



Correlation between overactive bladder and detrusor overactivity: a retrospective study

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Abstract

Introduction The primary objective of this study is to determine the prevalence of overactive bladder (OAB) and detrusor overactivity (DO) in female patients who were referred for urodynamic study (UDS) because of lower urinary tract symptoms (LUTS). The secondary objective is to determine the subjective and objective differences between female OAB patients with and without DO.

Materials and methods All female patients who underwent UDS for LUTS between June 2016 and September 2019 were retrospectively reviewed. Personal history, medical history, physical examination, and validated questionnaires were collected. One-hour pad test and multichannel urodynamic study was performed. All statistical analyses were conducted by SAS 9.4. *P*-value < 0.05 was considered statistically significant.

Results A total of 4184 female patients underwent UDS because of LUTS between June 2016 and September 2019; 1524 patients were analyzed for OAB or DO. The occurrence of OAB was 36.4%. The overall incidence of DO in OAB patients was 15.5%; 9.5% of all patients had DO findings on UDS, and 4.6% were incidental findings. There were significant differences among mean age, parity, ICIQ-UI SF, OABSS, POPDI-6, and all UDS parameters (except for maximal urethral pressure and pressure transmission ratio) between patients with and without DO. In patients with DO, there were no significant differences among age, parity, and BMI with or without OAB symptoms. However, there were significant differences among mean OABSS, ICIQ-UI SF, UDI-6, POPDI-6, IIQ-7, and pad test.

Conclusions Patients with DO are associated with older age, increased parity, greater urine leakage, and worse storage and micturition functions on UDS. Combinations of subjective and objective measurements are better predictive models for OAB patients.

Keywords Detrusor overactivity · Overactive bladder · Predictive model · Urodynamic study · Validated questionnaire

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Introduction

Overactive bladder (OAB) is defined by the International Continence Society (ICS) as a syndrome with “urinary urgency, usually accompanied by frequency and nocturia, with or without urinary incontinence, in the absence of urinary tract infection (UTI) or other obvious pathology” [1]. It is diagnosed clinically, based on the patient’s symptoms and history.

Urodynamic study (UDS) assesses patient’s lower urinary tract function while replicating the patient’s symptoms [2]. Detrusor overactivity (DO), defined as the occurrence of detrusor contraction during filling cystometry, is a demonstratable UDS finding correlating to OAB symptoms [1]. However, the etiology of OAB and DO is not

well defined. Studies have shown more than half of the patients with OAB do not have DO detected on UDS [3]. There are controversies about whether OAB and DO are part of a spectrum of the same disease or if they are of an entirely different etiology [4]. The diagnosis of OAB is not dependent on presence of DO, and the presence of DO is not predictive of OAB.

There is an ongoing debate about whether treatment should be based on patient's symptoms and clinical findings (such as voiding diary, residual urine, pelvic floor exam, etc.) or UDS findings. Most guidelines recommend patients to undergo UDS only if initial symptoms do not improve after conservative therapy because of the invasiveness of UDS and poor correlation with clinical symptoms [5]. However, a recent prospective study showed that not only the women who received consistent treatment with their UDS findings were more likely to find improvement of their bladder symptoms, but also the clinicians changed treatment management in patients with OAB complaints [6]. In addition, many patients have both storage and voiding problems, which may be multifactorial or related to each other [7]. OAB symptoms are not useful for predicting the presence of concurrent voiding dysfunction that may alter management; thus, UDS is necessary for diagnosis [8]. Serati et al. found 59.9% of patients clinically diagnosed with mixed urinary incontinence had pure urodynamic stress incontinence (USI), 25.9% of stress urinary incontinence (SUI) patients had DO, and 14.2% of SUI patients in fact had pure urgency urinary incontinence. Patient's subjective symptoms are often unreliable, and objective measures such as UDS are needed for better assessment [9].

The primary objective of this study is to determine the prevalence of OAB and DO in female patients who were referred to our single tertiary teaching center gynecology department for UDS due to lower urinary tract symptoms (LUTS). The secondary objective is to determine the subjective and objective differences between OAB patients with and without urodynamically proven DO.

Materials and methods

Participants

All gynecologic female patients who underwent UDS in a single tertiary medical center for LUTS between June 2016 and September 2019 were retrospectively reviewed. Patients who complained of OAB symptoms and/or had the diagnosis of DO in the UDS were recruited. Those with incomplete data were excluded. This study was approved by the Chang Gung Memorial Foundation Institutional Review Board (IRB no. 201901269B0).

Procedures

Initial assessment comprised personal history, medical history, and physical examination. UDS was arranged for all patients who complained of LUTS.

One-hour pad test and multichannel urodynamic study with a filling rate of 70 ml/min at room temperature was performed according to ICS Standard Good Urodynamic Practices (ICS-GUP2016) [2]. The UDS device used was Solar Gold MMS (Medical Measurement B.V., Enschede, The Netherlands). The results of the study were reviewed by one of the four urogynecology specialists in our center. Detrusor overactivity is defined as involuntary detrusor contractions during filling cystometry [1].

All women were asked to complete the following validated questionnaires in Traditional Chinese on the day of the UDS: Overactive Bladder System Score (OABSS) [10], International Consultation on Incontinence Questionnaire for Urinary Incontinence-Short Form (ICIQ-UI SF) [11], Urogenital Distress Inventory Short Form (UDI-6) [12], Pelvic Organ Prolapse Distress Inventory-6 (POPDI-6) [13], Incontinence Impact Questionnaire-7 (IIQ-7) [12], Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire-12 (PISQ-12) [14], and Colorectal-Anal Distress Inventory-8 (CRADI-8) [13]. If the patient was illiterate, the questionnaires were read to them by family members or medical staff personnel.

Statistical analysis

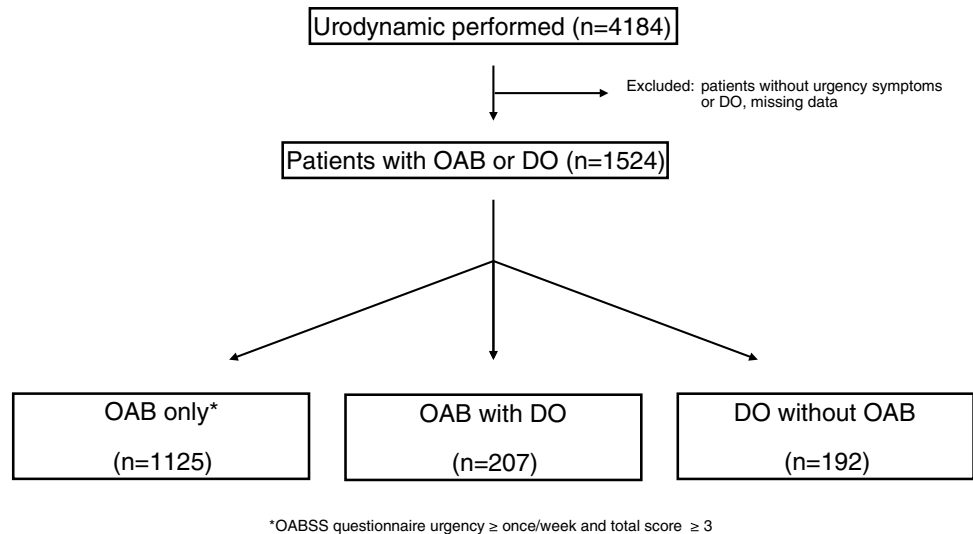
Descriptive statistics were presented as mean with standard deviation. Independent t-test was performed to compare the two groups. A subsequent regression analysis was carried out, and three logistic regression models were generated from different perspectives. ROC (receiver-operating characteristic) analysis was used to assess the prediction performance among the generated models. All statistical analyses were conducted by SAS 9.4. $P < 0.05$ was considered statistically significant.

Results

From June 2016 to September 2019, 4184 patients underwent UDS for LUTS (Fig. 1). After exclusion of patients with incomplete records and who did not complain of OAB symptoms or had DO diagnosis, 1524 patients were analyzed.

Primary outcomes

There were 1125 patients who complained of OAB without associated DO; 207 patients had OAB with DO, and 192 patients had incidental DO on UDS (Fig. 1). The overall incidence of DO in patients with OAB was 15.5%. In all

Fig. 1 Flow chart of patient enrollment in the study

patients with LUTS, the occurrence of OAB was 36.4%; 9.5% of all LUTS patients had DO findings on UDS, and the incidental finding of DO was 4.6%.

Secondary outcome

Of the 1524 patients, 399 had DO diagnosed on the UDS. Comparison between patients with and without DO is depicted in Table 1. There are significant differences between the mean age (66.4 vs 55.9 years old, $P < 0.001$) and parity number (3.31 vs 2.57, $P < 0.001$). There are no significant differences in BMI between the two groups.

Subjectively, there are significant differences in ICIQ-UI SF, OABSS, and POPDI-6 overall score. Except for maximal urethral pressure and pressure transmission ratio, all other urodynamic parameters have significant differences between the two groups.

Multiple logistic regression analysis was performed by a stepwise variable selection algorithm. Variables which were significant in univariate analyses was considered in the modeling process. Table 2 shows the three logistic regression models for DO of patients with OAB. The first model (Model I) consists of noninvasive parameters, including personal and medical history, pad test, and uroflow study. The second model (Model II) consists of only objective parameters including pad test and UDS. The third model (Model III) consists of all subjective and objective parameters. The area under the ROC curve (AUROC) indicates the predictive accuracy of the model (Fig. 2). Model III is significantly better than the other 2 models (AUROC 1 = 0.8203, 2 = 0.7954, 3 = 0.8640, $p < 0.0001$) in prediction performance.

A subsequent analysis of all patients with DO (with and without symptoms) is shown in Table 3. Patients with and without OAB symptoms did not differ significantly with age, parity, and BMI. There are significant differences among

the mean OABSS, ICIQ-UI SF, UDI-6, POPDI-6, IIQ-7, and pad test.

In the studied patient population, 13.5% had advanced pelvic organ prolapse (POP) and another 6.7% underwent pelvic reconstructive surgery; 63.2% of the patients had both OAB and SUI symptoms. Only 4.1% had both DO and USI on UDS; 45.3% patients had OAB symptoms with USI on UDS, and 17.5% had SUI symptoms and DO on UDS.

Discussion

The etiology of OAB is unclear. Many consider DO an underlying pathophysiology of OAB while others have proposed that the cause of OAB may be multifactorial with different phenotypes [15]. Our results showed the total incidence of DO in all LUTS patients was 9.5%; 15.5% of OAB patients had urodynamically proven DO during filling cystometry. This is less compared to previous reporting, where nearly half of OAB patients have DO [6].

The detection rate of DO differs with different methods of UDS. Ambulatory UDS and lower physiological filling rate have a greater DO detection rate than conventional UDS [15]. When the filling capacity was stopped at 500 ml during UDS, 16% of patients with DO would be missed [16]. In our study, we used a filling rate of 70 ml/min on a conventional UDS, which is greater than the physiological diuresis and may account for the lower DO detection rate. Higher filling rates cause mechanical trauma to the receptors, nerve endings, muscle cells, and cell junctions, thereby impairing detrusor contractility [17]. Second, our study did not differentiate patients with only urgency symptoms from those with urgency urinary incontinence. With urgency urinary incontinence being on the more severe end of the spectrum, it can be expected to have a higher associated rate of DO. Patient's understanding

Table 1 Comparison of patients with and without detrusor overactivity or detrusor overactive incontinence

Parameter	All patients <i>n</i> = 1524	Without DO/DOI <i>n</i> = 1125 Mean ± SD	With DO/DOI <i>n</i> = 399	<i>P</i> -value
History				
Age	58.65 ± 14.26	55.92 ± 13.39	66.36 ± 13.80	< 0.001
BMI	24.49 ± 4.09	24.46 ± 4.03	24.58 ± 4.28	0.619
Parous	2.71 ± 1.52	2.57 ± 1.41	3.13 ± 1.71	< 0.001
Questionnaire				
OABSS	8.66 ± 3.07	8.80 ± 2.79	8.28 ± 3.74	0.013
ICIQ-short	5.47 ± 3.50	5.07 ± 3.36	6.62 ± 3.63	< 0.001
UDI-6	7.04 ± 3.61	7.03 ± 3.43	7.07 ± 4.07	0.855
POPDI-6	5.44 ± 3.98	5.72 ± 3.95	4.62 ± 3.95	< 0.001
IICQ-7	8.70 ± 6.00	8.74 ± 5.78	8.60 ± 6.58	0.699
PISQ-12	30.35 ± 6.90	30.15 ± 6.91	31.81 ± 6.70	0.060
CRAD-8	4.63 ± 4.22	4.58 ± 4.09	4.77 ± 4.58	0.571
Pad test				
Pad test (gram)	19.98 ± 32.70	14.77 ± 27.93	34.79 ± 39.95	< 0.001
Uroflow				
Peak flow rate (ml/s)	17.86 ± 13.47	18.95 ± 12.69	14.79 ± 15.06	< 0.001
Voided volume (ml)	253.1 ± 140.7	280.7 ± 139.4	175.0 ± 112.2	< 0.001
Flow time (s)	35.67 ± 19.20	37.76 ± 19.59	29.76 ± 16.69	< 0.001
Residual urine (ml)	70.48 ± 98.16	66.27 ± 97.32	82.36 ± 99.65	0.005
Residual urine percentage (%)	21 ± 23	18 ± 21	31 ± 26	< 0.001
Filling cystometry				
First desire (ml)	146.1 ± 89.70	154.0 ± 89.89	124.1 ± 85.50	< 0.001
Maximal cystometric capacity (ml)	336.0 ± 204.6	364.8 ± 199.4	201.5 ± 172.5	< 0.001
Urethral pressure profile				
Maximal urethral pressure (cmH ₂ O)	61.68 ± 41.74	63.34 ± 27.74	56.98 ± 66.87	0.066
Functional urethral length (mm)	26.27 ± 36.41	27.57 ± 42.07	22.61 ± 7.15	< 0.001
Total profile area (cmcmH ₂ O)	698.9 ± 576.6	726.5 ± 600.6	620.8 ± 494.7	0.001
Proximal area to peak (cmcmH ₂ O)	382.5 ± 357.7	398.1 ± 343.2	338.3 ± 392.8	0.007
Pressure transmission ratio (%)	33.29 ± 25.53	32.81 ± 20.45	34.66 ± 36.30	0.338
Voiding cystometry				
Peak flow rate (ml/s)	14.44 ± 9.44	15.19 ± 7.83	12.36 ± 12.68	< 0.001
Detrusor pressure at peak flow (cmH ₂ O)	25.48 ± 29.82	26.39 ± 31.58	22.93 ± 24.08	0.028
Voided volume (ml)	310.8 ± 166.4	351.1 ± 157.3	199.0 ± 137.3	< 0.001
Bladder scan (ml)	78.39 ± 125.3	84.05 ± 130.5	62.38 ± 108.1	0.001

p-value by independent *t*-test

Bold numbers have a *p*-value of < 0.05 which are considered statistically significant

of “urgency” sensation may differ, and the presence of such symptoms may be overestimated, resulting in lower overall DO rate. It is reasonable to expect that patients treated at a tertiary medical center would reflect the severe end of the population. However, the national health care system in Taiwan does not require referral, and receiving treatment at a tertiary medical center is as affordable and accessible as that at a community hospital. This may in turn dilute the prevalence of DO in OAB patients and in fact reflect the true prevalence in the general population in Taiwan.

The prevalence of OAB was found greater in patients with POP [18]. Interestingly, OAB actually occurred more often in women with a less advanced stage of prolapse [19]. Most patients who come to our center because of POP have advanced stage and are seeking surgical treatment since such surgeries are not readily available in community hospitals. In this study, 20.2% of the patients had either advanced POP or had already undergone pelvic reconstructive surgery. This may provide insight into why our patients with DO/DOI scored lower on POPDI-6.

Table 2 Multiple logistic regression predictive model

Variables	Univariate analysis		Model I		Model II		Model III	
	OR (95%CI)	P-value	aOR (95%CI)	P-value	aOR (95%CI)	P-value	aOR (95%CI)	P-value
Age	1.061 (1.051 - 1.071)	< 0.001	1.056 (1.043 - 1.068)	< 0.001	1.050 (1.034 - 1.066)	< 0.001	1.050 (1.034 - 1.066)	< 0.001
BMI	1.007 (0.979 - 1.035)	0.619						
Parous	1.268 (1.176 - 1.367)	< 0.001						
OABSS	0.946 (0.911 - 0.983)	0.004	0.737 (0.695 - 0.782)	< 0.001	0.692 (0.639 - 0.749)	< 0.001	0.692 (0.639 - 0.749)	< 0.001
ICIQ-UI SF	1.139 (1.101 - 1.179)	< 0.001	1.228 (1.162 - 1.298)	< 0.001	1.220 (1.137 - 1.308)	< 0.001	1.220 (1.137 - 1.308)	< 0.001
UDI-6	1.003 (0.972 - 1.036)	0.842						
POPDI-6	0.928 (0.899 - 0.958)	< 0.001	0.922 (0.888 - 0.957)	< 0.001	0.919 (0.873 - 0.967)	0.001	0.919 (0.873 - 0.967)	0.001
IIQ-7	0.996 (0.977 - 1.015)	0.680						
PLSQ-12	1.038 (0.998 - 1.079)	0.061						
CRADI-8	1.010 (0.977 - 1.045)	0.549						
Pad test (g)	1.017 (1.013 - 1.020)	< 0.001	1.015 (1.011 - 1.019)	< 0.001	1.010 (1.005 - 1.015)	< 0.001	1.010 (1.004 - 1.016)	0.001
Peak flow rate (ml/s)	0.955 (0.942 - 0.969)	< 0.001						
Voided volume (ml)	0.993 (0.992 - 0.994)	< 0.001	0.994 (0.992 - 0.995)	< 0.001				
Flow time (s)	0.972 (0.965 - 0.980)	< 0.001						
Residual urine (ml)	1.002 (1.000 - 1.003)	0.006						
Residual urine percentage (%)	9.050 (5.632 - 14.543)	< 0.001			11.204 (4.591 - 27.342)	< 0.001	13.860 (4.905 - 39.167)	< 0.001
First desire (ml)	0.995 (0.994 - 0.997)	< 0.001						
Maximal cystometric capacity (ml)	0.992 (0.990 - 0.993)	< 0.001			0.992 (0.991 - 0.994)	< 0.001	0.992 (0.991 - 0.994)	< 0.001
Maximal urethral pressure (cmH ₂ O)	0.993 (0.988 - 0.997)	0.001						
Functional urethral length (mm)	0.947 (0.931 - 0.965)	< 0.001						
Total profile area (cmcmH ₂ O)	1.000 (0.999 - 1.000)	0.002						
Proximal area to peak (cmcmH ₂ O)	0.999 (0.999 - 1.000)	0.004						
Pressure transmission ratio (%)	1.003 (0.998 - 1.007)	0.233						
Peak flow rate (ml/s)	0.954 (0.938 - 0.969)	< 0.001						
Detrusor pressure at peak flow (cmH ₂ O)	0.995 (0.990 - 1.000)	0.054						
Voided volume (ml)	0.993 (0.992 - 0.994)	< 0.001						
Bladder scan (ml)	0.998 (0.997 - 0.999)	0.003			0.997 (0.995 - 0.999)	0.005	0.997 (0.995 - 0.999)	0.007

Model I: stepwise forward model selection, AUROC = 0.8203

Model II: stepwise forward model selection, AUROC = 0.7954

Model III: stepwise forward model selection, AUROC = 0.8640

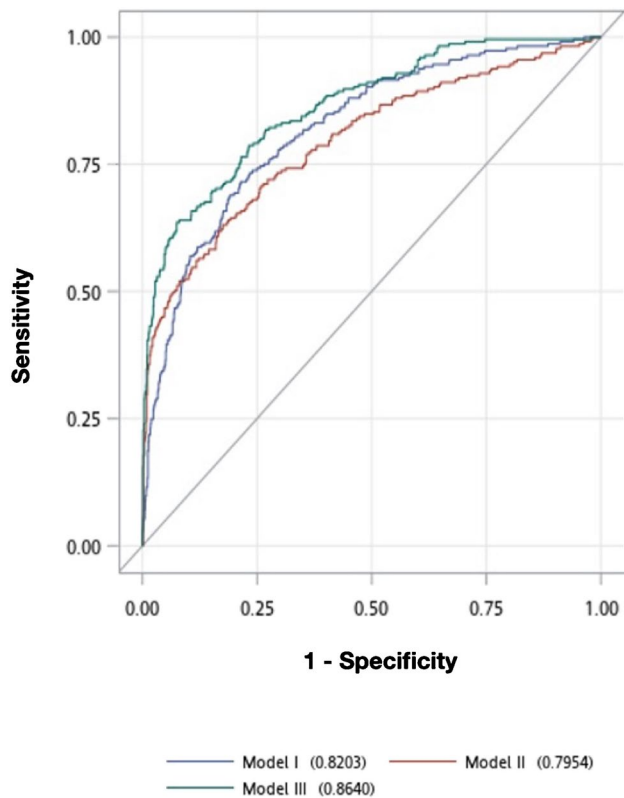


Fig. 2 ROC curve. Model III is a significantly better predictive model than the other 2 models

However, further studies are needed to investigate the causative relationship between POP and OAB.

Historically, OAB was believed to be a motor disorder where patient-reported sensation or urinary urgency is the result of concomitant involuntary detrusor contraction [20]. Guralnick et al. found that patients with DO were older, had smaller maximal voided volumes, and had abnormal sensation [21]. Our findings were similar. Patients with DO were older with increased parity. Motor functions of DO patients were significant for lower peak flow rate, decreased voiding volume, and increased residual urine. Yet, modulation of unmyelinated afferent C fibers with capsaicin and lidocaine has been shown to reduce DO in induced OAB of animal models [22]. This suggests that afferent signals (sensory component) also contribute to the etiology of OAB [20]. We have found that OAB patients with DO have significant small first desire to void volume and maximal cystometric capacity compared with those without DO.

When comparing DO patients with and without OAB symptoms, there were only significant differences in pad test and total profile area of urethral profile pressure objectively. However, the subjective questionnaires

showed significant difference between the two groups. This raises the question of why patients with similar characteristics have such different perceptions. The infamous saying of “the bladder is an unreliable witness” simply means that LUTS do not correlate with the underlying pathophysiology [23]. Various scoring systems based on history and noninvasive examination assessments developed for the prediction of DO are limited as a screening tool and cannot replace UDS [24]. Comprehensive assessment of history, physical examination, and bedside tests has been shown to be less helpful in diagnosing DO [25]. In the three logistic regression models generated in this study for prediction of DO, Model III (consisting of noninvasive and objective parameters) has the greatest area under the ROC curve and is the best predictor model. Subjective symptoms alone are a poor mirror of the cause of the patient’s condition, and objective findings are not consistent with the patient’s symptoms. By combining both the subjective and objective parameters, our study shows that we can then truly reflect the patient’s condition.

The necessity of having DO diagnosis prior to initiation of treatment is an ongoing debate. There are controversies regarding whether the diagnosis of DO aids in treatment guidance and predicts response to therapy. In a 12-week evaluation of tolterodine ER for the treatment of OAB, patients showed greater improvement in mean voided volume and mean voiding frequency with tolterodine use compared to placebo. However, the effect was not dependent on the presence of DO. There was a lack of clear relationship between DO and response to therapy, and the use of UDS assessment prior to treatment with antimuscarinic therapy has been questioned [26]. On the other hand, Patel et al. found that the presence or absence of DO and the volume at which the patient experiences OAB symptoms are predictive of treatment success and can be helpful in management [27]. In OAB patients, filling cystometry can evaluate compliance, sensation, and detrusor activity [5]. These patients experience earlier sensations, which can be used to characterize symptom severity and as an objective evaluation marker following intervention [28]. It has been recently suggested that there are several subtypes of OAB with different pathophysiologies. Urgency sensation may arise from different etiologies, and DO associated OAB is just one of many [29]. Utilization of UDS can aid in differentiation of etiologies, risk stratification, patient education, and expectant management.

Forty-three to 83% of patients discontinue antimuscarinic therapy for OAB within 1 month period [30]. Perhaps instead of being concerned about the invasiveness of UDS, we should also consider the fact that OAB patients have a high discontinuation rate due to intolerable side

Table 3 Comparison of patients with and without overactive bladder symptoms in patients with detrusor overactivity

Parameter	All DO Patients	DO Without OAB Mean ± SD	DO With OAB	<i>p</i> -value
History				
Age	66.63 ± 13.78	67.74 ± 12.80	65.49 ± 14.65	0.109
BMI	25.31 ± 12.46	25.85 ± 17.04	24.78 ± 4.43	0.400
Parous	3.23 ± 2.97	3.34 ± 3.79	3.13 ± 1.80	0.489
Questionnaire				
OABSS	8.48 ± 3.63	6.07 ± 2.61	10.93 ± 2.78	< 0.0001
ICIQ-UI SF	6.72 ± 3.54	6.24 ± 3.71	7.21 ± 3.29	0.007
UDI-6	7.15 ± 4.06	6.08 ± 3.70	8.23 ± 4.12	< 0.0001
POPDI-6	4.57 ± 3.87	3.99 ± 3.51	5.17 ± 4.13	0.003
IIQ-7	8.52 ± 6.51	7.22 ± 6.28	9.85 ± 6.49	< 0.0001
PISQ-12	31.49 ± 6.79	32.73 ± 6.23	30.71 ± 7.08	0.237
CRADI-8	4.76 ± 4.57	4.37 ± 4.21	5.21 ± 4.93	0.151
Pad test				
Pad test (g)	34.88 ± 40.04	30.56 ± 37.76	39.27 ± 41.87	0.035
Uroflow				
Peak flow rate (ml/s)	14.95 ± 15.21	15.42 ± 19.39	14.48 ± 9.19	0.5442
Voided volume (ml)	174.9 ± 111.3	172.7 ± 106.6	177.2 ± 116.1	0.693
Flow time (s)	29.61 ± 16.57	29.78 ± 18.15	29.43 ± 14.84	0.835
Residual urine (ml)	80.50 ± 98.23	80.98 ± 105.1	80.01 ± 91.01	0.922
Residual urine percentage (%)	31 ± 26	30 ± 25	32 ± 27	0.549
Filling cystometry				
First desire (ml)	121.1 ± 82.47	121.3 ± 84.15	120.8 ± 80.95	0.945
Maximal cystometric capacity (ml)	196.0 ± 165.4	206.7 ± 171.1	185.4 ± 159.6	0.333
Urethral pressure profile				
Maximal urethral pressure (cmH ₂ O)	56.34 ± 67.76	50.71 ± 25.02	62.09 ± 92.73	0.103
Functional urethral length (mm)	22.75 ± 7.25	22.09 ± 7.14	23.43 ± 7.32	0.068
Total profile area (cmcmH ₂ O)	623.5 ± 502.9	560.5 ± 440.6	687.5 ± 552.9	0.013
Proximal area to peak (cmcmH ₂ O)	342.1 ± 403.7	329.2 ± 465.2	355.3 ± 330.5	0.526
Pressure transmission ratio (%)	34.64 ± 36.73	36.84 ± 49.53	32.40 ± 14.98	0.235
Voiding cystometry				
Peak flow rate (ml/s)	12.31 ± 12.74	13.00 ± 16.63	11.62 ± 6.83	0.291
Detrusor pressure at peak flow (cmH ₂ O)	23.64 ± 24.42	22.29 ± 26.85	24.97 ± 21.74	0.295
Voided volume (ml)	193.9 ± 128.5	197.2 ± 131.4	190.5 ± 125.7	0.617
Bladder scan (ml)	59.79 ± 105.5	56.36 ± 104.2	63.28 ± 107.0	0.521

p-value by independent *t*-test

effects of OAB medication. In a longitudinal, prospective study, Verghese et. al found that clinicians' treatment decisions are affected by UDS diagnosis. The authors also found that patients who were treated concordant with their UDS findings were more likely to report an improvement in bladder symptoms [6]. The aid of UDS for targeted treatment with expected better outcomes is of paramount importance. Performing UDS may provide both clinicians and patients a better understanding of their condition, aid in treatment decisions, and provide higher patient satisfaction and compliance rates.

Limitation of study

Our study has a few pitfalls. First, the enrolled population was all of Asian descent, and the results may not apply to the general female population worldwide. Second, as commonly seen in the Asian communities, patients suffering from LUTS often refer to these symptoms of the aging process and may not seek medical attention. Hence, the prevalence and severity of the symptoms cannot reflect the general community. Third, we used a non-physiological medium filling rate for the filling cystometry. The detection rate of DO in a

conventional UDS has been known to be inferior and DO is not always demonstrated.

Strength of the study

Our study included a large sample size. All patients were subjected to an uniform and standardized UDS and validated questionnaire survey.

Conclusion

In the present study, we found female patients with DO are associated with older age, increased parity, greater urine leakage, and worse storage and micturition functions on UDS. The combinations of subjective and objective measurements are better predictive models for OAB patients than either one alone. Patient's self-reported symptoms are often unreliable, and incorporation of UDS findings for treatment planning may increase patient's compliance with treatment of OAB and satisfaction. Further prospective study utilizing findings of UDS for patient treatment and management is warranted.

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Authors contribution TX Huang: Project development, Data collection, Manuscript writing and editing
 TS Lo: Project development, Manuscript editing
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 YH Lin: Manuscript editing
 CC Liang: Manuscript editing
 WC Hsieh Manuscript editing

Declarations

Conflicts of interest None.

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