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Dysfunctional Voiding: Is it a Spectrum of Abnormalities with Corresponding Urodynamic Findings or One Distinct Disease?

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Abstract

Purpose: Children with no obvious anatomic or neurological abnormalities who present with various urinary symptoms such as urgency, frequency, incontinence or urinary tract infection (UTI) are often diagnosed as having dysfunctional voiding. However, it is likely that dysfunction voiding represents a spectrum of abnormalities with different etiologies. The purpose of this study is to correlate the clinical presentation of children diagnosed with dysfunctional voiding with specific urodynamic findings, with the goal of defining the different etiologies of dysfunction voiding.

Materials and Methods: Clinical assessment and urodynamic evaluation was underwent for 84 children (mean age of 8.2 years, range 3-17) with urinary symptoms suggestive of dysfunctional voiding. All the patients had a normal urogram, voiding cystogram and neurological evaluation. Urodynamic study including urethral pressure profile (UPP) was performed using a 7 Fr, 4-channel membrane catheter in all patients. Urodynamic findings were then correlated with clinical presentation. Statistical analysis was performed using 95% confidence interval.

Results: Enuresis with daytime symptoms was the most common mode of presentation and was associated more commonly with urodynamic findings of detrussor sphincter dyssynergia, overactive bladder and hypertonic bladder. Interestingly, children with dysfunctional voiding who presented with UTI had similar urodynamic findings. There was no correlation between UUP findings and clinical presentation or urodynamic findings. Similarly, there was no correlation between urodynamic findings and bowel function.

Conclusions: Patients with dysfunctional voiding may have different clinical presentation but seem to demonstrate similar urodynamic findings. This suggests that dysfunctional voiding may be a discrete problem rather than a spectrum of diseases.

Keywords: Voiding; Children

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Introduction

The term lower urinary tract dysfunction (LUTD) is used to describe children with voiding or storage symptoms. It is associated with day-time incontinence, enuresis, urinary tract infection, urinary retention and vesicoureteral reflux with potential for a significant impact on future lower urinary tract and renal function [1-3]. It is also a very common problem in the office of the pediatric urologist, accounting for up to 40% of the visits [4]. Symptoms of LUTD are found in up to 26% of 7-year-old children. Regarding children from 7 to 12 years old, isolated enuresis rates varies from 2.8% to 20.0%, meanwhile enuresis combined with day-time incontinence happens in around 2.0%. Day-time incontinence prevalence can be as high as 6.0% in girls and 3.8% in boys [5,6]. Furthermore, childhood LUTD may be associated with higher rates of lower urinary tract symptoms in adult women [7].

Diagnosis relies heavily on a good history and physical examination, but also includes radiologic and urodynamic evaluation [8]. Urodynamic examination is said to be the most reliable, but also a rather invasive tool for the diagnosis of LUTD in children, therefore it is reserved for children who do not respond to conservative treatment [9]. Uroflowmetry determines the voiding profile,

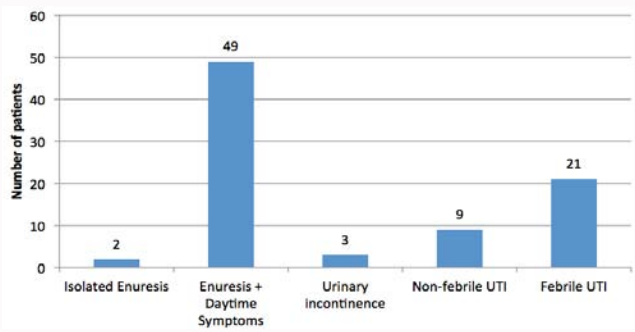

Figure 1: Clinical presentation of patients.

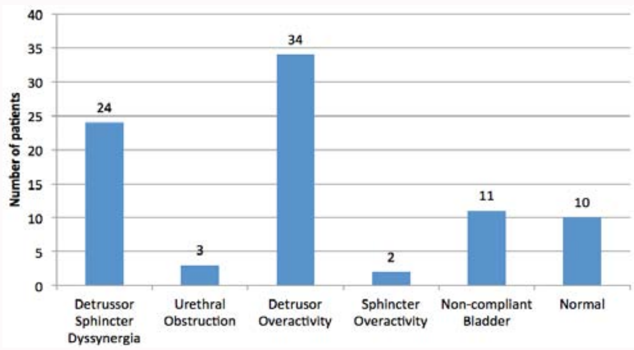

Figure 2: Urodynamic findings.

including the velocity and flowtime. A normal flow should be continuous and uninterrupted. Coupled with ultrasonography to establish the presence or absence of a post-void residual, this tool can assess pelvic floor relaxation indirectly. The composite data derived from the history, physical examination, radiographic studies, uroflow, and urodynamic study assign patients into the broad classifications of voiding abnormalities [10,11]. Taking in consideration the wide spectrum of abnormalities encompassed as LUTD, the purpose of this study is to correlate the clinical presentation of children diagnosed with LUTD with specific urodynamic findings, with the goal of defining the different etiologies of LUTD.

Patients and Methods

This was an observational study, approved by the ethics committee of our institution. In the study 82 children (mean age of 8.2 years, range 3-17) with urinary symptoms suggestive of LUTD underwent clinical assessment and urodynamic evaluation. All the patients had a normal urogram, voiding cystogram and neurological evaluation. Urodynamic study including urethral pressure profile (UPP) was performed using a 7 Fr, 4-channel membrane catheter in all patients. Urodynamic findings were then correlated with clinical presentation.

Urodynamic study was performed in the awaken states. A dual; lumen 4-Fr catheter was inserted from the urethra for perfusion of contrast media and recording of intravesical pressure in both boys and girls. The intra-abdominal pressure was recorded using a 5-Fr pediatric nasogastric tube mounted with a balloon and inflated with 5 ml normal saline. The perfusion rate of 20% urografin containing normal saline was 4 ml/min to10 ml/min depending upon the child body weight. Cystometric capacity was defined as the maximal capacity that patients urinated spontaneously. Detrusor over-activity was defined as the presence of a phasic detrusor contraction occurring during filling phase or before the voiding detrusor contraction. Voiding pressure was determined by subtracting the intra-abdominal pressure from the intravesical pressure at the maximum flow rate. Bladder compliance, post-void residual volume, and voiding pattern were also recorded. Detrusor sphincter dyssynergia was diagnosed through eletromiography performed in the suspected cases. Sphincter over activity was considered when urine stream curve presented several fluctuations, in a "staccato" pattern. Non-compliant bladder was considered when bladder compliances were lower than 12.5 ml/ cmH_20.

Clinical presentations were: enuresis, enuresis+day-time symptoms, continuous incontinence, non-febrile urinary tract infection (UTI) and febrile UTI. Enuresis was defined as intermittent incontinence while sleeping in children with more than five years-old. Day-time symptoms were defined as presence of urinary tract symptoms when assessing incontinence, frequency, voided volumes and fluid intake in children with more than five years-old.

The results of urodynamic study were assessed and compared among patients with different clinical characteristics, and appropriate management was undertaken according to the urodynamic results.

Fisher exact test was used for comparing the urodynamic findings. A 'p' value lower than 0.05 was considered statistically significant.

Results

Findings are described in Figure 1 and 2. Enuresis with daytime incontinence was the most common mode of presentation of LUTD and was associated more commonly with urodynamic findings of detrusor sphincter dyssynergia (30.6%), overactive bladder (38.8%) and non-compliant bladder (16.3%). Interestingly, children with LUTD who presented with UTI (febrile+non-febrile) had similar urodynamic findings, 23.3% of detrusor sphincter dyssynergia, 46.6% of overactive bladder and 10.0% of non-compliant bladder. There was no correlation between UUP findings and clinical presentation or urodynamic findings. Similarly, there was no correlation between urodynamic findings and bowel function (Table 1).

Discussion

In our results we did not find a clear correlation between clinical presentation and urodynamic findings predicting the urodynamic finding through the clinical presentation. Forty nine (58.3%) of our patients had enuresis associated with daytime incontinence, among these patients 38.8% presented with overactive bladder at the urodynamic study, others 30.6% presented with detrusor sphincter dyssynergia and the remaining 30.6% had other urodynamic findings. The second most common clinical presentation (febrile UTI) accounted for 25.0% of the patients. More than half (52.4%) had the same urodynamic finding: overactive bladder, other 23.8% had detrusor sphincter dyssynergia, and again the remaining 23.8% had a wide spectrum of urodynamic findings. From this data one could say that the most common urodynamic finding in patients with enuresis associated with daytime incontinence is overactive bladder and that the most common finding in patients with febrile UTI is detrusor sphincter dyssynergia, but based on our data we cannot predict the urodynamic finding of all patients through clinical presentation. In a study by Bael et al. [12] one of the aims his study was to correlate clinical presentation with urodynamic findings. The clinical diagnosis of LUTD predicted increased pelvic floor activity during voiding in 53% of his 100 patients, finding a poor correlation between urodynamic findings and clinical presentation. Therefore, in patients

Table 1: Urodynamic or radiologic findings.

Clinical Presentation	Detrusor Sphincter Dyssynergia	Urethral Obstruction	Detrusor Overactivity	Sphincter Overactivity	Non-compliant bladder	Normal	Total
Enuresis			1 (50%)			1 (50.0%)	2 (2.4%)
Enuresis+Daytime incontinence	15 (30.6%)	3 (6.1%)	19 (38.8)	1 (2.0%)	8 (16.3%)	3 (6.1%)	49 (58.3%)
Continuous incontinence	2 (66.7%)					1 (33.3%)	3 (3.6%)
Non-febrile UTI	2 (22.2%)		3 (33.3%)		2 (22.2%)	1 (22.2%)	8 (10.7%)
Febrile UTI	5 (23.8%)		11 (52.4%)	1 (4.8%)	1 (4.7%)	2 (14.3%)	20 (25.0%)
Total	24 (28.6%)	3 (6.1%)	34 (40.5%)	2 (2.4%)	11(13.1%)	8 (11.9%)	82 (100%)

with indication of urodynamic study this tool has a great importance in identifying the pathological alteration in the voiding and allowing an optimal therapeutic choice [13].

There are many treatment options for LUTD, including bowel program, biofeedback, eliminating inflammations and anticholinergic drugs. In patients with suspect of bladder bowel dysfunction it is possible to introduce enemas, laxatives and/or a high fiber intake, with a good response to the treatment stool softeners can be removed while the child remains on high fiber intake indefinitely [10].

Biofeedback therapy is a recognized treatment option for children with dysfunctional voiding. The neurophysiologic goal of the biofeedback therapy is that children learn to sustain concentration and maintain a relaxed pelvic floor and voluntary urethral sphincter during voiding [14,15]. Anticholinergic drugs, including oxybutynin chloride are indicated mainly to treat idiopathic detrusor instability [16]. Children with recurrent UTIs enter a cycle of pain, causing poor relaxation that increases the risk of subsequent infections, interfering in the voiding. In some cases a short course of antibiotic is may be used attempting to break the cycle [10]. Although LUTD may result in severe morbidity in up to 40% of patients, it seems that its long-term outcomes are favorable. More than 90% of children with LUTD improve to a complete resolution of their symptoms within 5 years from the initial evaluation [17,18]. Only small fractions remain still wet, infected or with urgency. Maturation seems to be the most important factor leading to improvement and open room for an important question: how much of the clinical improvement is due to the treatment and how much is associated with an auto-solving process [17].

Urodynamic evaluation should be reserved for those children with LUTD who fail conservative therapy, have myogenic failure, and/or reveal signs of non-neurogenic neurogenic bladder. Urodynamic criteria for LUTD include too large or small bladder capacity, poor bladder compliance, detrusor over-activity or premature contractions, an un-sustained voiding contraction, excessive voiding pressure, an intermittent uroflow pattern, or elevated residual urine [19]. Another feasible option for assessing LUTD in children is to combine uroflowmetry and electromyography (EMG). Uroflowmetry measures the urinary stream during the emptying phase of micturition, providing a picture of bladder and outlet function, as well as quantifying the volume of fluid expelled through the urethra per unit of time. The normal urinary flow curve is bell-shaped, regardless of sex age and voided volume. The shape of the flow curve is the most important factor to analyze when evaluating the flow curve of a child.

In the case of a static anatomic obstruction, for example, the obtained curve will be continuous but lower than normal and extended in time. A dynamic obstruction, on the other hand, will interrupt the continuous flow pattern and the bell shape will disappear (staccato pattern). Uroflowmetry helps to select patients who need further examinations, such as urodynamics in children. A minimum age of 4 years is required to let a child void on the flowmeter. Specific adaptations are needed so that the child can sit in a relaxed position. Uroflowmetry is also the perfect tool for follow-up of bladder training and for biofeedback training is LUTD. Mathematical models based on urodynamics use more objective criteria to differentiate uroflow patterns, such as straining or obstructive voiding. Mathematical models are ideal to help less experienced observers to distinguish the different uroflow patterns, and a higher sensitivity and specificity for the diagnosis of LUTD will perhaps be obtained [20].

Electromyography (EMG) of the levator muscle or external urethral sphincter is helpful in the evaluation of impaired sphincter relaxation. It is of proven value in the diagnosis of detrusor-sphincter dyssynergia in neuropathic disease. EMG of the pelvic floor muscles has also been of proven value in non-neuropathic dysfunctional voiding as a diagnostic test and as a therapeutic biofeedback mechanism by means of surface electrodes. It has been of proven value in differentiating neurogenic and non-neurogenic LUTD [20,21]. No correlation between UUP findings and clinical presentation or urodynamic findings has been reported before. However, simultaneous measurement of detrusor and urethral pressure will provide a useful message of etiology of voiding dysfunction [22].

Regarding limitations, the main limitations of our paper concern the boundaries of a transversal study, with lack of long-term data of these patients. Therefore, we were not able to observe how the clinical presentation evolved and correlated to the urodynamic findings throughout the time. In addition, having more patients could have enriched our findings.

Conclusion

LUTD may have different clinical presentations but seem to demonstrate similar urodynamic findings; however, it seems that clinical presentation cannot predict the urodynamic finding.

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