

## Sonographic Comparison of Prostate Size with Post void Residual Urine Volume

Birendra Raj Joshi, Dwivedi SK

Joshi BR, Dwivedi SK, Department of Radiology and Imaging, Tribhuvan University Teaching Hospital, Kathmandu, Nepal

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**Correspondence to:** Birendra Raj Joshi, Department of Radiology and Imaging, Tribhuvan University Teaching Hospital, Kathmandu, Nepal.

Email: [bjoshi01@yahoo.com](mailto:bjoshi01@yahoo.com)  
Telephone: +977 9841701333

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### ABSTRACT

**INTRODUCTION:** The clinical diagnosis of benign prostatic hyperplasia is made by assessment of prostate size or volume and reduced urinary flow rate. The purpose of this study was to determine the distribution of post void residual urine volume and its relationship with prostate size.

**MATERIALS AND METHODS:** In this prospective cross sectional study conducted on males aged 50 and above, prostate size and inner gland volume were measured by transrectal ultrasonography and post void residual volume was measured by transabdominal ultrasonography in 44 male patients referred from various departments. Collected data were analysed with standard statistical method.

**RESULTS:** The average post void urine volume was 48 ml in persons with normal sized prostate. The post void volume increased with increasing prostate size as well as with inner gland volume. No correlation between age and post void residual volume was seen.

**CONCLUSIONS:** These results based on randomly selected persons suggested little variation in post void residual urine volume with age. However a somewhat stronger correlation was found between residual urine and prostate volume and inner gland size.

**Key words:** Post void Residual Urine Volume; Prostate Size; Ultrasound

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### INTRODUCTION

Lower urinary tract symptoms are one of the commonest presentations in urology clinics. Benign prostatic hyperplasia is one of the common causes for this problem. Benign prostatic hyperplasia has been known as a cause of urinary dysfunction and the most common disease affecting the ageing men. Fifty percent of men aged 51-60 years and 90% men over 80 years have histological evidence of benign prostatic hyperplasia.

The clinical diagnosis of benign prostatic hyperplasia is made by assessment of prostate size or volume and reduced urinary flow rate. Histopathologically benign prostatic hyperplasia is characterized by an increased number of epithelial and stromal cells in periurethral transition zone of prostate.

The etiology of benign prostatic hyperplasia is not clear but androgens, estrogens, stromal epithelial interactions, growth factors and neurotransmitters may play a role, either alone or in combination in the initiation of prostatic growth. Prostatic hyperplasia increases the resistance to the flow of urine. Compensatory changes in the urinary bladder function along with age related changes in nervous system

function lead to urinary frequency, urgency and nocturia, the most troublesome benign prostatic hyperplasia related complaints<sup>[1]</sup>.

Measurement of volume of residual urine in bladder after voiding is a common procedure in urological examination of patients presenting with lower urinary tract symptoms and has traditionally been thought to have a prominent role in identifying those with obstruction. High value of post void residual volume is an indication for surgery.

Despite the controversy surrounding the usefulness of post void residual as a diagnostic test, it continues to be used. European countries routinely use post void residual measurement as a diagnostic test and most suggest that high values of post void residual are an indication for surgery.

The complex symptoms commonly referred as prostatism is not specific for benign prostatic hyperplasia. Ageing men with a variety of lower urinary tract pathologies may exhibit similar symptoms. Although non-specific causes of symptoms can be excluded in a significant majority of these patients on initial clinical evaluation including digital rectal examination, additional diagnostic tests are necessary in quite a number of patients where the diagnosis is still unclear.

Ultrasonography of prostate is the investigation that enables us to visualize the prostate gland directly and is one of the commonest diagnostic modalities performed nowadays. It can be done using the suprapubic abdominal approach as well as transrectal approach.

In 1971 Dr. Watanable *et al* at Tohoku University published their first reproduction of prostatic ultrasonography in English literature<sup>[1]</sup>. Since then it is rapidly advancing with growing acceptance and importance in diagnosis and management of prostatic diseases. Transrectal method is an accurate means of assessing prostatic volume and is superior in this regard to abdominal ultrasonography<sup>[2,3]</sup>. Among several methods, the diameter method is the most commonly used for determination of prostate volume. It comprises measurements of height (H), width (W) and length (L) and volume is calculated using the formula  $(HXW \times L) \times 0.523(K)^{[4]}$ .

Accurate determination of intravesical residual urine is of significant importance and serves as an index of the adequacy of bladder emptying. The ability to confirm this measurement noninvasively in patients avoids discomfort, urethral trauma and urinary tract infection [UTI]. Also by avoiding the need for catheterization, this technique permits more physiological assessment and allows for repeated examination without fear and anxiety for the patient.

Residual urine volume in persons above 50 years is used for objective assessment of prostate size. However to decide what is abnormal it is necessary to agree on what can be considered normal. Although residual urine volume measurement is frequently used to evaluate prostate size, only few studies have included sufficient age matched control.

This is a comparative study to compare the influence of inner gland volume, total prostate volume and age on residual urine volume. The purpose of this study was to describe the distribution of post void residual urine volume and its relationship with prostate size.

## MATERIALS AND METHODS

The study was conducted in a tertiary hospital in Kathmandu, Nepal from October 2007 to August 2008. Informed consent was obtained from all the subjects selected for study. Inclusion criteria included symptomatic and asymptomatic male patients of 50 yrs or above. Exclusion criteria included below 50 yrs of age, bladder volume > 540 ml, critically ill subjects, patients on anticholinergics, patients with UTI or neuropathic bladder.

Subjects were instructed to arrive in ultrasound room with a full bladder and if this was not possible they were given fluids. Once the patient's bladder was full, prevoid residual volume was assessed with transabdominal ultrasound and after ascertaining that bladder was full, they were instructed to come just after micturition. After micturition, patients post void volume was measured with transabdominal ultrasonography using the formula for elliptical volume.

Transrectal ultrasound was performed in all men using a 7.5 MHZ biplanar endorectal transducer. Prostate size was measured by planimetric ultrasound with the patient resting in lateral decubitus position. The central and total prostate volumes were 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 prostatic volume and central zone volume. The anteroposterior and transverse diameters were measured at the maximal dimensions, whereas 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 measured by one operator on static films from these baseline images, which were optimized to measure total prostatic volume. Total prostate volume was manually reread in a similar manner and volumes were calculated with the ellipsoid formula.

Bivariate correlation analysis was done using SPSS 11.5 package. Data are expressed as the mean and  $p < 0.05$  was considered statistically significant. Data were expressed as correlation coefficient ( $r$ ).

## OBSERVATIONS AND RESULTS

A total of 44 patients were included in this cross sectional study. Prostate gland volume and inner gland volume were obtained by transrectal ultrasonography and post void residual urine volume was obtained by transabdominal ultrasonography.

All the patients were aged 50 years and more and the mean age was 63.05 years (range 50-79). The distribution according to age group is shown in Figure 1.

Correlation between prostate volume and post void residual volume is shown in Figure 2. There was increase in mean post void residual volume with increasing prostate size. A statistically significant correlation was present between post void residual volume and prostate volume ( $p = 0.004, r = 0.422$ ).

There was increase in post void residual urine volume with increasing inner gland volume (Table 1) (Figure 3).

There is no correlation between age and post void residual volume ( $r = 0.039, p = 0.802$ ) (Figure 4).

**Table 1** Relationship between inner gland volume and residual urine volume.

Inner gland volume (gms)	Post void residual volume (ml)
< 10	56.25
19-Oct	78.375
20-29	105.714
30 or more	120

**Table 2** Relationship of age with residual volume.

Age group	Patient group	Control group
50-59	106	38
60-69	66.625	59.6
70 or more	86.285	50.75

## DISCUSSION

One of the commonest problems seen in elderly people is lower urinary tract symptoms. Benign prostatic hyperplasia is one of the common diagnoses made for this patient in radiology department. This is a disease process affecting the elderly male. In subjects above 50 years knowing relationship of prostate volume and inner gland volume with post void residual urine volume can help a lot to predict the degree of obstruction. Larger the prostate gland size and inner gland volume, larger the post void residual urine volume. It holds great significance in the management of these patients.

Hyperplasia of the prostate gland is a progressive condition with an onset in the early 30s and worsening with age. It has been shown that 50% of men aged 51-60 years and 90% of men over age of 80 years have histological evidence of benign prostatic hyperplasia. In our study 43% of patients were in 50 to 59 years age group, 32% of patients were in 60-69 years age group and 25% of patients were in >70 years age group.

Prostate volume is an important contributing factor to post void residual urine volume. In our study there was a significant correlation of post void residual urine volume with prostate volume ( $r = 0.422, p = 0.004$ ). In a community based study in Rotterdam, Bosch reported correlation (0.21) ( $p < 0.05$ ) between post void residual urine volume and prostate size<sup>[5]</sup>.

However, C. J Beacock *et al* found no correlation between post void volume and estimated prostate volume<sup>[6]</sup>.

We found a statistically significant correlation between inner gland volume and post void ( $r = 0.352, p = 0.019$ ).

Rotterdam study found modest correlations between post void residual urine volume and age ( $r = 0.12, p < 0.05$ ). Kolman *et al* found no relationship between post void residual urine volume and age<sup>[7]</sup>.

In our study, post void residual urine volume was not related to age ( $r = 0.039, p = 0.802$ ). There was no shift in the distribution of post void residual urine volume with increasing age decade and the degree of variability was high regardless of age (Table 2).

In patients with lower urinary tract symptoms, knowing the relationship between prostate volume, inner gland volume and its relationship with postvoid residual urine volume can help a lot to predict the degree and cause of obstruction. Larger the size of the gland, greater the post void residual urine volume. It will help the clinicians to determine the severity of the symptoms and line of management to be undertaken. Higher the inner gland volume and prostate volume, higher is the possibility of benign prostatic hyperplasia being the cause of increased post void residual urine volume.

## CONCLUSION

Significant correlation was found between post void residual urine volume and prostate volume ( $p = 0.004, r = 0.422$ ). Similarly significant correlation was also found between post void residual urine volume and inner gland size ( $p = 0.019, r = 0.352$ ). No significant correlation between post void residual urine volume and age ( $r = 0.039, p = 0.802$ ).

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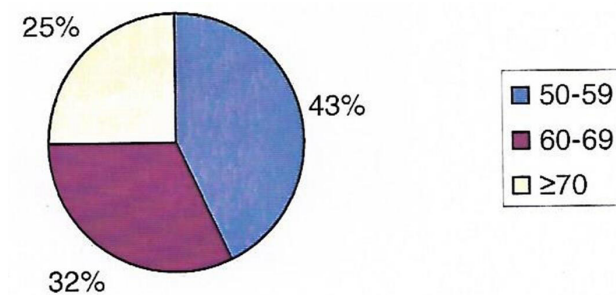


Figure 1 Distribution of patients according to age group.

### Relation between prostate volume and post void residual volume

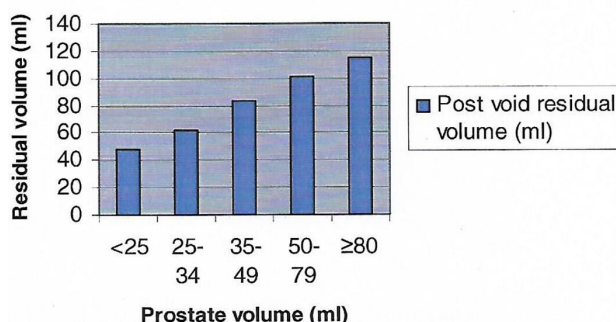


Figure 2 Bar diagram showing the relationship of post void residual urine volume with prostate volume.

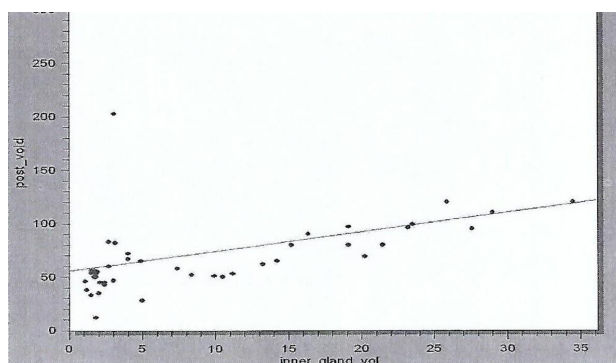


Figure 3 Scatter diagram showing correlation between inner gland volume and post void residual volume.

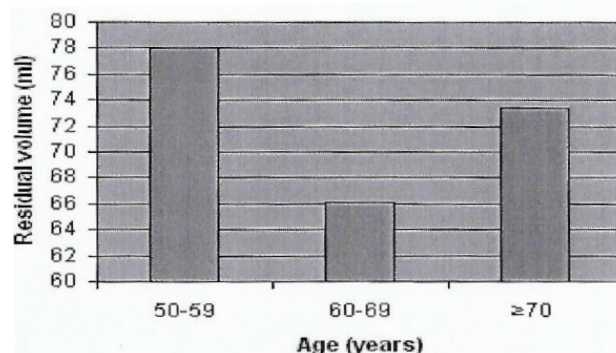


Figure 4 Relationship between age and post void residual volume.

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