

CORRELATION OF PSA, PV, AND IPP IN DETECTING BOO CAUSED BY PROSTATE ENLARGEMENT

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ABSTRACT

Objective: To define the relationship between intravesical prostatic protrusion (IPP), prostate specific antigen (PSA), and prostate volume (PV), and to determine which one is the best predictor of bladder outlet obstruction (BOO) due to benign prostatic enlargement. **Material & method:** 95 male patients > 40 years old presenting with LUTS and BPH, between January until July 2012. They were evaluated with digital rectal examination (DRE), International Prostate Symptoms Score (IPSS), total PSA serum, uroflowmetry, post-void residual urine measurement, IPP and PV using transabdominal ultrasound. Statistical analysis included Chi-square and Spearman's Rank correlation test. Receiver Operator Characteristic (ROC) curves were used to evaluate the correlation of PSA, PV, and IPP with BOO. **Results:** Mean PSA was significantly higher in obstructed patients (8.6 ng/mL; 0.76-130) compared to non-obstructed patients (6.44 ng/mL; 1.0-40.6). Mean PV was significantly larger in obstructed patients (50.33 mL \pm 24.34) compared to non-obstructed patients (45.39 mL \pm 23.43). Mean IPP was significantly greater in obstructed patients (7.29 \pm 2.78) compared to non-obstructed patients (6.59 \pm 2.93). The Spearman rho correlation coefficients were 0.617, 0.721, and 0.797, for PSA, PV, and IPP, respectively. Using ROC curves, the areas under the curve for PSA, PV, and IPP were 0.509, 0.562 and 0.602, respectively. The positive predictive values of PV, PSA, and IPP were 59.7%, 55.6% and 60.2% respectively. **Conclusion:** PSA, PV, and IPP measured through transabdominal ultrasonography are noninvasive and accessible method that significantly correlates with BOO in BPH patients. IPP is a better predictor for BOO than PSA or PV.

Keywords: Bladder outlet obstruction, intravesical prostatic protrusion, prostate specific antigen, prostate volume, transabdominal ultrasound, benign prostate hyperplasia.

ABSTRAK

Tujuan: Menentukan hubungan antara intravesical prostatic protrusion (IPP), prostate specific antigen (PSA) dan volume prostat, dan menentukan mana yang merupakan prediktor terbaik bladder outlet obstruction (BOO) karena pembesaran prostat. **Bahan & cara:** 95 pasien laki-laki berusia > 40 tahun dengan LUTS dan BPH, antara bulan Januari sampai Juli 2012. Mereka dievaluasi dengan digital rectal examination (DRE), International Prostate Symptoms Score (IPSS), total serum PSA, uroflowmetri, pengukuran post-void residu urine, IPP dan volume prostat menggunakan transabdominal ultrasound. Analisa statistik termasuk tes Chi-square dan tes korelasi Spearman. Kurva receiver operator characteristic (ROC) digunakan untuk membandingkan korelasi PSA, volume prostat dan IPP dengan BOO. **Hasil:** Rerata PSA secara statistik lebih tinggi pada pasien obstruksi (8.6 ng/mL; 0.76-130) dibandingkan pasien non-obstruksi (6.44 ng/mL; 1.0-40.6). Rerata volume prostat secara signifikan lebih besar pada pasien obstruksi (50.33 mL \pm 24.34) dibandingkan pasien non-obstruksi (45.39 mL \pm 23.43). Rerata IPP secara signifikan lebih besar pada pasien obstruksi (7.29 \pm 2.78) dibandingkan dengan pasien non-obstruksi (6.59 \pm 2.93). Ko-efisien korelasi Spearman rho adalah 0.617, 0.721, dan 0.797 untuk PSA, volume prostat, dan IPP. Menggunakan kurva ROC, area dibawah kurva untuk PSA, volume prostat dan IPP secara berurutan adalah 0.509, 0.562, dan 0.602. Nilai prediktif positif volume prostat, PSA dan IPP secara berurutan adalah 59.7%, 55.6% dan 60.2%. **Simpulan:** Pengukuran PSA, volume prostat, dan IPP melalui USG transabdominal adalah metode noninvasif yang dapat diakses, dan secara signifikan berkaitan dengan BOO pada pasien BPH. IPP adalah prediktor yang lebih baik untuk BOO daripada PSA atau volume prostat.

Kata kunci: Bladder outlet obstruction, intravesical prostatic protrusion, prostate specific antigen, volume prostat, USG transabdominal, benign prostate hyperplasia.

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INTRODUCTION

Benign Prostate Hyperplasia (BPH) is the most common benign tumor in men, and the incidence increases with age. The prevalence of histological BPH at autopsy ranged from 20% in men aged 41-50 years, 50% in men aged 51-60 years, and > 90% in men over 80 years old. Prostatic obstruction symptoms also appear related to age. At the age of 55 years, approximately 25% of men reported symptoms of obstruction during urination.¹ At age 75 years, 50% of men reported a reduction in the power of his urination. The Risk factor for BPH is not much understood. Some studies suggest a genetic predisposition, and several found its relationship with race.^{1,2}

BPH is a benign neoplasm of the prostate that is often found in older men. At first, if it is not complicated, the patient is given medical treatment; usually requires long-term treatment. Prostate volume is a major predictive factor for determining the progression of BPH and the response to 5 α reductase-inhibitor therapy.³ Based on epidemiology studies and in patients with medical treatment, prostate volume increased related to symptoms, the development of acute urinary retention occurs, and an increased incidence of prostate-related surgery.⁴

In addition, the larger the prostate volume, the greater the likelihood of failure of medical treatment. PSA value, prostate volume and prostate intravesical protrusion has a linear logistic relationship increases proportionally with age.⁵ The higher the age, the higher the prostate volume.⁶ Thus, PSA is a predictor that can be used to assess the response of 5 α -reductase inhibitors and progression of BPH, for example, if prostate volume can be estimated by knowing the value of PSA, it can be estimated that the patient has a high risk of medical failure because of the large volume prostate, especially for doctors who can not use Transrectal Ultrasonography (TRUS).⁷

OBJECTIVE

To define the relationship between intravesical prostatic protrusion (IPP), prostate specific antigen (PSA) and prostate volume (PV), and to determine which one of them is the best predictor of bladder outlet obstruction (BOO) due to benign prostatic enlargement.

MATERIAL & METHOD

Research data were taken from male patients aged 50 years or more with Lower Urinary Tract Symptoms (LUTS) due to benign prostatic enlargement suspect (BPH) in Sardjito Hospital from January to July 2012. A total of 114 patients underwent digital rectal examination, IPSS, uroflowmetry (Qmax), and measurement of total PSA value. Patients were also examined for transabdominal ultrasound to assess prostate intravesical protrusion (IPP), prostate volume (PV) and residual urine. Serum total PSA were divided into 3 groups, total PSA < 4 ng/mL, total PSA of 4-12 ng/mL, and total PSA > 12 ng/mL. Prostate volume measurement by transabdominal ultrasound were divided into 3 groups, prostate volume < 20 mL, prostate volume 20-40 mL, and prostate volume > 40 mL.

The exclusion criteria of this study is that if there is a history of pelvic surgery, pelvic trauma, patients who underwent radiotherapy and neuropathic bladder. Patients with high value of total PSA is underwent biopsy to rule out malignancy in the prostate before become inclusion criteria. Uroflowmetry examination is conducted to measure the maximum urinary stream (Qmax). From the results of uroflowmetry, researchers divided into 2 groups, Qmax < 10 mL/s (obstruction) and Qmax > 10 mL/s (non-obstruction).

SPSS version 17 is used for statistical analysis. To test normality and demographic characteristics, we used one sample Kolmogorov-Smirnov. To assess the association between variables Prostate intravesical protrusion (IPP), PSA and prostate volume (PV), we used Spearman's correlation coefficient with scatter plots. To assess the degree of strength index obstruction from an enlarged prostate, we used Receiver Operating Curves (ROC).

RESULTS

This study consisted of 95 patients with clinical characteristics of patients with BPH, i.e. age, prostate volume (PV), prostate specific antigen (PSA), prostatic intravesical protrusion (IPP), International Prostate Symptom Score (IPSS), uroflowmetry (Qmax) and residual urine (PVR). IPP and prostate volume measured using TAUS (transabdominal ultrasonography) by colleagues from the Radiology (table 1).

Table 1. Demographic and clinical characteristic of BPH patients.

Demographic and clinical characteristic of BPH patients	Value	p
Age (years)	66.84 ± 10.09 (34; 99)	0.367*
Prostate Volume (ml)	43.09 ± 18.96 (16.16; 128.56)	0.471*
PSA (ng/ml)	8.43 ± 6.27 (0.76; 29.9)	0.680*
IPP (mm)	8.65 ± 2.33 (3.1; 14.3)	0.210*
IPSS	23.67 ± 5.1 (5; 30)	0.07
Qmax (ml/s)	12.4 (4.8-26.3)	
PVR (ml)	52 (8-125)	

* Normality test with the one sample Kolmogorov-Smirnov test

Table 2. Distribution of uroflowmetry results based on PV, PSA, and IPP.

Variable	Non Obstruction (Qmax < 10 mL/s)	Obstruction (Qmax = 10 mL/s)	Total (n = 95)
PV (mL)			
= 20	9 (56.3%)	7 (43.7%)	16
> 20-40	17 (39.5%)	26 (60.5%)	43
= 40	8 (22.2%)	28 (77.8%)	36
PSA (ng/mL)			
= 4	20 (51.3%)	19 (48.7%)	39
> 4-12	10 (29.4%)	24 (70.6%)	34
= 12	4 (18.2%)	18 (81.8%)	22
IPP grade (mm)			
= 5	18 (60%)	12 (40%)	30
> 5-10	10 (29.4%)	24 (70.6%)	34
= 10	6 (19.4%)	25 (80.6%)	31

Table 3. Accuracy value PV, PSA and IPP for prediction of the incidence of obstruction.

Statistics	PV	PSA	IPP
Sensitivity (%)	51	30	46
Specificity (%)	38	70	65
Positive Predictive Value (%)	65	68	72
Negative Predictive Value (%)	42	38	46

On table 2, obstruction is found on examination of the variables uroflowmetry prostate volume > 40 mL of 77.8% compared with prostate volume < 20 mL was 43.7%. On variable PSA value, amounting to 48.7% of patients with PSA values 4 with obstruction, while patients with a PSA value 12 was 81.8% with obstruction. For IPP variables, obstruction score is 80.6% in patients with 10 mm IPP (prostate grade 3) and only 40% in patients with

IPP 5 mm (prostate grade 1).

Table 3 concludes descriptive statistics of PV, PSA and IPP. Although all three clinical indicators had a positive predictive value of more than 65%, IPP has the highest rate which is 72%. There is a good positive correlation between IPP, PSA, and PV. Coefficient of correlation between PSA and PV is 0.592 and between PSA and IPP is 0.559. The correlation coefficient between the IPP

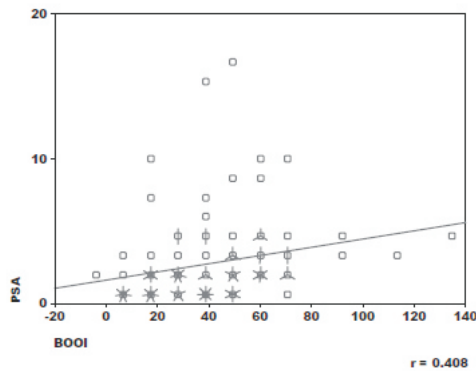


Figure 1. Scatter plot of the relationship between the volume of obstruction with obstruction events.

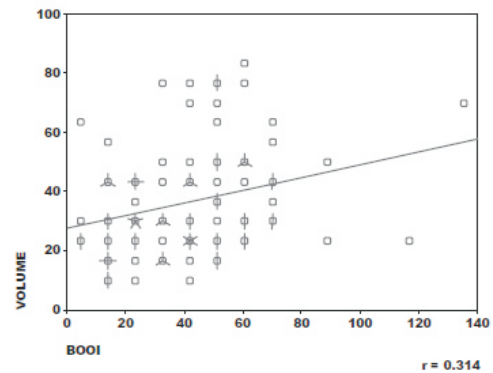


Figure 2. Scatter plot of the relationship between PSA with the incidence of prostate obstruction with obstruction events.

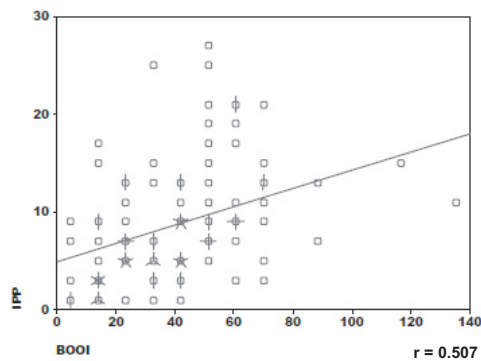
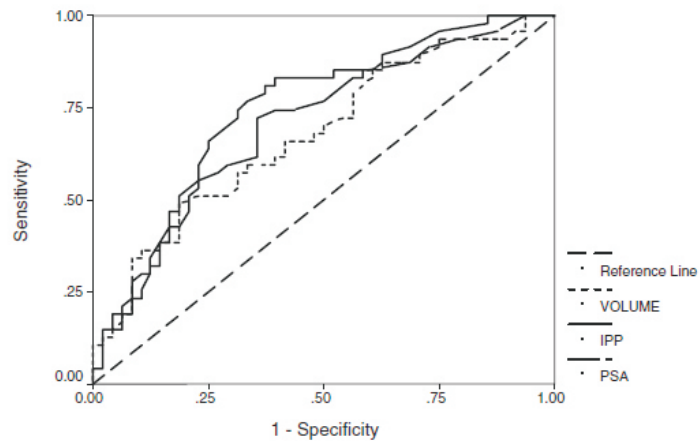


Figure 3. Scatter plot of the relationship between IPP and the incidence of obstruction.



	Prostate Volume	Serum PSA	IPP
AUC	0.637 (0.527 – 0.747)	0.703 (0.602 – 0.805)	0.772 (0.685 – 0.860)

Figure 4. ROC of variable PV, serum PSA and IPP causes obstruction.

and PV is the strongest, i.e. 0.614. When all three indicators were correlated with BOO with scatter plots, correlation coefficient varied from $p = 0.314$ -0.507 (fig. 1-3).

Among the three variables, IPP has the best correlation with BOO (fig. 3). Based on the ROC, IPP have the best area under the curve when compared to PSA and PV (fig. 4). Using the nominal

regression, IPP is the only independent variable that indicates the degree of obstruction ($p = 0.02$, 1.21 OR, 95% CI 1.03 to 1.43).

DISCUSSION

Benign prostate enlargement is a major cause of obstruction of BOO in men aged over 50 years who have symptoms of LUTS. Selecting patients for the most appropriate therapeutic strategy remains a challenge. Urodynamic studies are the gold standard in the diagnosis of BOO but the invasive nature limits application on a regular basis. Several non-invasive clinical indicator has been used to provide similar information so that aggressive therapy is performed only in patients who benefited from such action. IPSS is a simple tool in the evaluation of benign prostate enlargement, with poor grades indicate a need for intervention,⁸ but poor correlation with BOO made it infrequent in usage.^{9,10} PVR can indicate the severity of BOO but bladder dysfunction affects the value.¹¹ To further demonstrate contribution to the diagnosis of BOO anatomical components, such as parts of the prostate gland size (shown with PV and PSA serum) and configuration (indicated by IPP) should be considered. BOO show the existence of a physical obstruction in the bladder neck. It is important for urologists to provide aggressive therapy such as prostatectomy to release the obstruction. This study shows that PV, serum PSA and IPP correlated with each other. The higher the PSA, the PV will also tend to increase, so does the value of the IPP. This is the first discovery of the relationship between the three non-invasive clinical indicators.

Although this study showed a good correlation between prostate size and configuration, but only in small-sized prostate gland with obstruction the importance of IPP is more apparent. This is a unique group of patients who have a small prostate gland with a high degree of IPP. Obstruction should not exist when viewed from the size criteria. We believe that the high rate of obstruction with increased IPP is caused by median lobe protrusion resulting in obstruction to create the effect of 'ball valve' during micturition. At this prospective study, with a single examiner, we can also show that the IPP correlated best with the degree of obstruction (BOO), when compared with PSA and PV. Other studies show a correlation between the size of the prostate with BOO and the relationship between IPP and BOO. However, direct comparison between the various aspects of the prostate gland and its correlation with BOO does not exist.^{12,13}

Prostate volume is a predictor of progression of benign prostate enlargement. Men with PV ≥ 30 mL tend to experience moderate to severe symptoms, reduced flow rate and acute urinary retention. It is also an indication for benign prostate enlargement associated with surgery.^{14,15} Serum PSA is often used as marker for prostate size and has been recognized as a good predictor for the degree of obstruction and incidence of benign prostate enlargement. Mochtar et al have shown a group of patients with a PSA in 18.59 amounted to estimate closest to PV.^{16,17} Patients with a PSA ≥ 1.4 ng/mL has increased the risk of acute urinary retention, increased severity of symptoms and Qmax decreased. Laniado et al. also showed that patients with high PSA associated with the degree of obstruction is seen from urodynamic.^{18,19} Although our prospective study have some drawbacks, the study population was small. Although the findings are statistically proven, but its significance may be weak. We continue to believe that this could be the basis for validation with a larger scale in the future. Long-term follow-up of 5-10 years for this group of patients will also give valuable clinical information to the progression and outcome, especially in patients with urodynamic proven obstruction. In the clinical scenario of LUTS, IPP better predicts degree of obstruction than PSA or PV. IPP is a more effective predictor of the degree of obstruction to identify patients at risk and lead clinician in offering more proactive treatment strategies.

Where researchers conducted the study, measurement of the degree of IPP is routinely performed using transabdominal ultrasound. We have made a grading system that has been shown to correlate well with the degree of obstruction (BOO). This can be a role model in making clinical decisions on the selection and operation of identifying patients who can follow the trial without catheter after micturition episodes of acute urinary retention. Our study shows that the configuration of the prostate (IPP) is more important than the size of the prostate (PV and PSA). IPP measurements can be easily obtained by abdominal ultrasound in the measurement without requiring outpatient transrectal probe or blood sampling. Therefore, IPP measurements required in the evaluation of benign prostate enlargement and decision-making in the choice of operation therapy.²⁰

CONCLUSION

PSA, PV, and IPP measured through transabdominal ultrasonography are noninvasive

and accessible method that significantly correlates with BOO in patients with BPH. The correlation of IPP is much stronger than PSA and PV. It showed that IPP is a better predictor to indicate the degree of obstruction (BOO) compared with PSA or PV.

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