, 64.6%), a finding similar to Larcombe J, Ladhani S, Gary M. Lum and Jack S. Elder^[4, 5, 6, 7].

Regarding the chief complain, fever was commonest, and accounted for 38.4% of the total cases (more than one third), this figure was higher than that reported by Fjell et al., they reported that fever as the sole symptom found in one out of six^[21].

While diarrhea with vomiting and failure to thrive were found in 29% and 9.4% of total respectively, other presenting complaints (including urinary tract related symptoms) were less common^[21].

Regarding age groups; diarrhea & vomiting was the commonest presentation in group 1 (under 2 years), while fever was the commonest in group 2 (2-7 years) and 3 (>7 to 15 years), a finding similar to Jerry Michael Bergstein et al^[22].

We recorded that most UTIs in boys occur in those who were uncircumcised^[7, 23].

In our study, worm infestation (pin worm) was predominantly found in culture positive cases, which was similar to that adopted by Jack Elder^[7].

In the present study; positive urine culture with significant bacteria was found in 65 samples (47.1%), which was higher than that reported by Wammanda et al. they found that the significant urine bacterial culture was (24.3%)^[24].

In keeping with other studies; Gram negative organisms accounted for over 90 % (98.5%) in our study. With the exclusion of *Staph. aureus* of the isolates, *Escherichia coli* was predominating, a finding similar to Sakran, Larcombe J, Ladhani S, Gary M. Lum, Jack S. Elder, Smellie JM and Arslan^[2, 4, 5, 6, 7, 25, 26].

While *E. coli* remain the predominant urinary pathogen, so awareness of trends and susceptibility is of importance^[5].

In our study, *E. coli* growth accounted for (47.7%) of the isolates, which was about half of all pathogens, as comparing with the study done by

James Larcombe^[4] who found that *E. coli* accounts for about three quarters of all pathogens^[4]. In our study *E. coli* was the most prevalent pathogen, followed by *Klebsiella pneumoniae*, and *Proteus mirabilis* which coincide with that reported by others^[2, 27].

We found that *Proteus* was more common in boys (the four cases were recorded in boys)^[4, 6, 7, 18].

In this study, from the culture positive urine samples (65 samples), urine samples containing (0-4) pus cells had accounted for 9/65 (13.8%), pyuria may be absent in young children with UTI^[6].

This means that we can not depend on leukocyturia only but urine culture should be done in the symptomatic patients in childhood, and these accords with Arslan et al^[26].

We found that fever was the commonest presentation with significant leukocyturia (10 pus cells/HPF to >=25), no reported similar studies to be compared.

In our study, of culture positive samples, the nitrite dipstick test was positive in five urine samples (7.7%) only, this figure was lower than that reported by Wammanda et al. While urine microscopy for leukocyturia was significant in 40/65 urine samples (61.5%), which was higher than that reported by Wammanda et al. they found that positive nitrite dipstick test and significant leukocyturia of culture positive urine samples were accounted for 28.9% & 51.1% respectively^[24].

So the nitrite dipstick test was found to be less sensitive than significant leukocyturia in detecting UTI, similar to Wammanda et al^[24].

Renal ultrasonography was performed in all children with culture positive urine samples, more than half of the evaluated children 36/65 (55.4%) had abnormalities^[21].

The pelvocalyceal dilatation (PCD) was noted in 8/65 (12.3%), this figure was higher than that reported by Gelfand et al. they found that sonography was abnormal in 16.7%, and PCD was noted in 3.2%^[28].

In the present study; *E. coli* and *Klebsiella pneumoniae* organisms showed high in vitro sensitivity to nitrofurantoin, while *Proteus* organisms showed high in vitro sensitivity to gentamycin, which was similar to that adopted by Ladhani et al., they reported that nitrofurantoin should be considered for first line empiric treatment and or prophylaxis of UTI in children^[5]. But in contrast to that reported by Musa-Aisien et al., they adopted that *E. coli* and *Klebsiella pneumoniae* organisms showed high in vitro sensitivity to clavulanic acid-potentiated amoxicillin, gentamycin, and ceftriaxon^[29].

In this study *Staphylococcus aureus* growth was accounted for 1.5% only because infection with this organism is rare in children without in-dwelling catheters or other source of infection^[1].

Conclusion:

Overall Gram negative organisms cause 98.5% of the UTI. E coli are the leading pathogen and the most suitable antibiotics are nitrofurantoin, Proteus pathogen was more common in boys. Age and sex differences are common in UTI.

The rate of UTI varied with age, with rate in the <2 years age group and in females.

Most UTIs in boys occur in those who are uncircumcised, and pinworm infestation was predominantly found in culture positive cases.

Our finding revealed that neither method of urine screen should substitute for a urine culture in the symptomatic patients during childhood.

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