ANNALES
UNIVERSITATIS MARIAE CURIE-SKŁODOWSKA
LUBLIN – POLONIA
VOL. LIX, N 2, 169 SECTIO D 2004

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Dysfunctional voiding and urodynamic disorders in children with recurrent urinary tract infection

Urinary tract infection (UTI) is one of the most common infectious diseases in children. Factors that predispose to recurrent UTI include anatomical and functional abnormalities of the urinary tract and virulence of the invading uropathogens. To identify those factors a numerous diagnostic techniques have been introduced. Over the past decade, knowledge relating to the significance of functional disturbances of the lower urinary tract in the pathogenesis of recurrent UTI has accrued rapidly. Nowadays, functional disturbances of the lower urinary tract are thought to be one of the most important factors predisposing to recurrent UTI (3). Unfortunately, some symptoms of functional disturbances of the lower urinary tract, such as nocturnal enuresis or diurnal urinary incontinence, are still embarrassing. Sometimes voiding disturbances in children are neglected by their parents. Nevertheless, parents of children with dysfunctional voiding more and more frequently seek for medical consultations. During medical consultation, parents generally focus on the problem of nocturnal enuresis and do not mention about other voiding disturbances. Therefore, a carefully taken history, in addition to physical examination, laboratory, imagining and urodynamic studies, plays an important role in the diagnosis of voiding disturbances (9).

International Children s Continence Society elaborated definitions relating to particular functional disturbances of the lower urinary tract in children (10). The symptoms of functional disturbances of the lower urinary tract include urethral symptoms, nocturnal enuresis, diurnal urinary incontinence, urinary urgency, and voiding postponement syndrome. Each of mentioned above symptoms may indicate urinary tract infection or functional disturbances of the lower urinary tract (7).

The purpose of the study was to determine: a) the incidence of particular symptoms of dysfunctional voiding, b) the incidence of particular urodynamic disorders, and c) urodynamic patterns typical of particular symptoms of dysfunctional voiding in children with recurrent UTI.

MATERIAL AND METHODS

The study comprised 282 children (28 boys and 254 girls) with recurrent UTI aged 1–16 years (the mean 8+/- 3.11) treated in the Department of Pediatric Nephrology, University Children's Hospital, Lublin. Children with neurogenic bladder dysfunction were excluded from the study.

In order to identify the potential presence of vesico-ureteral reflux, in all children voiding cystourethrography was performed. Then, children were divided into two groups: A – 81 (28.72%)

children (9 boys and 72 girls) with recurrent UTI and VUR, B – 201 (71.28%) children (19 boys and 182 girls) with recurrent UTI and without VUR. In all children and in children from each group, the incidences of particular symptoms of dysfunctional voiding (urethral symptoms – US, nocturnal enuresis – NE, diurnal urinary incontinence-DUI, urinary urgency – UU, and voiding postponement syndrome – VPS) and particular urodynamic disorders (detrusor instability – DI, detrusor-sphincter dyscoordination – DSD, detrusor instability associated with detrusor-sphincter dyscoordination – DI-DSD, and functional subvesical obstruction-FSO) were determined. Urodynamic pattern for each symptom of dysfunctional voiding was also determined.

Functional disturbances of the lower urinary tract were diagnosed by urodynamic examination (Elipse, Andromeda). The examination was performed after resolution of acute urinary symptoms. In the majority of children urinary tract infection was diagnosed in early childhood or at pre-school age (mean age 3.97 +/- 2.54). In boys, the diagnosis was generally made at the age below 3 years, and in girls – between 2 and 5 years of age. The duration of follow-up ranged from several months to 16 years (mean follow-up 4.11+/- 3.06). Statistical analysis was performed using STATISTICA 5.0. P value of less than 0.05 was considered statistically significant.

RESULTS

In children with recurrent UTI, UU, NE and DUI were most commonly observed symptoms of dysfunctional voiding. There were no statistically significant differences in the incidences of particular symptoms of dysfunctional voiding between boys and girls. Similarly, the incidences of particular symptoms of dysfunctional voiding in children with and without VUR did not differ significantly (Table 1).

Table 1. Symptoms of dysfunctional voiding in children with (group A) and without (group B) vesico-ureteral reflux

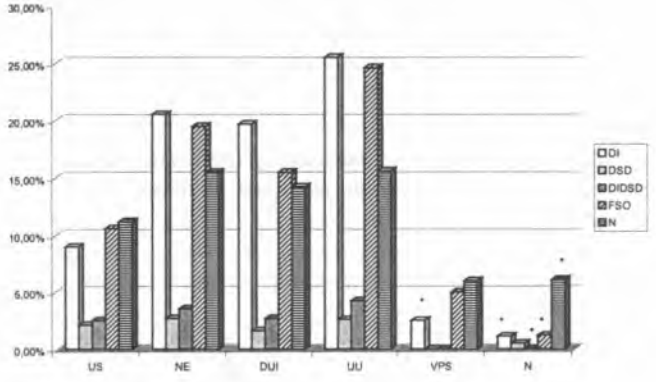
Symptoms of dysfunctional voiding	Group A (N = 81)		Group B (N = 201)		Total (N = 282)	
	N	%	N	%	N	%
US (urethral symptoms)	16	19.75	70	34.83	86	30.50
NE (nocturnal enuresis)	36	44.44	109	54.23	145	51.42
DUI (diurnal urinary incontinence)	27	33.33	100	49.75	127	45.04
UU (urinary urgency)	46	56.79	123	61.19	169	59.93
VPS (voiding postponement syndrome)	5	6.17	27	13.43	32	11.35
Normal	10	12.35	11	5.47	21	7.45

Urodynamic disorders were detected in 62.41% of the studied children. DI was most commonly observed urodynamic disorder. The incidences of particular urodynamic disorders in children with and without VUR did not differ significantly (Table 2).

In all children with recurrent UTI, UU was typical of DI, DI-DSD and FSO. Similar urodynamic disorders were detected in children with NE and DUI. DI was diagnosed in 25.53% and 20.57% of children with UU and NE, respectively ($p < 0.001$). DI-DSD was revealed in 4.26% of children with UU and in 3.55% of children with NE ($p < 0.05$). In children with recurrent UTI and without symptoms of dysfunctional voiding, the statistically significant incidence of normal function of the lower urinary tract was observed (Fig.1).

Table 2. Urodynamic patterns in children with (group A) and without (group B) vesico-ureteral reflux

Urodynamic pattern	Group A (N = 81)		Group B (N = 201)		Total (N = 282)	
	N	%	N	%	N	%
DI (detrusor instability)	28	34.56	67	33.33	95	33.69
DSD (detrusor-sphincter dyscoordination)	3	3.70	7	3.48	10	3.54
DI-DSD (detrusor instability associated with detrusor--sphincter dyscoordination)	5	6.17	8	3.98	13	4.61
FSO (functional subvesical obstruction)	14	17.29	44	21.89	58	20.57
Normal	31	38.28	75	37.32	106	37.59
Total	81	100.00	201	100.00	282	100.00



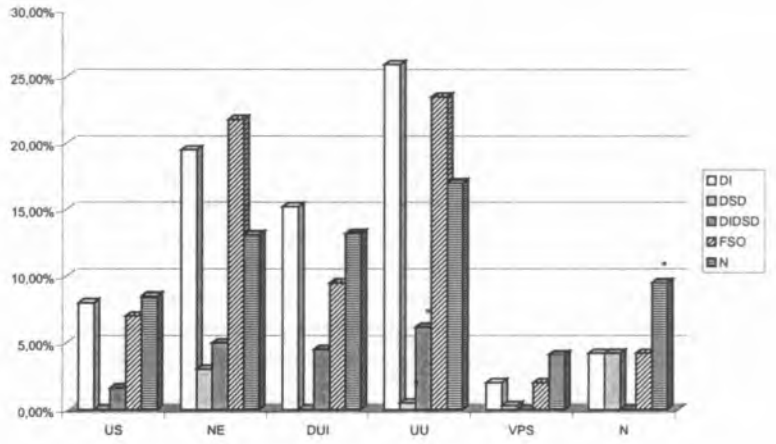
US – urethral symptoms; NE – nocturnal enuresis; DUI – diurnal urinary incontinence; UU – urinary urgency; VPS – voiding postponement syndrome; N – normal; DI – detrusor instability; DSD – detrusor-sphincter dyscoordination; DI-DSD – detrusor instability associated with detrusor-sphincter dyscoordination; FSO – functional subvesically obstruction

* Statistical significant

Fig. 1. Urodynamic patterns of particular dysfunctional voiding symptoms in children with recurrent urinary tract infection

In children with VUR, the relationships between symptoms of dysfunctional voiding and urodynamic disorders were less distinct than those in all patients. Only in children with VUR and UU, the incidences of DI and DI-DSD were statistically significant ($p < 0.05$) and they were 25.93% and 6.17%, respectively. In children with VUR and DSD, UU was not observed. In children with VUR and without symptoms of dysfunctional voiding, the statistically significant incidence of normal function of lower urinary tract was observed ($p < 0.05$) (Fig. 2).

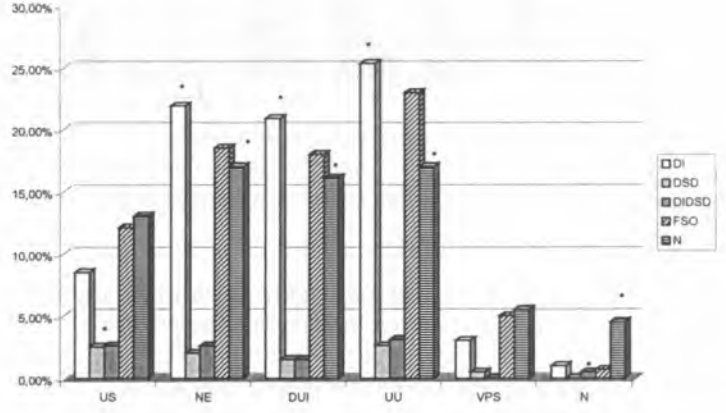
In children without VUR, NE, DUI and UU were most commonly observed symptoms of dysfunctional voiding. In the majority of those children, symptoms of dysfunctional voiding were caused by DI. DI was diagnosed in 21.89%, 20.90% and 25.37% of children without VUR and with NE, DUI and UU, respectively ($p < 0.001$). In children without VUR and with US, the statistically significant incidence of DSD was observed ($p < 0.05$). In children without VUR and with FUO, various symptoms of dysfunctional voiding were present (Fig. 3).



US – urethral symptoms; NE – nocturnal enuresis; DUI – diurnal urinary incontinence; UU – urinary urgency; VPS – voiding postponement syndrome; N – normal; DI – detrusor instability; DSD – detrusor-sphincter dyscoordination; DI-DSD – detrusor instability associated with detrusor-sphincter dyscoordination; FSO – functional subvesical obstruction

* Statistically significant

Fig. 2. Urodynamic patterns of particular dysfunctional voiding symptoms in children with vesico-ureteral reflux



US – urethral symptoms; NE – nocturnal enuresis; DUI – diurnal urinary incontinence; UU – urinary urgency; VPS – voiding postponement syndrome; N – normal; DI – detrusor instability; DSD – detrusor-sphincter dyscoordination; DI-DSD – detrusor instability associated with detrusor-sphincter dyscoordination; FSO – functional subvesically obstruction

* Statistical significant

Fig. 3. Urodynamic patterns of particular dysfunctional voiding symptoms in children without vesico-ureteral reflux

DISCUSSION

In our study, UU was the most commonly observed symptom of dysfunctional voiding. It was revealed in almost 60% of children with recurrent UTI whereas Cox et al. (7) reported that as many as 91.9% of children with recurrent UTI had UU. UU reflects detrusor hypercontractility and is caused by non-controlled detrusor contractions in the phase of bladder filling (10). Detrusor hypercontractility is also known as unstable or spastic bladder.

It is well established that urodynamic disorders may be primary or secondary to UTI. In our study, the majority of children with recurrent UTI had voiding disturbances. Only 7.45% of the studied children did not display symptoms of dysfunctional voiding. Therefore, the supposition that UTI may be secondary to urodynamic disorders seems to be justified. Similarly, in some children VUR may be secondary to urodynamic disorders. These observations are consistent with those of other authors (1).

In children with VUR, the recurrent UTI may be a result of VUR, independently of its cause (8). In our study, the presence of voiding disturbances in over 87% of children with VUR may suggest its functional origin. In children with VUR, we diagnosed such urodynamic disorders as DI, DSD, and DI-DSD. In girls, those urodynamic disorders resulted in UU and less commonly in NE. In boys, they primarily caused NE. The same functional disturbances of the lower urinary tract in children with VUR were observed by other authors. In boys with VUR, DI without anatomical subvesical obstruction was diagnosed by Sillen (12), Chandra (4) and Yeung (13).

In our study, different urodynamic disorders were most frequently diagnosed in children with NE, DUI and UU. DI most frequently resulted in such symptoms of dysfunctional voiding as UU, NE and DUI. The relationships between symptoms of dysfunctional voiding and urodynamic disorders were more distinct in children without VUR than in those with VUR. Similar observations were made by other authors (2), although Paruszkiewicz (10) demonstrated that in children with UTI and without VUR, NE and DUI were caused by DI in 69% of patients, whereas in children with UTI and VUR – only in 55% of patients. In series of Rodriguez et al. (11), DI was observed in 80% of patients with UTI, in all patients with NE and in 70% of patients with UTI, NE and DUI. VUR was diagnosed only in 20% of those children. Zwolińska et al. (14) showed that 24% of children with UTI without VUR had DI or FSO. Urodynamic disorders and symptoms of dysfunctional voiding were observed in 83% and 35% of children of this series, respectively. There were no typical urodynamic patterns for particular symptoms of dysfunctional voiding. In children with UTI and VUR, urodynamic disorders were diagnosed in 88% of patients. The authors did not observe distinct differences in the incidences of particular urodynamic diorders between children with and without VUR. In children with VUR, the majority of patients with FSO or DI-DSD displayed NE. This is consistent with our observations.

The results of our study showed that urodynamic examination is a very useful diagnostic method in children with recurrent UTIs, since functional disturbances of the lower urinary tract may play the significant role in the pathogenesis of recurrent UTIs. Dysfunctional voiding may be a result or a cause of UTI. The primary and secondary nature of dysfunctional voiding may be differentiated by disease history. The persistent presence of dysfunctional voiding indicates its primary nature whereas the secondary nature of dysfunctional voiding is evident when it occurs only during UTI recurrences. The results of our and other authors' studies revealed the existence of relationship between voiding disturbances and functional disturbances of the lower urinary tract. The history of symptoms of dysfunctional voiding is strongly suggestive for urodynamic disorders. In children with recurrent UTI and without anatomical urinary tract abnormalities, it is essential to perform urodynamic examination which enables not only to exclude anatomical subvesical obstruction but also to diagnose functional disturbances of the lower urinary tract occurring both in bladder filling and voiding phases. Urodynamic

examination is also useful in the assessment of the efficacy of pharmacological therapy of lower urinary tract functional disturbances (10). In addition, the successful treatment of lower urinary tract functional disturbances associated with UTI indicates that normal function of the bladder and urethra plays an important role in the maintenance of urinary tract sterility.

CONCLUSIONS

1. Recurrent UTIs associated with voiding disturbances strongly suggest the presence of functional disorders of the lower urinary tract.

2. In children with recurrent UTI, detrusor instability was the most common urodynamic disorder.

3. Recurrent UTI is an indication for urodynamic examination.

4. In children with and without VUR, urodynamic disorders occurred with similar incidences. This seems to suggest that functional disturbances of the ower urinary tract are secondary to urinary tract infection.

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SUMMARY

The purpose of the study was to determine: a) the incidence of particular symptoms of dysfunctional voiding, b) the incidence of particular urodynamic disorders, and c) urodynamic patterns typical of particular symptoms of dysfunctional voiding in children with recurrent urinary tract infection. The study comprised 282 children with recurrent urinary tract infection. In order to diagnose functional disturbances of the lower urinary tract, such as detrusor instability, detrusor-sphincter dyscoordination, detrusor instability associated with detrusor-sphincter dyscoordination, and functional subvesical obstruction, in all children, urodynamic examination was performed. For each symptom of dysfunctional voiding (nocturnal enuresis, diurnal urinary incontinence, urinary urgency, and voiding postponement syndrome) urodynamic pattern was determined. The study revealed that functional disturbances of the lower urinary tract coexist with positive histories of micturition disturbances. In the studied children, detrusor instability was the most common urodynamic disorder. Nocturnal enuresis, diurnal urinary incontinence and urinary urgency were symptoms of dysfunctional voiding typical of detrusor stability. In children with and without vesico-ureteral reflux, the incidences of particular urodynamic disorders were similar. This seems to suggest that disturbances of the lower urinary tract may be secondary to infection.

Zaburzenia oddawania moczu a zaburzenia urodynamiczne
u dzieci z nawracającymi zakażeniami układu moczowego

Celem pracy było zbadanie częstości występowania zaburzeń czynnościowych dolnych dróg moczowych (ddm) u dzieci z zakażeniami układu moczowego (zum), a także zbadanie zależności między zaburzeniami oddawania moczu a zaburzeniami czynnościowymi. Badaniem objęto 282 dzieci z zakażeniami układu moczowego. Wyodrębniono grupę z odpływem pęcherzowo-moczowodowym (opm) i bez opm. Badaniem urodynamicznym określano obecność niestabilności wypieracza (NW), zaburzeń koordynacji zwieracz–wypieracz i czynnościowej przeszkody podpęcherzowej. Zaburzenia urodynamiczne korelowano z objawami takimi, jak moczenie nocne (MN), moczenie dzienne (MD), parcia naglące (PN). Wyniki badań wykazały, że zaburzenia czynnościowe dolnych dróg moczowych współistnieją z obecnością zaburzeń oddawania moczu podawanych w wywiadzie, a najczęściej występującym zaburzeniem urodynamicznym u dzieci z zum jest NW dobrze korelująca z MN, MD i PN. Ponadto stwierdzono podobną częstość zaburzeń urodynamicznych w przebiegu zum u dzieci z opm i bez opm, co może sugerować wtórne do zakażenia podłoże czynnościowe zaburzeń dolnych dróg moczowych.