

Research Article

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## A Study of Urodynamic Findings in Children Presenting with Urinary Tract Infection with and Without Reflux

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**Mostafa Sharifian,\*  
Samad Faghihizadeh,  
Mohsen Ruzrokh,  
Alireza Mirshemirani,  
Fateme Abdollah Gorji,  
Zahra Musavian**

Pediatric Infections  
Research Center (PIRC),  
Pediatric Nephrology  
Research Center (PNRC)  
and Pediatric Surgery  
Research Center, Shahid  
Beheshti University of  
Medical Sciences, Tehran,  
Iran

**\* Corresponding Author**  
Mostafa Sharifian MD,  
Mofid Children Hospital,  
Shariati Ave, Tehran, Iran  
Phone: +982122227033  
E-mail:  
sharifian.dorche@gmail.com

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**Introduction:** Urinary Tract Infections (UTIs) are common in childhood and are frequently associated with abnormalities of the urinary tract. UTIs are the leading cause of morbidity in patients with neurologic bladder; this causes recurrent UTIs and Chronic Kidney Injury & Disease (CKD) that affects their quality of life. Children with UTIs are mostly neurologically intact, but may have infections as a result of a voiding dysfunction. The present study aimed to examine the relationship between occult bladder dysfunction and recurrent UTIs in our patients.

**Material and Methods:** A cross-sectional study was done on 210 children aged 10 months to 15 years presenting with UTI with/without reflux who were admitted to the Nephrology Ward of Mofid Children's Hospital between April 2011 and September 2013 using convenient sampling. Statistic analyses were conducted using descriptive statistics, Kolmogorov-Smirnov test, Mann Whitney test, Fisher's Exact test, and odds ratio, and p values <0.05 were considered significant.

**Results:** Of 210 Children 74% were female and 26% were male. 25% had one, 25% had two, 31% had 3, and 19% had more than 3 episodes of UTI. Eighty percent of the female and 56% of the male children had recurrent UTI (P: 0.004, odds ratio: 0.361). Fifty eight percent of the patients had Vesicoureteral Reflux which was bilateral in 34% of them. There was no correlation between UTI and Urinary Reflux (P=0.152, odds ratio=1.591) and also no correlation was detected between urodynamic findings and urinary reflux (P=0.243, odds ratio=1.485). Seventy six percent of the children with recurrent UTI had abnormal urodynamic results.

**Conclusions:** Since many children with recurrent UTI and multiple renal scars have bladder dysfunction, it is recommended that urodynamic studies should be included in the evaluation of every child with recurrent UTI and renal scar.

**Keywords:** Urinary Tract Infections; Urodynamics; Vesico-Ureteral Reflux; Child.

**Running Title:** Urodynamic Findings in Children with Urinary Tract Infection

### Introduction

Urinary Tract Infections (UTIs) are very common in childhood and are frequently associated with abnormalities of the urinary tract. UTIs are the leading cause of morbidity in patients with neurologic bladder and spinal injuries [1]; this causes recurrent UTIs and Chronic Kidney Injury (CKD) that affects their quality of life [2-5]. Children with UTIs are mostly neurologically intact, but may have infections as a direct result of

a voiding disorder. Despite taking an adequate history, this disorder may be suspected but not diagnosed unless specialized studies are performed. The traditional approach (imaging by VCUG), using a history, physical examination, and bladder and renal ultrasonography, does not provide complete information about the voiding problem, and can potentially leave the child either poorly treated or untreated. In a study on 38 patients (15 males and 23 females) aged 4-16

years, Glazier concluded that video urodynamic study (VUDS) provided information about the etiology of UTI and voiding dysfunction in children that cannot be obtained from any other source [6]. In another study, Salinas Casado considered 114 women aged 28-74 years with recurrent UTI and concluded that post voiding residual volume would explain 13% of the recurrent UTIs in women [7]. This study was conducted to examine the relationship between occult bladder dysfunction and recurrent UTI in our patients.

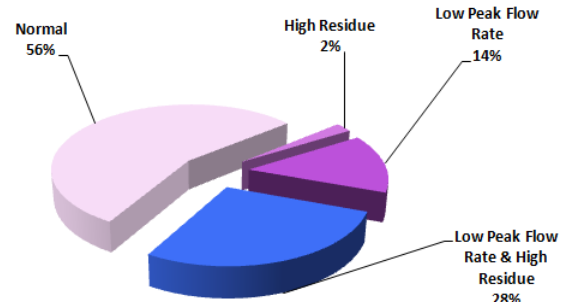
**Materials and Methods**

A cross-sectional study was done on 210 children aged 10 months to 15 years presenting with UTI with/without reflux who were admitted to the Nephrology Ward of Mofid Children’s Hospital between April 2011 and September 2013 using convenient sampling. Statistic analyses were conducted using descriptive Statistics, Kolmogorov-Smirnov test, Mann Whitney test, Fisher’s Exact test, and odds ratio, and p values <0.05 were considered significant.

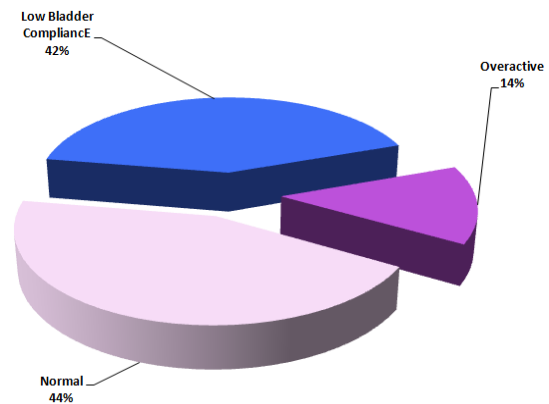
**Results**

Of 210 Children 74% were female and 26% were male. The mean age of the children was 5.6 years (range: 0.83- 15 years); 25% had one, 25% had two, 31% had 3, and 19% had more than 3 episodes of UTI. Eighty percent of the female and 56% of the male children had recurrent UTI (P: 0.004, odds ratio: 0.361). Fifty eight percent of the patients had Vesicoureteral Reflux (VUR) which was bilateral in 34% of them. Figure 1 shows the prevalence of each grade of VUR in our patients. Uroflowmetry findings are shown in Figure 2. Cystometry findings are shown in Figure 3. Urodynamic findings in children with recurrent UTI are shown in Figure 4.

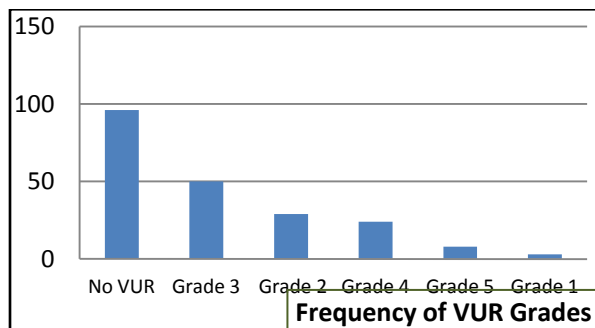
Urinary tract infection was recurrent in 80% of the female and 59% of the male children; therefore, there was a significant correlation between recurrent UTI and sex (P=0.004, odds ratio=0.361). There was no correlation between UTI and urinary reflux (P=0.152, oddsratio=1.591) and also no correlation was detected between urodynamic findings and urinary reflux (P=0.243, odds ratio=1.485). Seventy six children with recurrent UTI had abnormal urodynamic results.



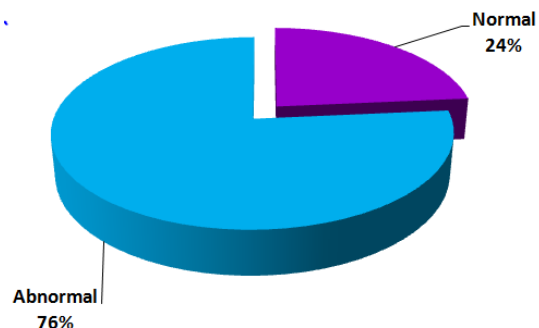
**Fig 2.** Uroflowmetry findings in 210 patients with UTI admitted to Mofid Children’s Hospital



**Fig 3.** Cystometry findings in 210 patients with UTI admitted to Mofid Children’s Hospital



**Fig 1.** Prevalence of VUR in 210 patients with UTI admitted to MofidChildren’sHospital



**Fig 4.** Urodynamic results in children with recurrent UTI admitted to Mofid Children’s Hospital

## Discussion

This is the physician's responsibility to find the etiology when a patient has recurrent episodes of UTI. Traditionally, VUR was investigated via Direct Radionuclide Cystography (DRNC) in females to cause less radiation; however, we found no correlation between recurrent UTI and urinary reflux, especially when the VUR was low to moderate. This is the case when we explore the etiology of renal scars as is stated in the medical literature which emphasizes that primary reflux is not a significant risk factor for upper tract deterioration, but bladder dysfunction.

In 2007, Madani performed UDS study in 133 children aged 7 months to 14 years with UTI and reported that the most common disturbance of the lower urinary tract function in children with recurrent UTI was Detrusor Sphincter Dyssynergia (DSD), which occurred more often in children with VUR [8]. On the other hand, Athanasious S et al. from Greece studied 144 adults with UTI and reported that urodynamic testing did not help to identify specific urogynecologic mechanisms that could improve medical and/or surgical management or prevent recurrent UTI [9]. Urinary tract complications in patients with spinal dysraphism were reported in 2008 by Sharifian et al [10]. In this report, 94 patients with various types of spinal dysraphism (54.6% male) with a mean age of 7.2 years (range: 0.1-35 years) were evaluated. Sixty-eight patients (72.3%) had at least one episode of pyelonephritis. Hydronephrosis was reported in 32 (34.1%), vesicoureteral reflux in 33 (35.1%), renal atrophy in 13 (13.9%), and end stage renal failure in 3 cases (3.2%). Among 61 patients aged 4 years or older, 47 (77%) had urinary incontinence. Urodynamic studies (UDS) were performed in 16 cases (17%) to evaluate the lower urinary tract function. Of 94 patients, 76 cases (80.9%) had paraclinical findings in favor of neurogenic bladder, of whom 45 (59.2%) received medical treatments (CIC, anticholinergic agents, or both) to offset the complications of this disorder; the mean age of these patients at the onset of medical treatments was 4.8 years. Cystoplasty was performed in 33 cases (35.1%). The author concluded that the high prevalence of urinary complications of bladder dysfunction in this group of patients was an alarm for health administrations and suggested that careful surveillance and follow up of patients with spinal dysraphism would significantly improve the life quality of these patients. Zegers Bas S J. et al

reviewed 41 European centers with 6000 patients with spinal dysraphism in 2008. They found that while there were protocols for treating UTI, comprehensive protocols were established in only 25% of these centers for managing neurologic bladder complications such as CIC, etc. [11]. This study reemphasized the need for proper evaluation and management of neurologic bladder dysfunction. In a study entitled "neuropathic bladder as a cause of chronic renal failure in children in developing countries" Kari J A evaluated 15 patients who presented with variable degrees of CKD (six cases of moderate CRF with GFR 49–30 ml/min per 1.73 m<sup>2</sup>, four cases of severe CRF with GFR 29–15 ml/min per 1.73 m<sup>2</sup>, and five cases of end-stage with GFR <15 ml/min per 1.73 m<sup>2</sup>). The female to male ratio was 1:4. Ten patients had spina bifida, one patient had sacral agenesis, and four had occult or non-neurogenic neurogenic bladder (NNNB or Hinman syndrome). The author stated that neuropathic bladder due to spina bifida or NNNB was an important cause of CRF in the developing countries. There was a considerable delay in the diagnosis of NNNB and a significant delay in starting the appropriate management in all reported patients. The author concluded that pediatricians should keep NNNB in mind and suggested specialized spina bifida clinics with a multidisciplinary approach to help to reduce the delay in starting appropriate management of these patients [12]. Szabó L et al. performed video urodynamic studies (VUD) for the diagnosis of urinary tract abnormalities in their center; during a 12-year study period from January 1990 to December 2001, 422 children aged 5 days to 20 years prospectively underwent VUD to define their urinary tract abnormalities. The VUD results were normal bladder function in 46 patients (9%), VUR in 212 (43%), unstable bladder dysfunction in 152 (31%), neurogenic bladder dysfunction in 35 (7%), urine outflow obstruction in 15 (3%), wide bladder neck in 22 (4%), and intra vaginal reflux in 9 (2%) patients. Neurogenic bladder dysfunction was excluded in 7 patients (1%). They concluded that VUD was a useful technique for the complex investigation of the lower urinary tract function together with X-ray morphology. They reported that the advantage of these studies was that they combined the objectivity of urodynamic tests with the visual radiographic image. The authors recommended VUD mostly for children under 6 years with recurrent UTI and for all children with voiding problems [13]. Urinary tract infection in patients with neurogenic bladder was

studied by Matsumotoa T et al. Two hundred and twenty patients were admitted as emergency cases to spinal cord injury centers and UTI was analyzed in acute and recovery phases of spinal cord injury. Almost all patients (209 of 220; 95%) were managed by aseptic intermittent catheterization in the acute phase. Five (23%) patients were managed with cystostomy, and five (23%) were managed with indwelling catheter. The incidence of pyelonephritis was very high both in the acute and chronic phases of neurogenic bladder (up to 32.5% in acute and 67.5% in chronic phase of spinal cord injury). The authors recommended that antimicrobial chemotherapy had to be started without delay in these patients [14]. Our study also showed that 76% of the children with recurrent UTI had abnormal Urodynamic findings. In our study, there was no significant correlation between age, VUR, and recurrent UTI, and also no correlation was detected between urodynamic findings and urinary reflux (P: 0.243). Considering the relationship between recurrent UTI and urodynamic findings, there was no significant correlation between recurrent UTI and abnormal UDS in our study (P: 0.243) which is because in our situation, many patients with recurrent UTI are not diagnosed until complications such as high fever, hypertension, seizure, or even renal failure develop. On the other hand, we could not perform urodynamic studies on children without UTI or other related complaints since it is not ethical, which is a limitation of our study. However, when we encounter recurrent UTI and multiple renal scars while the patient has no VUR as the predisposing risk factor, we find that urodynamic results are profoundly abnormal.

### Conclusion

Since many children with recurrent UTI and multiple renal scars have bladder dysfunction, it is recommended that urodynamic studies should be included in evaluation of every child with recurrent UTI and renal scar. Further studies are required with larger sample sizes to evaluate this recommendation.

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### Conflict of Interest

This study was funded by Pediatric Infections Research Center (PIRC), Shahid Beheshti University of Medical Sciences.

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