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RESEARCH ARTICLE

Intravesical Prostatic Protrusion and Surgical Outcomes in Benign Prostatic Hyperplasia: A Magnetic Resonance Imaging-Based Evaluation

Emre Uzun [1], Kazım Ceviz [1], Hüseyin Gültekin [1], Hasan Batuhan Arabacı [1], Giray Özgirgin [1], Samet Şenel [1]

[1] Department of Urology, Ankara City Hospital, Ankara, Türkiye

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Corresponding Author;
Emre Uzun, MD
Address: Department of Urology, Ankara City Hospital, Türkiye, Ankara Ankara City Hospital Oncology Building Çankaya, Ankara, Türkiye
E-mail: emr.uzun.7@gmail.com

ORCID

E.U.	0000-0002-1929-0074
K.C.	0000-0001-6343-383X
H.G.	0000-0003-2763-0777
H.B.A.	0000-0002-0138-9092
G.Ö.	0009-0000-6364-2148
S.Ş.	0000-0003-2280-4192

Abstract

Objective: This study aimed to investigate the impact of preoperative intravesical prostatic protrusion (IPP) measurements obtained via magnetic resonance imaging (MRI) on postoperative outcomes in patients undergoing transurethral resection of the prostate (TURP) for benign prostatic hyperplasia (BPH).

Material and Methods: A retrospective review was performed on 160 patients who underwent monopolar TURP at our clinic between January 2021 and December 2023. IPP was measured on sagittal MRI images as the vertical distance from the bladder base to the tip of the prostate protruding into the bladder. Patients were divided into three groups according to IPP length: Group A (IPP <5 mm, n=25), Group B (5 mm ≤ IPP <10 mm, n=30), and Group C (IPP ≥10 mm, n=38). Preoperative and postoperative data, including prostate-specific antigen (PSA) levels, International Prostate Symptom Score (IPSS), average urinary flow rate (Qavg), and maximum urinary flow rate (Qmax), were collected and analyzed across the groups.

Results: The mean age of the patients was 65.3 ± 6.7 years. PSA levels were significantly higher in Group C compared to Group A (p=0.014). Prostate volume and the volume of resected tissue were significantly greater in Group C than in Groups A and B (p<0.001). Postoperatively, all groups showed significant decreases in PSA and IPSS values, along with significant increases in Qmax and Qavg. The improvement in Qmax after TURP was significantly greater in Groups B and C compared to Group A (p=0.019). However, the reduction in IPSS scores did not differ significantly among the groups (p=0.727).

Conclusion: IPP correlates positively with prostate volume, PSA levels, and the amount of resected tissue. TURP significantly improves urinary function and symptom scores regardless of IPP length. However, the improvement in Qmax is more pronounced in patients with a higher IPP. IPP measurement may serve as a useful parameter in the surgical decision-making process for BPH patients.

Keywords: intravesical prostatic protrusion, benign prostatic hyperplasia, transurethral resection of the prostate, magnetic resonance imaging, urinary function.

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INTRODUCTION

Benign prostatic hyperplasia (BPH) is a histological diagnosis characterized by the proliferation of stromal and epithelial cells. It is found in more than half of men over the age of 60 and in almost all men over the age of 80. It is the most common cause of bladder outlet obstruction (BOO), leading to lower urinary tract symptoms (LUTS) in men over 50 years of age (1,2).

For patients with mild to moderate symptoms, initial management of BPH includes observation and medical treatment (3). Surgical options are primarily considered for patients who do not benefit from conservative treatment (careful monitoring and lifestyle modifications) or medical therapy and have severe symptoms (4). Although alternative treatments have emerged in the last 20 years with advancing technology, transurethral resection of the prostate (TURP) has traditionally been considered the gold standard for surgical treatment of BPH due to its low complication rates and high satisfaction rates (5).

Intravesical prostatic protrusion (IPP) is defined as the anatomical extension of the median or lateral lobes of the prostate into the bladder. Several studies have shown that IPP measurement affects the success of medical treatment, catheter-free follow-up of patients with acute urinary retention (AUR), and surgical outcomes (6,7,8).

This study aims to evaluate the effect of IPP measurement using multiparametric magnetic resonance imaging (MRI) of the prostate on postoperative outcomes following TURP.

MATERIAL AND METHODS

The data of 160 patients who underwent monopolar transurethral resection of the prostate (M-TURP) at Ankara Bilkent City Hospital between January 2021 and December 2023 were retrospectively analyzed after institutional review board approval (TABED 2-24-605). Patients with a history of prostate or urethral surgery (n=15), those diagnosed with neurogenic bladder (n=2), and those without multiparametric prostate MRI or detectable IPP on MRI (n=50) were excluded. A total of 93 patients were included in the study.

Multiparametric prostate MRI was performed using a 3T system (Verio, Erlangen, Siemens, Germany) with an empty bladder. IPP was measured by a specialized urologist on sagittal multiparametric prostate MRI images as the vertical distance from the protruding tip of the prostate to the bladder base (Figure 1). The patients were divided into three groups according to IPP measurements, taking as an example the studies conducted by Topazio L. and Oshagbemi AO. et al.: Group A (IPP <5mm, n=25), Group B (5mm < IPP <10mm, n=30) and Group C (IPP >10mm, n=38)(7, 8).

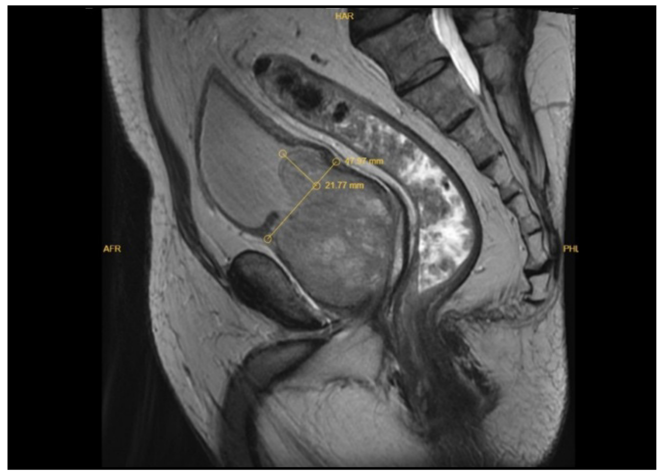

Figure 1. Prostate MRI sagittal section image, IPP measurement

Patient demographics, comorbidities (hypertension, diabetes mellitus, coronary artery disease, neurological diseases), history of hematuria and urinary retention, preoperative parameters (prostate-specific antigen [PSA] level, International Prostate Symptom Score [IPSS], maximum urinary flow rate [Qmax], mean urinary flow rate [Qavg], prostate volume [PV]) were recorded.

Surgical indications included acute urinary retention, Qmax <15 ml/s, and upper urinary tract dilation. All procedures were performed by experienced urologists specializing in endoscopic prostate surgery.

PSA levels, IPSS, Qmax, and Qavg were recorded six months postoperatively, and changes were analyzed.

Surgical Technique

TURP was performed by experienced urologists using a 26Fr resectoscope, monopolar electrocautery, and a continuous irrigation system with 5% mannitol following conventional techniques.

Statistical Analysis

Statistical analyses and data coding were performed using SPSS 22 software (IBM SPSS Statistics, IBM Corporation, Chicago, IL). The Shapiro-Wilk test was used to evaluate the normality of variable distributions. Variables with normal distribution are reported as mean ± standard deviation, while non-normally distributed variables are expressed as medians (interquartile ranges). Categorical variables were compared using the Chi-square or Fisher's exact test, and numerical variables were compared using the Kruskal-Wallis variance analysis. Wilcoxon or Paired Samples tests were used to compare preoperative and postoperative parameters. The two-way mixed ANOVA test was used to evaluate differences in Qmax and IPSS changes among groups. Statistical significance was set at $P < 0.05$ significance.

RESULTS

The mean patient age was 65.3±6.7 years. The clinical, preoperative, and postoperative data of the patients are presented in Table 1. The median IPP was 4mm in Group A, 7.2mm in Group B, and 15.9mm in Group C. The median PSA level in Group C was significantly higher than in Group A (p=0.014). While the prostate volume and resected tissue mass were similar in Groups A and B, they were significantly higher in Group C (p<0.001). Postoperatively, PSA levels and IPSS scores significantly decreased, whereas Qmax and Qavg significantly increased in all groups. The increase in Qmax post-TURP was significantly higher in Groups B and C than in Group A ($F(2,90)=137.499$, p=0.019) (Figure 2). However, there was no significant difference in IPSS reduction among the three groups postoperatively ($F(2,90)=241.122$, p=0.727) (Figure 3).

Table 1. Grouping of patients who underwent TURP for BPH according to IPP length and their clinical, preoperative and postoperative characteristics

	Group A (n=25, % 26.9)	**Group B (n=30, % 32.3)**	**Group C (n=38, % 40.8)**	**p**	**p (Pairwise Comparisons)**
Age (Years) (Mean±SD)	63.9±6.6	66.4±7.2	65.3±6.2	0.266^k	
Comorbodities					
DM, n (%)	5 (20)	6 (20)	14 (36.8)	0.198^c	
HT, n (%)	13 (52)	12 (40)	18 (47.4)	0.663^c	
CAD, n (%)	7 (28)	11 (36.7)	7 (18.4)	0.239^c	
COPD, n (%)	1 (4)	2 (6.7)	0 (0)	0.267^f	
Neurological Diseases, n (%)	1 (4)	1 (3.3)	1 (2.6)	0.955^f	
Hypothyroidism, n (%)	2 (8)	1 (3.3)	3 (7.9)	0.759^f	
Clinical Data					
History of Hematuria, n (%)	1 (4)	3 (10)	7 (18.4)	0.256^f	
History Of Urinary Retention, n (%)	5 (20)	5 (16.7)	9 (23.7)	0.774^c	
Preoperative Data					
Preoperative PSA (ng/dL) (Median [IQR])	1.7 (0.9-3.1)	2.7 (1-6.5)	3.7 (2.1-6.3)	**0.019^k**	*0.33 **0.687 ***__0.014__
Postoperative PSA (ng/dL) (Median [IQR])	1.2 (0.5-2.1)	1.4 (0.7-1.9)	1.9 (1-3.6)	0.069^k	
P	**0.007^w**	**0.001^w**	**<0.001^w**		
Preoperative Qmax (mL/sec) (Median [IQR])	11.3 (8.1-15.5)	10.8 (8.3-16.3)	7.9 (6.4-12.9)	0.072^k	

Postoperative Qmax (mL/sec) (Median [IQR])	17.5 (14.9-20.4)	23.2 (16.7-29.6)	20.5 (14.8-30.2)	**0.047**[k]	*0.047 **0.296 ***0.985
P	**<0.001**[p]	**<0.001**[p]	**<0.001**[p]		
Preop Qavg (mL/sec) (Median [IQR])	4 (3.3-5.9)	4.7 (3.1-7.3)	3.2 (2.6-4.6)	0.13[k]	
Postop Qavg (mL/sec) (Median [IQR])	8.5 (7.2-13.1)	8.2 (6.7-9.5)	9.2 (5.9-11.1)	0.414[k]	
P	**<0.001**[p]	**<0.001**[p]	**<0.001**[p]		
Preoperative Voided Volume(cc) (Median [IQR])	255 (182-375)	214 (172-299)	185 (154-268)	**0.02**[k]	*0.662 **0.364 ***0.017
Postoperative Voided Volume (cc) (Median [IQR])	285 (222-362)	290 (187-371)	249 (172-325)	0.437[k]	
P	0.753[w]	**0.037**[p]	**0.018**[p]		
Preoperative IPSS (Median [IQR])	21 (17-25)	23.5 (19-29)	22.5 (18.7-25.2)	0.313[k]	
Postoperative IPSS (Median [IQR])	13 (8-15.5)	12 (7.5-17)	9.5 (7-16.2)	0.705[k]	
P	**<0.001**[p]	**<0.001**[p]	**<0.001**[p]		
Prostate Volume (cc) (Median [IQR])	45 (32-62)	55 (47-64)	70 (56-90)	**<0.001**[k]	*0.548 **0.014 ***<0.001
IPP (mm) (Median [IQR])	4 (3.3-4.2)	7.2 (6.1-8.8)	15.9 (13-17.8)	**<0.001**[k]	*<0.001 **<0.001 ***<0.001
Preoperative PVR (cc) (Median [IQR])	42 (28-92)	105 (43-191)	105 (78-170)	**0.019**[k]	*0.194 **0.999 ***0.018
Amount of Tissue Resected (gr) (Median [IQR])	12 (6.5-17.5)	15 (11.5-21)	24 (20-30)	**<0.001**[k]	*<0.295 **0.004 ***<0.001

SD: *Standard Deviation,* ***IQR:*** *Interquartile Range,* ***DM:*** *Diabetes Mellitus,* ***HT:*** *Hypertension,* ***CAD:*** *Coroner Arter Disease,* ***COPD:*** *Chronic Obstructive Pulmoner Disease,* ***PSA:*** *Prostate Specific Antigen,* ***IPP:*** *Intravesical Prostatic Protrusion,* ***IPSS:*** *International Prostate Symptom Score,* ***Qmax:*** *Maximal Urinary Flow Rate,* ***Qavg:*** *Average Urinary Flow Rate,* ***PVR***: *Post-void Residual Volume* [k]: *Kruskal Wallis Analysis Of Variance,* [c]: *Chi-square Test,* [f]: *Fisher's exact test,* [w]: *Wilocoxon Test,* [p]: *Paired Samples Test*

* *Difference Between Group A and Group B*

** *Difference Between Group B and Group C*

*** *Difference Between Group A and Group C*

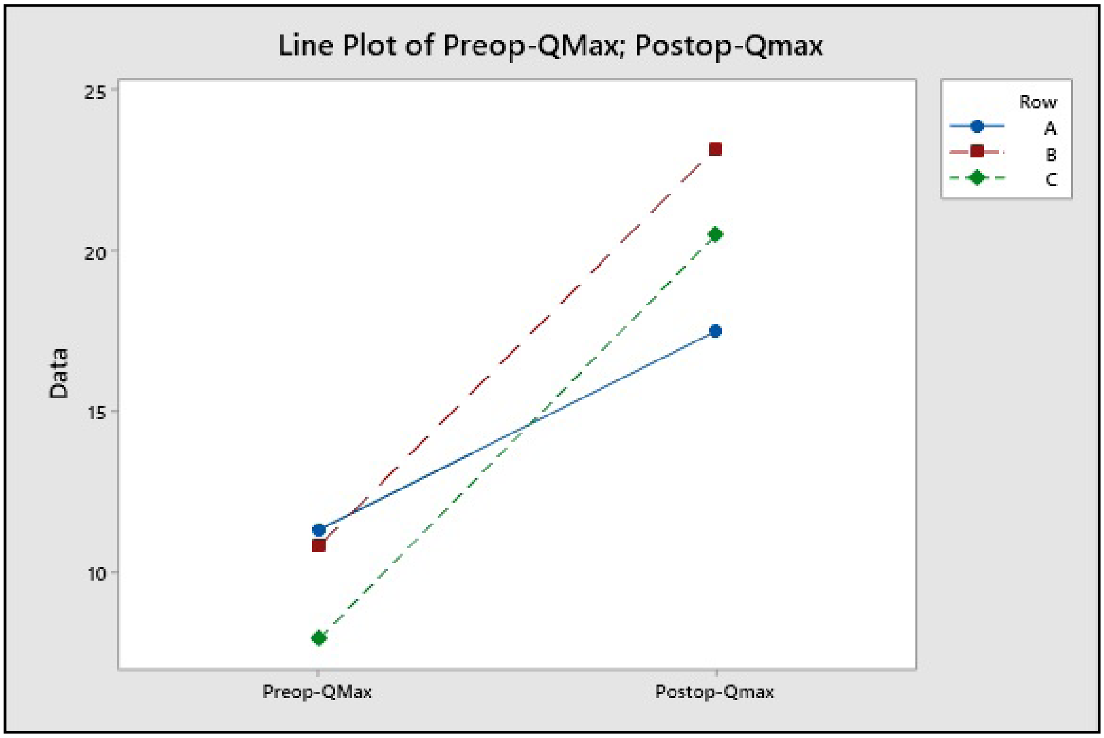

Figure 2. Comprasion of Qmax changes between groups.

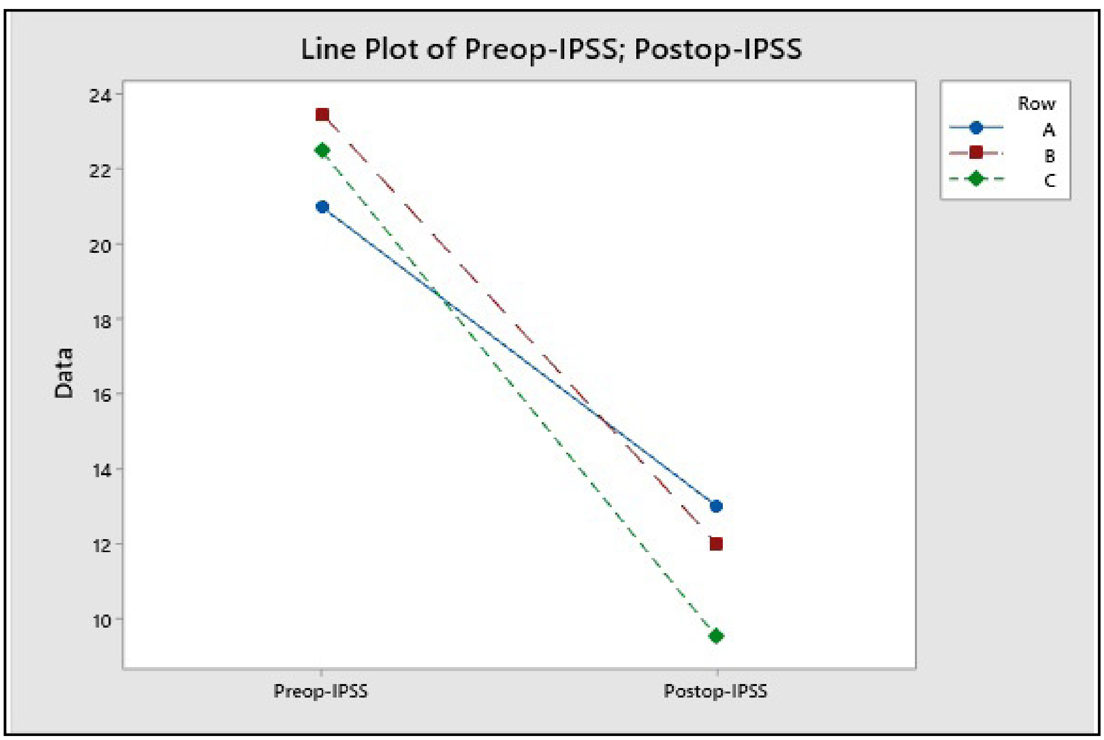

Figure 3. Comprasion of IPSS changes between groups.

DISCUSSION

Various parameters, including uroflowmetry, patient age, preoperative IPSS, prostate volume, and IPP, have been used to determine surgical candidacy and predict surgical success in BPH (8). Foo et al. (9) reported that lower preoperative IPP measurements might rule out BPH. The role of IPP in BPH-related BOO, its predictive value for medical treatment response, its association with bladder stone formation, its link to overactive bladder, and its potential as a prognostic factor for prostate cancer have been investigated (10). However, there is no consensus regarding the effects of IPP on surgical outcomes.

Several studies have reported a strong correlation between IPP and PV, supporting IPP as a non-invasive predictor of BOO and correlating IPP length with PSA levels (11). Our study found significantly higher PSA levels in Group C (p=0.019), particularly in comparison to Group A (p=0.014). The increased prostate volume in Group C may explain this finding. IPP contributes to LUTS and may lead to AUR due to high post-void residual (PVR) volume (12). However, Kadihasanoglu et al. (13) found no relationship between IPP length and AUR incidence. In our study, preoperative PVR differed significantly among groups (p=0.019), with significantly higher values in Group C than in Group A, although AUR incidence was not significantly different among groups.

Our study has several limitations, including its retrospective design and limited sample size. Another limitation is the lack of urodynamic assessment for detrusor activity. Additionally, the six-month follow-up period prevents long-term outcome evaluation and assessment of TURP-related side effects (e.g., urgency, erectile dysfunction). However, compared to other studies, the use of MRI instead of ultrasound for IPP measurements provides a more accurate assessment. Due to this case, this study can be considered as unique.

CONCLUSION

IPP may be considered an important parameter in assessing BOO due to BPH and is associated with improved postoperative voiding function. Given the larger prostate volume and greater resected tissue mass in patients with longer IPP, preoperative IPP measurement should be considered in surgical planning. However, TURP effectively provides symptomatic improvement regardless of IPP length, making it a viable surgical option for all patients.

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Conflict of Interest: The authors declare no conflicts of interest.

Informed Consent: Informed consent was obtained from all participants involved in the study.

Ethical Approval: The study was approved by the Ethics Committee of Ankara Bilkent City Hospital (Approval No: TABED 2-24-605).

Author Contributions: Concept and Design: HG, EU, Supervision: EU, SŞ, Data Collection and/or Analysis: GÖ, HBA, Analysis and/or Interpretation: KC, HG, HBA, Literature Search: EU, KC, Writing: EU, KC, Critical Review: EU, SŞ.

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