

Is There a Correlation Between the Presence of Idiopathic Detrusor Overactivity and the Degree of Bladder Outlet Obstruction?

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OBJECTIVE	To assess the factors associated with the presence of idiopathic detrusor overactivity (IDO) in male patients with clinical benign prostatic hyperplasia (BPH).
MATERIALS AND METHODS	We prospectively evaluated 193 men who presented with lower urinary tract symptoms. Each patient underwent urodynamic evaluation, International Prostate Symptom Score (IPSS), uroflowmetry, residual volume check, and transrectal ultrasound for estimation of prostate volume. IDO was defined according to the new International Continence Society classification (2002) as involuntary detrusor contractions during cystometry, which may be spontaneous or provoked, regardless of amplitude. Patients were divided into groups according to the presence of detrusor overactivity and bladder outlet obstruction index (BOOI) greater than 40. Variables associated with the presence of IDO were analyzed using Student's <i>t</i> -test, chi-square test, linear-by-linear association test, and logistic regression analysis.
RESULTS	Of 193 patients, IDO was present in 49 (25.4%). BOOI and prostate volume showed significant but weak correlation. On univariate analysis, patients with IDO were older and showed smaller maximal bladder capacity (MBC), higher BOOI, higher maximal detrusor pressure at maximal flow rate, and higher irritative IPSS subscores. On logistic regression analysis, MBC and BOOI were the factors affecting the presence of IDO, with odds ratios of 0.981 and 1.046, respectively. Positive linear association was noted between BOOI and prevalence of DO by linear association test with prevalence of DO rising continuously with increasing BOOI.
CONCLUSION	BOO is responsible for IDO and because the prevalence of IDO is inversely associated with the degree of obstruction, the treatment of BOO is potentially able to reverse the DO. UROLOGY 77: 167–170, 2011. © 2011 Published by Elsevier Inc.

Men with benign prostatic hyperplasia (BPH) can have benign prostatic enlargement (BPE), bladder outlet obstruction (BOO), lower urinary tract symptoms (LUTS), or a combination of these components.¹ Overactive bladder (OB) is one known common cause of LUTS, and BOO combined with OB is very common. Although voiding symptoms are more frequently reported, storage symptoms are more bothersome and reduce the quality of life more substantially.² Detrusor overactivity (DO) is one known cause of LUTS and has been linked to

bladder storage symptoms (urgency, frequency, or urge incontinence).³ The significance of DO is poorly understood and whether it is directly proportional to the degree of bladder outlet obstruction remains to be determined.⁴ Also, it remains controversial whether DO is caused only by age or is also related to BOO or BPE.^{5,6} Recently, it has been reported that BOO is partially responsible for DO, and treatment of BOO is potentially able to reverse bladder wall changes and DO.³ This study was performed to assess the factors associated with DO in patients with clinical BPH in association with objective symptom parameters and whether correlation exists between the degree of BOO and presence of DO.

MATERIAL AND METHODS

From April 2006 to April 2008, men with clinical BPH were included in this study. Clinical BPH was defined by LUTS, BPE

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Table 1. General characteristics of the patients

Age (years)	66.85 ± 8.86
BMI (kg/cm)	24.48 ± 2.81
MBC (mL)	313.41 ± 95.57
Detrusor overactivity on CMG(+)	49
Pdet Q _{max} (cm/H ₂ O)	51.61 ± 24.74
Q _{max} (mL/s)	7.97 ± 3.99
PVR (mL)	70.94 ± 86.17
BOOI < 20(n)	48
20 < BOOI < 40(n)	59
40 < BOOI (n)	86
BOOI	39.43 ± 26.90
IPSS 0 score	11.90 ± 5.93
IPSS I score	8.12 ± 4.13
IPSS total	19.95 ± 8.61
Prostate volume (g)	42.63 ± 24.70

Values are expressed as mean ± SE.

PdetQ_{max}, detrusor pressure at maximal flow rate; PVR, postvoid residual urine volume; IPSS 0, obstructive subscores; IPSS I, irritative subscores.

and/or suspicion of BOO in men aged 40 years or older.³ Patients with a previous history of lower urinary tract or pelvic surgery, radiotherapy of the pelvis, and neurological disease were excluded from this study. Digital rectal examination, transrectal ultrasound, uroflowmetry for maximal flow rate (Q_{max}), postvoid residual urine volume, multichannel urodynamic study with a pressure-flow study (MMS UD-2000; Medical Measurement System, Ennschede, The Netherlands), and International Prostate Symptom Score (IPSS) were assessed. Total IPSS was further divided into irritative (questions 2, 4, and 7) and obstructive (questions 1, 3, 5, and 6) IPSS subscores. Detrusor overactivity was defined as involuntary detrusor contractions during cystometry, which may be spontaneous or provoked regardless of the amplitude according to the International Continence Society Classification (2002).⁷ Urodynamic investigations and evaluations were performed according to the standards recommended by the International Continence Society.⁷ From the pressure-flow study, bladder outlet obstruction index (BOOI) was defined as PdetQ_{max}-2Q_{max}.⁸ Bladder outlet obstruction (BOO) was defined as BOOI > 40 and 20 < BOOI < 40 as *equivocal* and BOOI < 20 as *normal*.

Patients were divided into groups according to the presence of DO and BOOI and variables were analyzed with Student's *t*-test, chi-square test, linear-by-linear association test, simple correlation analysis, and logistic regression analysis using SPSS version 13 (SPSS, Inc., Chicago, IL).

RESULTS

During filling cystometry, of 193 patients enrolled, IDO was noted in 49 patients (25.8%) and BOO was noted in 86 patients (44.56%). General characteristics of the patients are listed in Table 1.

Patients with BOO (defined as BOOI > 40) showed higher bladder contractile index, larger postvoid residual urine volume, higher prevalence of DO, and larger prostate volume ($P = .004, .026, .001, \text{ and } .001$, respectively) (Table 2). There was a significant but weak positive correlation between BOOI and prostate volume (Spearman rank test; 0.30, $P = .001$). In addition, BOOI and age showed significant but weak correlation (Spearman rank test; 0.179, $P = .015$) (Fig. 1).

Patients with IDO were older and had lower maximal bladder capacity, higher PdetQ_{max}, higher BOOI, and higher irritative IPSS subscores (Table 3). Of 49 patients with DO, the prevalence of DO increased with increasing BOOI (1 patient in BOOI < 20, 10 patients in 20 ≤ BOOI < 40, and 38 patients in 40 ≤ BOOI). Positive linear association was noted between BOOI and prevalence of DO by linear association test, with the prevalence of DO rising continuously with increasing BOOI (correlation coefficient = 0.402, $P = .001$).

On logistic regression analysis, among all clinical and urodynamic parameters, BOOI and maximal bladder capacity were the factors associated with DO, with odd ratio of 1.046 and 0.981, respectively (Table 3).

DISCUSSION

BOO combined with OB is very common.⁹ It has been suggested that the main cause of BOO is BPE secondary to BPH, which is a condition almost inevitably associated with aging.¹⁰ In this study, BOOI and age showed statistically significant but weak correlation. Also prostate volume and BOOI showed significant but weak correlation (Fig. 1). Consequently, these results indicate that other undetermined factors might be responsible for the presence of BOOI along with age and prostate volume. The role of prostate volume in BOO has been under debate. Witjes et al¹¹ previously reported that prostate volume is a poor parameter for determining outlet obstruction in accordance with Jensen et al.¹² However, other data indicate a strong correlation among LUTS, prostate volume, and BOO than previously reported.^{13,14}

The prevalence of IDO in this study was 25.8%, which is quite lower than other reports because urodynamic studies were performed routinely and not limited to those who were planned for operation.

The correlation of several BPH symptom scores with BOO is still an area of controversy. Some insist that symptom score assessment in elderly men is influenced by subjective interpretation of symptoms and reflects the mixture of diseases, which may in different ways contribute to the development of BOO.¹⁰ Still, IPSS was originally formulated to define LUTS severity in patients with BPE and is not intended to be used as a tool to diagnose BPH.¹⁵ Our results show that patients with IDO show higher irritative symptom scores than patients without IDO, indicating that the presence of IDO is associated with more severe symptoms. From the study by Hyman et al, men presenting with the symptoms of urgency and urge incontinence have typically been diagnosed with detrusor instability, showing the close relationship of storage symptoms with OB.¹⁶

The instability in males with LUTS being suggestive of BPH could result from obstruction or the aging process. Although logistic regression analysis revealed that BOO was the key factor for the development of IDO, the patients with IDO were older in univariate analysis, and it seems that aging is also associated with development of

Table 2. Parameters according to BOOI

	BOOI < 40	BOOI ≥ 40	P Value
Number of subjects	107	86	
Age (years)	66.12 ± 8.88	67.79 ± 8.47	.198
BMI (kg/cm)	24.94 ± 2.72	23.82 ± 2.95	.051
MVV (mL)	323.16 ± 95.99	310.88 ± 93.24	.406
Pdet Q _{max} (cm/H ₂ O)	29.33 ± 12.21	56.27 ± 22.63	.001
Q _{max} (mL/s)	9.29 ± 2.45	6.29 ± 3.29	.001
PVR (mL)	60.73 ± 76.94	89.62 ± 96.45	.026
Do	11/107	38/86	.001
IPSS obstruction score	12.02 ± 5.99	11.95 ± 5.86	.950
IPSS irritative score	8.17 ± 4.23	8.07 ± 4.03	.897
IPSS total	20.20 ± 8.78	19.95 ± 8.39	.876
Prostate volume (g)	35.86 ± 16.82	50.87 ± 30.53	.001

PdetQ_{max}, detrusor pressure at maximal flow rate; DOA, detrusor overactivity; PVR, postvoid residual urine volume; IPSS O, obstructive subscores; IPSS I, irritative subscores.

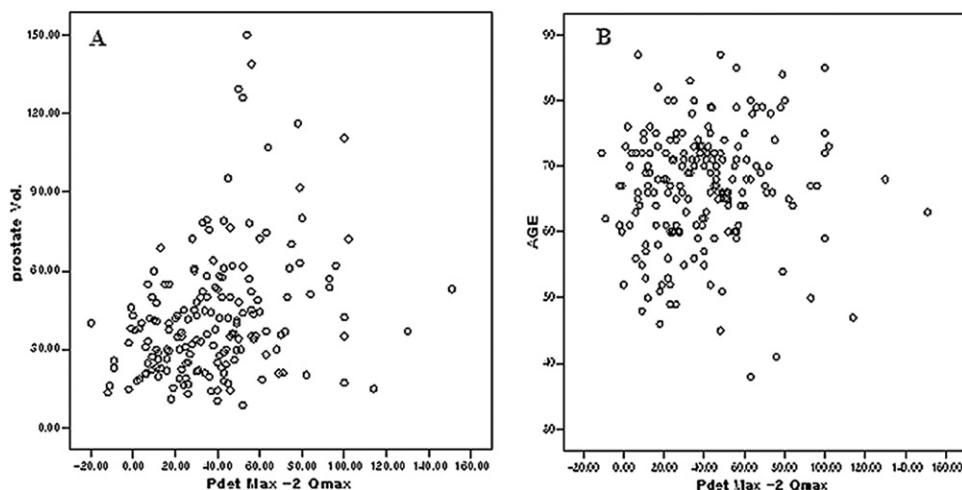


Figure 1. Relationship between prostate volume and BOOI. **(A)** With increasing BOO, prostate volume increased as well but showed weak correlation (Pearson's $R = .30$, $P = .001$). **(B)** BOOI and age showed significant but weak correlation (Spearman rank test 0.179 , $P = .015$).

Table 3. Univariate and multivariate analysis associated with presence of detrusor overactivity

	Detrusor Overactivity on CMG		P Value	LRA	
	Yes	NO		P Value	Odds Ratio
Number of subjects	49	144			
Age (years)	68.82 ± 8.47	66.13 ± 9.23	.033	.167	
BMI (kg/cm)	23.80 ± 2.64	24.59 ± 2.85	.795		
MBC (mL)	213.18 ± 79.74	345.84 ± 77.53	.001	.001	0.979
Pdet Q _{max} (cm/H ₂ O)	55.96 ± 31.63	48.04 ± 21.91	.048	.381	
Q _{max} (mL/s)	7.43 ± 3.35	8.31 ± 4.34	.204		
PVR (mL)	70.20 ± 90.10	70.72 ± 65.29	.971		
BOOI	61.25 ± 24.25	31.36 ± 22.63	.016	.040	1.063
IPSS O score	11.39 ± 6.52	12.03 ± 5.75	.593		
IPSS I score	9.63 ± 4.28	7.69 ± 4.05	.042	.691	
IPSS total	20.76 ± 8.61	19.70 ± 8.73	.542		
Prostate volume (g)	42.57 ± 24.77	41.29 ± 24.40	.762		

PdetQ_{max}, detrusor pressure at maximal flow rate; PVR, postvoid residual urine volume; IPSS O, obstructive subscores; IPSS I, irritative subscores.

IDO. It has been reported that the aging process of both sexes is associated with significant alterations of bladder function.¹⁷ Aging also goes along with autonomic nerve deterioration¹⁸ and significant increase of collagen fibers in the submucosa and around the neurovascular bundles

that may also directly have consequences for IDO. Smaller MBC and higher irritative IPSS subscores may be either the cause or the result of IDO.

The relationship of BOO and DO has been documented in numerous reports; the prevalence of detrusor

overactivity according to the degree of bladder outlet obstruction has rarely been reported. In our study, there was an increasing probability of IDO with increasing BOOI, confirming a recent report by Oelke et al. They demonstrated that with increasing BOO grade, there was an increasing probability of DO and tendency toward an earlier appearance and higher amplitude of DO.³ By contrast, Knutson et al reported that higher age was the an independent risk factor for coexisting IDO in BOO along with higher grade of obstruction in men.⁹ Because a positive correlation was reported between BOO grade and detrusor wall thickness,¹⁹ it is logical that the probability of detrusor overactivity shows positive correlation with BOO grade as well. Because BOO is responsible for IDO and because the prevalence of IDO is related to the degree of obstruction, the treatment of BOO is potentially able to reverse the DO, as Oelke et al implicated.³

Several hypotheses have been proposed for the presence of IDO in association with BOO. A larger and more severely obstructed prostate gives rise to more pronounced changes in the central nervous control mechanisms as well as possibly more directly affecting the peripheral innervations of the bladder.²⁰ In a hypothesis by Levin et al, the partial BOO leads to bladder hypertrophy, which causes cyclic ischemia/hypoxia, with generation of free radicals and disruption of calcium homeostasis, resulting in specific damage to neuronal membranes, sarcoplasmic reticulum, and mitochondria in the cell, with overactive bladder as a result.²¹ Also, in human studies, significant connective tissue infiltration and hypertrophy of the detrusor muscle are reported.²² Microscopic investigations of the detrusor muscle revealed abnormal intercellular connections that seem to be responsible for the propagation of spontaneous depolarization of detrusor cells leading to synchronous involuntary contractions of detrusor regions.²³

CONCLUSION

Along with the aging process, BOO is the factor associated with IDO. Because BOO is responsible for IDO, and the prevalence of IDO is related to the degree of obstruction, the treatment of BOO is potentially able to reverse the DO, as Oelke et al implicated.³ Furthermore, the assessment of BOO is more crucial in deciding operative treatment in patients with LUTS and suspected DO rather than prostate volume per se.

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