

Risk Factors for Urinary Tract Infection in Children

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ABSTRACT

Background & objective: Urinary tract infections (UTIs) are a common cause of febrile illness in young children. Due to the absence of overt clinical features in young children, appropriate collection of urine samples, and basic diagnostic tests at first-level health facilities in our country, UTIs are not generally reported as a cause of childhood morbidity. Due to a lack of studies on the epidemiology, risk factors, diagnosis, treatment, prognosis, and prevention of UTI in children in our country, the exact picture of this disease is yet unknown. This study is intended to identify the risk factors of UTI in children in our country.

Methods: The present cross-sectional study was carried out in the Department of Pediatrics (both indoor and outdoor) of Bangabandhu Sheikh Mujib Medical University, BIRDEM, and Dhaka Medical College Hospital over a period of 1½ years from January 2015 to June 2016. A total of 201 children with signs and symptoms suspected of having urinary tract infections were subjected to urine culture; of them, 98 had definitive UTI and the rest 103 had no UTI or possible UTI. Several factors such as circumcisional status, constipation, encopresis, previous hospital admission, and premature birth were investigated whether they had any role in contributing to the development of UTI.

Result: The children with UTIs were relatively young compared to those without UTIs. However, the age incidence of UTI was found to differ by sex. About one-third of UTI cases in boys were found in the first year of life, one-third between 2nd to 3rd year of life, and the rest one-third in 3rd year onwards. However, the peak age incidence in girls was observed to be 3rd year and onwards. In terms of clinical presentation, fever, and anorexia were more or less common (52% and 43.7% respectively), abdominal pain was less common (18%), and irritability and vomiting were seldom observed. The presence of constipation was significantly associated with UTI in children ($p = 0.001$). Encopresis was considerably higher in the UTI group than in the non-UTI group ($p = 0.169$).

Conclusion: Children with UTI usually present with fever with or without dysuria, frequency, anorexia, and abdominal or loin pain. While boys more often acquire the disease in their infancy, girls usually present with the problem from 3 years during their toilet training. Thus, the children presented with unexplained febrile illness or any other signs and symptoms should be suggested for a urine culture to find the clue of febrile illness. Identification of risk factors of UTI will go a long way in preventing the same illness in the future.

Key words: Risk factors, urinary tract infection (UTI), children etc

INTRODUCTION:

Urinary tract infection (UTI) is one of the most important & serious infections in children. It occurs in 3-5% of girls and 1% of boys up to 5 years, and peaks during infancy and the toilet training period.^{1,2} UTI may lead to renal scarring, impaired glomerular function, early hypertension, and end-stage renal

disease in the future.³⁻⁶ Treatment goals are to eliminate the infection & prevent kidney damage. Most UTIs in children result from ascending infections, although haematogenous spread may be more common in the first 12 weeks of life. UTIs in children are usually monomicrobial, often caused by *E. coli* (60-80% of cases), *Proteus* (more common in

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boys and children with renal stone), *Klebsiella*, *Enterococcus*, and *coagulase-ve Staphylococci*.⁷

The periurethral area is colonized by both anaerobic and aerobic bacteria from the gastrointestinal tract, which serve as part of a normal defense barrier against pathogenic microorganisms. The most common risk factor leading to UTI is urinary stasis which deranges this equilibrium.⁸ This can result from vesicoureteral reflux, bladder dysfunction, habitually infrequent or incomplete voiding, stones, and outflow obstruction due to labial adhesion or constipation.^{9,10} Other probable risk factors in girls include back-to-front wiping, poor perineal hygiene, and bubble baths.¹¹ The strongest risk factors identified are renal tract abnormalities such as vesicoureteric reflux or a neurogenic bladder. An uncircumcised state in boys, female gender, and young age are also known risk factors.¹²

Recurrence of UTI is common in children accounting for 12-30% of cases,¹³ and usually occurs within the first 12 months of the previous infection. Many strategies to prevent UTI recurrence are recommended (long-term low-dose antibiotics, reimplementation surgery for children with vesicoureteric reflux, circumcision for boys, and cranberry Juice).¹³⁻¹⁵ If the bladder contracts strongly and without warning, the muscles surrounding the urethra may not be able to keep urine from passing. This often happens as a consequence of UTI and is more common in girls. One possible cause of daytime incontinence is an overactive bladder. Socioeconomic status in our country is also an important factor. Living in crowded places, and poor sanitation may also be responsible for UTI. Repeated infections may cause renal scarring which may lead to hypertension. Besides, UTI is also associated with significant morbidity and mortality. Given the above context of UTI in children and its consequences, it is better to prevent UTI than to treat it. This study is, therefore, intended to determine the risk factors of urinary tract infections in children.

METHODS:

This cross-sectional analytical study was conducted in the Department of Paediatrics (both indoor and outdoor) of Bangabandhu Sheikh Mujib Medical University, BIRDEM and Dhaka Medical College Hospital, Dhaka over a period of 1½ years from January 2015 to June 2016. Before commencing the study, ethical clearance was taken from the Institutional Review Board (IRB), Bangabandhu Sheikh Mujib Medical University, Dhaka to carry out this study. Children aged 1 month to 5 years presented with signs and symptoms suspected of having urinary tract infections (UTI) were the study population. Children (within 1 month to 5 years), having pus-cells > 5 /HPF on a freshly voided sample of urine were included in the study. Children with known predisposing renal, neurological, and skeletal causes such as VUR, and PEM were excluded from the study. A total of 201 children with signs and symptoms suspected of having urinary tract infections were subjected to urine culture; of them, 98 exhibited growth of microorganisms and hence were considered as having definitive UTI, and the rest 103 without growth were considered having no UTI or possible UTI.

Data processing and analysis were done using SPSS (statistical package for social sciences), version 17. The test statistics used to analyze the data were descriptive statistics, Chi-square (χ^2), and Unpaired t-tests. The data presented on a categorical scale were compared between groups using Chi-square (χ^2), while the data presented on a continuous scale were compared between groups using an Unpaired t-test. The level of significance was set at 5% and a p-value < 0.05 was considered significant.

RESULTS:

The age distribution of the children is illustrated in Table I. Over 60% of the children with UTI were 36 or >36 months old followed by 20.4% 12-36 months, 8.2% 6-12 months, 6.1% 1-6 months

and only 4.1% 1 or <1 month old; however, majority of children without UTI was 36 or over 36 months of age. The children with UTI were relatively younger compared to those without UTI ($p < 0.001$). In the UTI group, almost half (48%) were male and half (52%) female, while in children without UTI, 37.9% were male and 62.1% were female (Table I). The relationship between age and sex shows that out of 98 children with definitive UTI, 47 were male and 51 were female. In the male group, the occurrence of UTI is more common in the 1st 3 years of life while in female children, the majority of the UTIs were reported after 3 years of life ($p < 0.001$) (Table II).

The mean weight of children with UTI at entry was significantly lower than that in children without UTI ($p < 0.001$). However, the mean birth weight was considerably higher in the former group than in the latter group ($p = 0.002$). The incidence of admission after birth, history of premature birth, and kidney problems were almost identically distributed between children with and without UTI ($p > 0.05$) (Table III). UTI was rarely observed in children who have had circumcision ($p = 0.019$) (Table IV). Of the clinical characteristics, fever, anorexia, irritability, and abdominal pain demonstrated their significant presence in children with definitive UTI than in those without UTI ($p < 0.001$, $p < 0.001$, $p = 0.006$, and $p = 0.014$ respectively). The presence of constipation was significantly higher in children with UTI than in children without UTI ($p = 0.001$). Encopresis was also considerably higher in the former group than the latter group, though the difference was not statistically significant ($p = 0.169$). Dysuria was significantly higher in children with definitive UTI than in children without UTI ($p < 0.001$). Dribbling was observed in a significant proportion of children with UTI as opposed to none in children without UTI ($p < 0.001$). Increased frequency was reported by the children with definitive UTI alone (3.1%) ($p = 0.114$) (Table V).

Table I. Comparison of demographic characteristics of the children between groups

Demographic characteristics	Group		p-value
	UTI (n = 98)	Without UTI (n = 103)	
Age (months)			
< 1	4(4.1)	2(1.9)	
1 – 6	6(6.1)	1(1.0)	
6 – 12	8(8.2)	0(0.0)	
12 – 36	20(20.4)	0(0.0)	
≥ 36	60(61.2)	100(97.1)	
Mean age#	44.6 ± 3.8	67.1 ± 3.1	< 0.001
Sex*			
Male	47(48.0)	39(37.9)	0.148
Female	51(52.0)	64(62.1)	

Figures in the parentheses indicate the corresponding %; * χ^2 test was done to analyze the data. #Data were analyzed using an Unpaired t-Test and were presented as mean ± SD.

Table II. Relationship between age & sex in the occurrence of UTI in children

Age group (months)	Group		p-value
	Male (n = 47)	Female (n = 51)	
<1 – 12	15(31.9)	7(13.8)	
12 – 36	15(31.9)	1(2.0)	< 0.001
≥ 36	17(36.2)	43(84.3)	

Figures in the parentheses indicate the corresponding %; *Chi-squared Test (χ^2) was done to analyze the data.

Table III. Association between anthropometric characteristics and UTI

Anthropometry and other variables#	Group		p-value
	UTI (n = 98)	Without UTI (n = 103)	
Anthropometry#			
Weight at enrollment (kg)	15.8 ± 8.7	23.3 ± 9.2	<0.001
Birth weight (kg)	2.7 ± 0.4	2.6 ± 0.2	0.002
History of medical significance			
Newborn admission*	10(10.2)	5(4.9)	0.149
Premature birth**	2(2.0)	1(1.0)	0.481
Kidney problem**	1(1.0)	2(1.9)	0.519

Figures in the parentheses indicate the corresponding %; *Chi-squared Test (χ^2) was done to analyze the data. **Fisher's Exact Test was done to analyze the data. #Data were analyzed using an Unpaired t-Test and were presented as mean ± SD.

Table IV. Association of circumcision and UTI in male children

Circumcision (for male)*	Group		p-value
	UTI (n = 47)	Without UTI (n = 39)	
Yes	1(2.1)	8(20.6)	
No	46(97.9)	31(79.4)	0.019

Figures in the parentheses indicate the corresponding %; *Chi-squared Test (χ^2) was done to analyze the data.

Table V. Comparison of clinical presentation between groups

Clinical presentation	Group		p-value
	UTI (n = 98)	Without UTI (n = 103)	
General characteristics			
Fever*	51(52.0)	12(11.7)	< 0.001
Malaise*	0(0.0)	2(1.9)	0.228
Anorexia*	45(43.7)	17(17.3)	< 0.001
Vomiting*	4(4.1)	4(3.9)	0.587
Past unexplained febrile illness*	6(6.1)	3(2.9)	0.316
Irritability**	6(7.1)	0(0.0)	0.006
Abdominal pain*	18(18.4)	6(5.8)	0.014
Bowel history			
Constipation*	19(19.4)	5(4.9)	0.001
Encopresis**	4(4.1)	1(1.0)	0.169
Urinary history			
History of UTI**	1(1.0)	0(0.0)	0.488
Dysuria*	59(60.2)	1(1.0)	<0.001
Increased Frequency**	3(3.1)	0(0.0)	0.114
Dribbling*	22(22.4)	0(0.0)	< 0.001

Figures in the parentheses indicate the corresponding %;

***Chi-squared Test** (χ^2) was done to analyze the data.

****Fisher's Exact Test** was done to analyze the data.

DISCUSSION:

In the present study children with UTI was relatively younger than those without UTI. However, the age incidence of UTI was found to differ by sex. About one-third of UTI cases in boys were found in the first year of life, one-third between 2nd to 3rd year of life, and the rest one-third in 3rd year onwards. However, the peak age incidence in girls was observed from 3rd year and onwards. Other studies also put forward similar opinions. In a WHO "Review of Urinary Tract Infection in Children in Developed Countries", it has been estimated that UTIs are diagnosed in 1% of boys and 3-8% of girls. In the first year of life, UTI is more prevalent in boys than in girls with rates being 2.7% and 0.7% respectively.¹⁶

Most infections in boys occur in the first three months of life.¹⁷ However, by school age, the rate decreases in boys and increases in girls.¹⁶ In the present study, un-circumscribed children demonstrated their significant presence in the UTI group (97.9%) which bears consistency with another study,¹⁸ which described a 10-12-fold increased risk

of UTI in uncircumcised boys. UTI is more common in patients with a history of newborn hospital admission. However, the difference is not statistically significant. Other risk factors of UTI as revealed in the present study are constipation and dysuria. Encopresis was also considerably higher in definitive UTI cases. In terms of clinical presentation, fever and anorexia are more or less common (52% and 43.7% respectively), abdominal pain is less common, and irritability and vomiting are rare. Few studies have assessed the sensitivity, specificity, and predictive value of symptoms and signs associated with UTI in children.^{19,20} Fever is the commonest symptom of UTI in infants and the presence of other sources of fever on clinical examination does not exclude UTI.²¹ In infants and young children, symptoms and signs of UTI tend to be non-specific. Older children may have symptoms including loin or abdominal pain, frequency, dysuria, urgency, hesitancy, enuresis, and haematuria.²² The 1999 American Academy of Pediatrics practice parameter, based on the accompanying technical report, recommended that UTI should be considered in any child younger than two years of age with unexplained fever.²³

A study of 2411 febrile children (males up to one year and females up to two years of age) with a rectal temperature > 38.5°C showed an overall UTI prevalence of 3.3%. Higher prevalence occurred in children with malodorous urine or haematuria (8.6%), abdominal or suprapubic tenderness (13.2%), children who appeared ill (5.7%) or had a fever of > 39°C (3.9%) though these signs were uncommonly elicited. Symptoms of vomiting, diarrhoea, irritability, and poor feeding were common in febrile children with UTI but equally common in children with fever due to other causes.²¹ The Pediatric Research in Office Settings (PROS) Febrile Infant Study showed that fever >38°C of duration >24 hours is also a predictor of UTI.²⁴ A UK study has reported that a history of urine smell was unlikely to be of benefit in UTI diagnosis.²⁵ Studies have shown no difference in clinical symptoms in children with bacteraemic and non-bacteraemic UTIs.²⁶ Acute pyelonephritis is a UTI with systemic

features including fever, vomiting, abdominal or loin pain, and lethargy.²⁷ Nuclear renal scans have suggested that the majority of febrile young children with UTI will have acute pyelonephritis.^{18,21} Available studies with data to assess fever as a marker of pyelonephritis provide a wide range of sensitivity (53% to 84%) and specificity (44% to 92%).¹⁹ Diagnosing acute pyelonephritis using clinical and laboratory parameters is unreliable in children particularly those less than two years old.¹⁶

CONCLUSION:

Summarizing the above discussion, it is evident that children with UTI usually present with fever with or without dysuria, frequency of urination, anorexia, and abdominal or loin pain. Boys more often suffer from the problem in early infancy and uncircumcised boys are the usual victims, when several fecal bacteria may cause retrograde infections. Thus, children presenting with febrile illness should be suspected of having urinary infections unless otherwise proven after a urine culture. Girls usually present with this problem from 3 years onwards during their toilet training. UTI in children should be dealt with utmost caution, for its association with a wide range of complications. Thus, children presented with febrile illness should be suggested for a urine culture to find the clue of febrile illness.

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