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Comparison between prostate volume and intravesical prostatic protrusion in detecting bladder outlet obstruction due to benign prostatic hyperplasia

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Abstract

The objectives of this study were to determine and compare the correlation of intravesical prostatic protrusion (IPP) and prostate volume (PV) with bladder outlet obstruction (BOO). This study was conducted in the department of urology, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, between July 2009 to September 2010. Fifty benign prostatic hyperplasia (BPH) patients were included in the study. Their evaluation consisted of history along with International Prostate Symptoms Score (IPSS), digital rectal examination (DRE), transabdominal ultrasonography to measure prostate volume, intravesical prostatic protrusion & post voidal residual (PVR) urine and pressure-flow studies to detect bladder outflow obstruction (BOO). Statistical analysis included Unpaired 't' test, Chi-square test and Spearman's Rank correlation test. Receiver Operator Characteristic (ROC) curves were used to compare the correlation of PV and IPP with BOO. Mean prostate volume was significantly larger in bladder outlet obstructed patients ($P<0.05$). Mean IPP was significantly greater in obstructed patients ($P<0.001$). Area under ROC curve was 0.700 for PV and 0.821 for IPP. Prostate volume & intravesical prostatic protrusion measured through transabdominal ultrasonography are noninvasive and accessible method that significantly correlates with bladder outlet obstruction in patients with benign prostatic hyperplasia and the correlation of IPP is much more stronger than that of prostate volume.

Introduction

Benign prostatic hyperplasia (BPH) is one of the most common diseases in elderly men. The prevalence of histological BPH increases with age and appears in approximately 40% of men aged 50-60 years and in approximately 90% of men aged more than 80 years[1]. Benign prostatic hyperplasia may lead to prostatic enlargement, bladder outlet obstruction (BOO) and lower urinary tract symptoms (LUTS). But the symptoms and obstruction do not entirely depend on prostate's size. In contrast, intravesical prostatic protrusion (IPP) has been found to correlate with BOO[2]. IPP is a morphological change due to overgrowth of prostatic median and lateral lobes into the bladder and may lead to diskinetic movement of bladder during voiding. This IPP would cause more obstruction than if there were no protrusion and just enlargement of lateral lobes, as the strong bladder contraction could force open a channel between the lobes[3]. Several studies have previously demonstrated that the ultrasonographic measurement of IPP is able to detect BOO in BPH patients quickly and non-invasively[4]. This study was designed to diagnose BOO through non-invasive methods and aimed to define the correlation of prostate volume and intravesical prostatic protrusion with bladder outlet obstruction and to determine which one of them is a better predictor of BOO.

Materials and Methods

This was a hospital based cross sectional study conducted in the department of urology and radiology & imaging, Bangabandhu Sheikh Mujib Medical University (BSMMU), Bangladesh, from July 2009 to September 2010.

Male patients aged more than 40 years presenting with LUTS and suggestive of BPH were selected for the study. Their initial evaluation consisted of history along with IPSS, physical examination including DRE and neurological examination. Urinalysis was done to exclude UTI, random blood sugar, serum creatinine and serum PSA were measured. Patients with suspicious DRE and raised PSA were sent for prostate biopsy. Transabdominal ultrasound scan was done to measure IPP, PV & PVR and to exclude any other pathology. Potential participants were

counselled about the study and written consent was taken. Pressure-flow studies were done in the participants. Bladder outlet obstruction (BOO) was defined by the BOO index[5]. Values less than 40 were considered non-obstructed and more than 40 were obstructed. BOO index was then correlated with the clinical variables. IPP measurements were divided into two groups: non-significant - 10 mm or less and significant – more than 10 mm. Prostatic volumes were divided into two categories – less than 40 ml and 40 ml or more.

A prescribed form of data collection sheet was filled for each patient. Fifty patients with complete data were found who were finally enrolled for statistical analysis. Statistical analysis was performed using SPSS version 16. Mean, standard deviation (SD) and tests of significance (Unpaired 't' test & Chi-square test) were performed. Scatter plot together with Spearman's Rank correlation tests were used to estimate the nature & strength of relationship of PV & IPP with BOO. ROC curves were used to compare the correlation of PV & IPP with BOO.

Results

Total 50 patients with complete data were included in the study. Their mean age was 64.3 years (range 51-78 years). The mean IPSS was 16.5 (range 8-27ml), mean PV was 38.82 ml (range 25-98 ml), mean IPP was 9.63 mm (range 2-25 mm), mean PVR was 69 ml (range 0-270 ml), mean Qmax was 8.3 ml/s (range 1.6-26 ml/s), mean BOO index was 37.5 (range 5-78). PV less than 40 ml was found in 27 (54%) patients & 40 ml or more in 23 (46%) patients. IPP 10 mm or less was found in 27 (54%) patients and more than 10 mm was found in 23 (46%) patients. Based on BOOI, 26 (52%) patients presented with obstruction and 24 (48%) patients did not present obstruction.

Mean prostate volume in nonobstructed group was 33.17±10.50 ml (range 24-68 ml) and in obstructed group was 44.03±14.32 ml (range 28-98 ml). The prostate volume differed significantly between the two groups (P<0.05).

Mean IPP in nonobstructed group was 6.45±5.50 mm (range 2-16 mm) and in obstructed group was 12.57±6.50 mm (range 4-25 mm). There was highly significant difference in IPP between the two groups (P<0.001).

Among the nonobstructed group, prostate volume was <40 ml in 16 patients and ≥40 ml in 8 patients. In obstructed group, prostate volume was ≥ 40 in 15 patients and < 40 ml in 11 patients. IPP was ≤ 10 mm in 19 non-obstructed and 8 obstructed patients and > 10 mm in 18 obstructed patients and 5 non-obstructed patients.

Table I: Distribution of various clinical variablesaccording to BOO.

Variables	Nonobstructed	Obstructed	P Value
PV(ml)			
< 40	16	11	< 0.05
≥ 40	8	15	
IPP(mm)			
≤ 10	19	8	< 0.001
>10	5	18	

Chi-square test

Prostate volume cutoff value 40 ml or more demonstrated 57.69% sensitivity and 66.67% specificity. Positive predictive value was 65.21% and the negative predictive value was 59.26%.

IPP cutoff value more than 10 mm demonstrated 69.23% sensitivity and 79.17% specificity. Positive predictive value was 78.26% and the negative predictive value was 70.37%.

Table II: Diagnostic accuracy of prostate volume (≥ 40 ml) & intravesical prostatic protrusion (>10 mm)

Diagnostic parameter	PV (≥ 40 ml)	IPP (>10 mm)
Sensitivity	57.69%	69.23%
Specificity	66.76%	79.17%
Positive predictive value	65.21%	78.26%
Negative predictive value	59.26%	70.23%

Scatter plot of relationship of PV and IPP with BOOI showed better correlation than PV with BOO index. The Spearman rank correlation coefficients were 0.399 & 0.691 for PV and IPP respectively. Area under ROC curve was 0.700 for PV and 0.821 for IPP

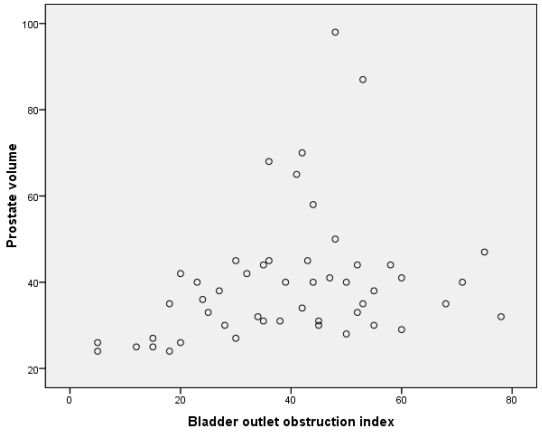

Fig. 1: Scatter plot of relationship between BOOI and PV

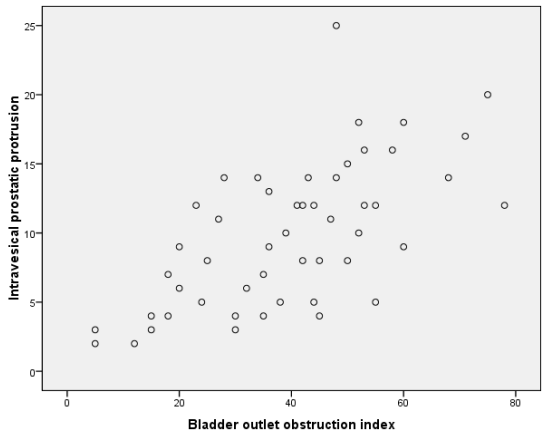

Fig. 2: Scatter plot of relationship between BOOI & IPP

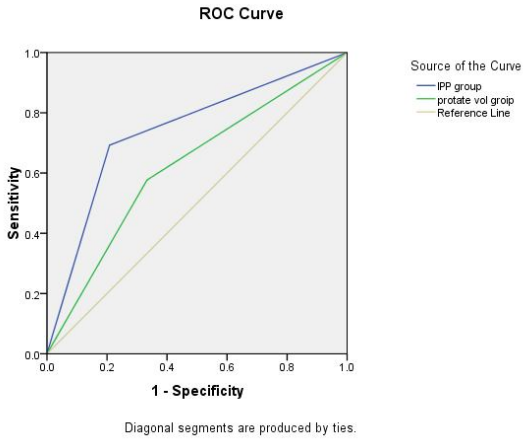

Fig. 3: ROC curve for IPP cutoff value more than 10 mm & PV cutoff value 40 ml or more

Discussion

Present study was designed to evaluate bladder outlet obstruction in patients with benign prostatic hyperplasia through a noninvasive approach of transabdominal ultrasonography by measuring prostate volume and intravesical prostatic protusion, and to determine and compare the correlation of PV and IPP with BOO. Bladder outlet obstruction was determined by the pressure-flow studies and defined by BOO index.

In the present study, the mean prostate volume was 38.82 ml and significantly higher in obstructed patients than non-obstructed and 57.69% of patients with obstruction had prostate volume 40 ml or more. A prospective study of 42 Latin American patients by Leonardo O. Reis et al[6] which showed mean prostate volume 45 ml and 76% of the obstructed patients had prostate volume more than 40 ml. This difference may be due to geographical and racial variation. Another prospective study of 200 patients by Chia et al[7] showed 79% of the patients with obstruction had prostate volume more than 30 ml. This difference may be due to the grouping of patients by prostate volume 30 ml instead of 40 ml.

The results of the present study showed mean IPP of obstructed patients were significantly higher and 69.23% of the patients with obstruction had IPP more than 10 mm and 30.77% had IPP 10 mm or less. These findings were similar to that of K.B. Lim et al[8] who prospectively studied 114 patients. 66% of the obstructed patients had IPP more than 10 mm and 34% had IPP < 10 mm. Another prospective study by Leonardo O Reis et al[6] in Latin American patients showed that 47% of the obstructed patients had IPP more than 10 mm. This difference may be due to geographic and racial variations.

Zhang Keqin et al[9] retrospectively studied 206 patients with BPH and divided the patients into two groups based on degree of IPP: the significant IPP group (> 10 mm) and the non significant IPP group (≤ 10 mm). Increased prostate volume, significant IPP and PVR appeared more often in the obstructed patients and significantly lower peak flow rate (Qmax) was found in obstructed patients ($P<0.05$). Present study also showed significantly higher PV, PVR ($P<0.05$) and IPP ($P<0.001$) in obstructed patients. But in the present study there was no significant difference in the Qmax. This may be due to secondary hypertrophy of detrusor from BOO.

In the present study sensitivity and specificity of PV≥40 ml were 57.69% and 66.67% respectively for diagnosing BOO. IPP more than 10 mm showed 69.23% sensitivity and 79.17% specificity. These are comparable to the results of the study conducted by Chia et al[7]. Present study showed, the area under ROC curve was 0.821 for IPP and 0.700 for PV and so IPP had the more area under curve compared to PV. These results are comparable to the study conducted by Lim KB et al[8] which showed area under the ROC curve 0.772 and 0.637 for IPP and PV respectively.

The present study showed positive correlation of PV & IPP with BOO index and the correlation of IPP was stronger than PV. The Spearman rho correlation coefficients were 0.399 and 0.691 for PV and IPP respectively. K.T. Foo et al[10] prospectively studied 114 patients. PV & IPP had good correlation with BOO index and the Spearman rho correlation coefficients were 0.314 and 0.507 for PV and IPP respectively. These results are comparable to the results of the present day.

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