ORIGINAL REPORT

When is the Best Time for Voiding Cystourethrogram in Urinary Tract Infection of Children?

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Abstract- This study was conducted to investigate whether the length of the interval between a urinary tract infection and the performance of the voiding cystourethrogram influences the presence or severity of vesicoureteral reflux (VUR). In this study 161 children with first episode of urinary tract infection were evaluated. Depending on time of performance of voiding cystourethrogram (VCUG), patients divided into two groups: early (within the first 7 days following treatment) and late (during second week or thereafter of the start of treatment). The prevalence and severity of vesicoureteral reflux in both groups were compared. Out of 161patients, the early and late groups consisted of 75 and 86 patients, respectively. The prevalence of vesicouretral reflux in the early and late groups was 25.3% and 30.2%, respectively. No significant difference was observed between two groups regarding prevalence (P=0.598) and severity (P=0.379) of vesicoureteral reflux. This study showed that the prevalence and severity of VUR is not affected by timing of VCUG. Therefore, it is recommended that in children with urinary tract infection, VCUG should be done following negative urine culture as soon as possible.

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Introduction

Urinary tract infection (UTI) results from bacterial invasion to the urinary tract system. It is one of the most important causes of chronic renal failure. To prevent serious complications, early diagnosis, proper treatment and elimination of risk factors is very important (1-6). Multiple risk factors increase predisposing to UTI including renal abnormalities, constipation, hypercalciuria and vesicoureteral reflux (VUR) (1,4). VUR results from abnormal backflow of urine from the bladder to ureter and in some instance to pelvis and calyx (1). Based on previous studies, the prevalence of VUR is 25 to 40% in children with UTI (1,7). Performance of voiding cystourethrography (VCUG) is necessary for diagnosis and treatment of VUR. The timing of VCUG performance is controversial. Some authors recommend that VCUG should be done 4-6 weeks after treatment of UTI (8,9). But others believe that VCUG must be done as soon as possible (10,11). Due to the controversies, this study was performed to determine the time of performance of VCUG in children with UTI hospitalized in Qazvin children hospital, Qazvin (Iran).

Materials and Methods

In this cross-section study, 161 children with UTI that were admitted in Qazvin children's hospital during September 2008 to March 2010 were investigated. Qazvin children hospital is affiliated to Qazvin University of Medical Sciences, Iran. All patients were younger than 12 years. Inclusion criteria included: 1-first episode of UTI 2-positive urine culture (more than 10^5 colonies of one organism per ml of urine by clean catch method or more than 10^3 colonies of one organism

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per ml of urine by catheterization or presence of any number of colonies of organism in urine culture taken by suprapubic method). Patients with negative urine culture, presence of more than one organism in urine culture and history of more than once episode of UTI were excluded.

According to the time of performance of VCUG, patients were divided into two groups: early (within the first 7 days following treatment) and late (during second week or thereafter of the start of treatment). VUR was diagnosed in all children by contrast VCUG. All VCUG were performed by the radiologist of Qazvin children's hospital. Reflux was graded according to the International Study of Reflux in children (12). Patient's data were gathered from medical records including: symptoms, laboratory tests, imaging and results of VCUG. Two groups were compared and analyzed by Chi-square and Mann-Whitney test using SPSS software. *P* value < 0.05 was considered significant.

Results

Out of 161 children with urinary tract infection 35 (21.6%) were males and 126 (78.4%) females. Minimum and maximum ages were 12 days and 132 months, respectively with median 13 months. Minimum and maximum ages in male were 30 days and 96 months, respectively with median11 months. In females similar values were 12 days and 132 months, respectively with median of 18.5 months (*P*=0.063). Symptoms and signs in patients included fever 142 (88%), dysuria 92 (57%), abdominal pain 55 (34%), vomiting 45 (28%), urine frequency 10 (6%) and flank pain 4 (2%).

Abnormal laboratory findings included

Active urinanalysis 125 (78%), increased ESR 122 (76.3%), leukocytosis 110 (78%), positive CRP 109 (68.2%). Ultrasonography and renal DMSA scan were abnormal in 36.6% and 35.5% of patients, respectively. Abnormal sonography included pyelocalyces dilation (83.08%), hydronephrosis (25%) and ureteral dilation (20%). Pyelocalyceal dilation was more prominent in the left side (68.04%). Abnormal DMSA scan included photopenia (90.07%), decreased uptake (70.83%) and renal scar (13.4%). Positive urine culture consisted: *E.coli* 145 (90%), *klebsiella* 9 (5.5%), *proteus* 4 (2.48%) and *staphylococcus epidermis* 2 (1.24%). Antibiogram of urine culture revealed that ceftriaxone (89.98%) was most and ampicillin (19%) was least effective medicine.

Out of 161 patients that performed VCUG, 75 (46.6%) belonged to the early and 86 (53.4%) to the late groups (*P*=0.386). Time between UTI and performance of VCUG in late group was 8-14 days 30 (34.8%), 15-21 days 15 (14.4%), 22-28 days 20 (23.2%) more than 28 days 21 (24.4%). Statistically there was no significant difference between two groups regarding the sex and average of age, (Table 1).

Of 161 patients VCUG was abnormal in 45 (27.9%). The prevalence of VUR in early and late groups were 19 (25.3%) and 26 (30.2%), respectively (Table 2). No significant difference was observed between the two groups regarding the prevalence (*P*=0.598), severity (*P*=0.379) and site of VUR (*P*=0.775) (Tables 2-4). No significant difference was observed comparing timing VCUG in two groups regarding sonography (*P*=0.413) and DMSA scan (*P*=1) (Tables 5 and 6).

Table1. Gender distribution and age average in both groups.

Group	Gender	Number	Median (month)	95% Confidence interval	
early	boy	15	11	6.67	40.39
	girl	60	24	23.75	37.66
	total	75	24	22.92	35.62
late	boy	20	10	8.96	29.33
	girl	66	12	17.78	31.92
	total	86	12	17.67	29.36
P		0.703	0.283		

Table 2. Comparison of two groups regarding the prevalence of vesicoureteral reflux.

VCUG	Early group		Late group	
Reflux	n	%	n	%
yes	19	25.3	26	30.2
no	56	74.7	60	69.8
total	75	100	86	100

Chi-square test, *P*=0.598

Table 3. Comparison of two groups regarding the severity of vesicoureteral reflux.

VCUG	Early group		Late group	
Grade	**n**	**%**	**n**	**%**
I	10	52.6	8	30.8
II	6	31.6	9	34.6
III	3	15.8	8	30.8
IV	0	0.0	1	308
total	19	100	26	100

Chi-square test, *P*=0.379

Table 4. Comparison the two groups regarding the reflux site.

VCUG	Early group		Late group	
Reflux direction	**n**	**%**	**n**	**%**
Right	9	47.4	14	53.8
Left	7	36.8	7	26.9
Both	3	15.8	5	19.2
Total	19	100	26	100

Chi-square test, *P*=0.775

Table 5. Comparison of two groups regarding the sonography findings.

Sonography	Normal		Abnormal	
VCUG	**n**	**%**	**n**	**%**
early	50	49	24	42.1
late	52	51	33	57.9
total	102	100	57	100

Chi-square test, *P*=0.413

Table 6. Comparison of two groups regarding the renal DMSA scan findings.

Renal DMSA scan	Normal		Abnormal	
VCUG	**n**	**%**	**n**	**%**
Early	55	45.8	17	42.1
Late	65	54.2	19	57.9
Total	120	100	36	100

Chi-square test, *P*=1

Discussion

Vesicoureteral reflux is the most common anomaly of urinary system. It is one the most important risk factor of UTI (1). VUR is backflow of urine from the bladder to the ureter and in some instance to the pelvis and the calyx (1-4). There are two types of reflux: primary and secondary. Primary type is more common and has familial and hereditary origin, and results from malfunction of ureterovesical valve. Secondary type results from increased intravesical pressure due to conditions such as neurogenic bladder or posterior urethral valves (PUV) (1,13-17).

VCUG is the method of choice for diagnosis of VUR. The timing of VCUG is controversial. Many researchers suggest postponing the VCUG until 4-6 weeks after treatment. They believe that acute infection and release of endotoxins lead to transient reflux. Also, this process results in over-estimation of the grade of reflux (8,18). This suggestion was based on the results of animal studies and to our knowledge this theory has not been proved on human (19).

According to studies in recent years, the timing of VCUG affects neither the rate nor the grade of the VUR. Soccorso *et al*. showed that the prevalence and severity of reflux was not statistically significant in patients who performed VCUG in the first and 2 month following UTI (20). So, they recommended, VCUG should be done as soon as possible (20). McDonald *et al*. revealed that timing of VCUG did not influence the prevalence and severity of reflux during the first week and later. They mentioned that the traditional recommendation to perform the VCUG at 3 to 6 weeks after the diagnosis of UTI should be reconsidered (11). Results of other studies were in accordance with report of McDonald *et al.* (11). They recommended that VCUG should be performed as soon as possible (9,21,22). Elder believes that VCUG should be done at the end of treatment, when discharging the patient from hospital (3).

The data of this study was in accordance with recent researches. Therefore we also suggest that VCUG should be performed as soon as possible. Early performance of VCUG has following advantages: 1- It eliminates the need for antibiotic prophylaxis until the VCUG performance. 2- It is more convenient to perform this procedure at the same time as other imaging procedures are being done. 3- The patients would not be missed for VCUG. 4- This strategy relieves parental anxiety regarding the presence of VUR and increases obedience. In conclusion, this study showed that the prevalence and severity of VUR is not affected by timing of VCUG. Therefore, it is recommended that in children with UTI, VCUG should be done following negative urine culture as soon as possible.

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