

Urodynamic Evaluation in Pediatric Neurogenic Bladder

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Urodynamic evaluation in pediatric neurogenic bladder is prerequisite for accurate prediction of prognosis and selection of appropriate treatment modality. We classified normal, hyperreflexic and areflexic bladders by cystometry. Hyperreflexic bladder was subdivided into two groups with or without detrusor sphincter dyssynergia and areflexic bladder into low pressure and high pressure. Among 36 patients with myelodysplasia on whom we performed a videourodynamic study vesicoureteral reflux was found in three of 7 patients with hyperreflexia with detrusor sphincter dyssynergia, two of 6 patients with hyperreflexia without detrusor sphincter dyssynergia and five of 10 patients with areflexia with high pressure. Low pressure areflexic bladder didn't show vesicoureteral reflux. When we evaluated 39 pediatric neurogenic bladder patients with a mean 25.5 follow-up months period, upper tract deterioration was improved and normal findings persisted in all the compliant patients to treatment. In the noncompliant group initial abnormal upper tract findings persisted or aggravated, especially in hyperreflexic bladder with dyssynergia and high pressure areflexic bladder. One of the three hyperreflexic bladders with dyssynergia and two of six high pressure areflexic bladders received augmented cystoplasty. These data show that urodynamic evaluation in pediatric neurogenic bladder provides excellent criteria for selecting high risk groups in pediatric neurogenic bladder.

Key Words: *neurogenic bladder, myelodysplasia, urodynamic study.*

INTRODUCTION

Pediatric neurogenic bladder is different from adult neurogenic bladder in some aspects. Congenital anomaly such as myelodysplasia is the most frequent etiologic disease (Strassburg, 1982) and almost all pediatric patients with voiding dysfunction suffer from incontinence, and renal deterioration occurs easily without appropriate treatment. Therefore, precise urodynamic study is especially needed in children but patient compliance to treatment is not satisfactory as in adults. There are several recent classifications for neurogenic bladder (Krane and Siroky, 1979; ICS Stan-

dardization Committee, 1981; Wein, 1981). However, none of these classifications were used as a standard classification in the pediatric neurogenic bladder. McGuire et al. (1981) first emphasized that high leak pressure relates to upper tract deterioration in pediatric neurogenic bladder. Recently, a poorly compliant bladder with a leak pressure greater than 40 cm H₂O has been used as a predictive factor for upper tract deterioration in newborns and infants (Ghoniem et al. 1989). And Bauer et al. (1984) recommended early intermittent catheterization in bladders with detrusor sphincter dyssynergia in infants to prevent renal deterioration. So we did urodynamic evaluation with these concepts in the pediatric neurogenic bladder for predicting the patient's status and response to treatment.

MATERIALS AND METHODS

Thirty-six patients (age: two months to 13 years old)

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with myelodysplasia were evaluated for the study of upper tract change at urodynamic test and grouped for classification of neurogenic bladder. All the patients had received a videourodynamic test since 1986. The videourodynamic test was performed with a Life-Tech Video/Urodynamic Unit and C-arm fluoroscopy. A surface electrode was used to check external sphincteric activity. During cystometry fluid was infused at a speed of 30 ml./min. through the 10F catheter. The speed was adjusted as 10% of bladder volume per minute in small infants. Uninhibited contraction was defined when more than 15 cm H₂O detrusor contraction was found during the filling phase. Hyperreflexia was defined when the bladder had uninhibited detrusor contraction during cystometry. Areflexia was defined when the bladder didn't have any definite detrusor contraction. Detrusor sphincter dyssynergia was defined when the detrusor contraction was accompanied with increased sphincteric electromyographic activity and unrelaxed external sphincter on video monitoring. Leak pressure was checked in areflexic bladders. If urine leaked at less than 40 cm H₂O or if there was no pressure rising during cystometry we defined it as low pressure areflexic bladder. If urine leaking occurred at more than 40 cm H₂O or urine leaking didn't occur at more than 40 cm H₂O we defined it as high pressure areflexic bladder (Fig. 1). All the patients were checked with ultrasonography or IVP for evaluating upper tract change. We compared the incidence of vesicoureteral reflux and upper tract dilatation between each type of bladder dysfunction. With this classification 39 patients (age: two months to 14 years old) who were followed up more than six months with an average 25.5 months were checked to evaluate the response to treatment during the past six years. Among them hyperreflexic bladder with detrusor sphincter dyssynergia were 12 and hyperreflexic bladder without dyssynergia were six. High pressure areflexic bladders were 11 and low pressure areflexic bladders were 10. Myelodysplasia was the most frequent etiologic disease and four spinal tumors and one spinal injury case were included. Intermittent catheterization and anticholinergics were recommended in hyperreflexic bladder with dyssynergia and high pressure areflexic bladder. In hyperreflexic bladder without dyssynergia and low pressure areflexic bladder, intermittent catheterization or conservative treatment was recommended. Thirteen patients had not performed the recommended protocol and we grouped these patients as the noncompliant group. Oxybutinin chloride was recommended as 0.2 mg./Kg. PO t.i.d. or five mg./time intravesically in the indicated cases. Intermittent catheterization was performed 4-6

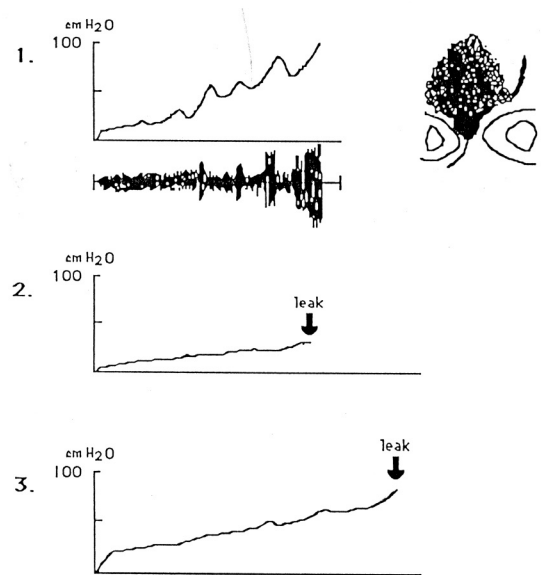


Fig. 1. 1) Hyperreflexia with detrusor sphincter dyssynergia: video-urodynamic test shows uninhibited detrusor contraction and nonrelaxed external sphincter during detrusor contraction. 2) low pressure areflexic bladder: detrusor contraction is not found and urine leaking is seen at 25 cm H₂O of intravesical pressure. 3) high pressure areflexic bladder: no detrusor contraction and 75 cm H₂O of leak pressure are seen.

times per day individually. We compared the improvement in upper tract findings between the compliant and noncompliant groups. Improvement of the upper tract was defined as when the degree of dilatation in the collecting system was decreased on regular ultrasonography or IVP and the grade of vesicoureteral reflux was decreased. Voiding cystourethrography was checked in some patients who had received urodynamic study without video monitoring.

RESULTS

Among the 36 bladders checked for upper tract change by urodynamic test the number of patients with areflexic bladder was more than those with hyperreflexic bladder. Vesicoureteral reflux and upper tract dilatation were found in hyperreflexic bladder and high pressure areflexic bladder. Whether or not the hyperreflexic bladder was accompanied by detrusor sphincter dyssynergia did not affect the incidence of upper tract change in the hyperreflexic group. High pressure areflexic bladder had the highest incidence of

Table 1. The incidence of upper tract change in the various neurogenic bladders in myelodysplasia

Neurogenic bladder	No. Cases	No. Reflux (%)	No. Dilatation (%)
Hyperreflexia			
Dyssynergia	7	3 (43)	2 (29)
Synergia	6	2 (33)	1 (17)
Areflexia			
Low pressure	13	0 (0)	0 (0)
High pressure	10	5 (50)	6 (60)
Total	36	10 (28)	9 (25)

Table 2. The upper tract findings in the compliant group to treatment in more than six months follow up patients.

Neurogenic bladder	Improved No. Cases	Stationary		Aggravated No. Cases	Total No. Cases
		N-N No. Cases	Ab-Ab No. Cases		
Hyperreflexia					
Dyssynergia	4	5	0	0	9
Synergia	0	5	0	0	5
Areflexia					
Low pressure	0	7	0	0	7
High pressure	4	1	0	0	5
Total	8	18	0	0	26

Note: N: normal upper tract, Ab: abnormal upper tract.

Table 3. The upper tract findings in the noncompliant group to treatment in more than six months follow up patients.

Neurogenic bladder	Improved No. Cases	Stationary		Aggravated No. Cases	Total No. Cases
		N-N No. Cases	Ab-Ab No. Cases		
Hyperreflexia					
Dyssynergia	0	1	1	1*	3
Synergia	0	1	0	0	1
Areflexia					
Low pressure	0	3	0	0	3
High pressure	0	2	2	2*	6
Total	0	7	3	3	13

Note: N: normal upper tract, Ab: abnormal upper tract.

*: Augmentation cystoplasty was performed in these three cases.

vesicoureteral reflux and upper tract dilatation among all the groups. Low pressure areflexic bladder had no deteriorated upper tract (Table 1). Among the 39 follow up patients upper tract abnormality was improved and normal findings persisted in all the compliant groups (Table 2). In the noncompliant group initial abnormal upper tract findings persisted and aggravated, especially in hyperreflexic bladder with dyssynergia and high pressure areflexic bladder. One

of the three hyperreflexic bladders with dyssynergia and two of six high pressure areflexic bladders received augmented cystoplasty in these noncompliant patient groups (Table 3).

DISCUSSION

Performance and interpretation of urodynamic study in children are not easy for several reasons such as

communication problems, unstable bladder in a normal child, small caliber urethra and so on. Furthermore, it is more difficult in children to predict specific neurogenic type with the symptoms and pathologic levels that the patients have because myelodysplasia was the most frequent etiologic disease. For instance, sacral lesion does not always mean detrusor areflexia. And almost all the children with voiding problems suffer from incontinence and they are in the diaper stage. Furthermore, we frequently found thickened bladders with areflexic bladders. In other words, dissociated damage between detrusor and sphincter frequently occurred and fibrotic denervated urethral sphincter has a possible role in generating trabeculated bladder in areflexic bladder (Bauer et al., 1977). The Krane-Siroky classification divides sphincteric activity in areflexic bladder into coordinated sphincter, nonrelaxing sphincter, denervated sphincter and nonrelaxing smooth sphincter (Krane and Siroky, 1979). However, it is not easy to recognize the various activities with electromyography and a more simple classification that can predict patient's status and prognosis on the basis of urodynamic test is thought to be needed.

High pressure areflexic bladder was the most serious neurogenic bladder type in our study. Although functional obstruction occurs when uninhibited contraction is accompanied by sphincter dyssynergia in the hyperreflexic bladder, low compliant areflexic bladder that has persistent high intravesical pressure seems to cause more damage to the kidney during 24 hours a day (Bauer and Joseph, 1990). McGuire et al. (1981) reported that if there was more than 40 cm H₂O of intravesical pressure when urine leaking started during cystometry in myelodysplastic patients, ureterovesical reflux was found in 68% of patients and 81% of patients had dilated ureters. If the leak pressure was less than 40 cm H₂O, there was no incidence of vesicoureteral reflux and 10% of patients had dilated ureters. This observation is very similar to that of our finding in areflexic bladder. However, we experienced that it is not easy to apply these criteria to all patients. The pressure of uninhibited contraction was usually less than 40 cm H₂O and although it was more than 40 cm H₂O, the abrupt rising of pressure prevented us from knowing the exact pressure when the urine started leaking. So we decided to subdivide hyperreflexic bladder into with dyssynergia and without dyssynergia. This division was based on Bauer's observation in myelodysplastic patients (Bauer et al., 1984). He evaluated newborns with myelodysplasia by type of electromyographic activity in the external sphincter. Seventy-one per cent of newborns with dys-

synergia had, on initial assessment or subsequent studies, urinary tract deterioration, whereas only 17 per cent of synergic children and 23 per cent of completely denervated individuals developed similar changes. Although his criteria also included the circumstance of abnormally increased electromyographic activity during filling phase, practically this finding cannot be easily differentiated from normal electromyographic activity in the child.

However, some patients without dyssynergia also had upper tract abnormality in this study. Although these patient's electromyographic activity did not increase during uninhibited contraction and truly there was no definite external sphincter contraction during detrusor contraction on video monitoring, we think there are several possibilities: that one time urodynamic study does not represent the real type of neurogenic bladder that the patient has, and that the sphincter does not actively relax during detrusor contraction but sphincteric area dilates passively. And another possibility is that the type of neurogenic bladder had changed virtually during the growing period before the time when the urodynamic test was performed because operation of pathologic lesion or persisting tethering cord may affect these changes. (Kaplan et al., 1988; Bauer, 1988).

With this classification we classified pediatric neurogenic bladders easily and applied it in making decisions to select treatment modality. On follow up, the upper tract improved in most of the compliant patients to treatment. However, in the noncompliant group to treatment a large portion of hyperreflexic bladders with dyssynergia and high pressure areflexic bladder showed deterioration or no improvement in upper tract. Hyperreflexia without dyssynergia and low pressure areflexic bladder had contrarily better results.

We think that our experience provides more insight to understand childhood neurogenic bladder in terms of patient's status and treatment response. The differentiation of neurogenic dyssynergia and physiologic dyssynergia is not easy in the childhood bladder. Noncommunication with infants is also a difficult problem. A small caliber urethra can affect the accurate assessment of leak pressure. Further study is needed to overcome these problems.

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