

## Voiding Dysfunction

# Comparative Analysis of Outcomes after Transurethral Resection of the Prostate according to Prostate Shape Shown by Transrectal Ultrasonography

Hyo Serk Lee, Sung Jin Kim, Jae Mann Song, Kwang Jin Kim, Hyun Chul Chung

Department of Urology, Wonju Christian Hospital, Yonsei University Wonju College of Medicine, Wonju, Korea

**Purpose:** Transrectal ultrasonography (TRUS) is a non-invasive modality widely used in urology on an outpatient basis to measure the volume and anatomical structure of the prostate. However, the prostate volume measured by TRUS often varies from test to test. The aim of this study was to determine the clinical significance of the different shapes of the prostate, as shown by TRUS before and after transurethral resection of the prostate (TURP).

**Materials and Methods:** We evaluated 103 patients who underwent TURP. TRUS was performed preoperatively, and the International Prostatic Symptom Score (IPSS) and quality of life (QoL) were assessed preoperatively and at 6 months postoperatively. Patients were classified into two groups: patients with a bilaterally enlarged transitional zone were assigned to group A, and those with a protruding retrourethral zone were assigned to group B.

**Results:** There were no statistically significant differences between the two groups in preoperative variables. However, postoperative IPSS scores were lower in group A than group B ( $9.87 \pm 6.15$  vs.  $13.18 \pm 8.07$ ,  $p=0.02$ ). With regard to postoperative IPSS scores relative to preoperative IPSS scores, both groups showed a significant decrease, but group A experienced a significantly greater decrease than group B ( $13.43 \pm 7.47$  vs.  $8.67 \pm 8.33$ ,  $p=0.005$ ).

**Conclusions:** Patients with a prostate protruding into the bladder have less of a decrease in their IPSS scores after TURP, compared to patients that do not have prostate protrusion, meaning that patients with protrusion experience less symptomatic relief.

**Key Words:** Prostatic hyperplasia; Transurethral resection of prostate

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

### Article History:

received 14 May, 2010

accepted 17 June, 2010

### Corresponding Author:

Hyun Chul Chung  
Department of Urology, Wonju  
Christian Hospital, Yonsei University  
Wonju College of Medicine, 162,  
Ilsan-dong, Wonju 201-701, Korea  
TEL: +82-33-741-0114  
FAX: +82-33-742-3245  
E-mail: chc8174@yonsei.ac.kr

## INTRODUCTION

Transrectal ultrasonography (TRUS) is a relatively non-invasive method that is widely used in urology on an outpatient basis to evaluate the volume, anatomical structure, and shape of the prostate. The mean prostate size increases as a population ages, and, since the average life expectancy has increased in recent years, so has the mean prostate size [1]. Many mathematical formulas have been used to determine the volume of the prostate, but the formula for an ellipsoid (transverse diameter x anteroposterior diameter

x cephalocaudal diameter x  $\pi/6$ ) is generally accepted as the most reliable and accurate method. However, using TRUS to take measurements is known to result in 10-12% variability in the calculated volume upon repeated tests [2]. It is also known that there is an error of approximately 17-22% when volumes calculated using TRUS measurements are compared with direct volume measurements taken before and after prostate resection by robot-assisted radical prostatectomy [3]. These direct measurement methods have less variation than methods utilizing TRUS, primarily due to user-dependent variation. Prostates can

also be classified according to the shape observed on TRUS [4].

Transurethral resection of the prostate (TURP) is an effective therapy for the treatment of benign prostatic hyperplasia (BPH) [5]. There have been studies concerning factors that can predict post-TURP results, and these results are currently known to be primarily related to prostate volume, urodynamic study (UDS) results, and the International Prostate Symptom Score (IPSS) [6,7]. However, as mentioned previously, prostate volume measurements are quite variable.

According to a recent study of the factors predicting bladder outlet obstruction (BOO), prostate-specific antigen (PSA) level, prostate volume, and intravesical prostate protrusion (IPP) are significantly associated with the occurrence of BOO, IPP being the most closely associated [8].

However, there have been few studies regarding the changes in IPSS scores, voiding and storage symptoms, improvements in quality of life (QoL), and urinary flow rate (UFR) after TURP according to the shape of the prostate. The aim of this study was to determine whether preoperative prostate shape has any effects on outcomes after TURP.

## MATERIALS AND METHODS

One hundred and three patients were selected from a population of 652 who underwent TURP for BPH performed by a single urologist at Wonju Christian Hospital from January 2001 to June 2008. Among these patients, those with a urologic tumor, neurogenic bladder (including detrusor overactivity), urinary tract infection (UTI), or bladder stones that may affect voiding were excluded. These 103 patients were selected because they could be followed up on for 6 months postoperatively, and they underwent preoperative TRUS and pre- and post-TURP IPSS evaluations. Prior to TRUS, patients underwent several types of evaluations, including UDS, PSA, and urine analysis (UA). According to the results of TRUS, group A (type I) was defined as patients with bilateral transitional area enlargement, and group B (type II and III) was defined as those with retrourethral zone proliferation without bilateral transitional area enlargement and with bilateral transitional area enlargement. Changes in pre- and postoperative IPSS scores and UFR were compared and analyzed retrospectively.

TRUS images were obtained and reviewed by a single operator. The size of the prostate was measured using the formula for an ellipsoid. UFR was calculated with Medtronic DUET<sup>®</sup> system (MED TRONIC). Maximal urinary flow of the two groups was compared, and the amount of resected prostate tissue was determined by weighing the prostate tissue postoperatively. Statistical analysis was performed with SPSS 12.0K for Windows. A paired sample t-test was used to evaluate the pre- and post-TURP variables in the patients, a Student's t-test was used to evaluate the two groups, and a p-value of less than 0.05 was set as

the threshold for statistical significance.

## RESULTS

The mean age of the 103 patients was 67.94 years, with a range of 54 to 83 years. Sixty-six (64.1%) of the patients belonged to group A, and 37 (35.9%) belonged to group B. There were no statistically significant differences in age, PSA level, preoperative IPSS score, or duration of surgery between the two groups (Table 1).

The prostate volume of group B was significantly larger than that of group A ( $61.66 \pm 22.13$  vs.  $42.02 \pm 18.88$  cm<sup>3</sup>,  $p < 0.001$ ), and the weight of the gross specimen was heavier in group B as compared to group A ( $17.58 \pm 10.86$  vs.  $11.65 \pm 9.26$  g,  $p = 0.007$ ). However, the ratio between the size and the resected volume of the prostate was not significantly different between group B and group A ( $26.89 \pm 13.35\%$  vs.  $27.48 \pm 12.93\%$ , respectively).

Preoperative UFR was significantly different between group A and group B ( $8.18 \pm 4.14$  vs.  $6.16 \pm 3.66$ ,  $p = 0.03$ ). However, postoperative UFR was not significantly different between the two groups ( $13.65 \pm 8.24$  vs.  $12.04 \pm 7.81$ ,  $p = 0.36$ ). Also, when each group was compared pre- and postoperatively, each group had a significant improvement in UFR.

Preoperative IPSS scores were not significantly different

**TABLE 1.** Preoperative and postoperative values of the two groups (Mean $\pm$ SD)

Parameters	Group A	Group B	p-value
Age (years)	67.62 $\pm$ 6.64	68.51 $\pm$ 5.52	0.49
PSA (ng/ml)	3.67 $\pm$ 4.20	5.69 $\pm$ 11.13	0.19
Preoperative IPSS	23.31 $\pm$ 7.11	21.86 $\pm$ 7.64	0.33
Preoperative voiding symptom	13.81 $\pm$ 4.94	12.97 $\pm$ 4.64	0.38
Preoperative storage symptom	9.53 $\pm$ 3.22	9.00 $\pm$ 4.02	0.46
Preoperative Qmax (ml/sec)	8.18 $\pm$ 4.14	6.16 $\pm$ 3.66	0.03
Prostate vol (cm <sup>3</sup> )	42.02 $\pm$ 18.88	61.66 $\pm$ 22.13	<0.001
Transitional zone vol (cm <sup>3</sup> )	18.81 $\pm$ 12.94	31.79 $\pm$ 16.03	<0.001
Operation time (min)	36.57 $\pm$ 14.84	43.45 $\pm$ 19.57	0.06
Resection vol (cm <sup>3</sup> )	11.65 $\pm$ 9.26	17.58 $\pm$ 10.86	0.007
Resection vol/prostate vol ratio (%)	26.89 $\pm$ 13.35	27.48 $\pm$ 12.93	0.82
Postoperative IPSS	9.87 $\pm$ 6.15	13.18 $\pm$ 8.07	0.02
Postoperative voiding symptom	9.87 $\pm$ 4.06	6.00 $\pm$ 5.1	0.057
Postoperative storage symptom	5.68 $\pm$ 3.09	7.18 $\pm$ 3.87	0.033
Postoperative Qmax (ml/sec)	13.65 $\pm$ 8.24	12.04 $\pm$ 7.81	0.36

Values are presented as Mean $\pm$ SD. PSA: prostate-specific antigen, IPSS: International Prostate Symptom Score, Qmax: maximal flow rate

between group A (23.31±7.11) and group B (21.86±7.64); however, group A (9.87±6.15) had significantly lower IPSS scores than group B (13.18±8.07) postoperatively (p=0.02) (Fig. 1). Both groups had statistically significant decreases in their postoperative IPSS scores relative to their preoperative scores, but the change in group A was significantly greater than that in group B (13.43±7.47 vs. 8.67±8.33, p=0.005). QoL improved significantly from the preoperative to postoperative states in both groups, and there was no difference in the degree of improvement between the two groups (Table 2).

**DISCUSSION**

Voiding difficulty is problematic in daily life and lowers the quality of life in people affected by it. BPH is a common cause of voiding difficulty, and, as the average male life expectancy continues to increase, the number of males suffering from voiding difficulty secondary to BPH will increase accordingly. As a male ages, his probability of developing lower urinary tract symptoms (LUTS), for which BPH is the most common cause, increases [9,10]. Currently, European Association of Urology BPH guidelines recommend

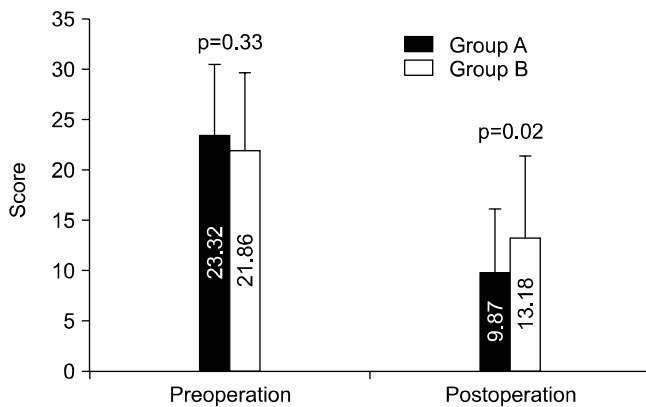
evaluating IPSS, digital rectal examination, serum creatinine, UA, voiding charts, and UFR to assess the disease initially and recommend surgery and finasteride as treatment. TRUS is suggested as the evaluation tool. Even though TRUS is an effective method for determining prostate volume [11-14], measurements using this modality can vary depending on the operator [3]. A reported error rate as high as 10-20% is associated with the timing of the performance of the procedure [2]. However, the volume of the prostate gland or the level of BOO have no significant relationship with the QoL or voiding symptoms [15].

Medical and surgical methods of treating prostatic disease are available, and TURP is currently the most effective treatment method [5]. About 29% of patients with BPH undergo some type of surgery [16]. However, approximately 5-35% of BPH patients who undergo TURP have no improvement in their symptoms [17]. Approximately 10% of these patients actually develop detrusor muscle overactivity despite undergoing TURP [18], and this detrusor overactivity persists in about 30-50% of these patients who subsequently undergo prostatectomy [18,19].

Persistent overactive bladder (OAB) after TURP was frequently observed in patients 80 years of age and older [20], and more cases were found to be related to storage symptoms than voiding symptoms after TURP [21]. Also, when detrusor instability is present preoperatively, patients have a high probability of having persistent voiding dysfunction after TURP [22]. Detrusor overactivity was observed in 52% of patients with BOO. Even with medical therapy, this overactivity continues for a long period of time. However, when BOO is treated by TURP or prostatectomy, the incidence of detrusor overactivity decreases greatly and re-develops less frequently for at least the first five years after the operation [18].

TURP often alleviates most OAB symptoms. This relief likely occurs because TURP destroys both the entire urothelium and submucosal tissue of both the prostatic urethra and bladder neck region. Accordingly, this OAB symptoms can be attenuated by denervation of the associated afferent neurons [23]. According to the data from the conservative management, laser therapy, transurethral resection of the prostate (CLasP) study, side-fire laser treatment of BOO was as effective as TURP in reducing OAB symptoms, and although side-fire laser treatment is not as effective as TURP in reducing mechanical obstruction, it is probably as effective at destroying the prostatic and bladder neck urothelium and suburethral structures [24]. Therefore, it is likely that both laser therapy and TURP are effective for reducing OAB symptom because they denervate the afferent neurons responsible for initiating involuntary detrusor muscle contraction [23].

Our findings demonstrate that voiding and storage symptoms and QoL are improved after TURP in both groups. Additionally, the storage and voiding symptoms of group A were significantly more improved than those of group B. Bladder outlet obstruction has been shown to be more frequently found in patients with IPP, as compared



**FIG. 1.** Comparison of the two groups' preoperative and postoperative International Prostate Symptom Score (IPSS).

**TABLE 2.** Preoperative and postoperative values of IPSS scores and QoL score of the two groups (Mean±SD)

	Preoperation	Postoperation	p-value
<b>Group A</b>			
IPSS	23.32±7.11	9.87±6.15	< 0.001
Voiding symptom	13.81±4.94	4.22±4.06	< 0.001
Storage symptom	9.53±3.22	5.68±3.09	< 0.001
QoL	4.77±1.37	2.28±1.37	< 0.001
<b>Group B</b>			
IPSS	21.86±7.64	13.18±8.07	< 0.001
Voiding symptom	12.97±4.64	5.00±5.15	< 0.001
Storage symptom	9.00±4.02	7.18±3.87	0.005
QoL	4.83±1.06	2.62±1.44	< 0.001

Values are presented as Mean±SD. IPSS: International Prostate Symptom Score, QoL: quality of life

to those without, which was the case with group B, as compared to group A [25]. Furthermore, it is known that bladder outlet obstruction leads to structural changes in the bladder, such as thickening of the bladder wall and decreased bladder compliance. Also established is that thickening of the bladder wall increases the amount of extracellular collagen and causes nerve thickening, inducing storage symptoms by activating unmyelinated C nerve fibers that are nonexistent in the normal bladder [26]. As reported by Mitterberger et al, this phenomenon is attributable to physical alteration of the bladder neck and ischemia of the bladder; however, more anatomical research in this area is necessary [27].

BPH presents clinically as BOO, but morphologically, the prostate can take various shapes. Wasserman classified prostatic hyperplasia as having seven distinct types and compared the ultrasonographic appearance of each type with its pathological appearance [4]. In the case of BOO caused by prostatic hyperplasia, TURP significantly improved voiding symptoms and QoL; however, in our study, group A had significantly greater improvement than group B. This result suggests that careful preoperative evaluation should be undertaken to determine if IPP is present, and sufficient consideration should be given during surgery when the prostate is found to be protruding into the bladder.

## CONCLUSIONS

Transurethral resection of the prostate is an exemplary method for treating prostatic hyperplasia. Most patients experience improvement in their symptoms after surgery, but 20-30% of patients have persistent symptoms, for which medical treatment is often required. Most notably, patients with IPP experience a smaller decrease in their IPSS scores after the operation than patients without IPP, meaning that patients with IPP experience less symptomatic relief on average. This phenomenon is a factor that affects the outcomes after TURP and, therefore, should be considered when selecting patients for this operation.

## Conflicts of Interest

The authors have nothing to disclose.

## REFERENCES

- Rha KH, Choi YD, Hong SJ, Song JS, Kim BH, Choi HS, et al. Prostate volume variation with age: community-based survey in Namhae region. *Korean J Androl* 2001;19:119-24.
- al-Rimawi M, Griffiths DJ, Boake RC, Mador DR, Johnson MA. Transrectal ultrasound versus magnetic resonance imaging in the estimation of prostatic volume. *Br J Urol* 1994;74:596-600.
- Nunez-Nateras R, Andrews JR, Martin GL, Andrews PE, Humphreys MR, Ferrigni RG, et al. Accuracy of ultrasound in estimation of prostate weight: comparison of urologists and radiologists. *Can J Urol* 2010;17:4985-8.
- Wasserman NF. Benign prostatic hyperplasia: a review and ultrasound classification. *Radiol Clin North Am* 2006;44:689-710.
- Thomas AW, Cannon A, Bartlett E, Ellis-Jones J, Abrams P. The natural history of lower urinary tract dysfunction in men: minimum 10-year urodynamic followup of transurethral resection of prostate for bladder outlet obstruction. *J Urol* 2005;174:1887-91.
- Ignjatovic I. Prediction of unfavourable symptomatic outcome of transurethral prostatectomy in patients with the relative indication for operation. *Int Urol Nephrol* 1997;29:653-60.
- Kuo HC, Chang SC, Hsu T. Predictive factors for successful surgical outcome of benign prostatic hypertrophy. *Eur Urol* 1993;24:12-9.
- Lim KB, Ho H, Foo KT, Wong MY, Fook-Chong S. Comparison of intravesical prostatic protrusion, prostate volume and serum prostatic-specific antigen in the evaluation of bladder outlet obstruction. *Int J Urol* 2006;13:1509-13.
- Homma Y, Kawabe K, Tsukamoto T, Yamanaka H, Okada K, Okajima E, et al. Epidemiologic survey of lower urinary tract symptoms in Asia and Australia using the international prostate symptom score. *Int J Urol* 1997;4:40-6.
- Sagnier PP, MacFarlane G, Richard F, Botto H, Teillac P, Boyle P. Results of an epidemiological survey using a modified American Urological Association symptom index for benign prostatic hyperplasia in France. *J Urol* 1994;151:1266-70.
- Gormley GJ, Stoner E, Bruskewitz RC, Imperato-McGinley J, Walsh PC, McConnell JD, et al. The effect of finasteride in men with benign prostatic hyperplasia. The Finasteride Study Group. *N Engl J Med* 1992;327:1185-91.
- Kirby RS, Bryan J, Eardley I, Christmas TJ, Liu S, Holmes SA, et al. Finasteride in the treatment of benign prostatic hyperplasia. A urodynamic evaluation. *Br J Urol* 1992;70:65-72.
- Peters CA, Walsh PC. The effect of nafarelin acetate, a luteinizing-hormone-releasing hormone agonist, on benign prostatic hyperplasia. *N Engl J Med* 1987;317:599-604.
- Stone NN. Flutamide in treatment of benign prostatic hypertrophy. *Urology* 1989;34:64-8.
- Eckhardt MD, van Venrooij GE, Boon TA. Symptoms and quality of life versus age, prostate volume, and urodynamic parameters in 565 strictly selected men with lower urinary tract symptoms suggestive of benign prostatic hyperplasia. *Urology* 2001;57:695-700.
- Glynn RJ, Campion EW, Bouchard GR, Silbert JE. The development of benign prostatic hyperplasia among volunteers in the Normative Aging Study. *Am J Epidemiol* 1985;121:78-90.
- Bruskewitz RC, Larsen EH, Madsen PO, Dorflinger T. 3-year followup of urinary symptoms after transurethral resection of the prostate. *J Urol* 1986;136:613-5.
- Van Venrooij GE, Van Melick HH, Eckhardt MD, Boon TA. Correlations of urodynamic changes with changes in symptoms and well-being after transurethral resection of the prostate. *J Urol* 2002;168:605-9.
- de Nunzio C, Franco G, Rocchegiani A, Iori F, Leonardo C, Laurenti C. The evolution of detrusor overactivity after watchful waiting, medical therapy and surgery in patients with bladder outlet obstruction. *J Urol* 2003;169:535-9.
- Gormley EA, Griffiths DJ, McCracken PN, Harrison GM, McPhee MS. Effect of transurethral resection of the prostate on detrusor instability and urge incontinence in elderly males. *Neurourol Urodyn* 1993;12:445-53.
- Seki N, Yuki K, Takei M, Yamaguchi A, Naito S. Analysis of the prognostic factors for overactive bladder symptoms following surgical treatment in patients with benign prostatic obstruction. *Neurourol Urodyn* 2009;28:197-201.
- Nitti VW, Kim Y, Combs AJ. Voiding dysfunction following tran-

- surethral resection of the prostate: symptoms and urodynamic findings. *J Urol* 1997;157:600-3.
23. Housami F, Abrams P. Persistent detrusor overactivity after transurethral resection of the prostate. *Curr Urol Rep* 2008;9:284-90.
24. Donovan JL, Peters TJ, Neal DE, Brookes ST, Gujral S, Chacko KN, et al. A randomized trial comparing transurethral resection of the prostate, laser therapy and conservative treatment of men with symptoms associated with benign prostatic enlargement: The CLasP study. *J Urol* 2000;164:65-70.
25. Lee JM, Chung H, Kim TW, Kim HS, Wang JH, Yang SK. The correlation of intravesical prostatic protrusion with storage symptoms, as measured by transrectal ultrasound. *Korean J Urol* 2008;49:145-9.
26. Dinis P, Silva J, Ribeiro MJ, Avelino A, Reis M, Cruz F. Bladder C-fiber desensitization induces a long-lasting improvement of BPH-associated storage LUTS: a pilot study. *Eur Urol* 2004;46:88-93.
27. Mitterberger M, Pallwein L, Gradl J, Frauscher F, Neuwirt H, Leunhartsberger N, et al. Persistent detrusor overactivity after transurethral resection of the prostate is associated with reduced perfusion of the urinary bladder. *BJU Int* 2007;99:831-5.