

# ASSOCIATION OF URINARY TRACT ABNORMALITIES IN CHILDREN WITH FIRST URINARY TRACT INFECTION

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## ABSTRACT

**Background:** Urinary Tract Infections (UTI) may be a variety of presentation of underlying urinary tract abnormalities including vesicoureteral reflux (VUR), obstructive uropathy, urolithiasis, and ureteral duplication. The long-term complications of UTI with these conditions are renal scarring, hypertension, and chronic renal failure.

**Objective:** The aim of this study was to determine the incidence of urinary tract anomalies associated with first UTI.

**Methodology:** We reviewed 158 patients (aged one month to 15 years) who were hospitalized with symptomatic UTI during a 2-year period (2001-2003). Patients with incomplete investigations were excluded from the study. One hundred twenty six patients (100 girls and 26 boys) were included in the study. Ninety-seven (77%) were under 5 years. Confirmed cases of UTI underwent renal and urinary tract ultrasonography (US), voiding cystourethrography (VCUG), and 99mTc-dimercaptosuccinic acid (DMSA) scan.

**Results:** The most common presentation were fever (83%) and dysuria (48%). The commonest causative agent was E coli (88%). VUR was found in 50 (39.6%), 39 girls, and 11 boys. Other urinary tract abnormalities were renal stone in 10 (8%) patients, pelvic ureteric junction obstruction in 8 (6.3%), neurogenic bladder in two boys and one girl, double collecting system in 2 girls, posterior urethral valves in two boys and ureterocele in one girl, respectively.

**Conclusion:** Forty percent of patients had VUR and 20% had other associated abnormalities in urinary tract. We recommend that US, VCUG and DMSA scan should be routinely performed on all patients after the first UTI.

**KEY WORDS:** Urinary tract infection, Vesicoureteral reflux, Urinary tract anomaly.

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## INTRODUCTION

Urinary tract infection (UTI) may be a presentation of variety of underlying urinary tract abnormality. The long-term complications of recurrent UTI are renal scarring, hyperten-

sion and chronic renal failure.<sup>1,2</sup> UTI in young children serve as a marker for abnormalities of the urinary tract.<sup>3</sup> Several studies have shown that radiological abnormalities exist in as many as 25%-55% of children investigated after their first UTI, with one-third having vesicoureteral reflux (VUR). In most cases the first episode of UTI occurs in the 1st year of life and it is believed that young growing kidneys are more vulnerable to renal parenchymal damage.<sup>4</sup> The purpose of this study was to determine the association of renal abnormalities in children with their first documented UTI.

## PATIENTS AND METHODS

From April 2001 to March 2003 all patients presenting with UTI were investigated prospectively. The study enrolled children aged

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one month to 15 years, who presented with first proven UTI. Ultraasonography (US), voiding cystourthrography (VCUG), and DMSA renal scan were performed in all patients. One hundred and fifty-eight patients were managed, 32 of whom with incomplete radiological investigation were excluded from the study. Of the remaining 126 patients, 100 were girls and 26 boys. History of fever, irritability, poor feeding, anorexia or vomiting, dysuria, frequency, dark urine and foul smell urine were documented in a proforma. All patients were examined clinically. Blood pressure was recorded and the circumcision status of the male patients was noted. UTI was diagnosed when a single pathogenic bacillus was detected on culture. The urine samples were collected, depending on age of patients by suprapubic aspiration, catheterization, clean-catch or mid-urine stream. Urine cultures were obtained by at least two consecutive bag urine samplings with  $> 10$  colony forming units (CFU)/ml of a single bacterial species or by suprapubic aspiration (any growth), catheterization (growth of  $10^3$  CFU/ml).<sup>2</sup> All patients were treated with intravenous ceftriaxone or an aminoglycoside (amikacin or gentamycin) with or without ampicillin for at least 7 days followed by an oral cefixime for up to 10 days. The antibiotics were changed, if necessary, according to the results of bacterial sensitivity. Patients with abnormal imaging received antibiotics for 14 days. Renal and urinary tract ultrasound were

performed for detecting abnormalities within 2-3 days of admission to the hospital. All patients were evaluated for VUR by voiding cystourthrography (VCUG) 3-6 weeks after the UTI when urine culture proved negative. VCUG was performed using urograffin 30%, which was instilled into the bladder through a pediatric feeding tube or Foley's catheter according to patient's age, by gravity until voiding occurred. A post-void film of the bladder was taken to document bladder emptying and residual bladder volume. For male children, a view of the urethra was also obtained. VUR was classified according to the international reflux study classification.<sup>7</sup> DMSA scan was performed in all children to evaluate renal scarring and split renal function. A kidney uptake of 45%–55% of the total renal activity was considered normal. Renal scar was defined as focal or generalized areas of diminished uptake of the isotope associated with loss or contraction of function renal cortex. This may appear as wedge-shaped defects, cortical thinning or flattening. All renal scans were reviewed by the same panel of nuclear radiologists. All male patients included in this study were circumcised due to religious obligation because it is a religious custom here to circumcise male children early in life. Data were analyzed with Fisher's exact test and chi-squared test. A P value  $< 0.05$  considered significant.

## RESULTS

Fifty patients (39.6%), 39 girls and 11 boys were found to have VUR (Table-I). VUR was bilateral in 18 (14.3%) and unilateral in 32 (25.3%). The grading of reflux was grade I in 6 (4.7%), grade II in 10 (7.9%), grade III in 25 (19.8%), grade IV in 7 (5.5%) and grade V in two (1.5%) respectively. Urinary tract abnormalities other than VUR were observed in 26 (21%) patients (Table-II). These included urolithiasis in 10 (7.9%), obstructive hydronephrosis in 8 (6.3%), neurogenic bladder in three (two boys and one girl), double collecting system in two boys, posterior urethral valves (PUVs) in two boys and ureterocele in one girl respectively. DMSA scan was abnormal in 78 (62%)

Table-I: Prevalence of Vesicoureteral Reflux (VUR) detected by voiding cystourethrography in 126 hospitalized children with symptomatic Urinary Tract Infection in relation to Reflux status

Grade of VUR	Girl		Boy		Both	
	N (n=100)	%	N (n=26)	%	N (n=126)	%
0	61	(61)	15	(57.69)	76	(60.31)
I	5	(5)	1	(3.8)	6	(4.76)
II	8	(8)	2	(7.6)	10	(7.93)
III	19	(19)	6	(23)	25	(19.84)
IV	5	(5)	2	(7.6)	7	(5.55)
V	2	(2)	0	(0)	2	(1.58)
Unilateral	24	(24)	8	(30.76)	32	(25.39)
Bilateral	15	(15)	3	(11.53)	18	(14.28)
Total	39	(39)	11	(42.30)	50	(39.6)

Table-II: Frequency of Urinary Tract Abnormalities other than Vesicoureteral Reflux in 126 hospitalized children with symptomatic Urinary Tract Infection.

Abnormality	Girl		Boy		Both	
	No	%	No	%	No	%
Utero pelvic junction obstruction	8	(8)	0	(0)	8	(6.34)
Ureteral duplication	2	(2)	0	(0)	2	(1.58)
Posterior Urethral Valves	0	(0)	2	(7.6)	2	(1.58)
Ureterocele	1	(1)	0	(0)	1	(0.79)
Urolithiasis	8	(8)	2	(7.6)	10	(7.93)
Neurogenic bladder	1	(1)	2	(7.6)	3	(2.38)
Total	20	(20)	6	(23.07)	26	(20.63)

of patients. Renal scarring were unilateral in 49 (39%) and bilateral in 29 (23%) patients. The causative agent was *Escherichia coli* in 111 (88%), *Klebsiella* in 8 (6%), *Proteus* in three, *Staphylococcus suprophyticus* in two and others in two patients. Thirty-eight (30%) patients were less than one year, 59 (47%) between one to 5 years, 24 (19%) 5 to 10 years and 5 (4%) 10 to 15 years old. In 10 patients with high grade VUR the urine specific gravity was repeatedly less than 1005 which confirmed reflux nephropathy.

In 121 (96%) patients, serum creatinine level was normal (for the age of patient) but in five (three girls and two boys) was elevated. Of the patients four (two girls and two boys) patients had higher grade reflux. Of these 4 cases, 3 (two girls and one boy) had primary VUR and one boy had PUVs. The fifth case with elevated serum creatinine and low glomerular filtration rate (GFR) had bilateral renal stone due to idiopathic hypercalciuria.

## DISCUSSION

Approximately 13-15% of end-stage renal diseases are thought to be related to unrecognized UTI in children.<sup>2</sup> Congenital anomalies of the urinary tract are well known causes of UTI in children.<sup>3</sup> In our study fever occurred in 104 (83%) and dysuria in 53 (42.3%). *E.coli* was the predominant organism in our patients; it was isolated from 111 (88%) of cases. This is supported by the literature and coincides with

the neighboring countries.<sup>8</sup> The prevalence of reflux in general population is not well known.

Bailey surveyed the literature and reported 0.4 to 1.8% of children without a history of UTI had reflux.<sup>9</sup> The prevalence of VUR in children with UTI varies among different racial groups, being highest in white children with symptomatic UTI. Studies from the United States, United Kingdom, and Italy show the highest prevalence of VUR (41%–63%).<sup>10-12</sup> In our study VUR was the most common associated abnormality detected in 50 (39.6%) patients of these 39 (39%) of the girls and 11 (42.3%) boys. This was similar to findings reported by Howard et al.<sup>13</sup> which reported the presence of VUR in 39% of symptomatic Chinese children with UTI. In this study, male patients had a higher frequency of reflux than females (42.5% vs. 39%). Renal scarring was detected in 78 (62%) patients, unilaterally in 49 (39%) and bilaterally in 29 (23%). But only in 5 patients (3 girls and 2 boys, severe scars were found in both kidneys. These cases had an elevated serum creatinine and a low GFR. Of these four had high-grade (III –V) reflux, the fifth case with impaired renal function had bilateral renal stones due to idiopathic hypercalciuria. Dilatation of the collecting system may involve any or all portions of the collecting system from the renal calyces to the ureterovesical junction, resulting in various degrees of hydronephrosis and hydroureter. Ureteropelvic junction obstruction is the most common congenital renal anomaly and ultrasound is the most sensitive imaging modality for detection of hydronephrosis and hydroureter.<sup>14</sup> In our series associated abnormality other than VUR was detected in 26 (21%) cases, renal stone (8%), obstructive hydronephrosis (6.3%), neurogenic bladder 3 (2.3%), PUV 3 (2.3%) and ureterocele 1(0.79%).

## CONCLUSIONS

The results of the present study show that about 40% of infants and children with (symptomatic) UTI had VUR. Other associated urinary tract abnormalities were also seen in one-fifth of patients. These support the idea

that nearly all the patients with UTI need a complete imaging work up. We recommend that ultrasound, VCUG and scan should be routinely performed on all patients after the first UTI. DMSA scan may also be performed if any abnormality is detected on these studies.

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