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Sonographic Association of Prostate Volume with Post Micturition Residual Volume in Benign Prostate Hyperplasia

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ABSTRACT

Objective: To evaluate the association of prostate volume with post micturition residual urinary volume (PMR) in benign prostate hyperplasia (BPH).

Methods: This was cross-sectional analytical study with sample size of 100, performed at Gilani Ultrasound Centre, for six months. Study was performed in Gilani Ultrasound Centre, Lahore, from 15-5-2017 to 16-11-2017. Individuals of age 40-80 years diagnosed for BPH were included. The patients who had prostate cancer, who had undergone minor urinary tract or prostate surgery, patient with UTI or bladder stone were not considered in this research. Transabdominal sonography was performed with convex transducer of 3.5 - 5MHz frequency. Outcome variables were Prostate volume and post micturition residual (PMR) volume.

Results: Hundred BPH positive individuals were recruited in this study. The results were gathered which showed that the association between prostate volume and post void residual volume was not significant.

Conclusion: There was no significant correlation between BPH and PMR, rather bladder outlet obstruction could be caused by the enlargement and protrusion of median lobe of prostate.

Keywords: Benign prostate hypertrophy, bladder outlet obstruction, central obstruction, post-micturition residual volume, urinary reflux.

INTRODUCTION

Prostate gland enlargement in size is benign prostate hyperplasia. Size of prostate gland increase is common and appeared when apoptosis fails to occur in prostatic tissue due to advancing age. Some medicines used to treat BPH can cause failure of this process [1]. Prostate gland produces about 20 to 30% of the seminal fluid [2]. According to worldwide Continence Society the total of fluid noted in the urinary bladder instantly after the completion of micturition is called residual urinary volume [3]. Conventionally, the calculation for post micturition residual urinary volume (PMR) was investigation of choice in the diagnosis and follow-up of patients with benign prostate hyperplasia. A joint committee on International Consultation on Benign Prostatic Hyperplasia, has given recommendations about the calculation of PMR in the investigative assessment of patients with

symptoms of prostatism [4]. The benign Prostatic Hyperplasia Guideline Panel has declared clinical practice guidelines and measurement of PMR was considered as an elective test [5].

Most of the urologists prefer their patients for abdominal ultrasound to measure PMR. Sonographically, five different formulas are used to measure PMR. Researches revealed 93.6% similarity among the result of these different methods [6]. An advance method for volume estimation using the ellipsoid formula (0.523 x width x height x length exhibited a brilliant association with those measured with having folly's in situ (r^2 = 0.982; P < 0.001). Theses writer also observed that the ratio of error was maximum in the low volume range but that the total difference among real and projected PMR values were constantly low [7]. Benign prostate hyperplasia (BPH) is declared when patients having clinical features of bladder outlet obstruction (BOO), frequency of micturition, poor stream, minor lower urinary tract symptoms and enlargement of prostate on physical and sonographic examination [8]. BPH is unusual in men with age below 40, but it exists in about 50% of men with age 60 years and almost 88% in men near 80 years of age [9]. Symptoms of BPH can be classified into two categories, one causing obstruction during micturition and other causing irritation. Obstructive symptoms are associated with abnormal growth of the prostatic tissue and poor muscular tone of the prostatic tissue (dynamic component). Irritation is caused due to obstruction of bladder outlet due to increased size of prostate gland [10]. Transrectal ultrasound (TRUS) of the prostate was considered as investigation of choice for benign and malignant diseases (e.g. benign hyperplasia, obstructive infertility) and for taking biopsy, diagnosing, staging of cancer and for evaluating the response of therapy [11,12]. Currently most of the patients are referred for TRUS examination related to prostate cancer evaluation, biopsy, and guidance of therapeutic procedures [13]. TRUS was initially considered as essential diagnostic investigation for prostate cancer. But with the advancement, to some extent, it has now been replaced by prostate specific antigen (PSA) and digital rectal test (DRE) [14,15].

Initially, prostate was examined by transvesical approach. The transvesical approach is useful for gross prostate and bladder evaluation. Transvesicle assessment is limited to prostate size, shape, and weight. However, detail is inadequate for prostate cancer detection. Also, most prostate cancers occur posteriorly, where transvesical scanning cannot see them. Current interest in ultrasonographic prostatic imaging follows the development of small, intracorporeal transducers that can be employed with transrectal techniques. In the 1960s and 1970s, Japanese investigators published their experience with a radial scanner situated on a chair [16,17]. They installed this device in a van called the "Dolphin," which was used as a mobile monitor for prostate cancer in Japan. Since then the technique has evolved, with the development of smaller probes; gray scale, real-time imaging; improved transducer crystal design; and attachment of biopsy guidance devices. Lindgren developed biopsy gun in Sweden in addition to color flow Doppler newer ultrasound imaging techniques include contrast enhanced ultrasound, 3D ultrasound, and electrography. It is important to have appropriate history, DRE results, and PSA results available before starting the examination [18-20].

METHODOLOGY

This was cross-sectional analytical study with sample size of 100 patients. Study was performed in Gilani Ultrasound Centre, Lahore, from 15-5-2017 to 16-11-2017. The target was diagnosed patients of BHP, age 40-80 years old were included. The patients who had prostate cancer, who had undergone minor urinary tract or prostate surgery, patient with UTI or bladder stone were not considered in this research. Sonographic examination was performed with ultrasound machine Mindray (DC7) having convex transducer of 3.5 - 5MHz frequency. Outcome variables were Prostate volume and post micturition residual (PMR). Patients were scanned in supine position with full urinary bladder and post micturition residual volume (PMR) was measured after micturition. Prostate was measured by ellipsoid formula, (0.52 x width x height x length). Prostate weight and volume are theoretically about the same as the specific gravity of prostate tissue is 1.05 [21]. One is a single true measurement and the other is mathematically calculated.

AIUM abdominal sonographic practice guidelines were observed during this study, which were routinely practiced in this department.

Research was started after the authorization of the Institutional Review Board. Patients were explained the procedure and outcomes of the study and their consent was taken in written form. The data collection sheet was used to record observed data and the patient was assured that individual patient personal data will not be published. Patient privacy was maintained throughout the study. Study variables were age of patient, prostate volume, pre-micturition residual volume and post micturition residual volume.

The collected data was statistically analyzed by SPSS Version 24. All the descriptive variables were offered in the form of mean and standard deviation, but frequency in the shape of number and percentage. Association was calculated in the form of Pearson's correlation and significant P-valued was considered less than 0.05 with 95% confidence interval.

RESULTS

In our study the observed sample were statistically evaluated for mean and standard deviation and presented in Table **1** for Age, Weight, Height, Prostate weight, Residual volume. Out of 100 patients 19 (19%) were diabetic, 67 (67%) were non-diabetic and 14 (14%) were unknown. Among 100 patients of BPH, 22 (22%) were hypertensive, 70 (70%) were non-Hypertensive and 8 (8%) were unknown. Out of 100 patients 1 (1%) had heart disease and 99 (99%) had no heart disease. Out of 100 patients 5 (5%) were obese and 95 (95%) were non-obese. Frequency distribution of Beta blocker user, 14 (14%) were taking Beta blockers, 80 (80%) were not taking and 6 (6%) were unknown.

The association between prostate volume and post-void residual volume was not significant, because the P-value was greater than 0.05. Although some additional findings were observed; correlation between prostate volume and age was significant; with p-value 0.006. The correlation between prostate volume and diabetes was significant; p-value is 0.029 (Table **2**). Scattered plot also Showing weak Relationship of Prostate volume with post Maturation Residual Volume (Figure **1**).

Table 1. Mean and Standard deviation for observed parameters.

	N	Minimum	Maximum	Mean	Std. Deviation
Age (years)	100	45.00	85.00	66.2400	7.69510
Weight (?)	100	60.00	97.00	75.2100	6.77532
Height (?)	100	165.00	196.00	173.2700	4.36898
Prostate weight (?)	100	16.70	175.00	56.4560	26.23801
Residual volume (/)	100	8.70	300.00	96.5500	68.18363

Table 2. Pearson Correlations among BPH and PMR, Age, Weight, Height, Diabetes, HTN, Obesity and Beta blocker (medicine) user.

		Prostate weight	Residual volume	Age	Weight	Height	Diabetes	Hypertensive	Heart disease	Obesity	Beta blocker use
Prostate weight	Pearson Correlation	1	0.086	0.274	0.046	0.143	-0.218*	-0.059	-0.456**	0.102	0.018
	Sig. (2-tailed)		0.396	0.006	0.651	0.155	0.029	0.559	0.000	0.312	0.858
	N	100	100	100	100	100	100	100	100	100	100

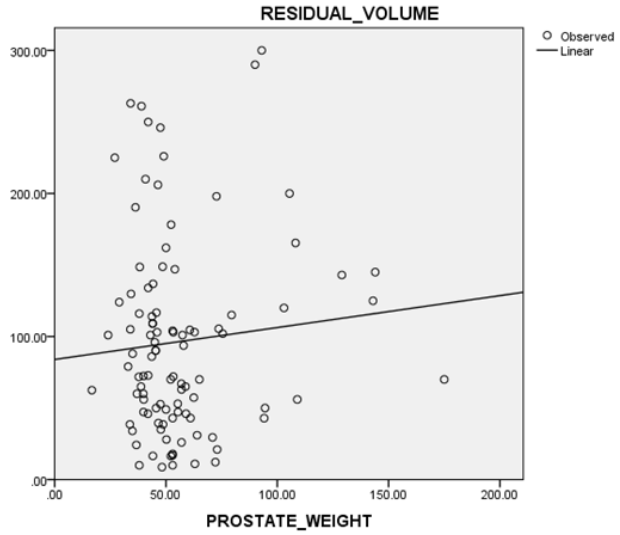

Figure 1. Scatterplot shows relationship of benign prostate Hypertrophy (BPH) with Post-micturition residual volume (PMR).

DISCUSSION

We consider conventional transabdominal ultrasonography a dependable, safe, and quick technique for evaluating the residual urine volume in patients with benign prostatic hyperplasia. Due to increased demand for pharmacological treatment of benign prostatic enlargement, this test can be repeated as often as considered compulsory as an office-based procedure to observe progress of treatment without the hazard of trauma or infection to the urinary tract. Benign prostatic hyperplasia (BPH) is a reason of increased morbidity and trouble in old men due to recurrently related lower urinary tract symptoms, the LUTS can adversely affect the eminence of life. BPH is also a progressive disease, generally characterized by a worsening of LUTS over times [22].

It is better to evaluate the harshness of symptoms as compared to increased volume of prostate in treatment of BPH. Both American urology association and European urology association practice guideline concur to use the international prostate symptom score to evaluate severity of BPH. Trans abdominal ultrasonography helps not only in evaluation of prostate but also urinary bladder, kidneys and ureters. Pre-void and post-void residual urine can also be calculated. The prostate volume, patient clinical symptoms and sonographic findings of kidney, ureter and urinary bladder are very important in clinical decision making. According to Basawaraj NG, et al., in 2015, there was positive but weak correlation between prostate volume and IPSS grading. Agrawal et al., in 2008, showed no relationship between prostate size and IPSS score [23-26].

According to Eckhardt MD, et al., the most important consideration for guessing obstruction is peak flow rate (Qmax). If the Qmax is above 10 ml/sec, the obstruction is approximately 90% and if the Qmax is between 10-14 ml/sec then the obstruction is approximately 67% obstruction and if the Qmax is above 15 ml/sec there is only 30% of obstruction [27].

Huge post-void residual volume of above 350 ml suggests bladder dysfunction and somewhat below may respond to appropriate treatment. Huge post-void residual volume might exaggerate progression of disease. This study suggested that urinary retention could be due to larger gland and no statistical significance was found between post-void residual volume and size of prostate gland, suggested that the active component of prostate obstruction could be significant in causing urinary retention [28]. Post-void volume less than 150 ml should be considered unreliable [29]. According to a study of J. L. H. Ruud Bosch in 1995, the correlation between post-void residual volume and age was significant (P = 0.02). There was poor correlation between post-void residual volume and prostate size. (r = 0.07; P = 0.35) [30]. Trumbeckas, et al., in 2011, proved in their study that correlation of prostate volume with residual urine was significantly poor (r = 0.198, p = 0.03) [31]. The prostate gland assessed for volume, echo texture, morphology, focal lesions and median lobe parenchymal calcification. Parenchymal calcifications: Their post void residual volume was measured and statistical analysis was done. The p value of prostate volume and post- void residual volume was 0.396 which is greater than 0.05, therefore it was proved that correlation between prostate volume and post-void residual volume was not significant. However; association between prostate volume and age was significant; with p-value 0.006 which was less than 0.05. The correlation between prostate volume and diabetes was significant; p-value was 0.029 which was less than 0.05. Previous studies also suggested that correlation between prostate volume was significant with age and was not significant with post-void residual volume [32].

CONCLUSION

Ultrasonographic imaging has improved the ability to diagnose early prostatic enlargement and related conditions. Transabdominal ultrasound is more accurate and less invasive investigation for evaluation of prostate and urinary bladder. Pre-void and post-void residual volume was also calculated by transabdominal ultrasound. This study also suggested that the correlation between prostate volume and post void residual volume was not significant.

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