

Relationship between Prostate-Urethral Angle, Intravesical Prostatic Protrusion, International Prostatic Symptom Score, and Uroflowmetry in Benign Prostatic Hyperplasia Patients

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Abstract

Objective: To investigate the correlation between intravesical prostatic protrusion (IPP), prostate urethral angle (PUA), international prostatic symptoms score (IPSS), and uroflowmetry in benign prostatic hyperplasia (BPH) patients with lower urinary tract symptoms (LUTS).

Methods: A cross-sectional study was performed to 71 BPH patients with LUTS who attended the Urologic Clinic of Dr. Hasan Sadikin General Hospital and matched the inclusion and exclusion criteria. The intravesical prostatic protrusion and PUA were measured using transrectal ultrasound and the degree of LUTS was measured using IPSS and uroflowmetry. Patients were classified based on PUA (<350 and ≥350) and degree of IPP (grade I < 5 mm; II 5-10 mm; III >10 mm). Data were analyzed using Spearman correlation test.

Results: Prostatic-urethral angle had a strong correlation with IPSS total and voiding (0.670 and 0.715). However, the correlation with IPSS storage was weak (0.381). Furthermore, PUA had a strong negative correlation with Qmax dan Qave values. The bigger the PUA, the smaller the Qmax dan Qave values. Intravesical prostatic protrusion had a strong correlation with IPSS total and voiding (0.645 and 0.662, respectively), but moderate correlation with IPSS storage (0.442). Furthermore, IPP had no correlation with the values of Qmax, Qave, voided volume and PVR.

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Conclusions: Prostatic-urethral angle and intravesical prostatic protrusion have a strong correlation with the occurrence of LUTS in BPH patients.

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Introduction

Benign prostate hyperplasia, or known as BPH, is a condition that is more commonly found in elderly men. In 2000, a total of 4.5 million visits in the United States were diagnosed as BPH cases.^{1,2} In Indonesia, there has been no definitive data on the incidence of BPH but the prevalence in two major hospitals in Jakarta, Dr. Cipto Mangunkusumo General Hospital and Sumber Waras Hospital was 1,040 cases in 3 years (1994–1997).³ A report from Dr. Hasan

Sadikin General Hospital also shows that there is an increasing number of outpatient BPH cases, i.e. from 3,822 cases in 2009 to 4,402 cases in 2014.³ Benign prostate hyperplasia is the largest case in urology outpatient unit and the third rank in urology ward (147 cases in 2013).

Factors that are considered to influence the occurrence of lower urinary tract symptoms (LUTS) in BPH patients are still widely studied.⁴ One of the factors mentioned by researchers is the anatomy of the prostate. Lee et al.⁵ and Cho et al.⁶ found that the prostatic urethral angle (PUA) is inversely related to Qmax. This is due to an energy lost in the bending tube during micturition. The energy loss increases with the prostate urethral angulation and resulting in decreased urine velocity.^{4,5} Some

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other studies have suggested a link between the protrusion and bladder outlet obstruction (BOO) index. Protrusion of the bladder into the prostate may block the urine flow into the bladder neck, leading to blockages with a severity that depends on the degree of the prostate protrusion. The blockage also affects the efficacy of alpha-receptor blockers as the therapy for lower urinary tract obstruction.⁴⁻⁷

This study aimed to analyze the correlation between PUA, intravesical prostatic protrusion (IPP), international prostatic symptoms score (IPSS), and value of uroflowmetry.

Methods

This was a cross-sectional study performed on 71 BPH patients with LUTS who visited the Urology Outpatient Unit of Dr. Hasan Sadikin General Hospital. The inclusion criteria for this study were: male patient attending the urology outward clinic, age ≥ 50 years, and suffering from symptoms of LUTS. The exclusion criteria were history of taking drugs that affect the process of urination, presence of urinary tract infection, use of urethral catheter, history of previous prostate surgery or radiation of the prostate or pelvic area, history of urethral stricture and presence of bladder or prostate tumor, bladder stone, and neurogenic bladder. Patients who were not willing to participate in the study were also excluded.

The independent variables in this study were PUA and IPP that were measured using 4–12 Mhz transrectal probe ultrasound with

Ultraview 800 BK Medical® Ultrasound device. PUA were measured based on an angle of an imaginer line that was drawn from bladder outlet to veromentanum and veromentanum to urethra. IPP were measured based on the length of intravesical prostate from bladder neck. PUA were divided into 2 groups, $<35^\circ$ and $\geq 35^\circ$. and IPP were divided into 3 grades (grade 1: < 5 mm, grade 2: 5–10 mm and grade 3: >10 mm). The dependent variables in this study were the IPSS, maximum urinary flow rate (Qmax), average urinary flow rate/ (Qave), voided volume and postvoid residual volume (PVR). Data were analyzed using the Spearman correlation test with $\alpha=0.05$.

Results

This study found 71 BPH patients who met the inclusion criteria with an average age of 65.74 years and average of prostate volume of 37.39 mL. There were 35 patients with PUA less than 35° and 36 patients with PUA greater than or equal to 35° . Patients with PUA less than 35° had mild to severe IPSS, with most of them had moderate IPSS (9/36) (Table 1), Meanwhile, patients with PUA greater than or equal to 35° had severe IPSS (33/35).

Furthermore, patients with PUA less than 35° have a Qmax of 12.82 ± 3.09 and a Qave of 139.11 ± 2.84 , voided volume of 233.69 ± 113.90 and PVR of 37.97 ± 29.58 ; whereas patients with PUA that was greater than or equal to 35° have a Qmax of 7.28 ± 2.11 , a Qave of 5.44 ± 2.06 ,

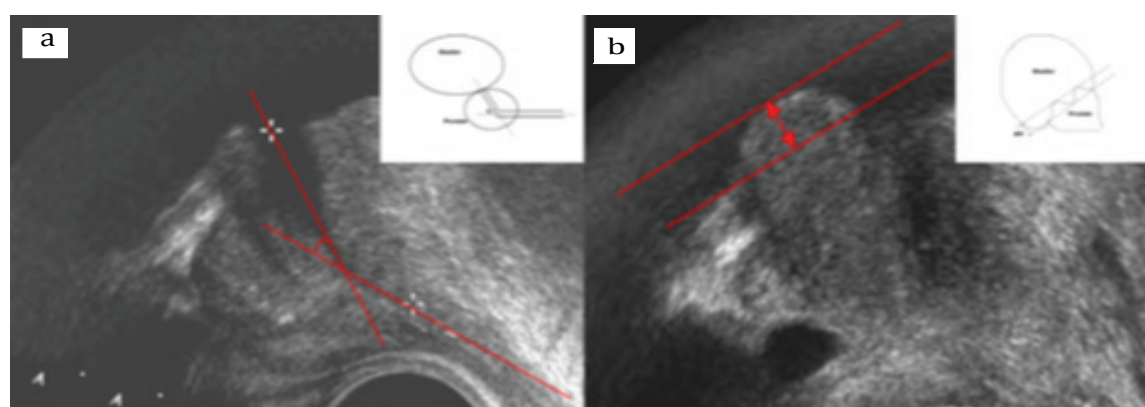


Fig. 1 Measurement of PUA (a) and IPP (b) Using Ultrasound⁶

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Table 1 Prostate Urethral Angle Based on International Prostatic Symptoms Score (IPSS)

Prostate-Urethral Angle	IPSS			Total (mean±SD)	Voiding (mean±SD)	Storage (mean±SD)
	Mild	Moderate	Severe			
< 35° (n=35)	4	19	13	13.97±4.57	8.80 ±3.14	5.16 ±2.184
≥35° (n=36)		2	33	22.31±4.87	15.28±3.40	7.08 ±2.38

voided volume of 184.00±79.55, and PVR of 55.30±29.69 (Table 2).

The measurement of intravesical prostatic protrusion using ultrasound showed that the majority of grade 1 patients had either mild, moderate, or severe IPSS, with the highest percentage of these patients were found with moderate IPSS. In patients with grade 2, most of them had severe IPSS (18/23). Meanwhile, grade 3 patients had severe IPSS (Table 3). Total and voiding IPSS in patients with grade 1 were smaller than in those with grade 2 and 3.

Various degrees of IPP had led to various values of Qmax, Qave, voided volume and PVR that were not consistent with the degree of IPP (Table 4).

Statistical analysis showed PUA had strong correlation with IPSS total and voiding (0.670 and 0.715) in this study. However, a weak correlation was found in IPSS storage (0.381).

PUA has a strong negative correlation with Qmax and Qave values. The bigger the PUA, the smaller the Qmax and Qave values. The degree of IPP had shown a strong correlation with the IPSS total and voiding (0.645 and 0.662) but a moderate correlation with IPSS storage (0.442). Furthermore, the degree of IPP had no correlation with the values of Qmax, Qave, voided volume, and PVR.

Discussion

Most of BPH patients are complaining about lower urinary tract symptoms (LUTS). Various factors, such as PUA width and IPP degree, are responsible for the symptoms. It is suggested by Park *et al.*⁶ that PUA greater than or equal to 35° has a strong correlation with the IPSS

Table 2 Prostate Urethral Angle Based on Value of Uroflowmetry

Prostate-Urethral Angle	Uroflowmetry			
	Qmax (cc/second)	Qave (cc/second)	Voided Volume (mL)	PVR (mL)
<35° (n=35)	12.82 ±3.09	139.11±2.84	233.69 ±113.90	37.97 ±29.58
≥35° (n=36)	7.28 ±2.11	5.44±2.06	184.00±79.55	55.30±29.69

Table 3 Degree of Intravesical Prostatic Protrusion (IPP) Based on International Prostatic Symptoms Score (IPSS)

Degree of Intravesical Prostatic Protrusion	IPSS			Total (mean±SD)	Voiding (mean±SD)	Storage (mean±SD)
	Mild	Moderate	Severe			
Grade 1 (n)	6	12	8	13.46±4.58	8.67±2.99	4.78±2.16
Grade 2 (n)	-	5	18	19.34±5.25	12.56±4.13	6.86±2.68
Grade 3 (n)	-	-	22	23.10±4.59	16.0±3.47	7.10±1.74

Table 4 Intravesical Prostatic Protrusion Based on Value of Uroflowmetry

Degree of IPP	Uroflowmetry			
	Qmax (cc/second)	Qave (cc/second)	Voided Volume (mL)	PVR (mL)
Grade 1 (n=28)	10.43±4.16	7.98±3.65	192±62.86	45.10±29.01
Grade 2 (n=23)	8.33±3.71	5.79±2.40	207.88±99.10	57.21±31.27
Grade 3 (n=20)	11.62±2.69	8.08±2.32	233.90±113.8	35.65±29.62

voiding score. Increase of PUA leads to an increase in IPSS, Qmax, Qave, voided volume and PVR. Lee *et al.*⁵ and Cho *et al.*⁶ also showed similar results. According to Cho *et al.*⁶ the possible reason might be an energy loss in the bending tube during micturition. The energy loss increases with the prostate urethral angulation which results in decreasing urine velocity. This study shows similar results with previous studies. There is a strong correlation between the PUA and the total and voiding IPSS. The same situation occurs with the Qmax and Qave. The wider the PUA, the smaller the values of Qmax, Qave, and voided volume. In addition, the wider the PUA, the higher the PVR. It was stated that the anterior angulation formed in the prostatic urethra increases the pressure within the prostatic urethra, which then leads to urinary flow turbulence.⁸ In this study, there is no correlation. This situation is probably caused by the good functional bladder contraction. In this study the voiding time was

not measured. Some studies have shown that measurement of PUA has a weakness because it is not measured at the time of micturition, when during micturition the width of the PUA can change because of bladder contraction or sphincter muscle relaxation. Further studies are also needed to assess the predictive value of the relationship and the therapeutic efficacy of the prostate angle.⁷⁻¹¹

A study on 200 patients with BOO showed that the higher the degree of IPP, the higher the PVR.¹³ IPP also affects the value of the IPSS score and uroflowmetry. Several other studies have shown the association between the IPP and BOO index, in which moderate to severe degree IPP has a significant influence on BOO and impact on the efficacy of alpha receptor inhibitors in the treatment of LUTS in BPH patients.^{12,13} This study found that the degree of IPP has a strong correlation with the total and voiding IPSS, but no correlation with Qmax, Qave, voided volume, and PVR.

Table 5 Correlation between Prostate Urethral Angle, Intravesical Prostatic Protrusion, International Prostatic Symptom Score, and Value of Uroflowmetry

	PUA		IPP	
	p Value	Coeffisien Correlation	p Value	Coeffisien Correlation
IPSS total	< 0.001	0.670	<0.001	0.645
IPSS voiding	< 0.001	0.715	< 0.001	0.662
IPSS storage	0.001	0.381	<0.001	0.442
Qmax	< 0.001	- 0.777	0.297	0.125
Qave	<0.001	-0.659	0.937	0.010
Voided volume	0.043	-0.241	0.210	0.151
PVR	0.013	0.295	0.328	-0.118

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