

A Study of Relationship of Prostate Volume, Prostate Specific Antigen and age in Benign Prostatic Hyperplasia

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ABSTRACT

Introduction: Benign prostatic hyperplasia (BPH) is one of the most common benign tumors in men with prevalence ranging from 50% for men in their 50s to 90% for men in their 90s. We sought to determine the relationship of prostate volume, prostate specific antigen and age in patients with benign prostatic hyperplasia getting admitted under the Department of Surgery in Assam Medical College and Hospital, Assam, India.

Material and Methods: The study was done in the Department of Surgery, Assam Medical College and Hospital, Dibrugarh, during the period of 1st June 2015 to 31st May 2016. The study was based on 40 cases of symptomatic Benign Prostatic Hyperplasia. Cases with prostate specific antigen >10 ng/ml were excluded. The variables of age, prostate volume and prostate specific antigen were examined. A *P*-value <0.05 was considered significant. Findings in patients were compared to other ethnicities.

Results: 40 men were enrolled with mean age 64.1 years, mean prostate volume 43 cc (range 23.8 - 143 cc) and mean prostate specific antigen 2.3 ng/ml (range 0.28 - 8.76 ng/ml). Overall, 27.5% (11/40) had prostate volume <30 cc and 42.5% (17/40) had prostate volume ≥50 cc. Age has significant correlation with prostate volume and prostate specific antigen. Also, there was significant positive correlation between prostate volume and prostate specific antigen.

Conclusion: Age demonstrated significant but weak positive correlations with prostate volume and prostate specific antigen. Only prostate specific antigen and prostate volume showed a significant and strong positive correlation. Prostate volume and prostate specific antigen values were found to be similar to other ethnicities.

Keywords: Prostate, Volume, Prostate Specific Antigen, Prostatic Hyperplasia

INTRODUCTION

Prostate volume (PV) varies widely throughout man's lifetime, and in the course of different prostatic diseases, including benign prostatic hyperplasia (BPH).¹⁻³ Both PV and serum prostate-specific antigen (PSA) predicts the clinical progression and response to medical therapy in patients with BPH, thus help in selecting the regimen for medical treatment (alpha-blockers, 5- α reductase inhibitors (5-ARI), or their combination).⁴⁻⁸ PV is also useful in determining episodes of acute urinary retention (AUR),⁹ predicts the outcome and future need for BPH-related surgery.^{4,7} Moreover, depending on different PV and PSA levels, protocols for transrectal ultrasound (TRUS) guided biopsies and detection rates of prostate cancer (PCa) vary.⁷ Therefore, PV and PSA is

important to understand the natural history of prostatic diseases, and also as criteria to diagnose and making decision regarding therapy.

With this background, the present study is undertaken with the aim to assess PV and serum PSA levels in Indian men with benign prostatic conditions in different age groups, as compared to those reported for men of different ethnicities.

MATERIAL AND METHODS

We conducted a hospital based observational study in the Department of Surgery, Assam Medical College and Hospital, Dibrugarh, during the period of 1st June 2015 to 31st May 2016. The study was based on 40 cases of Benign Prostatic Hyperplasia (BPH) getting admitted during the study period. Ethical clearance was obtained from the Intuitional Ethics Committee (Human) of Assam Medical College and Hospital, Dibrugarh. Informed consent was taken from patients for inclusion in the study.

The indications for evaluation were lower urinary tract symptoms (LUTS) and included digital rectal examination (DRE), Transrectal ultrasonography (TRUS) and Transabdominal ultrasonography were done for determination of PV. Serum PSA estimation was done in all cases. Patients with suspicious findings on DRE, TRUS and serum PSA (<10 ng/ml) who were found to have BPH on TRUS guided biopsies were included in the study. Patients with PSA >10 ng/ml, proven prostate cancer (PCa), previous prostate surgery or treatment with 5-alpha reductase inhibitors (5-ARIs) were excluded from the study. The study population was categorized into five successive age groups in years.

STATISTICAL ANALYSIS

All the data were presented in terms of percentage, mean, standard deviation. Pearson's correlation coefficient was calculated and significance was tested using t-test. A *P*-value of less than 0.05 was considered to be statistically significant. Statistical analysis was done using SPSS software

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Age group (in years)		Number (n)	PV (cc)		PSA (ng/ml)	
Group	Mean \pm SD-		Mean \pm SD	Range	Mean \pm SD	Range
Below 50	47.5 \pm 2.1	2	26.9 \pm 4.3	23.8 - 30	0.8 \pm 0.6	0.39 - 1.26
50-59	51.5 \pm 2.2	8	32.4 \pm 12.7	23.8 - 54	1.4 \pm 0.8	0.42 - 2.80
60-69	63.7 \pm 2.5	17	42.5 \pm 19.6	24 - 102.3	2.0 \pm 1.2	0.28 - 4.61
70-79	72.9 \pm 3.3	10	58.5 \pm 30.3	34 - 143	3.7 \pm 1.8	2.18 - 8.76
80-89	82.0 \pm 2.0	3	33.5 \pm 3.1	30 - 36	2.0 \pm 0.6	1.30 - 2.54
Total	64.1 \pm 9.8	40	43.0 \pm 22.4	23.8 - 143	2.3 \pm 1.5	0.28 - 8.76

PV = prostate volume, PSA = prostate specific antigen

Table-1: Prostate volume and PSA levels among men of different age groups.

Age group	PV<30cc n/total (%)	PV30-39cc n/total (%)	PV40-49cc n/total (%)	PV \geq 50cc n/total (%)
<50	1/2 (50%)	1/2 (50%)	0	0
50-59	7/8 (87.5%)	0	0	1/8 (12.5%)
60-69	4/17 (23.5%)	6/17 (35.3%)	0	7/17 (41.2%)
70-79	0	1/10 (10%)	1/10 (10%)	8/10 (80%)
80-89	0	3/3 (100%)	0	0
Total	11/40 (27.5%)	11/40 (27.5%)	1/40 (2.5%)	17/40 (42.5%)

PV = prostate volume

Table-2: Frequency distribution of different prostate volumes (PV) among men of different age groups

	r	P-value
Age vs PV	0.340	0.03
Age vs PSA	0.493	0.001
PV vs PSA	0.933	<0.001

PV = prostate volume, PSA = prostate specific antigen, r = Pearson correlation coefficient.

Table-3: Correlations age, PV and PSA

version 11, variables of age, PV and PSA frequencies were examined in the study population and among different age groups.

RESULTS

A total of 40 men fulfilling the inclusion and exclusion criteria were included in the study. The oldest patient in the series was 84 years old. The maximum numbers of cases were in the age group 60-69 years. The mean age at presentation was calculated to be 64.1 years (Table 1). The mean prostate volume (PV) was 43 cc (range 23.8 - 143 cc) and mean prostate specific antigen (PSA) was 2.3 ng/ml (range 0.28 - 8.76 ng/ml) (Table 1). Among different age group, PV and PSA varied widely. Overall, 27.5% (11/40) had PV <30 cc and 42.5% (17/40) had PV \geq 50 cc. PV varied widely over different age groups (Table 2). PV was < 30 cc in 11 (27.5%) patients, 30-39 cc in 11 (27.5%), 40-49 cc in 1 (2.5%) and \geq 50 cc in 17 (42.5%) patients. Among individual age groups, most men had PV <50 cc, and the 70-79 years age group where more patients (80%; 8/10) had PV \geq 50 cc. In the limited number of patients in the 80-89 years age group (n = 3) we found 100% with PV <40 cc (Table 2). Age demonstrated significant with PV ($P = 0.03$) and PSA ($P = 0.001$), but weak positive correlations with PV ($r = 0.340$) and PSA ($r = 0.493$) (Table 3). Only PSA and PV showed a significant and strong positive correlation ($P < 0.001$; $r = 0.933$) (Table 3).

DISCUSSION

Benign prostatic hyperplasia is a common cause of significant lower urinary tract symptoms in men and is the most common cause of bladder outflow obstruction in men > 70 years of age.¹⁰⁻¹² Benign enlargement of prostate is universally accepted to be a disease of old age. Lu S *et al*, remarks that the prevalence of pathological BPH is 8% in the 4th decade of life; however, 50% of men develop pathological BPH at age 51-60 years.¹³ Patel ND *et al*, reported that with age, the prevalence of BPH rises markedly. Autopsy studies have found a histological prevalence of 8%, 50% and 80% in the 4th, 6th and 9th decades of life, respectively.¹⁴ The present series conforms with the above findings to show an age range from 40years to 90 years. The peak incidence was between 60-69 years (42.5%). The prevalence of BPH is 5% in the age group <50 years and increases to 20% in men aged 51 to 60years.

In a study by Bohnen *et al* 52% of men with PSA ranging from 1.1-1.5 ng/ml and in 65% with PSA ranging from 1.6-2.0 ng/ml, were found to have PV >30cc. They reported that a serum PSA level >1.5 ng/ml could be a functional cut-off value to detect men with PV more than 30 cc.¹⁵ In a retrospective study, patients with PV >40 cc who were treated with different alpha-blockers demonstrated increased risk of treatment failure.¹⁶ In another study, patients receiving tamsulosin and having smaller total PV responded better on flow parameters.¹⁷ PV >30-40 cc is an indication for 5-ARI therapy in patients with moderate-to-severe LUTS, which is according to the BPH guidelines of the European Association of Urology.⁹ Thus, patients with bothersome LUTS and PV \leq 40 cc may get benefit using alpha-blocker medication, while 5-ARI therapy (with or without an alpha-blocker) is appropriate for those with PV \geq 40 cc.¹⁸

We assessed the relationship between PV, PSA and age in

Ethnicity	Population	N (pts)	Age (years) Mean (range)	PV (cc) Mean (range)	PSA (ng/ml) Mean (range)
Indian (Current study)	Patients with LUTS secondary to BPH	40	64.1 (46-84)	43.0 (23.8-143)	2.3 (0.28-8.76)
Saudi ¹⁹	Patients with LUTS secondary to benign prostatic disease	447	64.2 (20-89)	35.2 (7-184)	2.2 (0.18-10)
White (European) ²⁰	Patients with LUTS suggestive of benign prostatic enlargement	354	70.2 (45-91)	40.1 --	3.9 --
Predominantly White (Americans) ²¹	Patients with symptomatic BPH and no evidence of prostate cancer	4448	63.7 (40-80)	43.7 --	2.6 --
Japanese ²²	Patients with atleast moderate LUTS and clinical BPH	535	67.1 (43-89)	30.2 (5-140.3)	2.3 (0.2-9.9)
Korean ²³	Patients with LUTS and BPH	5716	64.3 (50-79)	36.9 --	2.2 --
Taiwanese ²⁴	Patients with LUTS and pathologically proven BPH	233	71.4 (42-89)	43.1 (10.5-104.6)	5.9 (0.5-9.9)

PV = prostate volume, PSA = prostate specific antigen.

Table-4: Comparison of prostate volume and PSA in Study population (Indian men) vs other ethnicities.

Indian men with benign prostatic conditions. The PVs in our study are similar to those reported in European, American, and Taiwanese studies (Table 4).^{20,21,24} But the reported PVs in the present study are larger than those reported in Saudi, Japanese and Korean studies.^{19,22,23} In a study done in Saudi men, 62% had PV <30cc while prostates larger than 50 cc were found in only 8.7%.¹⁹ In a European study from the Netherlands, with study population of 1859 patients aged 40-80 years with symptomatic BPH and no evidence of prostate cancer, 26.3% had PV <30 cc and 30.1% had prostates >50 cc.²⁵ In our study, 27.5% (11/40) of patients had PV <30 cc while 42.5% (17/40) had prostates ≥50 cc. Among different age groups, most men had PV <50 cc, and the 70-79 years age group where more patients (80%; 8/10) had PV ≥50 cc. In the limited number of patients in the 80-89 years age group (n = 3) we found 100% with PV <40 cc. Comparatively, in a study done in Saudi men, involving 447 patients aged 20-89 years with benign prostatic conditions, among different age groups, PV <30 cc was found in most of the men, except the 70-79 years age group where patients (55.2%; 53/96) had PV >30 cc. In the 80-89 years age group (n = 16) they found 62.5% with PV <30 cc.

The PV and its relationship to PSA are found to be variable in different races (Table 4).¹⁹⁻²⁵ The PV in Japanese and Korean men was reported to be lower than in white men. Also, the relationship between PSA and PV in Asian men is not similar to white men where more PSA per unit prostate volume has been noted in Japanese and Taiwanese men.^{22,24} The reported mean PSA (5.9 ng/ml) in the study on Taiwanese men was higher than in other studies, but similar to ours. In our study the variation in prostate volume with other studies in Asian men may be due to the sample size of the study population which is smaller than other studies. However, the study designs, methodologies and populations involved in these studies are not identical; hence the comparison of such findings should be interpreted with caution.

Vesely et al from Sweden reported on the relationship between age, PV, PSA, symptom score and uroflowmetry in

men with LUTS.²⁰ They found that progressive increase of mean PV (48.2ml) and mean PSA (5.4 ng/ml) in the <80 years age group as compared to the <54 years age group (27.5 ml and 1.5 ng/ml, respectively). Moreover, they found a decrease in both PV and symptom score in the 75-79 years age group, while PSA remained unchanged. In our study, the PV increases with increasing age except in the age group 80-89 years. In 80-89 years age group demonstrated 100% (3/3) with PV <40 cc, showing smaller prostates in this particular group as compared to the younger 60-69 and 70-79 age groups, where 41.2% and 80% had PV ≥50 cc, respectively. Although these findings can be explained by the hypothesis of prostatic atrophy, but this interpretation must be made with caution, as the sample size is very small in the 80-89 years age group and the individual patients were not done follow-up longitudinally.

Our study conforms with an Indian study done by Ganpule AP *et al*, in their study in a community-based population in Gujarat (India) found that 37 (1.8%) had a PSA more than 10ng/ml, 180 (8.9%) had a PSA between 4-10 ng/ml, while 1787 (89.17%) had a PSA of <4 ng/ml.²⁶ There was significant correlation between prostate volume and PSA (correlation coefficient 0.50) and between age and prostate volume (correlation coefficient 0.33). The age-specific PSA values calculated as the 95th percentile value were as follows, 40-49 years (0-2.1), 50-59 years (0-3.4), 60-69 years (0-4.2) and more than 70 years (0-5.0).⁷⁵ In the present study, the PSA levels were <4ng/ml in 95%, 4-10ng /ml in 5% and >10ng/ml were excluded from the study. There was a statistically significant correlation between age and prostate volume (correlation coefficient 0.340) and between PSA and prostate volume (correlation coefficient 0.933). The age-specific PSA values were as follows, 40-49 years (0.39-1.26), 50-59 years (0.42-2.80), 60-69 years (0.28-4.61) and more than 70 years (1.30-8.76).

We recognize that our study was limited by its relatively small single-center study population. Our findings need to be better characterized by prospective, multicenter,

long-term longitudinal studies entailing larger cohorts of randomly selected community-based populations. India being ethnically distinct, need a large community-based multicentre Indian studies.

CONCLUSION

Benign Prostatic Hyperplasia (BPH) is age related and the prevalence increases with increasing age. Changes in prostate volume (PV) and serum prostate specific antigen (PSA) vary among different ages. Age is found to be significant but showed weak positive correlations with PV and PSA. Only PSA and PV demonstrated a significant and strong positive correlation. The study also demonstrated that serum PSA correlates with age, and this is due to increasing prostate volume with advancing age. PV and PSA values were found to be closer to other ethnicities. India being ethnically distinct, need to have separate PSA reference ranges which need to be established with large community-based multicentre Indian studies.

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