



Are Urodynamic Studies Really Necessary in Voiding Dysfunction in Children?

Çocuklarda İşeme Bozukluklarında Ürodinamik Çalışmalar Gerçekten Gerekli mi?

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Abstract

Öz

Aim: Urodynamic examination is considered the most reliable, but also a quite invasive tool for the diagnosis of voiding dysfunctions in children. In this study, we evaluated the role of invasive urodynamics in the diagnosis of lower urinary tract dysfunction in children.

Methods: One thousand one hundred twenty seven patients underwent urodynamic studies in the pediatric nephrology clinic in Ege University Faculty of Medicine between March 2011 and March 2016. A retrospective analysis of data including symptoms of voiding dysfunction (urinary frequency, urgency, nocturia and/or urge incontinence) and findings of physical examination, urodynamics and ultrasonography was performed.

Results: Two hundred and seventy-seven (30.8%) boys and 620 (69.1%) girls with a mean age of 7.52 (\pm 2.6) years underwent urodynamic studies. The most common abnormality was overactive bladder detected in 630 patients (70.2%). 19.9% (n=179) of the participants had dysfunctional voiding, while 9.8% (n=88) had normal results.

Conclusion: A small and frequent voiding pattern, enuresis nocturna with daytime symptoms, and postvoid urinary residual volume were the common findings seen in patients with overactive bladder. In addition, dyssynergic voiding and a bladder with large capacity but residual volume after voiding were also commonly found. To that end, we may use ultrasound, clinical examination, symptoms and voiding frequency as first-line diagnostic tools.

Keywords: Children, voiding dysfunction, detrusor instability, dyssynergic voiding, urodynamic studies

Amaç: Ürodinamik inceleme çocuklarda işeme disfonksiyonu tanısı için en güvenilir, aynı zamanda oldukça invazif bir araç olarak kabul edilir. Biz bu çalışmada çocuklarda ürodinamik çalışmanın işeme bozukluğundaki rolünü araştırdık.

Yöntemler: Ege Üniversitesi Tıp Fakültesi Pediatrik Nefroloji Kliniği'nde, Mart 2011 ve Mart 2016 tarihleri arasında işeme bozuklukları, sık idrar yapma, enürezis diurna, acil işeme isteği yakınmaları nedeniyle ürodinamik çalışma yapılan 1127 olgunun 897'sinin böbrek mesane ultrasonografileri, fizik muayeneleri retrospektif olarak değerlendirildi.

Bulgular: Çalışmaya 277 (%30,8) erkek ve 620 (%69,1) kız olmak üzere ve yaş ortalaması 7,52 \pm 2,6 olan 897 ürodinamik çalışma yapılan çocuk alındı. En sık anormallik 630 (%70,2) hastada tespit edilen detrusör instabilitesiydi. Disfonksiyonel işeme 179 (19,9%) olguda tespit edildi. Ürodinamik çalışma 88 olguda (%9,8) normal saptandı.

Sonuç: Gündüz semptomlarının eşlik ettiği enürezis nokturna, tutma manevraları, işeme sıklığında artış, post-voiding rezidüel volüm detrusör instabilitesi olan hastalarda yaygın görülen bulgulardı. Buna ek olarak, disfonksiyonel işeme olan olgularda post voiding idrar ve mesane kapasitesinde artış bulundu. Bu bulgulara göre disfonksiyonel işeme bozukluklarının tanısında invazif ürodinamik çalışmalardan önce ultrasonografi, klinik semptomlar, fizik muayene bulguları birinci basamak tanı yöntemleri olarak kullanılabilir.

Anahtar Sözcükler: Çocuklar, işeme bozuklukları, detrusör instabilitesi, dissinerjik işeme, ürodinamik çalışmalar

Introduction

Functional voiding disorder (FVD) of the bladder may occur without any anatomic or neurological abnormality. It is comprehensively classified as a disorder of the filling phase of the bladder; that is, detrusor instability (DI), or

during the voiding phase, dysfunctional voiding (DV) (1). The assessment of FVD includes both invasive and non-invasive methods. Urodynamic studies (UDSs), the most common method in daily practice, is beneficial for an objective analysis of clinical diagnosis. However, cystometry

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and pressure-flow studies must be performed in selected cases due to their invasive nature. Other methods of non-invasive modalities, such as history, physical examination and imaging techniques that could give an opinion on bladder function should be assessed carefully, and invasive urodynamics should be performed only in whom the study could change the clinical approach. UDS are gold standard methods in the assessment of voiding disorders. However, this method is discomforting and not readily available. FVD has been poorly studied in children. Besides, the dependence on invasive UDS worsens the problem. In this study, we aimed to confirm the non-invasive urodynamic UDS in children with voiding disorders and to suggest a more useful and non-invasive evaluation method.

Methods

A retrospective evaluation of voiding dysfunctions, symptoms of urinary frequency, urgency, nocturia and/or urge incontinence, results of physical examination, UDS, ultrasonography and voiding cystourethrography, and the complaints was performed in 897 patients who underwent UDS in the pediatric nephrology clinic at Ege University Faculty of Medicine between March 2011 and March 2016. Children aged 5-18 years having possible voiding disorder in whom UDS were performed in our hospital in İzmir, Turkey over a five-year period, were evaluated retrospectively. Our criteria for performing UDS were enuresis, day-time wetting, recurrent urinary tract infections (UTI), dribbling, frequency, urgency, straining, posterior urethral valves after surgery, recurrent UTI, and persistent vesicoureteric reflux (VUR). UDS were always performed in the absence of UTI, and at least ten days after an episode of UTI. Two hundred thirty children with neurologic or physical abnormalities, posterior urethral valve, ureteropelvic obstruction and VUR as well as patients with missing data were also excluded from the study. Eight hundred and ninety-seven children were assessed with a complete medical history, physical examination, bladder ultrasonography, and urodynamics. The initial evaluation was composed of a careful history of voiding and defecation behavior. A thorough physical examination including clinical neurological testing was performed. We obtained a complete medical history. Besides, information on recurrent UTI, dribbling, frequency, urgency, and straining was obtained from the files of the patients. A frequency-volume chart of urine output was recorded for two days, and consequently, the bladder was classified as "small volume frequent voiding", "large volume infrequent voiding", "incontinent", or "normal". Voiding frequency of eight or more times a day was defined as an increased daytime frequency, whereas four or less voiding per day indicated a reduced daytime frequency. Urinary

output volumes were defined as "small" or "large" if they were <65% or >150% of the expected bladder capacity, respectively. Recurrent UTI was defined by a second positive urine culture result 2 or more weeks after the termination of therapy for the first UTI.

Sonographic evaluation: We evaluated bladder capacity, bladder wall thickness (BWTh), and post-void residual urine volume (PVRUV) of the bladder and the disorders of the upper urinary tract via sonographic evaluation using Siemens system (Siemens Sonoline Versa Plus). Ultrasonography was performed with the child lying in a standardized position by one of the three authors in all cases. The bladder capacity was evaluated when the bladder was full. We detected the BWTh during that time. We evaluated the longitudinal and transverse cross-sections of the bladder floor posterior to trigone in the filled bladder and matched with age. We accepted BWTh measurements credible when the bladder emptying was >90% of a full bladder. We measured three surfaces of the BWTh, i.e., the anterolateral, lateral and posterolateral wall of the bladder. Then, we calculated the mean BWTh by averaging these three measurements (1). PVRUV was measured after urination. The bladder capacity was calculated as the total urinated volume in addition to the PVRUV. The volume calculated for each child was accepted as their bladder capacity. Volumes of >20 mL or >10% of the expected bladder capacity was considered a significant PVRUV (2). Abnormalities of the upper urinary tract found by ultrasonography were recorded.

We performed UDS, as described above in detail. UDS were performed in department of pediatric nephrology at Ege University Faculty of Medicine using an Aymed Dyno urodynamics device (3-5).

Records of 897 children were obtained. Data including the number of recorded UTI episodes, findings of UDS, ultrasound and physical examinations, and symptoms were reviewed from patient records.

Statistical Analysis

Data analysis was performed using SPSS software, version 11.5 (SPSS, Inc., Chicago, IL). The results were presented as percentages (%).

Results

Two hundred and seventy-seven (30.8%) boys and 620 (69.1%) girls with a mean age of 7.52 (± 2.6) years (range: 5-18) underwent UDS. DI was the most common abnormality found in 630 patients (70.2%). On the other hand, DV was seen in 147 (16.3%). The course of the study was normal in 88 (9.8%). DI was the most common clinical symptom seen in patients with urgency and daytime symptoms. The most common ultrasonography finding was post-void residue. The clinical features and the

investigation results are demonstrated in Table 1.

The mean BWTh was 1.28 ± 0.17 mm in patients with DV, 1.7 ± 0.52 mm in those with DI. Based on UDS findings, it was found that BWTh was increased in patients with DI compared to those with DV. Ultrasound findings of significant PVRUV were found in 76% of patients with DV and 45% of those with DI (Table 2).

DI was the most common abnormality found in 630 patients (70.2%). On the other hand, DV was seen in 147 (16.3%). The course of the study was normal in 88 (9.8%). Enuresis nocturna with daytime symptoms, holding maneuvers, a mild frequent voiding pattern, and PVURV were the common findings observed in patients with DI. DV and a bladder with large capacity having PVRUV were also commonly found. Nocturnal enuresis with daytime symptoms was the most frequent finding observed in 76% of patients. Constipation was most frequent with 56% in patients with DV (Table 2).

Table 1. Clinical features and descriptive data of the study group (n=897)	
Parameter	Number of children n (%)
Clinical features	
Enuresis with daytime symptoms (Urgency, frequency)	530 (59.1)
Recurrent UTI	480 (53.5)
Holding maneuvers	362 (40.3)
Constipation	420 (46.8)
Frequency volume charting	
Pattern of voiding	-
Small frequent voiding	697 (77.7)
Infrequent voiding	60 (6.6)
Normal	30 (3.3)
Evaluation done	
Ultrasonographic scan	-
Post-void residue	450 (50.1)
Pelvic/lyceal dilatation	229 (25.5)
Normal	218 (24.3)
Bladder abnormality detected on urodynamic studies	
Detrusor instability	630 (70.2)
Dysfunctional voiding	147 (16.3)
Lazy bladder	32 (3.5)
Normal	88 (9.8)
Capacity bladder	
Large capacity bladder	179 (19.9)
Small capacity bladder	445 (49.6)
Normal	273 (30.4)
UTI: Urinary tract infection	

Discussion

Lower urinary dysfunction is a common clinical problem observed in childhood (6). Particularly in children, the necessity of catheterization and its associated discomfort limit its use though urodynamic evaluation remains the reference standard for an accurate assessment of bladder dysfunction. For this, a non-invasive method that is sufficiently sensitive to evaluate bladder dysfunction remains to be developed (7).

UDS was done with a saline-fill, and the results were typed as "detrusor imbalance", "DV", or "normal study". Statistical analysis was performed to evaluate the significance of relationship of the non-invasive assessment parameters with those of invasive UDS results and validated the non-invasive tests compared to invasive UDS (8).

In our study, based on UDS findings, the frequency of DI and DV was found 70.2% and 16.3% of children with voiding problem, respectively. In most studies, in which UDS was performed by similar selection criteria (9,10), the incidence of DI was reported to be 70% and that of DV as 13% to 28% that is similar to our findings. Hence, this data suggest assuming that an invasive UDS in the screened population is likely to increase the diagnostic revenue (11). A few clinicians have used non-invasive assessment methods adequately in diagnosing FVD (12,13).

Daytime symptoms in nocturnal enuresis are an indispensable part of the urological assessment. During UDS, nocturnal enuresis with daytime symptoms was detected in 76% of children with DI, while it was found in 27.9% of the children with DV disorder. DI should be suspected in case of nocturnal enuresis together with daytime symptoms. Assessment of FVD in children should begin with non-invasive methods (2).

DV and detrusor imbalance constitute a wide range of functional voiding disorders, however, their common indicator is odd pelvic floor contractions (14). Their relationship with constipation, which may be as high as 56.9%, generates a dysfunctional elimination syndrome. In our study, the frequency of constipation was found to be similar to those of DV and DI. We believe that constipation is not a parameter to be used as a non-invasive UDS method.

In the literature, it has been reported that there was a relationship between recurrent UTI and DI. In a study conducted on children with recurrent UTI without VUR, the frequency of DI was reported to be 38% (15). In our study, recurrent UTI was detected in 50% of children with DI, and in 34.6% of children with DV. DI should be suspected first in the presence of recurrent UTI. With invasive UDS, the frequency of recurrent UTI is found significantly higher in patients diagnosed with DI compared to the patients with DV.

Table 2. Correlation of urodynamic findings to clinical features and ultrasonographic scan findings

	Detrusor instability n=630, n (%)	Dysfunctional voiding n=147, n (%)	Lazy bladder n=32, n (%)	Normal n=88, n (%)
Clinical features enuresis nocturna with day-time symptoms	480 (76.1)	50 (27.9)	2 (6.25)	66 (75)
Recurrent UTI	318 (50.4)	50 (27.9)	3 (9.3)	5 (5.6)
Holding maneuvers	330 (52.3)	12 (6.7)	1 (3.1)	54 (61.3)
Constipation	282 (44.7)	102 (56.9)	2 (6.2)	12(13.6)
Small capacity bladder with post-void residue	430 (68.2)	15 (8.3)	0	0
Large capacity with post-void residue	87 (13.8)	92 (51.3)	28 (87.5)	0
USS findings				
BWTh	1.7±0.52 mm	1.28±0.17 mm	1.22±0.13	1.53±0.12
Significant post-void residual	478 (76%)	82 (45%)	10 (31.2)	3 (3.4)

UTI: Urinary tract infection, USS: Ultrasonographic scan, BWTh: Bladder wall thickness

Non-invasive parameters vary greatly in the presence of invasive UDS findings of DI and DV. Therefore, the non-invasive techniques can be useful in detecting bladder disorders in the general population.

We indicated that in a child diagnosed with detrusor imbalance using invasive UDS, the associated findings are enuresis nocturna with day-time symptoms, holding maneuvers, recurrent UTI, and a bladder with small capacity demonstrating post-void residue. DV should be suspected first in the presence of a big capacity and post-voiding residue as one of the non-invasive parameters. The treatment of DI is still conservative with negligible side effects. However; in DV, conservative treatment can be planned based on non-invasive assessment, but a proper urodynamic evaluation should be done before planning a long-term and invasive therapy.

As well known, occurrence of DI and dyssynergic voiding are known findings in children with voiding dysfunction, but the diagnosis for these disorders must be done with invasive UDS. This study found that VD may be diagnosed with non-invasive parameters (ultrasonographic scan findings and symptom) without performing invasive UDS. This study is the first with the largest number of patients performed in children.

According to our results, urodynamic evaluation among children is of extremely limited value. Treatment should be based on clinical information and non-invasive parameters. We, therefore, use ultrasound, urine examination, symptoms, voiding frequency and uroflowmetry as baseline diagnostic tools.

If we have found small capillary bladder with enuresis, holding maneuvers with recurrent daytime symptoms, recurrent UTI, and PVRUV, we should consider DI without UDS. We can start empirical treatment with oxybutynin with minimal side effects. If the treatment fails and a neurogenic bladder is suspected, an urodynamic

examination should be performed. Similarly, DI should be first considered in the presence of a small bladder capacity and PVR, and in the presence of constipation, DV should be considered firstly. Conservative therapy (behavioral therapy, biofeedback, etc.) may be initiated based on non-invasive assessment, but if instrumentation (self-catheterization) is to be initiated, a urodynamic evaluation is recommended.

Conclusion

In children with recurrent UTI, daytime enuresis, urgency, and frequent voiding, FVD should be suspected. The most common urodynamic diagnosis of FVD is DI. The presence of day-time symptoms, holding maneuvers, and a bladder with a small capacity having non-significant PVR, may predict DI, while a large-capacity bladder with significant PVR may be associated with DV.

Authorship Contributions

Surgical and Medical Practices: S.C., S.M. Concept: S.C., S.M. Design: S.C., S.M. Data Collection or Processing: S.C. Analysis or Interpretation: S.C., S.M. Literature Search: S.C., S.M. Writing: S.C., S.M.

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