RESEARCH BRIEF

Abnormal Urodynamic Findings in Children with Nocturnal Enuresis

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Received: February 19, 2011;
Initial review: March 17, 2011;
Accepted: September 30, 2011.

Reduced nocturnal bladder capacity has been suggested in the pathogenesis of nocturnal enuresis. This study was conducted to define frequency of bladder dysfunction in enuretic children and determine parameters which might predict bladder dysfunction. 60 children were enrolled. Full urodynamic study (UDS) was done in case of abnormal uroflowmetry, abnormal bladder ultrasound, daytime incontinence and age 10 years. Of 60 patients ultrasound 48 underwent complete UDS. In 11, results of UDS were unreliable. The results were normal in 10 (20.8%) and 27 (56.2%) had abnormal UDS .The study revealed that abnormal UDS is common in enuretic children and overactive bladder is the most common findings. No clinical feature were found, which could identify children requiring UDS.

Key words: *Bladder dysfunction, Children, Enuresis, UDS.*

S II: S097475591100144 – 2

A proportion of children in the first grade occasionally wet the bed and 4% wet two or more times a week [1]. The prevalence estimates of enuresis are highly variable. According to a study of 10960 children, the respective prevalence of enuresis in early school ages (7 and 10 years) were 9% and 7% in boys and 6% and 3% in girls, respectively [2]. Enuresis is categorized as monosymptomatic (MNE) and non-monosymptomatic (NMNE), respectively and also primary and secondary forms [3]. Reduced nocturnal bladder capacity has been suggested in the pathogenesis [4-6].

METHODS

Sixty children with enuresis were evaluated over a two-year period (2007-2008) to define urodynamic abnormalities in enuretics and to assess correlation between clinical and ultrasonographic (US) findings with results of urodynamic study (UDS). Patients were enrolled irrespective of their response to standard treatments. Children with mental or neurologic disorders were excluded. Enuresis, its subtypes, and lower urinary tract terminology were defined as per ICCS criteria [3]. The study was approved by the local ethics committee.

Forty eight patients fulfilled criteria for full evaluation (abnormal uroflowmetry; abnormal ultrasound findings: bladder wall thickening, bladder volume changes or increased post void residual volume; daytime incontinence; and children ≥10 years).

Following informed consent, bladder ultrasound was used to estimate volume, wall thickness and post void residue ≥15 cc. Values were considered abnormal as compared to the normal range for age [7,8]. Uroflowmetry, cystometrography and electromyography were performed [8]. Intra-vesical and abdominal pressures were recorded and detrusor pressure was derived. Electromyography was done using skin electrodes.

The volume at which patient felt the first desire to void was defined as bladder capacity [9]. Bladder wall thickness ≥3 mm in filled bladder and post void residue of more than 15 mL was defined abnormal; capacity <65% of the calculated value was defined as small and >150% as large [3]. Increase in detrusor pressure ≥15 cm water as bladder was filled to a normal functional capacity was defined as low compliance bladder [3,9]. Detrusor over activity was defined as involuntary detrusor contractions during the filling phase, involving a detrusor pressure increase of >15 cm water above baseline [3]. Detrusor under-activity was defined as a contraction of decreased strength resulting in prolonged bladder emptying and/or failure to achieve complete bladder emptying [3]. Overactive bladder was defined as involuntary detrusor contractions, small bladder capacity and urethral instability [3, 10]. Patients were divided into two groups and 5 subgroups: normal UDS (group 1) and abnormal UDS (groups 2-5) (***Table* I**). Clinical details and bladder US between 2 groups were compared by Chi square test, Fisher exact test and *t* tests $P \leq 0.05$ was regarded as statistically significant.

TABLE I URODYNAMIC STUDY FINDINGS IN 37 CHILDREN

Classification	*Patients (%)*	*Uroflometry results* (No.)	*Bladder capacity*	*Bladder compliance*
Group 1	10 (27)	- normal Uroflometry (8) - outflow tract resistant pattern (2)	Normal	Normal
Group 2	15 (40.6)	- Normal Uroflometry (6); - staccato voiding pattern(3); - DSD pattern (1); - outflow tract resistant pattern (4); - unreportable (1)	Low	Low
Group 3	2 (5.4)	- Normal Uroflometry (2)	Normal	Low
Group 4	8 (21.6)	- Normal Uroflometry (6); - outflow tract resistant pattern (1) - unreportable (1)	Low	Normal
Group 5	2 (5.4)	- Normal (1) - staccato voiding pattern (1)	High	High

RESULTS

Of 60 (33 boys) with mean age 8.8 ± 2.3 years (range 5-14 yr) met the inclusion criteria. The mean number of episodes was 5.4 ± 2 per week. Enuresis was primary in 50 (83.3%) and secondary in 9 patients; 28 (8 females) had monosymptomatic, while 32 (19 females) had non monosymptomatic enuresis. A positive family history of enuresis was seen in 42 (70%). Ultrasound findings were bladder wall thickening (30; 50%), IBW (27; 45%) and post void residence in (9; 15%) patients. BV changes were reported in 3 (5%) with abnormal UDS. 15 of 27 (55%) with bladder dysfunction had normal uroflowmetry while it was normal in 8 of 10 (80%) with normal bladder function (P >0.05). ***Table* II** compares details in children with normal and abnormal UDS.

DISCUSSION

Dysfunctional voiding is an urodynamic entity characterized by intermittent or fluctuating uroflow rate due to involuntary intermittent contractions of the striated muscle of the external urethral sphincter or pelvic floor during voiding in neurologically normal individuals [3]. Although NMNE is called as detrusor dependent enuresis and patients with symptoms suggestive of bladder dysfunction categorized as NMNE, accurate assessment of bladder function often necessitates invasive UDS. The most useful classifications for bladder dysfunction are ICCS and ICSI [3, 10].

The urodynamic classifications are based on functional state of detrusor during the filling and voiding phases of cystometry which may be overactive, underactive, and normal or areflexic. Overactive bladder (OAB) is a common disorder characterized by urgency, frequency, nocturia with or without urinary incontinence [10,11].

The published literature is not clear about the group of enuretics who need UDS. We evaluated all enuretics (with MNE or NMNE) in the first step of the study, but just those who had criteria for final step of study underwent UDS. Association of enuresis and bladder dysfunction has been reported [12,4] and small voided volume has been the most important urodynamic observation [4,13]. Our study revealed detrusor overactivity in 17 (63%), and small capacity bladder in 23 (80%). Although NMNE is called as detrusor dependent enuresis, we found abnormal UDS in 17 of 20 (85%) with NMNE and 7 of 17 (41.2%) with MNE (P>0.05).

Similar to Yeung, *et al.* [4], OAB with detrusor overactivity was the most common finding. In contrast to our

TABLE II COMPARING CLINICAL DETAILS AND IMAGING FINDINGS IN CHILDREN WITH NORMAL AND ABNORMAL UDS

Variable	*Normal (%)* (n=10)	*Abnormal (%)* (n=27)	*P value*
Age<10	8(80)	18(66.7)	0.69
Male sex	5(50)	16(59.3)	0.72
Positive family history	8(80)	18 (72)	1.00
Presence of bowel symptoms	1 (10)	4(14.8)	1.00
Daytime incontinence	1 (10)	7 (25.9)	0.40
Primary enuresis	8(80)	23 (88.5)	0.60
Abnormal bladder US	8 (80)	26 (96.3)	0.60
Monosymptomatic	7(70)	10(37)	0.14
Severe enuresis	4(44.4)	17(70.8)	0.24

WHAT THIS STUDY ADDS?

- Abnormal urodynamic study is not uncommon in nocturnal enuresis but clinical parameters and bladder US findings can not predict which patients are more likely to have abnormal urodynamic study.

results, their results cannot apply to all enuretics. Some enuretics with normal daytime UDS had abnormal findings at night in that study [4], which suggests that daytime UDS may miss some cases of dysfunctional voiding. Blatt, *et al*. [14] found that bladder wall thickness cannot reliably predict detrusor over-activity, thus it does not provide an alternative to UDS. Children with enuresis do have UDS abnormalities, and OAB and detrusor over-activity are the most common findings. We didn't find any parameter which can predict enuretics who need complete urodynamic investigations. Low sample size of our study is the main limitation and larger studies are recommended.

Acknowledgements: Authors would like to appreciate Dr Ramin Sadeghi (for editing the paper), Dr Alamdarn and, Dr Hebrani, (radiologists), Dr Esmaily and Mr. Akhlaghi (Statistics), and Miss Vafa and Miss Olomy for their help.
Contributors: MN and MH: Study design, protocol preparation, results interpretation. MN manuscript writing and editing. MN and MH analysis of data and other laboratory work.
Funding: Mashhad University of Medical Sciences; *Competing interests:* None stated.

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