

Urodynamic Detrusor Overactivity in Patients with Overactive Bladder Symptoms

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Purpose: To evaluate the relationship between urodynamic detrusor overactivity (DO) and overactive bladder (OAB) symptoms in men and women.

Methods: We reviewed the records of adult males and females who attended a tertiary referral center for urodynamic evaluation of OAB syndrome symptoms with the presence or absence of DO. DO was calculated for symptoms alone or in combination.

Results: The overall incidence of DO was 76.1% and 58.7% in male and female OAB patients, respectively. Of men 63% and 61% of women with urgency (OAB dry) had DO, while 93% of men and 69.8% of women with urgency and urgency urinary incontinence (OAB wet) had DO. Of women, 58% who were OAB wet had stress urinary incontinence symptoms with 26.4% having urodynamic stress incontinence. 6% of men and 6.5% of women with OAB symptoms had urodynamic diagnosis of voiding difficulties with postvoid residual greater than 100 mL. Combination of symptoms is more accurate in predicting DO in OAB patients. The multivariate disease model for males included urge urinary incontinence (UUI) and urgency while for females it included UUI and nocturia.

Conclusions: There was a better correlation in results between OAB symptoms and the urodynamic diagnosis of DO in men than in women, more so in OAB wet than in OAB dry. Combination of symptoms of the OAB syndrome seems to have a better correlation with objective parameters from the bladder diary, filling cystometry, and with the occurrence of DO.

Keywords: Overactive bladder; Urodynamic investigation; Urinary incontinence; Detrusor overactivity

INTRODUCTION

According to the latest International Continence Society (ICS) recommendation, the overactive bladder (OAB) syndrome is described as the presence of urgency, with or without urge urinary incontinence (UUI), usually with frequency and nocturia if there is no proven infection or other obvious pathological condition [1]. The implication of this definition is that the term OAB denotes a syndrome whose etiology is unknown. Generally speaking, detrusor overactivity (DO) is supposed to be a major underlying pathophysiology of OAB. OAB is a symptomatic diagnosis, while DO is an urodynamic observation defined

by involuntary detrusor contractions during the filling phase, which may be spontaneous or provoked [1].

Although there is consensus about the presence of these symptoms it is unclear how they are related, both individually as well as in combination, with objective parameters. Although improvement of symptoms is the principal goal of treatment, concurrent improvement in objective parameters will support the effectiveness of the intervention used. Some authors have suggested recently that patients with this symptom complex can be safely treated on the basis of their history, without the need for invasive urodynamics (UDS) tests. But whether it is an accurate method of diagnosis is not known. Several studies have

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demonstrated that urinary symptoms do not accurately diagnose the underlying pathology compared with UDS [2,3]. The bladder has been described as an unreliable witness [4].

Most of the previous studies included either male or female patients but not both male and female patients. According to the new definition OAB symptoms are suggestive of DO, although the definition does not specify the actual correlation between OAB and DO. We defined how well OAB symptoms, both individually as well as in combination, predict urodynamic DO using the new definitions of OAB and OAB symptoms in men and women from the same population group.

MATERIALS AND METHODS

This was a retrospective study of men and women (aged ≥ 18 years) with symptoms of an overactive bladder (urinary frequency, urgency, nocturia, and/or UUI) referred to our urodynamic unit for further evaluation, between February 2002 and February 2007. All UDS were done at a specialist referral center performing about 10 to 15 UDS tests weekly in male and female children and adults who undergo standard UDS. We reviewed urodynamic report sheets and evaluated patients' age, voiding frequency (\geq eight voids per day), nocturia (\geq two voids per night), urgency and symptomatic incontinence (OAB dry or OAB wet, respectively), first sensation, maximum cystometric capacity (MCC), bladder compliance, and the presence or absence of DO. Those with neurological, vesical, bladder outlet and pelvic floor diseases or surgery were excluded.

Patients with frequency alone or nocturia alone were not considered to have OAB. Patient traces were examined to see if DO was present. Detrusor overactivity was defined as the occurrence of an involuntary detrusor contraction during filling phase, either spontaneous or provoked [1].

Those on antimuscarinics are instructed to stop ingesting them 1 week prior to attending for the test, thus, providing a washout period and avoiding any interference with test results. All UDS information, including patient demographics, medical history, examination, voiding diary, urinalysis, urine free flow rate, post-void residual volume, results of the filling and voiding phases, and bladder capacity, are entered during the test. All UDS investigations were done according to the ICS good urodynamics practices protocol [5]. Conventional filling cystometry was performed with patients in the supine position. The bladder was filled at a constant rate of 25 mL per minute using normal saline solution at room temperature for standard UDS.

After patients denoted MCC, a series of provocative maneuvers were undertaken by coughing 10 times with maximal effort in supine and sitting positions.

The results were statistically evaluated using Mann-Whitney and Fisher's exact probability tests for comparison of the findings between DO and no DO patients, and for comparison between symptoms and UDS findings. Fisher's exact probability test was performed to assess the association between symptoms and DO. A binary logistic regression modeling selection process was done with DO as the dependent variable and the potential risk factors including symptoms as possible predictor variables. P-values less than 0.05 were considered statistically significant. All data were analyzed using the Statistical Package for the Social Sciences program (SPSS ver. 16.0, SPSS Inc., Chicago, IL, USA).

RESULTS

Our study enrolled 209 non-neurogenic patients adult patients (117 men and 92 women) referred to our unit because they had complete persistent storage symptoms data entries available in the database of frequency, nocturia, urgency and/or UUI. They were evaluated by a urologic specialist prior to urodynamics. The overall incidence of DO was 76.1% (89 patients) and 58.7% (54 patients) in male and female OAB patients, respectively. Ten male DO patients and nine female DO patients revealed DO after provocative maneuvers, such as posture change or coughing. Compared with no DO patients, DO patients revealed significantly lower urodynamic parameters in both sexes (Table 1).

In male, 40 of 89 (44.9%) of male DO patients were OAB wet and 3 of 28 no DO (10.7%) were also OAB wet. In female patients, 37 of 54 DO patients (68.5%) were OAB wet, whereas 16 of 38 no DO patients (42.1%) were also OAB wet. Also, 63% of men and 61.3% of women with urgency (OAB dry) had DO, while 93% of men and 69.8% of women with urgency and UUI (OAB wet) had DO. However, 58% of women who were OAB wet had stress urinary incontinence (SUI) symptoms with 26.4% having urodynamic stress incontinence.

The associations between the reported symptoms and UDS findings are presented in Table 2. In men, the urgency and incontinence symptoms were significantly associated with the presence of DO with lower micturition and bladder sensation volumes. In women, only incontinence was significantly associated with DO with a significant effect on all urodynamic parameters examined. However, there is a significant effect of

Table 1. Comparison between DO patients and no DO patients in both sexes

	Age (yr)	MCC (mL)	FS (mL)	COMP (mL/cm H ₂ O)	OAB wet
Men					
DO (n=89)	50.8 ± 17.6	271 ± 61.5	117.4 ± 19.3	24.7 ± 4.0	40 (44.9)
No DO (n=28)	53.7 ± 14.0	337.1 ± 50.8	141.8 ± 21.4	32.1 ± 6.2	3 (10.7)
P-value	0.4	<0.001	<0.001	<0.001	0.001
Women					
DO (n=54)	46.4 ± 14.8	280.0 ± 27.4	105.4 ± 11.7	51.2 ± 4.1	37 (68.5)
No DO (n=38)	45.6 ± 12.8	347.9 ± 29.0	132.4 ± 12.2	60.0 ± 4.0	16 (42.1)
P-value	0.8	<0.001	<0.001	<0.001	0.01

Values are presented as mean ± SD or number (%).

DO, patients with detrusor overactivity; no DO, patients without detrusor overactivity; MCC, maximum cystometric capacity; FS, first sensation; COMP, bladder compliance; OAB, overactive bladder.

Table 2. Association of overactive bladder symptoms and uroynamics findings in men and women

	Men			Women		
	MCC (mL)	FS (mL)	COMP (mL/cm H ₂ O)	MCC (mL)	FS (mL)	COMP (mL/cm H ₂ O)
Frequency						
Yes	284.8	121.7	26.7	306.8	115.1	54.8
No	293.3	127.7	25.7	309.5	118.2	54.9
P-value	0.6	0.4	0.4	0.9	0.5	0.9
Nocturia						
Yes	281.6	122.2	26.0	304.3	114.6	53.7
No	301.3	125.9	27.6	314.4	119.9	56.9
P-value	0.2	0.4	0.1	0.3	0.2	0.03 ^{a)}
Urgency						
Yes	272.0	120.3	25.4	305.3	115.2	54.3
No	316.9	129.2	28.6	320.0	122.4	57.2
P-value	<0.001 ^{b)}	0.02 ^{a)}	0.02 ^{a)}	0.2	0.1	0.06
UUI						
Yes	265.0	116.8	23.9	296.9	112.6	53.3
No	217.5	132.2	29.9	334.8	125.9	58.6
P-value	<0.001 ^{b)}	<0.001 ^{b)}	<0.001 ^{b)}	<0.001 ^{b)}	0.001 ^{b)}	<0.001 ^{b)}

UUI, urge urinary incontinence; MCC, maximum cystometric capacity; FS, first sensation; COMP, bladder compliance.

^{a)}P < 0.05. ^{b)}P < 0.001.

nocturia on bladder compliance while the other parameters did not change significantly. We further analyzed these retrospective data to find out if clinicians could better predict DO when some clinical factors were present. As shown in Table 3, analysis of OAB symptoms and DO were studied in male and female subjects, separately. Of the four symptoms only incontinence was associated significantly with DO in male patients. In female patients, nocturia and incontinence were significantly associat-

ed with DO. Univariate logistic regression showed that the highest odds ratios (OR) of DO were for UUI in men (4.2) and women (2.8) (Table 4). In both sexes, age was not significantly involved in the risk of DO. When symptoms were studied separately, the frequency and urgency were not significantly involved in risk of DO in both sexes. However, analysis of interactions showed that they played a role in slightly increasing the risk of other factors. The interaction of frequency and urgency was

Table 3. Association of detrusor overactivity and selected factors

	Men		Women	
	DO	P-value	DO	P-value
Age				0.5
≥ 50	42 (47.2)	0.2	21 (38.9)	
< 50	17 (60.7)		16 (42.1)	
Frequency				0.3
Yes	67 (75.3)	0.4	31 (57.4)	
No	20 (71.4)		19 (50.0)	
Nocturia				0.03 ^{a)}
Yes	67 (75.3)	0.2	39 (72.2)	
No	18 (64.3)		19 (50.0)	
Urgency				0.2
Yes	63 (70.8)	0.07	46 (85.2)	
No	15 (53.6)		29 (76.3)	
UUI				0.02 ^{a)}
Yes	59 (66.3)	0.001 ^{b)}	43 (79.6)	
No	9 (32.1)		22 (57.9)	

Values are presented as number (%).

UUI, urge urinary incontinence; DO, detrusor overactivity.

^{a)}P < 0.05. ^{b)}P < 0.001.

significant in men (P = 0.04) but not in women (P = 0.1).

As for binary interactions in men, the most noticeable was the urgency and incontinence (P = 0.003). The OR of incontinence increased from 4.2 to 6.8 by the addition of the urgency (thus neglecting the cases with urgency alone). Further, the results show nearly a doubling in OR when any of the other factors is added to these two. Adding either nocturia or frequency increased the OR to 12.4 (P = 0.02).

In women, the situation is different. Since univariate risks of nocturia and incontinence were significant, further interactions showed more significant risks, namely the interactions of nocturia with either frequency (P = 0.005) or incontinence (P = 0.008). Although incontinence had the highest OR in univariate analysis, the interactions showed that frequency and nocturia were the major risk players in women. Adding either incontinence or urgency to these two factors increased the OR to 11.5 (P = 0.002).

Multivariate logistic regression was used for prediction of the direct risk factors involved in the disease model. The OR in a multivariate model represents the exponential factor for each variable in a one equation (Table 5). The disease model for males included UUI and urgency while for females it included UUI and nocturia. So far, the results of multivariate analysis were

Table 4. Univariate binary logistic regression analysis for odds ratios of detrusor overactivity

Factors	Men			Women			
	OR	95% CI	P-value	OR	95% CI	P-value	
Univariate	Age (≥ 50)	0.5	0.2-1.4	0.2	0.9	0.4-2.0	0.8
	Frequency	1.2	0.5-3.2	0.7	1.3	0.6-3.1	0.5
	Nocturia	1.7	0.7-4.2	0.3	2.6	1.1-6.2	0.03 ^{a)}
	Urgency	2.1	0.9-5.0	0.1	1.8	0.6-5.1	0.3
	UUI	4.2	1.7-10.3	0.002 ^{a)}	2.8	1.1-7.2	0.03 ^{a)}
Interactions	Fr × Nocturia	1.4	0.6-3.2	0.5	4.1	1.5-10.9	0.005 ^{a)}
	Fr × Urgency	2.6	1.1-6.3	0.04 ^{a)}	2.0	0.8-4.8	0.1
	Fr × UUI	3.0	1.1-8.1	0.03 ^{a)}	3.3	1.2-8.8	0.02 ^{a)}
	Nocturia × Urgency	3.2	1.2-8.3	0.02 ^{a)}	3.2	1.3-7.5	0.01 ^{a)}
	Nocturia × UUI	3.3	1.2-8.9	0.02 ^{a)}	3.3	1.4-8.0	0.008 ^{a)}
	Urgency × UUI	6.8	1.9-24.2	0.003 ^{a)}	3.0	1.3-7.1	0.01 ^{a)}
	Fr × Nocturia × UUI	1.9	0.7-5.5	0.2	11.5	2.5-52.7	0.002 ^{a)}
	Fr × Nocturia × Urgency	3.7	1.2-11.6	0.02 ^{a)}	11.5	2.5-52.7	0.002 ^{a)}
	Nocturia × UUI × Urgency	12.4	1.6-95.8	0.02 ^{a)}	4.1	1.5-10.9	0.005 ^{a)}
	Fr × Urgency × UUI	12.4	1.6-95.8	0.02 ^{a)}	6.9	1.9-25.2	0.004 ^{a)}

UUI, urge urinary incontinence; Fr, frequency; OR, odds ratio; CI, confidential interval.

^{a)}P < 0.05.

Table 5. Multivariate binary logistic regression analysis for odds ratios of detrusor overactivity in both sexes

Factors	OR	95% CI	P-value
Men			
Urgency	2.7	1.0-7.0	0.04 ^{a)}
UII	4.8	1.9-12.5	0.001 ^{a)}
Women			
Nocturia	2.6	1.1-6.4	0.04 ^{a)}
UII	2.9	1.1-7.4	0.03 ^{a)}

UII, urge urinary incontinence; Fr, frequency; OR, odds ratio; CI, confidential interval.

^{a)}P < 0.05.

consistent with the binary interactions. However, in the case of women, the frequency was neglected from the model for simple reason of insignificant univariate result, which is a rule for multivariate model prediction.

DISCUSSION

In the latest recommendation, the ICS had updated the definition for OAB syndrome into urgency, with or without urge incontinence, usually with frequency and nocturia [1]. The main symptom of this definition is the urgency symptom, but it is unclear what this is based on. Although according to the ICS definition, urodynamic study is not required routinely to make a diagnosis of OAB, some physicians are concerned that a correct diagnosis will be missed in many patients, and they will not receive appropriate treatment because the bladder has been described as an unreliable witness [6].

Sekido et al. [7] retrospectively evaluated 50 patients (12 males and 38 females) with OAB symptoms in regard to urodynamic parameters and the presence or absence of DO. The overall incidence of DO was 75% and 36.8% in male and female patients, respectively. They concluded that, in contrast to male OAB, DO might not be a major underlying cause of uncomplicated female OAB. Therefore, the prevalence of DO in OAB females may depend on the population studied, the definition of this condition and the methods used.

Each symptom of frequency, nocturia, urgency and incontinence was associated with lower micturition and sensation volumes on filling cystometry. This association was not significant except for each of urgency and incontinence in men and incontinence alone in women. Of the four symptoms that are currently considered to be part of the OAB syndrome, the incontinence

symptom is the best associated with objective parameters from the bladder diary, filling cystometry, and with the occurrence of DO in both sexes. Although urgency is associated with a significant effect on all urodynamic parameters examined in men, there is no significant effect on the occurrence of DO (Tables 2, 3). We agree with the others that there is a need for a validated urgency scale that measures urgency rather than bladder sensation [8,9]. In univariate analysis, when symptoms studied separately, the frequency and urgency were not significantly involved in risk of DO in both sexes while interactions showed that both slightly increase the risk of other factors. The interaction of these was significant in men but not in women (Table 4). This is supportive to our belief that OAB symptoms may have different pathophysiology in both sexes. We believe clinicians could better predict DO when some clinical factors were combined together and not by depending on a single symptom. This is obvious from the binary interactions of OAB symptoms such as urgency and incontinence. Incontinence is usually associated with urgency, so this can explain the increase in OR of incontinence from 4.2 to 6.8 by the addition of the urgency in men. Furthermore, the results show nearly a doubling in OR when any of the other symptoms is added to these two symptoms.

In women univariate risks of nocturia and incontinence were significant and further interactions showed more significant risks, namely the interactions of nocturia with either frequency or incontinence. Although incontinence had the highest OR in univariate analysis, the interactions showed that frequency and nocturia were the major risk factors in women in contrast to men. The frequency is univariately weakly predictive of DO but not significant in a multivariate model with urgency, incontinence and nocturia. This is similar to the findings of other authors demonstrated by a self reported mail questionnaire in women [10]. Also, Hashim and Abrams [8] showed in their study that increasing voiding frequency did not have any effect on increasing the accuracy of diagnosis of DO except in women with 10 or more daytime micturition episodes. However, we cannot ignore the role of frequency in predicting DO especially when combined with other symptoms. Van Brummen et al. [11] investigated the association between overactive bladder symptoms in women and objective parameters from the bladder diary and conventional filling cystometry. The frequency symptom as well as the UII symptom was significantly associated with the presence of DO. They considered the frequency symptom as being obligatory for considering one to have an OAB. The weakness in their study and our study is that analysis

was not done to assess whether increasing frequency made a difference to the diagnostic value and association between OAB and DO, using different cutoff points for frequency.

Urgency in men was associated with DO in multivariate analysis, but not in univariate analysis. Some authors stated the frequency symptom, not the urgency symptom, is best associated with them in females who underwent UDS [11]. Conversely, frequency alone was reported to be a poor predictor of DO (31.4%) in female OAB patients, and having urgency, frequency and UUI had the highest sensitivity in predicting DO (61.0%) in females. In our study, 62% of women with frequency alone have DO, while 87% with combined urgency, frequency and UUI have DO. This confirms the need for a validated urgency scale that measures urgency more accurately.

This study adds to the body of evidence that questions the validity of using invasive urodynamic procedures before initiating treatment for the debilitating symptoms of an OAB. Indeed, the results of a randomized, double-blind clinical trial in which patients were enrolled and treated on the basis of symptoms alone support this management strategy [12]. This approach would encourage more physicians to explore these problems with their patients, reserving referral for costly urodynamics for those patients who fail to respond to first-line therapy. This management strategy may be suitable for our people with limited income to pay for the tests. For this reason, UDS should be done only if it is going to change patient treatment or help differentiate the etiology of voiding dysfunction, or if it is done after failed conservative/medical treatment [13]. If standard UDS fails to reproduce symptoms, referral for ambulatory UDS may be considered when available. The absence of DO during an artificial bladder test even with provocative maneuvers is not an absolute confirmation of lack of DO in “real life” situations.

The present study had several limitations. First, the study was retrospective. Second, our study population was a selected group of patients with complaints that were candidate for urodynamic investigation. Therefore, they represent patients with bothersome symptoms. To what extent our results can be generalized to the population remains unanswered. Third, the study compares subjective symptoms with objective parameters. The bladder is a bad witness, and the symptoms of frequency, nocturia, and urgency may arise because of hypersensitivity of the bladder stretch but also may occur when the bladder contracts inappropriately due to DO. Fourth, the follow-up data were lacking in some patients because some in the present study were referred to our urology unit purely for management for a

short duration. Therefore, there was not adequate information regarding whether or not urodynamic findings altered management for these patients. Continuing arguments against ‘no need for UDS in OAB patients’ might prove fruitless. Rather, we need knowledge and/or evidence-based guidelines that define the OAB patients in whom UDS could confer a benefit.

In conclusion, the definition of OAB based on urgency is a better predictor in men than in women. When symptoms were used together, only urgency and UUI in men and nocturia and UUI in women significantly increased the prediction of DO. It is important to inquire about the reproduction of symptoms during UDS and correlate this with findings during the test. There is a need for a validated urgency scale that measures urgency rather than bladder sensation. The pathophysiology of female OAB might be different from that of male OAB. Therefore, treatment outcomes must be evaluated for males and females, separately. Further prospective studies are needed to provide more information about the precise role of urodynamics for men and women with OAB symptoms.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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