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Relationship of Lower Urinary Tract Symptoms with Post Void Residual Urine and Prostatic Volume

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ABSTRACT

Benign prostatic hyperplasia (BPH) is a frequent occurrence in older male. **Objectives:** To assess the correlation between International Prostate Symptoms Score (IPSS), prostate volume, and post-void residual volume (PVR). **Methods:** This was an analytical cross-sectional study conducted in the Urology Department of Sheikh Zayed Hospital, Rahim Yar Khan. Eighty-four men aged 40-70 years with BPH and LUTS for ≥ two months were recruited consecutively. Participants completed the IPSS, and PVR was assessed by abdominal sonography and prostate volume through transrectal ultrasound. A urinary tract infection was labelled by the growth of ≥ 105 CFU/ml of pathogenic microorganisms. Pearson correlation between IPSS and prostate volume and post-void urinary volume was calculated at 5% significance level. **Results:** Mean age was 57.9 ± 6.9 years, and 63.1% were ≤60 years of age. Mean prostate volume was 68.9 ± 17.0cm^3, and PVR was 191.5 ± 53.3 ml. Mean IPSS was 16.3 ± 6.4, with 67.9% having moderate LUTS. UTI prevalence was 54.8%. IPSS correlated positively and strongly with prostate volume ® = 0.911) and PVR ® = 0.920; p<0.001). UTI was more common in patients >60 years (80.6% vs. 39.6%) and in those with moderate (56.1%) and severe (100%) versus mild (13.3%) LUTS. **Conclusions:** IPSS showed a positive correlation with prostate volume and PVR, highlighting the utility of combined symptom scoring and ultrasound in managing benign prostatic enlargement.

INTRODUCTION

Urologists, in their routine practice, deal with older patients having lower urinary tract symptoms (LUTS), which affect patients 'quality of life adversely [1]. Although the main reason for LUTS in older males is benign prostatic hyperplasia (BPH), LUTS is linked to a variety of conditions, including systemic metabolic diseases [2]. A simple physical examination, a review of sexual function, and a medical history are all included in the early assessment of males with LUTS [3]. When a patient first presents with such symptoms, he is evaluated by scoring the symptoms, getting his complete urine microscopy, and determining post-void residual (PVR) urine. A reliable method to assess the subjective intensity of LUTS and their evolution over time is the International Prostate Symptoms Score (IPSS) is commonly utilized in routine practice for symptom scoring [4]. After passage of urine, the residual urine, which is retained in the urinary bladder, is called PVR (post-void residual) urine volume. This is one important test used in the initial evaluation of LUTS secondary to BPH [5]. Because PVR is easy to use, accessible, and reasonably priced, urologists commonly use it in their everyday clinical practice to evaluate LUTS secondary to BPH [6]. Another crucial factor in the treatment of BPH patients is the evaluation of prostate volume. Although digital rectal

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examination (DRE) can estimate prostate volume, ultrasonography, especially transrectal ultrasound (TRUS), is now the gold standard because it is more accurate. Prostate volume and the intensity of LUTS have been correlated in many investigations, although the findings have been mixed. Significant correlations were found in some of the investigations, but not in others [7]. Two hundred and ninety patients who had LUTS, giving a clue of BPH, were the subjects of prospective correlational research. The self-administered IPSS questionnaire was utilized to gauge the severity of the symptoms. A transrectal ultrasound was used to measure the volume of the prostate. The study found that, with an average IPSS score of 16.41 ± 7.43, most patients (55%) reported moderate symptoms. Prostate volume and IPSS were significantly positively correlated [8]. One hundred males experiencing LUTS were recruited in a research study. A carefully crafted questionnaire was used to evaluate each subject. The mean volume of the prostate was 78.4 +/- 30.7 ml, and the IPSS was mild, moderate, and severe in 28%, 22%, and 50% of cases, respectively. Urine volume mean after voiding was 69.3 +/- 39.8 ml. The IPSS, prostate volume, PVR, and quality of life were found to be significantly correlated [9]. Further research was required due to the ongoing debates and information gaps about the association between prostatic volume, PVR urine, and LUTS, as well as the unknown thresholds for when elevated PVR contributes to symptom severity. Since there was currently conflicting information about how PVR and prostate size interact to affect LUTS, this study attempted to investigate these interactions. By looking at these elements, the study wanted to improve treatment plans and diagnostic standards, which will eventually improve patient care and quality of life.

This study aims to assess the correlation between International Prostate Symptoms Score (IPSS), prostate volume, and post-void residual volume (PVR).

METHODS

This analytical cross-sectional study was performed at the Urology Department of Sheikh Zayed Hospital, Rahim Yar Khan, over a study period of 6 months from 25th January 2025 to 24th July 2025 after approval from the institutional ethics review committee (Ref no. 43/IRB/SZMC/SZH). From all subjects, written informed consent was taken before the start of the study. Approval was also taken from the institutional ethical committee, and the principles highlighted in the Declaration of Helsinki. A total of 84 patients with benign prostatic enlargement (based on digital rectal examination and prostate volume > 30 ml on ultrasound), aged 40-70 years and LUTS for a minimum of 2 months, and with an IPSS ≥ 8 were consecutively recruited in the present study. Patients with urethral stricture, prostatic carcinoma, neurogenic or overactive bladder, and prior surgery for benign prostatic enlargement were excluded from the study. All subjects filled the self-administered IPSS, consisting of seven items on a score ranging from 0–5, with total score of 35. IPSS is used for grading LUTS. IPSS was developed in 1992 [10] and found to have a good internal consistency (Cronbach's α = 0.60 to 0.98) and good test-retest reliability (Intra-class correlation = ICC = 0.59 to 0.99) [11]. All patients were provided with help to fill in the IPSS questionnaire. Patients were classified as having mild (0–7), moderate (8–19), and severe (20–35) LUTS. A transabdominal ultrasound was performed immediately by a consultant radiologist with ≥ 5 years' post-fellowship experience to determine the PVR (ml) and prostate volume. Under full aseptic measures, transrectal ultrasound was performed in the left lateral position by use of a 6.6 MHz probe, which was well lubricated. The prolate ellipsoid formula (length x height x width x π/6) was used to calculate the prostate volume. A urinary tract infection was labelled if 105 CFU/ml of a single pathogen was cultured from a clean catch urine specimen. A minimum sample size of 84 patients was calculated through an online sample size calculator https://sample-size.net/correlation-sample-size/ using the correlation formula: $N = [(Z\alpha+Z\beta)/C]2 + 3$. Where $C = 0.5 * \ln[(1+r)/(1-r)]$, assuming a 5% significance level, 20% type II error (β), and 0.304 correlation (r) between prostate volume and IPSS [12]. Data analysis was done through SPSS version 27.0. Numerical data were normally distributed as determined through the Shapiro-Wilk test. Descriptive statistics are run as mean ± SD for numerical data and frequency and percentages for categorical data. Correlation between IPSS and prostate volume and PVR was assessed through the Pearson correlation coefficient (r) at 5% significance level. Confounding and effect modification were controlled through stratification on patient characteristics using the chi-square test for categorical and correlation was measured again.

RESULTS

The mean age of the participants was 57.9 ± 6.9 years, and 53 (63.1%) were 60 years or below. The mean prostate volume was 68.9 ± 17.0 cm^3, and the PVR volume was 191.5 ± 53.3 ml. The mean of IPSS was 16.3 ± 6.4, and 57 (67.9%) of the patients had moderate LUTS. Urinary tract infection was prevalent in 46 (54.8%) of the patients (Table 1).

Table 1: Characteristics of Patients Presenting with LUTS (n=84)

Characteristics	Mean ± SD, n (%)
Age	
Years	57.9 ± 6.9
≤60 Years	53 (63.1%)
>60 Years	31 (36.9%)

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Volume	
Prostate Volume (cm3)	68.9 ± 17.0
PVR (ml)	191.5 ± 53.3
IPSS Score	16.3 ± 6.4
Grades of LUTS	
Mild (1-7)	15 (17.9%)
Moderate (8-19)	57 (67.9%)
Severe (20-35)	12 (14.3%)
Urinary Tract Infection	
Yes	46 (54.8%)
No	38 (45.2%)

IPSS: International Prostate Symptom Score, LUTS: Lower urinary tract symptoms, and PVR: Post-void residual urine.

Out of 46 patients with urinary tract infection, the most common pathogen identified was E. coli (n=15, 32.6%) followed by K. pneumoniae (n=8, 17.4%) and P. aeruginosa (n=7, 15.2%)(Figure 1).

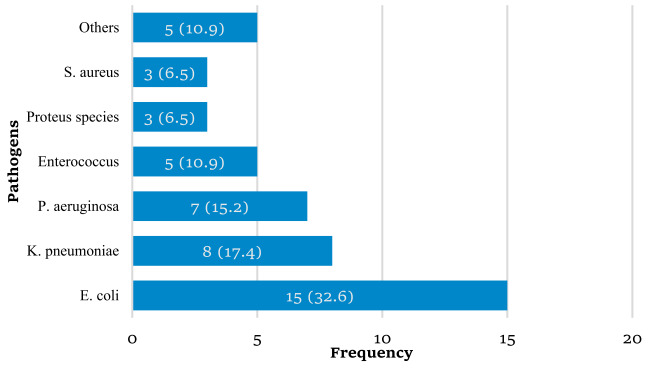

Figure 1: Uropathogens Isolated from Patients Presenting with Lower Urinary Tract Symptoms (n=84)

*Others: Enterobacter (2), Citrobacter (1), Acinetobacter species (1), and Serratia species (1)

IPSS had a strong, positive, and significant correlation with prostate volume (r = 0.911) and PVR volume (r = 0.920)(Table 2).

Table 2: Correlation of IPSS with Prostate Volume and PVR in Patients Presenting with LUTS (n=84)

Factors	Pearson Correlation	p-Value
Prostate Volume (cm^3)	0.911	<0.001*
PVR (ml)	0.920	<0.001*

*statistically significant

After stratification on patient characteristics correlation of IPSS with prostate volume and PVR remained strongly positive and significant (Table 3).

Table 3: Effect of Patient Characteristics on Correlation of IPSS with Prostate Volume and PVR in Patients Presenting with LUTS (n=84)

Factors	Pearson Correlation	p-Value
Prostate Volume (cm^3)		
≤60 Years	0.859	<0.001*
>60 Years	0.912	<0.001*
UTI – Yes	0.851	<0.001*
UTI - No	0.949	<0.001*
PVR Volume (ml)		
≤60 Years	0.890	<0.001*
>60 Years	0.900	<0.001*
UTI – Yes	0.890	<0.001*
UTI - No	0.894	<0.001*

UTI: Urinary tract infection

After stratification on patient characteristics, the prevalence of UTI was significantly more common in patients above 60 years (80.6% vs. 39.6%) compared to ≤60 years' patients and in patients with severe and moderate LUTS compared to mild symptoms (100% and 56.1% vs. 13.3%)(Table 4).

Table 4: Effect of Patient Characteristics on Prevalence of UTI in Patients Presenting with LUTS (n=84)

Patient Characteristics		Urinary Tract Infection		p-Value
		Yes	No	
Age Groups	≤60 Years	21 (39.6%)	32 (60.4%)	<0.001*
	>60 Years	25 (80.6%)	6 (19.4%)	
IPSS	Mild (1-7)	2 (13.3%)	13 (86.7%)	<0.001*
	Moderate (8-19)	32 (56.1%)	25 (43.9%)	
	Severe (20-35)	12 (100%)	0 (00%)	

*chi-square test

DISCUSSION

Compared to our study, Udo *et al.* reported that most of the patients (41.7%) were between the ages of 60 and 69, with a mean age of 65.1 ± 9.6 years [12]. Awaisu et al. found that the mean age was 64.2 ± 9.0 years [8], while Badmus *et al.* found that the mean age was 64.4 ± 8.9 years [13]. Patients' earlier healthcare-seeking behavior may be the main cause of our study's lower mean age when compared to other research studies. Our research population may have sought medical care for LUTS earlier because they were more aware of the condition or had easier access to healthcare services. The age distribution may be skewed downward by regional variations in comorbidities, diet, and lifestyle, which may contribute to the earlier onset of LUTS and prostate-related problems. In our study, half of the participants had a urinary tract infection. According to a study, patients presenting with BPH and LUTS had a 46.5% prevalence of UTIs. Long-term catheterization, poor bladder emptying, and age above 60 were all substantially linked to an elevated risk of UTI [14]. Another research reported that 5.9% of patients with prostate carcinoma and hyperplasia had recurring infections, and 35.6% of patients had de novo UTIs. The study highlighted how bladder outlet obstruction raises these individuals' chance of developing UTIs [15]. Frequent or prolonged indwelling catheters, comorbid conditions such as diabetes mellitus, variations in bacterial resistance profile, different practices of personal hygiene,

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hydration status, or access to proper toilets could all be contributing factors to our patients' high rate of UTIs, especially in settings with limited resources. The correlation between UTI and LUTS, and BPH highlights the importance of careful UTI screening and treatment in these patients to avoid complications and enhance patient prognosis. Udo *et al.* and Mbouché *et al.* reported mean IPSS values of 14.58 ± 6.17 and 13.2 ± 4.6, respectively, which are nearly comparable to our results [12, 16]. In contrast, a comparable study conducted in Nepal by Agrawal *et al.* [17] found a higher mean IPSS of 23.5 ± 2.8. The variation may be caused by late presentation and various health-seeking patterns. In our study two two-thirds of patients had moderate LUTS. These findings align with those of Udo *et al.* and Ofoha *et al.* who found that most study groups reported moderate symptoms [12, 18]. The mean prostate volume (measured through abdominal scan), as determined by Barry *et al.* was 69.84 cm3 ± 63.5 cm3 [10]. Robinson *et al.* documented a mean volume of 66.13 ± 30.43 cm^3 in another investigation on the link between prostate volume determined through transrectal scan and prostate-specific antigen (PSA) level in similar study environment [19]. These relate to what we have seen. However, Badmus *et al.* found a larger mean of 83.8 ± 37.7 cm3 [13]. The latter's use of a transrectal technique and the former's higher sample size may be the cause of the discrepancies. The numbers, however, exceed the mean prostate volumes of 40.1 cm^3 and 48.0 cm^3 measured in Sweden [20] and the US [21]. This may be explained by racial and regional variations, as well as the fact that patients in developed parts of the world tend to present earlier. This study observed that IPSS had a strong, positive, and significant correlation with prostate volume and PVR volume. IPSS and prostate volume were found to be significantly positively correlated in a cross-sectional study of 103 BPH patients in Karachi, Pakistan. The study concluded that symptoms of irritative voiding were more closely linked to an increase in prostatic volume [22]. A retrospective investigation including 45 patients with histologically verified BPH was carried out by Ngwa-Ebogo *et al.* Prostate volume and IPSS were shown to be somewhat positively related (r=0.410, p=0.006) [23]. Prostate volume and IPSS were shown to be significantly correlated (p=0.002) in another study that assessed the relationship between the two variables and the maximum urine flow rate in BPH patients. This suggests that higher prostate volumes are linked to more severe symptoms [8]. Prostate volume and IPSS demonstrated a weak positive connection (r = +0.109; P = 0.28) in a study of 100 men with BPH [24]. The association points to a pattern consistent with our findings, even though it was not statistically significant. Together, these research articles favor the association between higher IPSS scores and increasing PVR volumes and increased prostate volume, underscoring the significance of thorough evaluation in the treatment of BPH. By assessing the correlation between IPSS, prostate volume, and PVR, as well as the occurrence of UTIs in BPH patients, our work presents a significant clinical problem. This data will help to improve management and diagnostic approaches. The proven, non-invasive, and generally recognized techniques of IPSS, transabdominal ultrasound for PVR, and transrectal ultrasound for prostate volume improve the accuracy of collected data. By connecting symptomatology and infectious consequences, evaluating UTI prevalence in conjunction with LUTS characteristics gives the results more depth and clinical value. This study adds valuable regional evidence by demonstrating a strong relationship between IPSS, prostate volume, and PVR in men with BPH, an area with limited local data. It underscores the role of combining symptom scoring with ultrasound as a reliable, non-invasive, and cost-effective tool for assessing disease severity. Additionally, it highlights the significant burden of UTI among older patients and those with severe LUTS, a finding often underexplored. These insights help bridge existing gaps in the literature and support improved diagnostic and management strategies for BPH in resource-constrained settings. To improve generalizability, future research should involve a larger and more varied population from several centers. Prostate growth, UTI recurrence or chronicity, and symptom progression can all be evaluated using a prospective cohort design in the future. Actionable insights into managing UTIs in patients with BPH can be obtained by incorporating culture-sensitivity data.

CONCLUSIONS

The study concluded that there was a positive and significant correlation between IPSS, prostate volume, and PVR in men with BPH. Furthermore, urinary tract infections were more prevalent in older patients and those with more severe symptoms, underscoring the significance of combining ultrasonography examination with symptom score for efficient clinical evaluation and treatment.

Authors Contribution

Conceptualization: MZF
Methodology: MZF, SAH, SG, SH, MS, MIA
Formal analysis: MZF, SG, SH
Writing review and editing: MIA

All authors have read and agreed to the published version of the manuscript

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Conflicts of Interest

All the authors declare no conflict of interest.

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