



# A comparison of normal and high post-void residual urine and urodynamic parameters in women with overactive bladder

## Aşırı aktif mesanesi olan kadınlarda normal ve artmış işeme sonrası rezidülerin ve ürodinamik parametrelerin karşılaştırılması

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### Abstract

**Objective:** To investigate voiding functions and assess the relationships of voiding parameters to overactive bladder symptoms and postvoiding residue volumes.

**Materials and Methods:** This is a retrospective study analyzing urodynamic parameters in patients who were diagnosed as having overactive in our urogynecology clinic between April 2014 and April 2016. A total of 290 women who met the selection criteria were included in the study. The patients were divided into two groups according to postvoiding residue volumes: group 1, postvoiding residue volumes <100 mL (n=135); group 2, postvoiding residue volumes ≥100 mL (n=155).

**Results:** A total of 290 women were included in the study; the mean age was 71.4 years. A total of 158 (54.5%) patients had detrusor over-activity during urodynamic testing. The mean maximum bladder capacity in elevated group 2 (postvoiding residue volumes ≥100 mL) was significantly higher than in group 1 (postvoiding residue volumes <100 mL) (p<0.01). Additionally, there was a significant difference between detrusor pressure at Q<sub>max</sub> in both study groups (p<0.05). There were no significant differences in the first-sensation volume between the normal and elevated postvoiding residue volumes groups.

**Conclusion:** In conclusion, patients with overactive with elevated postvoiding residue volumes showed increased maximum bladder capacity, but detrusor over-activity was not more prevalent in these women compared with women with normal postvoiding residue volumes.

**Keywords:** Residue urine, urodynamics, voiding, bladder pressure

### Öz

**Amaç:** Çalışmanın amacı işeme fonksiyonlarını ve işeme fonksiyonları ile aşırı aktif mesane semptomları ve işeme sonrası rezidü idrar volümünü arasındaki ilişkiyi değerlendirmektir.

**Gereç ve Yöntemler:** Çalışmada 2014 Nisan ile 2016 Nisan arasında ürojinekoloji kliniğimizde aşırı aktif mesane tanısı alan hastaların ürodinamik parametrelerini geriye dönük olarak değerlendirdik. Çalışmaya seçilme kriterlerini karşılayan 290 hasta dahil edildi. Hastalar işeme sonrası rezidü miktarlarına göre 2 gruba bölündü: Grup 1, rezidü <100 mL (n=135); grup 2, rezidü ≥100 mL (n=155).

**Bulgular:** Toplam 290 hasta çalışmaya dahil edildi ve hastaların ortalama yaşları 71,4 idi. Ürodinamik testler sonucunda toplam 158 hastada (54,5%) detrusor aşırı aktivitesi saptandı. Grup 2'deki (rezidü ≥100 mL) hastaların ortalama mesane kapasitesi grup 1'deki (rezidü <100 mL) hastalardan belirgin olarak yüksekti (p<0,01). Ayrıca 2 grup arasındaki maksimum akış hızındaki detrusor basınçları belirgin olarak farklıydı (p<0,05). Ancak 2 grup arasında hastaların ilk idrar hissi miktarında belirgin fark yoktu.

**Sonuç:** Sonuç olarak; artmış rezidü idrar volümüne sahip aşırı aktif mesaneli hastalarda artmış maksimum mesane kapasitesi gözlenirken, bu grupta işeme sonrası normal rezidüye sahip olan gruba göre detrusor aşırı aktivitesi prevalansı daha fazla değildi.

**Anahtar Kelimeler:** Rezidü idrar, ürodinami, işeme, mesane basıncı

**PRECIS:** We studied urodynamic parameters and their clinical importance in patients with overactive bladders.

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## Introduction

Urinary incontinence is defined as involuntary leakage of urine<sup>(1,2)</sup>. It is estimated that between 26 and 61% of women receive care for urinary incontinence in their lifetime<sup>(3,4)</sup>. Overactive bladder (OAB) is a term that describes a syndrome of urinary urgency with or without incontinence, often accompanied by nocturia and urinary frequency<sup>(5,6)</sup>.

Urodynamics comprises a group of tests used to evaluate urinary tract function. Urodynamic testing is a simple and non-invasive procedure for evaluating lower urinary tract symptoms. It is also a way of assessing maximum flow rate ( $Q_{\text{maximum}}$ ;  $Q_{\text{max}}$ ), average flow rate ( $Q_{\text{average}}$ ;  $Q_{\text{ave}}$ ), bladder capacity, and post-void residual (PVR) urine<sup>(7)</sup>.

Voiding dysfunction is a broad term. It is defined by the International Urogynecological Association/International Continence Society as “incomplete micturition or abnormally slow micturition<sup>(8)</sup>.” It is the cause of elevated PVR. Parameters for interpreting the results of PVR testing are neither standardized nor well evaluated. In general, a PVR of less than one-third of total voided volume is considered adequate emptying<sup>(9,10)</sup>. Additional parameters include designation of PVR greater than 100 mL as abnormal<sup>(11)</sup>.

Urodynamic parameters and their clinical importance in patients with OAB have not been well studied. Therefore, we explored voiding functions and assessed the relationships of voiding parameters with OAB symptoms and PVR volumes.

## Materials and Methods

The patients' data were retrospectively collected from the hospital medical records. We analyzed urodynamic parameters in patients who diagnosed as having OAB in our urogynecology clinic between April 2014 and April 2016. All patients signed informed consent forms. The same researchers (H.D. and C.H.) conducted retrospective chart reviews for all patients with OAB. A total of 290 women who met the selection criteria were included in the study. The patients were divided into two groups according to PVR: group 1, PVR <100 mL (n=135); group 2, PVR ≥100 mL (n=155).

OAB syndrome is defined as urinary urgency with or without urge incontinence, typically associated with increased daytime frequency and nocturia<sup>(12)</sup>. Detrusor over-activity (DO) is a urodynamic symptom characterized by involuntary detrusor contractions during the filling phase, which may be spontaneous or provoked<sup>(1)</sup>.

Exclusion criteria were patients with pure stress incontinence, allergic diseases such as asthma, history of psychiatric disorders, urinary tract infection, urinary obstructive disease, metabolic diseases, neurologic disorders, and current use of diuretics.

All urodynamic tests were conducted by the same registered nurse and author (H.C.); the same instructions were used to prepare patients, and the same urodynamic machine was used for testing. Patients were evaluated using a multi-channel MMS® Solar (ADS, Ltd., Enschede, The Netherlands) urodynamic study

device. Filling cystometry and uroflowmetry were performed. Also residual urine was measured. Isotonic saline was infused at a rate of 50 mL/min at room temperature for the filling. The patients were in the semi-sitting position. After the urinary bladder was full, volumes at first sensation of urination (mL), feeling the need to urinate (mL), feeling the need to urinate immediately (mL), bladder capacity (mL), and compliance (mL/cm H<sub>2</sub>O) were measured. Detrusor contractions present after 15 cm H<sub>2</sub>O that could not be inhibited were recorded. During the procedure, maneuvers such as coughing and straining were performed to assess whether urinary leakage from the external meatus occurred. The results of urodynamic tests were interpreted and reported by a urogynecologist (H.C.) using an identical reporting form. Catheters for vesical and abdominal pressures were reset before placement of the catheters.

The filling sensations assessed as volumes at first sensation; first urge sensation; strong urge sensation; and bladder capacity. After reaching cystometric bladder capacity, all women were given permission to void. Each woman was repositioned to an upright position. In this position they could void without abdominal pressure. After the measurement of pressures, PVR volume was measured by a nurse who attached a urethral catheter. Bladder capacity was calculated. The values of  $Q_{\text{max}}$  and detrusor pressure at  $Q_{\text{max}}$  were calculated from the pressure-flow testing.

## Statistical Analysis

Statistical analysis was performed using the Number Cruncher Statistical System 2007 statistical software. The mean differences between groups were compared using Student's t-test, and the Mann-Whitney U and independent-samples t-test were applied for comparisons of median values. Logistic regression analyses were conducted to determine the association between voiding parameters and PVR volume. A p value less than 0.05 was considered statistically significant.

## Results

A total of 290 women were included in the study; the mean age was 71.4 years. Table 1 shows the characteristics of the women. A total of 158 (54.5%) patients had DO during urodynamic testing. The mean maximum bladder capacity in elevated group 2 (PVR ≥100 mL) was significantly higher than in group 1 (PVR <100 mL) (p<0.01). Additionally, there was a significant difference between detrusor pressure at  $Q_{\text{max}}$  in both study groups (p<0.05). There were no significant differences in first-sensation volume between the normal and elevated PVR groups. Women with elevated PVR had significantly higher voided volume and maximum flow rates than did women with normal PVR. Additionally, we found no significant difference in DO between the two groups (p=0.282). Table 2 shows a comparison of urodynamic parameters through PVR volumes. Table 3 shows the results of logistic regression analysis to determine the best predictor(s) to discriminate between the groups.

## Discussion

Urodynamic evaluation is a non-invasive process that provides objective and subjective data about bladder functioning. Measurements of urine flow and PVR with uroflowmetry are important parameters. There are some parameters that affect the urine flow rate including voided volume, detrusor contractibility, and bladder outlet obstruction. The purpose of this study was to evaluate urodynamic parameters in women who had OAB symptoms and either normal or elevated PVR volumes. There were 290 medical records for the analyses in the clinical setting.

During urodynamic testing, 158 (54.8%) women showed DO. In this study we find that nearly 50% of patients with OAB had DO on urodynamics testing. Our results are compatible with previous studies<sup>(11,13,14)</sup>. Additionally, Futyma et al.<sup>(15)</sup> observed DO in less than 20% of patients with OAB, which is much lower than the values in other studies where DO was found in more than 50% of patients. The authors believed that the difference in DO prevalence was associated with patients' performing maneuvers during the test that may have provoked urinary responses. The differences among studies may reflect differences in patient selection criteria before data analysis. Jeong et al.<sup>(16)</sup>

**Table 1.** Characteristics of the study groups

	Group 1		Group 2		p
	Normal PVR (<100 mL)		Elevated PVR (≥100 mL)		
	Mean ± SD/n-%	Median	Mean ± SD/n-%	Median	
Age	71.5±5.3	71	71.3±5.1	71	0.755
Vaginal parity (number)	2.5±1.3	2	2.4±1.5	2	0.271
Body mass index	31.0±5.0	31	30.4±4.8	30	0.302

PVR: Postvoiding residual urine, SD: Standart Deviation

**Table 2.** Comparison of urodynamic parameters through post-void residual volumes

	Group 1		Group 2		p
	Normal PVR (<100 mL)		Elevated PVR (≥100 mL)		
	Mean ± SD/n-%	Median	Mean ± SD/n-%	Median	
Max flow rate	26.7±12.7	24	30.3±11.8	28	<b>0.002</b>
Voiding volume	335.3±171.2	318	457.6±226.2	411	<b>&lt;0.001</b>
Max bladder capacity	429±84.7	437	503.5±67	500	<b>&lt;0.001</b>
Voiding efficiency vol/capacity*100	80.4±44.1	76	92.5±47.4	87	<b>0.011</b>

PVR: Postvoiding residual urine, SD: Standart Deviation

**Table 3.** Logistic regression analysis of voiding parameters though post-voidal residual urine in patients with overactive bladder

	OR	Univariate model	
		95% CI	p
Max flow rate	1.03	1.01-1.05	<b>0.013</b>
Voiding volume	1.00	1.00-1.00	<b>&lt;0.001</b>
Max bladder capacity	1.01	1.01-1.02	<b>&lt;0.001</b>
Voiding efficiency vol/capacity*100	1.01	1.00-1.01	<b>0.030</b>
First sensation volume	1.00	1.00-1.00	0.671
Detrusor overactivity	0.78	0.49-1.23	0.282
Valsalva leak point pressure	1.01	1.01-1.02	<b>&lt;0.001</b>
Vesical pressure at Q <sub>max</sub>	0.98	0.97-1.00	0.051
Abdominal pressure at Q <sub>max</sub>	0.98	0.97-1.00	<b>0.025</b>
Detrusor pressure at Q <sub>max</sub>	0.99	0.97-1.00	<b>0.048</b>

OR: Odds ratio, CI: Confidence interval

observed higher  $Q_{\max}$  detrusor pressures than were found in our study. We hypothesized that the difference might be explained by the age differences of the study samples. The mean age in the present study was 71 years, whereas in Jeong et al.<sup>(16)</sup> the mean age was 58.9 years. It has been established that bladder and urethral profiles change with age. Women who had voided less than 100 mL (n=18) were excluded from the present study because the minimum voided volume for reliable urine flow rate in persons aged 56-80 years is 100 mL<sup>(17)</sup>.

PVR volume can be measured using uroflowmetry or pressure-flow studies. These tests are non-invasive. Previous reports reflected a debate regarding the measurement of residual urine volume. Specifically, when voided volume was greater than 300 mL, the mean PVR volumes were not significantly different between non-invasive uroflowmetries and pressure flow studies<sup>(18)</sup>. Therefore, further studies on the differences in PVR volume in relation to voided volume and type of testing are required. Other limitations of the current study are related to its retrospective design. We did not use a bladder diary data to examine the women's naturally voided volume.

## Conclusion

Patients with OAB with elevated PVR volumes showed increased maximum bladder capacity, but DO was not more prevalent in these women compared with women with normal PVR volumes.

## Ethics

**Ethics Committee Approval:** Retrospective study.

**Informed Consent:** Retrospective study.

**Peer-review:** Externally peer-reviewed.

## Authorship Contributions

Surgical and Medical Practices: H.D., H.C., Concept: U.H., Design: M.E., Data Collection or Processing: Ç.H., Analysis or Interpretation: C.K., Literature Search: H.C., Writing: H.D.

**Conflict of Interest:** No conflict of interest was declared by the authors.

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