

Role of Ultrasonography in Evaluating Prostate Obstruction using Prostate Size and Post Void Residual Urine Volume: A Study from Western India

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Abstract

Background: Benign prostatic hyperplasia (BPH) is one of the primary causes of morbidity in older adults. Without timely intervention, the risk of developing urinary obstruction is 2.5% higher in men with BPH. Prostate size or volume and reduced urinary flow rate are significant predictors of prostate obstruction and can be visualized on a real-time basis using ultrasonography (USG).

Aims and objectives: To evaluate the relationship between prostate volumes (PV) and post-void residual volume (PVRV) to predict the degree of obstruction.

Materials and Methods: A tertiary care center in Gujarat studied fifty symptomatic and asymptomatic male patients with BPH (age ≥ 50 years) were studied at a tertiary care center in Gujarat. Sociodemographic details were recorded. The prostate size was measured by planimetric USG with the patient resting in a lateral decubitus position. Post-void residual volume was assessed with transabdominal USG.

Results: Mean age of patients with BPH were 62.78 ± 12.56 , the majority being 51- 60 years (48%) of age. PV showed a significant increase in mean size in different age groups ($P < 0.001$). An increasing trend in PVRV was observed with age; mean PVRV in patients with 51-60, 61-70, and >70 years age group was 54.82 ± 18.21 , 68.26 ± 12.28 , and 112.42 ± 8.34 respectively ($p < 0.001$). On Pearson correlation a significant positive correlation was obtained between prostate size and mean PVRV ($p = 0.001$, $r = 0.575$) and between age and PVRV ($r = 0.623$, $p = 0.008$).

Conclusion: Post void residual urine volume and PV using USG can serve as a novel accurate non-invasive test for predicting prostate obstruction in patients with BPH in decision making. USG provides real-time transabdominal scanning and has no risk of ionizing radiation like other methods.

Keywords: prostate obstruction, Benign prostatic hyperplasia, ultrasonography, Prostate Size

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Introduction

Benign prostatic hyperplasia (BPH) prevalence has increased with advancing age. Histological prevalence of BPH at

autopsy is as high as 50% to 60% for males in their 60's, rising to 80% to 90% of those over 70 years of age. [1]

Clinical diagnosis of BPH involves a basic tried of benign prostatic enlargement, bladder outlet obstruction, and lower urinary tract symptoms (LUTS). Evaluation of prostate size or volume and reduced urinary flow rate can assist in the clinical diagnosis of BPH. [2]

In patients with BPH, this measurement can be confirmed noninvasively using ultrasound (USG), avoiding discomfort, urethral trauma, and urinary tract infections. USG avoids catheterization and provides physiological assessment. [3] USG also allows repeat examinations without fear and anxiety for the patient. [2] When diagnosing and treating prostate problems, USG of the prostate is one of the most commonly used methods. Transrectal and suprapubic abdominal approaches can be used for this procedure. [4]

Residual urine volume measurement is the frequently used diagnosing modality. However, limited evidence is available in the Indian population compared with age. Hence in the present study, we evaluated the relationship between prostate volume (PV) and post-void residual urine volume (PVRV) to predict obstruction.

Materials and Methods

A cross-sectional observational study was performed on 50 symptomatic and asymptomatic male patients with BPH having age ≥ 50 years at a tertiary care center of Gujarat.

Written informed consent was obtained from all the patients before starting the study.

Those with age less than 50 years having bladder volume of more than 540 ml and were critically ill, having urinary tract infection or neuropathic bladder, and were on anticholinergics were excluded from the present study.

All the patients were instructed to arrive at the USG room with a full bladder. If full bladder was not possible, patients were given fluids until their bladder was full.

Prevoid residual volume was assessed with transabdominal USG, and after ascertaining that the bladder was full, they were instructed to come just after micturition. After micturition, patients' PVRV was measured with transabdominal USG using the formula for elliptical volume.

Transrectal USG in all men using a 7.5 MHZ biplanar endorectal transducer. The prostate size was measured by planimetric ultrasound with the patient resting in a lateral decubitus position. The central and total PV was measured directly from planimetric sections.

The central zone refers to the sonographically lucent region in the central part of cross-sectional images of the prostate. Three measurements were made to calculate the total PV and central zone volume. The anteroposterior and transverse diameters were measured at the maximal dimensions. In contrast, the superoinferior diameter was measured as the maximal length from the base to the apex in the midline sagittal plane.

The hypoechoic central zone volume caliper was measured by one operator on static films from these baseline images, optimized to measure total prostatic volume. Total prostate volume was manually reread similarly, and volumes were calculated with the ellipsoid formula.

Statistical Analysis

All the data analysis was performed using IBM SPSS ver. 25 software. Bivariate correlation analysis was done to obtain the correlation coefficient (r) and the association between age, PV, and PVRV. Data are expressed as the mean and standard deviation. The level of significance was assessed at 5%.

Results

The mean age of patients was 62.78 ± 12.56 , which ranged from 51 to 81 years. The most common age group was 51- 60 years (48%), followed by 61-70 years (34%) and >70 years (18%). Thus, it was seen that complaints of prostatic disease were common in the higher age group (Table 1).

Table 1: Showing association between age and post-void residual volume

| Age group | No of patients | Post void residual volume (ml) | P-value |
|-----------|----------------|--------------------------------|---------|
| 51-60 | 18 | 54.82±18.21 | <0.001 |
| 61-70 | 17 | 68.26±12.28 | |
| >70 | 15 | 112.42±8.34 | |

Mean post-void residual volume in patients with 51-60, 61-70, and >70 years age group was 54.82±18.21, 68.26±12.28, and 112.42±8.34, respectively. This shows a significant difference in mean size in different age groups ($p < 0.001$).

Prostate volume showed a significant increase in mean size in different age groups. Prostate size with age group 51-60 years, 61-70, and more than 70 years was 33.47±6.28, 56.28±8.12, and 75.23±12.16 ($p < 0.001$), respectively.

Table 2: Showing association between prostate volume and post-void residual volume

| Prostate volume (ml) | Post void residual volume ml) |
|----------------------|-------------------------------|
| <25 | 44.23 |
| 25-35 | 61.42 |
| 36-50 | 84.38 |
| 51-80 | 106.71 |
| >80 | 118.83 |

A significant positive correlation was obtained on Pearson correlation between prostate size and mean post-void residual volume ($p = 0.001$, $r = 0.575$).

No significant correlation was obtained between age and post-void residual volume on Pearson correlation ($r = 0.623$, $p = 0.008$).

Discussion

In the radiology department, BPH is one of the commonly diagnosed conditions of elderly males. [3] Evaluating the relationship between PV and inner gland volume with PVRV can assist in predicting the degree of obstruction. [5] In the present study, we evaluated the relationship between PV and PVRV to indicate the degree of obstruction.

Previous studies have shown that the larger the prostate gland size and inner gland volume, the larger the PVRV. It holds great significance in the management of these patients. [2]

The present study observed a significant increase in mean PV with the increasing age of the PBH patients. Patients with lower age had smaller PV, whereas patients with

higher age had larger PV, which showed a significant difference in the present study. In line with the present study, a cross-sectional study by Awadhi et al. involving 70 patients with BPH reported a significant correlation between the age of patients and their PV. [6] Park et al. studied 2,967 men (aged ≥ 40 years who had undergone 2 or more serial transrectal ultrasonography) from 13 university hospitals in Korea. They reported that age is a significant predictor of PV, aligning with the present study findings. [7]

In the present study similar trend was observed with PVRV where it was maximum with those having age more than 70 years (112.42±8.34), whereas it was lowest with the age of 51-60 years (54.82±18.21) ($p < 0.001$). Contrary to the present study, Joshi et al. reported no significant association between increases in PVRV with age. [4]

A direct correlation was observed between prostate size and mean PVRV ($p = 0.001$, $r = 0.575$). On increasing, PV and mean PVRV also increase. A study from Khartoum by Safa Hussain et al., including 100 men presenting with LUTS, reported a

significant correlation between PV and PVRV. [8] Joshi et al. reported a significant correlation between PV and PVRV and observed that PVUR increases as the PV increases. [4] Similar findings were reported by Kolman et al., where PVRV had a significant correlation with PV. [9]

Cross-sectional nature, small sample size, and non-randomization are the few limitations of the present study. There is a need for a large randomized clinical trial to provide more strength to present study findings.

Conclusion

A significant correlation is present between the age of the patients with BPH and PVRV. Also, PVRV and PV significantly correlate with each other. The present study showed evaluating PVRV and PV using USG can serve as a novel accurate non-invasive test for predicting prostate obstruction in patients with BPH in decision making. USG provides real-time transabdominal scanning and has no risk of ionizing radiation like other methods.

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