

Urodynamic Changes with Age in Boys with Posterior Urethral Valves

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ABSTRACT

Introduction: Bladder dysfunction is a common cause of morbidity in posterior urethral valve (PUV) patients and urodynamic study provides a useful tool to identify the bladder dysfunction. The aim of this study was to evaluate the urodynamic patterns in different age groups in PUV patients.

Material and Methods: Toilet trained patients more than 4 years of age were included in the study. Invasive urodynamic study was done in all patients. Patients were divided into three groups; Group-1 (4-8 years), group-2 (9-13 years) and group-3 (14-18 years). Various urodynamic parameters which were noted in each patient include compliance, bladder stability, bladder capacity, detrusor pressure during voiding, detrusor sphincter dysynergia and post void residue.

Results: 47 patients were included in the study. Age of patients ranged from 4 years to 17.8 years with mean age of 6.4 years. Bladder hyperreflexia (14.3% in group-1, 14.3% in group-2 and 8.3% in group-3), poor compliance (9.5% in group-1, 28.6% in group-2 and 41.7% in group-3), bladder capacity (normal in 76.2% group-1, 50.0% in group-2 and 33.3% in group-3), (decreased in 14.3% group-1, 28.6% in group-2 and 16.7% in group-3) and (increased in 9.5% group-1, 21.4% in group-2 and 50.0% in group-3), detrusor pressure during voiding (sustained in 42.5% group-1, 42.8% in group-2 and 25.0% in group-3), (waxing and waning in 28.6% group-1, 28.6% in group-2 and 41.7% in group-3) and myogenic failure in 14.3% group-1, 21.4% in group-2 and 33.3% in group-3.

Conclusion: Urodynamic pattern shows considerable overlap during childhood and through adolescence with hyper contractility generally seen in young children and hypo contractility and myogenic failure in older boys.

Keywords: Posterior urethral valves; Bladder dysfunction; Urodynamic changes

INTRODUCTION

Posterior urethral valve (PUV) is the most common form of congenital urethral obstruction with an incidence ranging from 1/3000 to 1/8000 male births [1]. In recent years, the overall prognosis of PUV patients has improved. Several factors have been identified as predictors of long term outcome [2-6]. The bladder dysfunction is one of the important predictor which is seen in about 75 % of boys with PUV after valve fulguration [2,7]. A poor understanding and inappropriate management of bladder dysfunction can result in early onset renal damage and unnecessary morbidity. It is important to identify the bladder dysfunction, so that timely, adequate and appropriate management can be offered to the child. Urodynamic study provides a useful tool to identify the bladder dysfunction and to test the efficacy of treatment as well as determine any refinements that is necessary to improve the outcome [8,9].

The bladder dysfunction shows a changing pattern with the age of the child in PUV patients and urodynamic studies are necessary to track changes in PUV patients throughout the first two decades of life [10]. It is important to know these bladder changes by urodynamic studies to modify the treatment and thus arrest the progression of bladder dysfunction. The aim of this study was to evaluate the urodynamic changing patterns in different age groups in PUV patients.

MATERIALS AND METHODS

This study was conducted in the department of Paediatric Surgery and Pediatric Urology IGICH, Bangalore, INDIA from third January 2017 to second December 2018. Patients with posterior urethral valves more than 4 years of age were included in the study. Those patients who have associated high grade vesicoureteric reflux (VUR) were not included in the study. Invasive urodynamic

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study was done in all patients using LABORIE URODYNAMICS. Most of these patients were primarily fulgurated, only few cases have vesicostomy before UDS. Bladder relaxant (oxybutynin) was stopped 48 hours before the study. Patients were divided in to the three groups as per age; Group-1 (4-8 years), group-2 (9-13 years) and group-3 (14-18 years). Various urodynamic parameters which were noted in each patient include compliance, bladder stability, bladder capacity, detrusor pressure during voiding (sustained, waxing and waning or myogenic failure), detrusor sphincter dysynergia and post void residue.

Cystometric capacity was calculated as $[30+(\text{age in years} \times 30)]$ ml. Stable bladder was defined, when the pressure during the filing of bladder does not rise more than 6-10 cmH₂O above baseline at the end of filling. Sustained detrusor pressure during voiding was defined when pdet is between 65 cm H₂O to 110 cm H₂O. Waxing and waning (unsustained) of detrusor pressure (impending myogenic failure) was defined when pdet during voiding does not sustain between 65 cm H₂O to 110 cm H₂O and drops down below the 50 cm H₂O in between. Detrusor overactivity (hyperreflexia) was defined as an involuntary detrusor contraction >15 cm of water from baseline. Bladder underactivity (myogenic failure) was recognized in patients who are filled to >150% of their expected bladder capacity and have a poor (pdetmax <50 cm H₂O) or absent detrusor contraction during voiding. Poor compliance was defined when during filling; bladder pressure is equal to or more than 20 cm of water at expected bladder capacity.

Room temperature normal saline was used for filling the bladder at 5-10% of the patients expected bladder capacity per minute. 7 Fr urethral catheter was used for the catheterization. Before the urodynamic study, uroflowmetry was done in all patients. After catheterization, any post void residue was noted. Post void residue was considered significant if the volume exceeds 15 % of the total bladder capacity.

After the procedure, oral antibiotics were given for 5 days. Patients were followed in pediatric urology clinic with ultrasonography (KUB) to see any post void residue (PVR) and upper tract dilatation. Urodynamic study was repeated only in those patients who have significant PVR, recent onset of incontinence/dribbling of urine and/or upper tract dilatation on ultrasonography.

RESULTS

47 patients were included in the study. Age of patients ranged from 4 years to 17.8 years with mean age of 6.4 years. The various urodynamic parameters in groups-1, group-2 and group-3 are shown in Tables 1-3 respectively.

In group-1, two patients had hyperreflexia, so compliance could not be assessed in these patients. Two patients did not void on catheter and one patient had severe hyperreflexia during filling and procedure was stopped due to constant leaking, so detrusor pressure during voiding could not be assessed.

Table 1: Urodynamic findings in group-1 (4-8 years).

UDM Parameter	No. of Patients (n=21)	Percentage (group %)
Hyperreflexia	3	14.3
Compliance	Good	76.2
	Poor	9.5
Bladder capacity	Normal	76.2
	Decreased	14.3
	Increased	9.5
Detrusor pressure during voiding	Sustained	47.6
	Waxing and waning	28.6
DSD	Myogenic failure	14.3
		2
Did not void on catheter	2	9.5
Post void residue	Insignificant	85.7
	Significant	9.5

Table 2: Urodynamic findings in group-2 (9-13 years).

UDM Parameter	No. of Patients (n=14)	Percentage (group %)
Hyperreflexia	2	14.3
Compliance	Good	57.1
	Poor	28.6
Bladder capacity	Normal	50.0
	Decreased	28.6
	Increased	21.4
Detrusor pressure during voiding	Sustained	42.8
	Waxing and waning	28.6
DSD	Myogenic failure	21.4
		Nil
Did not void on catheter	1	7.1
Post void residue	Insignificant	71.4
	Significant	28.6

Table 3: Urodynamic findings in group-3 (14-18 years).

UDM Parameter		No. of Patients (n=12)	Percentage (group %)
Hyperreflexia		1	8.3
Compliance	Good	6	50.0
	Poor	5	41.7
Bladder capacity	Normal	4	33.3
	Decreased	2	16.7
	Increased	6	50.0
Detrusor pressure during voiding	Sustained	3	25.0
	Waxing and waning	5	41.7
	Myogenic failure	4	33.3
DSD		1	8.3
Did not void on catheter		Nil	-
Post void residue	Insignificant	8	66.7
	Significant	4	33.3

In group-2, one patient did not void on catheter so detrusor pressure during voiding cannot be committed.

DISCUSSION

In PUV patients, there is progressive stretch injury to the bladder, which leads to a non-reversible changes in the cellular and extracellular characteristics of the bladder, leading to bladder dysfunction [11]. Due to over distension of the bladder wall, detrusor blood flow decreases resulting in ischaemia, shift to anaerobic metabolism and damage to nerves within the bladder wall [12,13]. In a rabbit model of over active bladder, there is free radical mediated ultrastructural damage and neurodegeneration [12,13]. Excess glycogen deposition within the detrusor in PUV patients results in loss of strength and elasticity of the bladder wall and tissue fibrosis. The end result of such changes in the bladder is gradual loss of bladder compliance, reduction in capacity and high storage pressures, bladder instability and poor compliance [14-19].

Persistent bladder dysfunction leads to deterioration of the upper urinary tract and kidney function, and hence urodynamic study should be a part of regular follow up in PUV patients [20].

Three patterns of bladder dysfunction overlap considerably, hyper contractility, unsustained voiding contractions (hypo contractility) and myogenic failure with true bladder atony; hypo contractility seems to be the predominant pattern. Urodynamic patterns change with age and that hypo contractility was probably a step toward detrusor decompensation, which may lead to myogenic failure with time. Therefore, myogenic failure is the likely end-stage of bladder dysfunction in boys with PUV [21]. Holmdahl et al [22] correlated the patients' age with these three classical patterns to determine whether bladder dysfunction changed during infancy, childhood and adolescence. They reported that there is uniform pattern of initial hyper contractility and low bladder capacity which changes with resolving hyper contractility and increasing bladder capacity in first year of life. Subsequently, the same authors reported urodynamic studies in boys with PUV aged <15 years, comparing them with those in post pubertal patients [23]. They found a decreasing prevalence of instability and more patients with unsustained voiding, leading to an over distended bladder after puberty. Based on these observations, Holmdahl et al [22,23] suggested that the three urodynamic patterns change with time, towards the detrusor decompensation and myogenic failure. In a series of urodynamic studies in patients with PUV at different ages

[24], 40% had bladder instability and 37% hypo contractility when assessed at 4-7 years of age. On the contrary, in patients aged 8-12 years, instability was present in 33% and hypo contractility in 45% of patients. Lal et al [25] noted that small, hypo compliant, and unstable bladders were almost always seen in prepubertal boys and in the first 5 years following undiversion, whereas large, hypotonic bladders with impaired contractility were seen in older boys. These results seem to confirm that bladder dysfunction in boys with PUV changes from the unstable/hyper contractile bladder found in infants to hypo contractility in childhood, which may deteriorate with age, leading to a true myogenic detrusor failure after puberty.

In our study also, good compliance, normal capacity, sustained detrusor pressure, hyperreflexia was seen in young children and poor compliance, over distended bladder with increased capacity, waxing and waning (unsustained) of detrusor pressure, myogenic failure in older children.

Serial urodynamic evaluation should be undertaken in all boys during evaluation after valve ablation. In this way any impairment in bladder compliance, storage pressures and detrusor contractile power which can deteriorate the upper tracts, renal damage and early onset of renal failure; can be detected early even if the boys do not complain of urinary incontinence or voiding problems.

CONCLUSION

Urodynamic pattern shows considerable overlap during childhood and through adolescence with hyper contractility generally seen in young children after the fulgration and hypo contractility and myogenic failure in older boys. The present urodynamic study supports the hypothesis of a natural development of valve bladder dysfunction toward detrusor failure. The early detection of subclinical hypo contractility and the possibility of early bladder rehabilitation might be helpful in preventing emptying difficulties secondary to functional obstruction, and the progression of hypo contractility to over distension and detrusor myogenic failure after puberty.

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