



## Research Article

# Predictive Factors of Post-Void Residual Urine in Patients with Lower Urinary Tract Symptoms

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### Abstract

**Objectives:** Benign prostatic hyperplasia is considered one of the most important health issues seen in older males, and is characterized by clinical lower urinary tract symptoms (LUTS). A high volume of residual urine can be seen in both organic obstructions as well as bladder dysfunctions. In this study, the primary objective was to evaluate clinical and lab results that can be used as predictive factors in significantly high residual urine volume/urinary retention.

**Methods:** A total of 491 patients over the age of 40 years who presented at the urology clinic with LUTS complaints from September 2015 to December 2016 were included in the study. Our routine evaluation protocol, which consists of patient history, physical examination, prostate-specific antigen test, urinalysis, uroflowmetry, and post-void residual volume assessment, was used to evaluate all the patients included in the study.

**Results:** In univariate analysis, body mass index, peak flow rate (Qmax), and prostate volume were found to be significant predictive factors of post void residual (PVR) urine ( $p=0.001$ ,  $<0.0001$ , and  $<0.001$ , respectively). Multivariate analysis also confirmed these as significant predictive factors of PVR ( $p=0.013$ ,  $<0.0001$ , and  $0.001$ , respectively).

**Conclusion:** Uroflowmetry is a very important tool in the assessment and follow-up of patients with LUTS. As a complementary action, PVR urine volume should also be measured. Residual urine can be significant in patients Qmax of less than 10.1 mL/second and with large prostate volume ( $>40$  cc).

**Keywords:** Bladder, prostate, residual urine, uroflowmetry

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Benign prostatic hyperplasia (BPH) is one of the most significant health issues of males at an advanced age, and manifests clinically with lower urinary tract symptoms (LUTS).<sup>[1, 2]</sup> Some patients who present with LUTS state that they have the sensation of not urinating completely. The sensation of incomplete urination is a symptom that may arise from the high presence of residual urine (PVR). While high residual urine may be caused by an organic obstruction, it may also arise from bladder dysfunction. Though it is not accepted as a value for meaningful PVR, values of 50 mL or less are considered to be normal. On the other hand

values of 100 mL and above are accepted as meaningful high residual urine.<sup>[3-5]</sup> The objective of this study was to evaluate clinical and laboratory findings that predict significant residual urine.

### Methods

A total of 491 male patients aged 40 years or more who presented at the urology clinic with LUTS between September 2015 and December 2016 were initially included in the study. The routine evaluation protocol of history (including the International Prostate Symptom Score [IPSS] and the

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**Table 1.** Factors in post void residual urine

	Meaningful residue (+) n=122	Meaningful residue (-) n=76	Univariate analysis	Multivariate analysis
Age (years)	61.3	60	0.342	
Body mass index (>30 kg/m <sup>2</sup> )	90	45	<0.001	0.013
Qmax (mL/sec)	8.2	12.2	<0.0001	<0.0001
Urine volume (mL)	320	304	0.521	
IPSS	18.1	17	0.127	
IIEF	15.5	15.6	0.204	
PSA (ng/dL)	2.76	2.04	0.094	
Prostate volume (mL)	44	34	<0.001	<0.001

IIEF: International Index of Erectile Function; IPSS: International Prostate Symptom Score; PSA: Prostate specific antigen

International Index of Erectile Function [IIEF]), physical examination (including digital rectal exam), prostate specific antigen (PSA) test, full urinalysis and uroflowmetry (including PVR by ultrasound) was performed with all patients. Sixty-eight patients who could not complete the IPSS and IIEF forms were excluded from the study. Furthermore, 78 patients with uroflowmetry results under 150 mL were also excluded. Prostate volume was measured using transabdominal ultrasound (US) before uroflowmetry, while PVR was measured with US after urination (Kretz Combison 330 ultrasound scanner with a 7.5 MHz transrectal probe (Kretz-technik AG, Zipf, Austria). A result of 100 mL or more was considered significant residual urine. Patients with PVR of 100 mL or more were identified as Group 1 and the others were identified as Group 2. All patients' height and weight were measured during the examination and body mass index (BMI) was calculated. A total of 154 patients who used an alpha blocker or 5-alpha-reductase inhibitor, patients with acute urinary retention history, neurological disease, instrument application history, urinary tract or pelvic surgery history, history of recently catheter insertion, or clean intermittent catheterization were also excepted from the study. A total of 198 patients who meet the criteria were included in our prospective study.

IBM SPSS Statistics for Windows, Version 20.0 (IBM Corp., Armonk, NY, USA) was used to perform the statistical analysis. Independent t-tests were conducted for continuous variables. Categorical variables were evaluated with chi-square analysis. A value of  $p < 0.005$  was considered to be statistically significant.

## Results

The mean age of patients was  $61.63 \pm 14.3$  years. In Group 1, 122 (61.6%) patients were observed to have 100 cc or more residual urine. The mean PSA level was 2.4 ng/dL (range: 1.3–12.1 ng/dL). The mean IPSS score was found to be  $18.5 \pm 5.76$ , and the mean IIEF score was  $15 \pm 10.2$ . The

mean BMI was  $30 \pm 8.7$  30 kg/m<sup>2</sup>. While the BMI of 90 patients in Group 1 (73.7%) was 30 kg/m<sup>2</sup> or more (obese), in Group 2, the BMI of 45 patients (59.2%) was 30 kg/m<sup>2</sup> or more (Table 1). In univariate analysis, BMI, peak flow rate (Qmax), and prostate volume were found to be significant predictors of PVR ( $p=0.001$ ,  $<0.0001$ , and  $<0.001$ , respectively). These variables were again found to be statistically significant in multivariate analysis ( $p=0.013$ ,  $<0.0001$ , and  $0.001$ , respectively) in predicting PVR. It was demonstrated that PVR risk was likely to be 2.2 times greater in patients with an average Qmax value of 10.1 mL/second or less as calculated using a web-based cut-off finder program, and in patients with a prostate volume greater than 40 cc.

## Discussion

Residual urine measurement following uroflowmetry is a useful examination in the evaluation of patients presenting with LUTS. Although increased PVR may suggest clinically worsening micturation, the cause of this occurrence has not been fully understood. Though it may be a condition related to bladder outlet obstruction, hypocontractile bladder may also be responsible.<sup>[6]</sup> Therefore, increased PVR is insufficient to define the type or degree of disease. However, interpretation of significant PVR in favor of isolated benign prostatic obstruction (BPO) has been proposed in numerous studies.<sup>[7–9]</sup>

It has been reported that PVR is useful in determining bladder outlet obstruction.<sup>[10]</sup> However, in another study in which detrusor contractility, BPO, and PVR interactions were evaluated, it was indicated that there is a poor correlation between PVR and bladder outflow obstruction, and that PVR alone may be insufficient to predict bladder outlet obstruction and should be evaluated with other diagnostic tests, such as uroflowmetry.<sup>[11]</sup> It has been stated that 30% of cases with bladder outlet obstruction may not have significant PVR<sup>[12, 13]</sup> in some studies.

Residual urine has been suggested as the cause of urinary tract infection.<sup>[14, 15]</sup> Similarly, recurrent urinary tract infection has been reported to be caused by residual urine in the elderly population and in girls.<sup>[6, 16, 17]</sup> Klarskov et al. demonstrated that PVR increased the risk of acute urinary retention 3.6 times.<sup>[18]</sup>

Increased PVR or low Qmax value may suggest bladder outlet obstruction and/or underactive bladder. A Qmax cut-off value of 15 mL/second is more predictive of bladder outlet obstruction.<sup>[19]</sup> In our study, likelihood of presence of significant PVR in patients with BMI >30 kg/m<sup>2</sup>, with lower Qmax value, and higher prostate volume was found to be statistically significant. When the cut-off value of Qmax was 10.1 mL/second, probability of significant PVR was observed to be 2 times higher than in other patients.

It has been reported in community-based studies that LUTS and erectile dysfunction have a common pathophysiological basis.<sup>[2, 20]</sup> Metabolic syndrome is a combination of metabolic risk factors which increase the risk of developing atherosclerotic disease and in which common genetic and environmental factors are influential. As such, obesity, one of the metabolic syndrome parameters, cannot be overlooked in LUTS. It can be predicted that as BMI increases, LUTS will increase and will affect PVR, which is one of the bladder outlet obstruction indicators. It has also been revealed in our study that PVR can be predicted in patients with BMI >30 kg/m<sup>2</sup>.

Uroflowmetry is an important tool in the evaluation and follow-up of patients with LUTS. However, uroflowmetry alone is not sufficient to assess these patients. Obese patients with a prostate volume greater than 40 mL and a Qmax volume of less than 10.1 mL/second in particular may have significant PVR. Therefore, residual urine volume should be checked with US following uroflowmetry.

## Conclusion

Uroflowmetry is an important measurement in cases of lower urinary system complaints. The amount of residual urine should also be measured to complement this process. It should be noted that residual urine may be significant in patients with a Qmax of 10.1 mL/second or less and in patients with large prostate volume (>40 cc).

### Disclosures

**Ethics Committee Approval:** The study was approved by the Local Ethics Committee.

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

**Conflict of Interest:** None declared.

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