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ESTABLISHMENT OF THE NOVEL CYSTOSCOPIC CLASSIFICATION SYSTEM FOR BLADDER TRABECULATION IN NEUROGENIC BLADDER

Hypothesis / aims of study
Patients with bladder dysfunction often show bladder trabeculation, an irregular contour with thick walls and hypertrophied muscle bundles. However, there had been no objective classification or grading system for bladder trabeculation. We previously established and validated a fluoroscopic grading system for bladder trabeculation [1]. Presently, we aimed to establish cystoscopic grading system for trabeculated bladder and also to correlate clinical parameters in patients with neurogenic bladder.

Study design, materials and methods
A total of 140 patients with neurogenic bladder underwent both fluoroscopic urodynamic study and cystoscopic examination within a 6 month interval between Sept 2005 and Dec 2012. The electronic medical records, including all cystoscopic and fluoroscopic images with urodynamic database, ere retrospectively reviewed.
We established the classification system based on the formation of muscle bundle and depth of mucosal layer with a resultant grading the severity of trabeculation into four grades: 0 (none), 1 (mild), 2 (moderate), and 3 (severe) (Table 1).
Nine participants, including 3 urologic residents, 3 medical school students, and 3 nursing school students, independently assessed the trabeculation grades within 30 seconds/ each case. Randomly assigned cystoscopic still images of the patients (4 still images/ case) were provided to participants. We evaluated the inter-observer reliability, test-retest reliability (two weeks interval), its correlation with fluoroscopic grades and urodynamic parameters. All variables are presented as mean ± SD and statistical significance was defined by a p-value <0.05.

Results
Median age of the patients (81 males and 59 females) was 62.4 (± 14.0, SD) years. The most common underlying disease was spinal cord disease (28.1%), followed by neurogenic bladder secondary to radical pelvic surgery (14.4%) and multiple system atrophy (10.3%). There was a significantly high inter-observer reliability with the intraclass correlation coefficient of 0.99 (95% CI 0.98 – 0.99, p<0.001). There was also a strong correlation between the intra-observer repeat grading: all values for Cronbach's alpha ranged from 0.93 to 0.98.
Cystoscopic grades and fluoroscopic grades were correlated in 52.9% (74/140) with a Spearman's correlation coefficient of 0.79 (p<0.001) (Table 2). More than half of cystoscopic grades of 1 and 3 were underscored in corresponding fluoroscopic grades in 57.5% (23/40) and 70% (21/30), respectively. Overall, 40% (56/140) of the cystoscopic grades were underscored and 7.1% (10/140) of cystoscopic grades were overscored compared with fluoroscopic grades.
There was a significant correlation between cystoscopic grading and urodynamic parameters. As the bladder compliance decreased, trabeculation grades increased, which was more prominent in grade 3. Maximal flow rate was significantly decreased and postvoid residual volume increased significantly in grades 2 and 3 (p<0.05). Bladder contractility index was significantly lower than other grades in grade 3 (p=0.005) and the bladder outlet obstruction index (BOOI) increased significantly in grades 2 and 3 (p=0.002).

Interpretation of results
To our knowledge, the present study is the first to establish a cystoscopic classification of trabeculated bladder. This classification is based on the conception of formation of muscle bundle and depth of mucosal layer if trabeculation presents. Our results demonstrated that even unspecialized individuals can use this classification system: 6 out of 9 participants were non-urologists who had never been trained to read cystoscopic images.
Overall cystoscopic grades showed significant correlation with fluoroscopic grade. However, each grade did not always show significant differences. This classification showed a good correlation of urodynamic results with the grade of bladder trabeculation. However, there were no significant differences between cystoscopic grades 2 and 3 in terms of maximal flow rate, compliance, bladder contractility index and BOO index. It is likely that a larger sample size might differentiate grade 2 from grade 3.
The present study included only patients with neurogenic bladder. Further studies should encompass various conditions with a larger sample size. We hope this novel cystoscopic grading system will be widely used in both daily clinical practice and clinical research.

Concluding message
We established a novel cystoscopic classification system of trabeculated bladder. Our results showed that this cystoscopic classification of bladder trabeculation is reliable and valid.

Table 1. The cystoscopic grading system of bladder trabeculation

	Grade 0 (none)	Grade 1 (mild)	Grade 2 (moderate)	Grade 3 (severe)
Criteria A: formation of muscle bundle layer	No	One layer	Two layers (<50% of the image)	Two layers (>50% of the image) or more layers
Criteria B: ratio of "the height" to "the width"	N/A	N/A	"the height" <"the width"	"the height" >"the width"
Typical images				

"the height", the height of muscle bundle, near a base of mucosa, from the deepest portion of the mucosa
"the width", the width between the muscle bundles described above

Table 2. Fluoroscopic and urodynamic correlation

Clinical parameters	Cystoscopic grades				Sum or p-value
	0 (Number or Mean ± SD)	1 (Number or Mean ± SD)	2 (Number or Mean ± SD)	3 (Number or Mean ± SD)	
Age	59.6±13.2	67.1±13.3	62.2±14.6	60.8±14.2	
Fluoroscopic grades†					
0	40 (100%)	23 (57.5%)	7 (23.3%)	0 (0%)	70 (50%)
1	0 (0%)	15 (37.5%)	5 (16.7%)	6 (20.0%)	26 (18.6%)
2	0 (0%)	2 (5%)	10 (33.3%)	15 (50.0%)	27 (19.3%)
3	0 (0%)	0 (0%)	8 (26.7%)	9 (30.0%)	17 (12.1%)
Total	40 (100%)	40 (100%)	30 (100%)	30 (100%)	140 (100%)
Free uroflowmetry					
Maximal flow rate (ml/sec)	9.6±6.8	7.8±7.0	5.0±5.5$^\downarrow$	5.5±6.6$^\downarrow$	0.016*
Postvoid residual urine (ml)	50.0±91.5	121.1±156.1	211.6±158.7$^\uparrow$	202.8±148.5$^\uparrow$	<0.001*
Filling cystometry					
First desire to void (ml)	168.5±96.9	209.7±135.3	236.9±140.9	238.2±121.3	0.082
Normal desire to void (ml)	267.4±284.7	284.7±126.0	342.5±210.1	318.1±117.3	0.206
Strong desire to void (ml)	353.9±113.5	339.8±112.3	384.8±140.9	386.4±134.4	0.543
Maximal cystometric capacity (ml)	358.8±115.2	323.0±147.7	328.0±156.9	320.1±157.1	0.667
Compliance (ml/cmH2O)	43.1±25.1	40.9±18.2	40.0±32.1	25.0±24.0$^\downarrow$	0.022*
Voiding cystometry					
PdetQmax (cmH2O)	35.2±15.7	43.5±15.5	48.7±19.8$^\uparrow$	46.3±21.6	0.038*
Opening pressure (cmH2O)	33.6±15.5	43.8±17.1	64.4±41.8$^\uparrow$	55.7±46.2$^\uparrow$	0.003*
Maximal flow rate (ml/sec)	10.3±7.0	7.9±5.4	5.9±4.0$^\downarrow$	5.2±3.7$^\downarrow$	<0.001*
Voided volume (ml)	261.2±168.3	181.3±115.2	123.6±117.1$^\downarrow$	103.3±135.1$^\downarrow$	<0.001*
Postvoid residual (ml)	105.5±120.4	147.7±156.0	239.0±186.9$^\uparrow$	272.9±179.8$^\uparrow$	<0.001*
Bladder contractility index	92.9±30.2	88.5±29.0	72.1±30.4	65.5±31.8$^\downarrow$	0.005*
BOO index	12.1±23.9	25.5±19.9	35.0±23.7$^\uparrow$	34.5±23.9$^\uparrow$	0.002*

†Spearman's correlation coefficient was 0.79 (p<0.001); BOO, bladder outlet obstruction; PdetQmax, detrusor pressure at maximum flow; *p<0.05; $^\uparrow$ significantly higher than other parameters according to trabeculation grades; $^\downarrow$ significantly lower than other parameters according to trabeculation grades

References

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Disclosures