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Research Article

Can Pediatric Lower Urinary Tract Symptom Score Predicts Urodynamic Findings?

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Abstract

Purpose: The aim of this work was to record and correlate pediatric lower urinary tract symptom score (PLUTSs) with urodynamic parameters.

Materials and Methods: PLUTSs was recorded from 30 patients who were referred for urodynamic evaluation. All patients underwent urine analysis, urine culture, sonography, voiding cystourethrography, flowmetry, EMG, filling and voiding cystometry. PLUTSs was correlated with both clinical and urodynamic findings.

Results: 30 patients between the age of 6-16 years (18 boys and 12 girls) with a mean age of 11.22 ± 0.8 (boys) and 10.0 ± 0.9 (girls) were involved. Mean pediatric lower urinary tract symptom (PLUTS) score was 20.5 ± 1.5 and 16.44 ± 0.44 in boys and girls respectively. The mean PLUTS score for those with and without recurrent urinary tract infections was 20.82 ± 1.6 and 14.46 ± 1.3 respectively (p-value 0.007). PLUTS score in patients with normal and abnormal bladder capacity was 17.08 ± 1.4 and 27.75 ± 1.6

respectively (p-value 0.007). All urodynamic parameters were not significantly associated with higher PLUTSs.

Conclusion: This study shows that higher pediatric lower urinary tract symptom score is associated with higher rates of recurrent urinary tract infections as well as abnormal bladder capacities. However, PLUTS score was unable to predict multiple urodynamics parameters.

Keywords: Urodynamics; Pediatric lower urinary tract symptom score; Lower urinary tract dysfunction

1. Introduction

Lower urinary tract dysfunction in children especially those of the school-age had been reported with different prevalence. In one of the studies, the prevalence of urological symptoms in the school-aged children reached 75% in its most [1]. On the other hand, other studies have reported the presence of lower urinary tract dysfunction symptoms in 21.8% of the studied population [2].

The range of symptoms and findings associated with dysfunctional voiding includes daytime incontinence, urgency, increased frequency, nocturnal enuresis, recurrent urinary tract infections, vesicoureteric reflux, and increased postvoid residual urine. Lower urinary tract dysfunction results in a huge burden on families and society. The impact on the social behavior of children suffering from lower urinary tract dysfunction was found to be profound with about 55% of children suffering from internalizing and externalizing issues [3]. Others reported that children with lower urinary tract dysfunction are 2.6 folds more likely to suffer from emotional and behavioral problems [4]. Furthermore, these patients represent an economical weight on the national health system, considering the number of visits required, the performance of invasive procedures like urodynamics, voiding cystourethrography, biofeedback training sessions, and drugs used. Accordingly, a number of questionnaires have been introduced with questions covering both urological symptoms as well as the quality of life for both the patients and their families. These questionnaires are considered an effective means for evaluating children and the quality of life affecting them and their parents.

They are also of great value to assess the response to treatment. Among there are variable symptom scores for lower urinary tract dysfunction in the pediatric population such as; Dysfunctional Voiding Scoring System, Incontinence Symptom Index-Pediatric score, and Pediatric Lower Urinary Tract Symptom (PLUTS) Score [5-7]. These questionnaires were not compared and assessed with urodynamic findings except for the Pediatric Lower Urinary Tract Symptom Score.

However, the comparison relied only on the pre and post-treatment scores in those with detrusor overactivity and there was no correlation performed with all urodynamic parameters in their work [7]. As one of the latest questionnaires introduced, we aimed at validating the pediatric lower urinary tract symptom (PLUTS) score using urodynamic parameters.

2. Materials and Methods

30 Patients between the age of five and sixteen years with lower urinary tract symptoms who were referred for urodynamic evaluations in a specialized urological center between July 2016 and January 2019 were included in this

study. Patients with identified neurological cause, previous surgeries of the bladder or pelvis, and parents not welling to participate in the study were excluded. Approval from medical research committee has been obtained.

All patients were assessed and examined by a senior urology consultant. The pediatric lower urinary tract symptom (PLUTS) score was used to assess the lower urinary tract symptoms and the parents were asked to fill the questionnaire in the presence of a senior urological resident. All children were routinely examined by urine microscopy with culture, urinary tract ultrasonography (USG), uroflowmetry, and voiding cystourethrography (VCUG) if not previously done by the referring urologists or pediatricians. Each patient underwent urodynamic study (UDS) both for the filling and voiding phases of bladder function as per the following protocol.

In UDS, each of the patients and their parents were explained about the procedure and parent's consent was taken. We used a double-lumen cystometry catheter Fr.6 as well as double-lumen rectal catheter Fr. 8 from Andromeda Medizinische System GmbH. Normal saline warmed at room temperature was used as the filling solution. The urodynamic assessment didn't include any video recordings during voiding. The filling rate was taken as one-fourth of the bodyweight of the patient and was continued till the child reported the presence of a full bladder, or if the pressure increased above 40cm H_2O in low compliance bladder to avoid any damage to the upper renal tract. Sensations were recorded whenever the child mentioned it.

Finally, the filling was stopped and the child was permitted to void in case no voluntary voiding started by the child without further notice. Bladder capacity, bladder compliance, detrusor overactivity (DO), detrusor leak point pressure (DLPP) were recorded. Detrusor contractions above 15cm H_2O were recorded and those below were neglected as non-significant activity [8, 9]. Bladder capacity was compared with the expected bladder capacity using the Koff's formula [(age in years +2) x 30] [10]. The pressure with flow and electromyography (EMG) were all recorded during voiding. Flow- EMG were also recorded separately using two electrodes perianal and on the thigh of the patient. Post void residual urine was recorded three times; sonographically on initial presentation, following catheter insertion, and after the voiding phase of UDS.

Descriptive statistics were used to summarize and determine the sample characteristics and distribution of the parameters related to demographic and clinical findings. Quantitative data were reported as mean and standard deviation (SD); categorical data were summarized using frequencies and percentages. The data were first tested for normal distribution using a one-sample Kolmogorov-Smirnov test. The clinical parameters as well as urodynamic findings were compared to pediatric lower urinary tract symptom score and correlations were tested using the student t-test and contingency test. Fisher's exact test was used to analyze the categorical data and significance was defined at $p < 0.05$. The analyses were performed with the Statistical Package for Social Science Software (SPSS, Chicago, IL, USA).

3. Results

The age of patients in our study ranged between 6 and 16 years. Patients included in this study were 18 boys and 12 girls with a mean age of 11.22 ± 0.8 and 10.0 ± 0.9 respectively.

Variable	**Total (%)**	**Boys (%)**	**Girls (%)**
Number of patients	30	18(60%)	12(40%)
Age (yr) Mean ± SD	__	11.22 ± 0.8	10.0 ± 0.9
Clinical Findings			
Diurnal urinary incontinence			
Yes	20(66.7%)	8(40%)	12(60%)
No	10(33.3%)	9(90%)	1(10%)
Nocturnal Enuresis			
Yes	21(70%)	11(52.4%)	10(47.6%)
No	9(30%)	6(66.7%)	3(33.3%)
Recurrent UTI			
Yes	17(56.7%)	6(35.3%)	11(64.7%)
No	13(43.3%)	11(84.6%)	2(15.4%)
Increased PVR			
Yes	15(50%)	10(66.7%)	5(33.3%)
No	15(50%)	7(46.7%)	8(53.3%)
VUR			
Yes	18(60%)	8(44.4%)	10(55.6%)
No	12(40%)	9(75%)	3(25%)

Values presented as mean ± SD (range) or number (%); UTI: Urinary Tract Infection; PVR: Post Voiding Residual Urine; VUR: Vesicoureteric Reflux.

Table 1: Demographic and clinical findings of patients (N= 30).

The clinical findings of the patients included in this study were recurrent urinary tract infections in 56.7%, nocturnal enuresis in 70%, and urinary incontinence in 66.7%. Further findings included vesicoureteric reflux and hydroureteronephrosis in 60%, abnormal flow (staccato, intermittent, and plateau) in 56.7%, and increased post-void residual urine in 50%. Table 1 summarizes the demographic and clinical features of the patients.

In terms of urodynamic findings, low bladder compliance was found in 15 patients (50%), Detrusor overactivity in 18 patients (60%), low bladder capacity in 8 patients (26.7%), large bladder capacity in 4 patients (13.3%) and increased detrusor pressure during voiding in 7 patients (23.4%). The flow curve was found to be bell-shaped in 13 patients (43.3%), staccato in 7 patients (23.3%), interrupted in 9 patients (30%), and plateau in 1 patient (3.3%). The EMG activity during voiding (Flow-EMG) was normal in 22 patients (73.3%) and increased in 8 patients (26.7%).

The mean pediatric lower urinary tract symptom (PLUTS) score collected from the patients and their parents was found to be 20.5 ± 1.5 and 16.44 ± 0.44 in boys and girls respectively (p-value 0.3358). The mean PLUTS score for those with and without recurrent urinary tract infections was 20.82 ± 1.6 and 14.46 ± 1.3 respectively (p-value 0.007). No significance was noticed between PLUTS score and nocturnal enuresis, urinary incontinence, or vesicoureteric reflux when compared to those without these findings. Furthermore, the PLUTS score in patients with normal and abnormal bladder capacity was 17.08 ± 1.4 and 27.75 ± 1.6 respectively (p-value 0.007) revealing a significant correlation between PLUTS score and abnormal bladder capacity.

The mean PLUTS score in those with low bladder compliance and detrusor overactivity was 18.93 ± 1.4 and 17.61 ± 1.9 vs. 17.20 ± 2.0 and 19.83 ± 1.9 in those with normal bladder compliance and no evidence of detrusor overactivity respectively (p value >0.05). Mean PLUTS score in those with high voiding pressure, and increased post-void residual urine was 17.43 ± 1.9 and 19.07 ± 1.9 vs.18.26 ± 1.5 and 17.92 ± 2.1 in those with normal voiding pressure and no significant post void residual urine respectively. No significant correlation was noted between the PLUTS score and different types of Flowmetry. EMG correlation with PLUTS score showed also no statistical significance. Table 2 summarizes the PLUTS score and all the clinical and urodynamic findings.

Variable	**Findings N (%)**	**PLUTS Score (Mean±SD)**	**P value**
Bladder Compliance			
Low	15(50%)	18.93 ± 1.4	0.490
Normal	15(50%)	17.20 ± 2.0	
Detrusor Overactivity			
Yes	18(60%)	17.61 ± 1.9	0.223
No	12(40%)	19.83 ± 1.9	
Bladder capacity			
Abnormal	12(40%)	27.75 ± 1.6	0.007
Normal	18(60%)	17.08 ± 1.4	
Voiding Pressure			
High	7(23.4%)	17.43 ± 1.9	0.780
Normal	23(76.6%)	18.26 ± 1.5	
Low	-	-	
Flow-EMG			
Normal	22(73.3%)	17.18 ± 1.47	0.238
Increased	8(26.7%)	20.50 ± 2.0	

Uroflow			
Bell shaped	13(43.3%)	20.85 ± 2.2	0.146
Abnormal	17(56.7%)	16.71 ± 1.7	
High PVR			
Yes	15(50%)	19.07 ± 1.9	0.693
No	15(50%)	17.92 ± 2.1	
VUR			
Yes	18(60%)	17.61 ± 1.6	0.657
No	12(40%)	18.75 ± 1.8	
Diurnal urinary incontinence			
Yes	20(66.7%)	19.75 ± 1.1	0.05
No	10(33.3%)	14.70 ± 2.7	
Nocturnal Enuresis			
Yes	21(70%)	19.10 ± 1.3	0.206
No	9(30%)	15.67 ± 2.6	
Recurrent UTI			
Yes	17(56.7%)	20.82 ± 1.6	0.007
No	13(43.3%)	14.46 ± 1.3	

Values presented as number (%) or mean ± SD; PLUTSS: Pediatric Lower Urinary Tract Symptom Score; EMG: Electromyography; PVR: Post-Voiding Residual Urine; VUR: Vesicoureteric Reflux; UTI: Urinary Tract Infection.

Table 2: shows the correlation of clinical and urodynamic findings with the PLUTS score.

4. Discussion

In our study, we found that the PLUTS score was significantly high in children and adolescents with history of recurrent urinary tract infections. Furthermore, as we compared the PLUTS score with objective parameters like urodynamics, sonography, and flowmetry both free and with electromyography of the pelvic floor muscles, we found that it was significantly increased in those with abnormal bladder capacity only. All other parameters were not significantly different from those with normal results.

Akbal et al. [7] when introducing the PLUTS score compared the score with multiple parameters including upper urinary tract sonography, voiding cystourethrography, MRI, DMSA scan as well as detrusor activity. In their work, the comparison between pretreatment score and 6-month post-treatment score was performed for all the parameters mentioned previously. A statistical significance was found in most of their results. However, no comparison of the mean PLUTS score in the normal group of patients and the patients with abnormal findings in MRI, upper urinary tract sonography, voiding

cystourethrography, or detrusor activity was performed. They, however, mentioned that among the non-responders to treatment, patients with VUR were having a significantly higher PLUTS score when compared to those without VUR. Accordingly, no data could be formed regarding the correlation between the score and any objective parameters used in their work. They concluded that the PLUTS score is a useful tool for evaluation of the response of the treatment in patients with lower urinary tract dysfunction.

In a comparative study performed between multiple pediatric questionnaires performed by Altan et al. Dysfunctional Voiding Symptom Score (DVSS) as well as the Dysfunctional Voiding and Incontinence Symptom Score (DVISS) were compared [11]. They found the DVISS had the highest accuracy in comparison to DVSS. They also found a significant correlation with p-value <0.001 between normal participants and those with dysfunction for both questionnaires. Although patients were subjected to perform urine analysis, uroflowmetry, sonography of the urinary tract as well as post-void residual urine measurement, no correlation between the scores and these parameters was performed.

Bartkowski et al. [12] compared DVSS with uroflowmetry, Electromyography, and post-void residual urine in children between 4 and 13 years old. They found that those with a normal DVSS (per gender) had a bell-shaped uroflowmetry curve in most of the cases (73%). On the other hand, DVSS was unable to predict EMG patterns or post-void residual urine. They also concluded that EMG patterns and post-void residual urine do not correlate with uroflowmetry curves in participants with normal DVSS. Our findings regarding these parameters supported their work although the questionnaire is not the same. Farhat et al when introducing DVSS made no objective assessment of the DVSS with urodynamics or uroflowmetry [5].

Afshar et al. [13] developed the Vancouver Score for Dysfunctional Elimination Syndrome which was also validated using a Dutch Version by Hoen et al. [14]. They all showed good statistical correlation between the control group and patients with a good test-retest reliability. However, no objective correlation with Uroflowmetry, EMG, or Urodynamics was performed in either of the two papers. Another questionnaire which was validated internationally with multiple languages includes the International Consultation on Incontinence Questionnaire – Pediatric Lower Urinary tract Symptoms (ICIQ – CLUTS) [15]. Although they concluded that the questionnaire was a good diagnostic tool for pediatric practice, no objective correlation with Urodynamics was performed. They relied on clinician judgment using history, physical examination, flowmetry, sonography for post-void residual urine.

To our knowledge, no validation of pediatric questionnaires concentrating on lower urinary tract symptoms alone or with bowel disturbance was performed using objective parameters like flowmetry, EMG of the pelvic muscles, post-void residual urine, and urodynamic parameters as a hole in the previous studies. Although Akbal et al. used detrusor activity in their correlation, the data was tested only for the comparison between pre and 6-month post-treatment assessment [7].

The results of this work should be considered in the light of some limitations. Although all previous studies with questionnaires on pediatric patients were involving a larger number of patients, this work was the first to present objective parameters and to compare it with questionnaire

scores. Regardless of the fact that most of the parameters correlated to PLUTS score were not significant except for the bladder capacity and recurrent urinary tract infections, questionnaires should be correlated with objective parameters in the future and using a larger number of patients in order to reach a highly validated questionnaire that can be used globally. Furthermore, these results also indicate that urodynamic findings cannot be anticipated by a routine examination of the patients.

This study shows that higher pediatric lower urinary tract symptom score is associated with higher rates of recurrent urinary tract infections as well as abnormal bladder capacity. Such findings should be taken into consideration when comparing between questionnaires as well as when introducing new questionnaires on pediatric lower urinary tract symptoms. PLUTS score remains a good choice for questionnaires used in pediatric urology and should not be used as a criterion for further invasive diagnostic procedures performed by the urologist like urodynamics.

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Conflicts of Interests

All authors certify that they have no affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Consent to Participate

Informed Consent was taken from the parents of the participants.

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