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Role of Uroflowmetry in Patients of Benign Prostatic Hyperplasia Presenting with Lower Urinary Tract Symptoms

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ABSTRACT

Benign Prostatic Hyperplasia (BPH) is prevalent among aging men, causing Lower Urinary Tract Symptoms (LUTS) that can impact quality of life. **Objective:** To assess the role of uroflowmetry in determining Lower Urinary Tract Symptom (LUTS) severity in Benign Prostatic Hyperplasia (BPH) patients by examining correlations between symptom scores and uroflowmetric parameters (Qmax, Qavg, PVR, and voiding time). **Methods:** This cross-sectional study was conducted on sixty BPH male patients presenting with a spectrum of symptom scores based on IPSS. With a standard uroflowmeter, uroflowmetric parameters were determined and correlation coefficients and t-tests between parameters about most severe complaints yielded statistical analyses. **Results:** Uroflowmetric parameters were significantly different among severity groups of symptoms. Mean Qmax values decreased successively from 12.5 mL/s in mild to severe symptoms of 6.5 mL/s ($p < 0.001$). The same results were evident for average flow rates, as mean flows at mild were 8.0 mL/s vs severe of 4.0 mL/s ($p < 0.001$) Residual urine increased from 25 mL to 110 mL ($p < 0.001$ and voiding times from 15 seconds up to 40 seconds ($p < 0.001$). Correlation analysis revealed moderate positive and negative correlations between residual urine and IPSS ($r = 0.60$), Qmax ($r = -0.54$), and Qavg ($r = -0.50$) with IPSS scores ($p < 0.001$). **Conclusion:** The importance of uroflowmetry in clinical assessments and management methods was shown by the substantial correlation found between uroflowmetric parameters and the severity of BPH symptoms.

INTRODUCTION

One disorder that causes the prostate gland to expand non-canceratically is called benign prostatic hyperplasia, or BPH. As it expands, it can impede bladder outflow and constrict the urethra, among other lower urinary tract symptoms. Dihydrotestosterone (DHT) and other androgens are necessary for the prostate gland to mature normally [1]. Both bladders may become obstructed and disturbed as a result of the prostate's ability to compress the urethra and reduce urine flow. The pathogenesis of BPH is complex and multifaceted, combining hormonal, molecular, and also structural changes in the prostate as well as surrounding structures [2]. According to a report, the overall incidence rate was 15 per 1000 man-years. The incidence increased linearly with age from three cases per 1000 man-years at the age of 45-49 years to a maximum of 38 cases per 1000 man-years at the age of 75-79 years. After the age of 80 years, the incidence rate remained constant. For a symptom-free man of 46 years, the risk of developing Lower Urinary Tract Syndrome (LUTS)/BPH over the coming 30 years, if he survives, is 45%. The overall prevalence of LUTS/BPH was 10.3%. The prevalence rate was lowest among males 45-49 years of age (2.7%) and increased with age until a maximum at the age of 80 years (24%). Pakistan with as many as 50% of the 2 million men

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older than 65 years are at risk of bladder outlet obstruction from BPH [3]. The enzyme 5-alpha reductase present in the prostate converts the most potent male hormone generated by the testes, which is then turned from testosterone to Dihydrotestosterone (DHT) [4]. DHT is a stronger androgen than testosterone and is responsible for prostatic development. It binds to androgen receptors in prostate cells, stimulating cell growth and inhibiting apoptosis. In men, a small quantity of estrogens was produced (mainly estradiol), but the levels increased with age due to androgen aromatization in adipose tissue. Estrogens could not only increase the local effects of androgens in prostate cells by increasing AR activity but might also improve it. Many adults, especially older men, suffer from Lower Urinary Tract Symptoms (LUTS), which are among the most common presentations in urology clinics. LUTS can be extremely detrimental to a patient's quality of life and are often associated with Benign Prostatic Hyperplasia (BPH), though they can also result from several different conditions [5]. The relationship between lower urinary tract symptoms (LUTS) and the storage and voiding cycle determines their classification. This association shows if there is an issue during the bladder's storage, during its emptying, or immediately after. Although the LUTS are categorized in this manner, there is a wide range of possible underlying mechanisms, and the balance of symptoms may point to contributing variables. Importantly, nocturia and higher frequency during the day are two symptoms of LUTS, but they can also result from processes completely unrelated to the lower urinary tract [6]. Urgency, with or without urgency incontinence, is typically accompanied by frequency and nocturia. Urinary tract infections can produce LUTS, including frequency, urgency, and dysuria (painful urination). The scar tissue narrows the urethra, causing obstructive voiding symptoms. Inflammation of the prostate gland can induce both LUTS and pelvic discomfort. Bladder stones can cause LUTS, which can manifest as frequency, urgency, and hematuria [7]. Bladder dysfunction is a symptom of neurological disorders such as multiple sclerosis and spinal cord damage. Usually, a combination of clinical surveys, questionnaires, and diagnostic tests is used to examine LUTS. BPH causes the balance between cell death and proliferation to be upset, allowing the prostate to grow longer and with more cells surviving. Increase cell survival rates via decreasing apoptosis. In response to increased resistance the bladder muscle (detrusor) hypertrophies, and generates higher pressures at voiding. As time passes, this may eventually lead to partial detrusor decompensation and reduced contractility. This leads to detrusor overactivity due to bladder outlet obstruction and incomplete emptying of urea symptoms of urgency, frequency, and nocturia [8]. The pathogenesis of Benign Prostatic Hyperplasia (BPH) is multifactorial and may have a hormonal cellular structural genetic basis. Androgens, especially DHT, are important in promoting prostatic growth, while alterations in apoptosis and proliferation induce hyperplasia. Subsequent nodular hyperplasia of the prostate GRAINS down on the urethra, resulting in bladder OUTLET obstruction and contributing to the diagnosis of BPH SYMPTOMS. Identification of such pathways is pivotal in the development of effective treatment regimens and disease control [9]. Lower Urinary Tract Symptoms (LUTS) caused by Benign Prostatic Hyperplasia (BPH) require prompt diagnosis and treatment. Various grading systems have been created to assess symptom severity and its impact on quality of life, including the Danish Prostatic Symptom Score (DAN-PSS), the Boyarsky score, the Madsen-Iversen score, and the International Prostate Symptom Score (IPSS). The American Urological Association (AUA) developed and validated the IPSS questionnaire. Which is frequently used to assess LUTS [10, 11]. Ultrasound of the prostate is a common diagnostic imaging method that permits direct visualization of the organ. It can be done both superpubic (through the abdominal wall) and transrectal. Lower Urinary Tract Symptoms (LUTS) are frequently caused by the common condition known as Benign Prostatic Hyperplasia (BPH), which has a major negative influence on the quality of life for older men. Uroflowmetry is a useful, non-invasive diagnostic technique that can objectively evaluate urine flow patterns, which helps with the diagnosis and treatment of LUTS in individuals with BPH.

The present study aimed to investigate the influence of the symptom severity on uroflowmetric parameters (Qmax, Qavg, post-void residual urine volume, and voiding time) in patients with LUTS BPH.

METHODS

It was a cross-sectional study carried out at Department of Urology of PMC Hospital Nawabshah from June 2024 to October 2024. There were sixty male participants in this study. Inclusion criteria were all these patients detailed history, age range above 50 years, physical examination, International prostatic symptom score (IPSS), and digital rectal examination. Exclusion criteria were prior urinary tract or pelvic surgeries, carcinoma, prostatic, ureteral stricture, and neurogenic bladder. For the sample size calculation, the formula was used: n=Z2×p×(1−p) d2. Confidence level (Z= 95%), Prevalence estimating (p=0.5 or 50%), and margin of error (d=0.125) [12]. The prevalence ratio was assumed as 50% due to the unavailability of the country-specific estimates of LUTS in BPH patients and the estimated sample size was N=60 participants. A convenience sampling technique was used for selecting participants. Uroflowmetry was a simple approach for calculating urine flow rate over time. Peak flow rate (Q max), flow time, and voided volume were computed using the apparatus. The device determined the time to peak flow, voiding volume, voiding duration, and peak flow rate. Patients experienced no discomfort throughout the test

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because it involved normal urine. The patients' data was analyzed and categorized according to IPSS-determined symptom severity. At the time of presentation, details regarding the patient's clinical status, demographics, and test findings were recorded. These patients' uroflowmetry data were compared using statistical methods. 26 SPSS was used to analyze the data statically. The relationship between uroflowmetric parameters and IPSS scores was the main result. "The IPSS includes eight items, seven of which were regarding urinary symptoms and one about quality of life. Each urinary symptom question has six choices that indicate increasing symptom severity, with a score ranging from 0 to 5. The overall score goes from 0 to 35. Higher scores indicate more severe symptoms. Clinical recommendations from the American Urological Association (AUA) and the European Association of Urology (EAU) serve as the foundation for the cut-off points used in the International Prostate Symptom Score (IPSS) to classify the severity of symptoms. This was how the severity was categorized: IPSS scores between 0 and 7 indicate mild symptoms, whereas scores between 8 and 19 indicate moderate problems. IPSS score of 20 to 35 indicates severe symptoms. To effectively evaluate, monitor, and treat patients with Benign Prostatic Hyperplasia (BPH), these cut-off points enable systematic assessment of Lower Urinary Tract Symptoms (LUTS). Calculating descriptive statistics and utilizing Pearson's correlation coefficient, the association between uroflowmetry findings and the intensity of symptoms was evaluated. Statistical tests ANOVA was applied to compare these parameters in different severity groups (i.e. mild, moderate, and severe symptoms). Further post-hoc test (Tukey's HSD) was applied for pairwise comparisons. The p-value of less than 0.05 showed that the variables were highly significant. This study was approved by the Institutional Review Board (IRB) under reference number [PUMHSW/SBA/PVC//ERC/41/2024]. Written informed consent was obtained from all participants before their inclusion in the study, ensuring that they were fully aware of the study's purpose, procedures, potential risks, and benefits.

RESULTS

There was a total of 60 males. The patient's average age was 55.2 years see table 1.

Table 1: Demographic Variables of study participants (n=60)

Variables	Total Number of Patients N (%)
Male	60 (100%)
Age	
50-60	32 (53.3%)
61-70	28 (46.6%)

The study comprised 60 male patients aged range 50 to 70 years, divided equally into two age groups: (53.3%) patients aged 50-60 years and (46.6%) patients aged 61-70 years. The younger group had a mean prostate size of 42 ± 5 mm, with 10 patients (33.3%) reporting mild symptoms, 15 (50.0%) experiencing moderate symptoms, and 5 (16.7%) exhibiting severe symptoms. In contrast, the older group had a mean prostate size of 48 ± 6 mm, where 5 patients (16.7%) had mild symptoms, 15 (50.0%) had moderate symptoms, and 10 (33.3%) had severe symptoms. Overall, 25% of patients experienced mild symptoms, 50% had moderate symptoms, and 25% exhibited severe symptoms, indicating a notable prevalence of moderate to severe lower urinary tract symptoms, particularly in the older age group, which underscores the need for effective management of Benign Prostatic Hyperplasia (BPH) in this population see table 2.

Table 2: IPSS Score Results and Clinical Status of Patients

Demographic Variables		N (%)	Prostate Size (Mean ± SD)	Mild Symptoms (0-7) N (%)	Moderate Symptoms (8-19) N (%)	Severe Symptoms (20-35) N (%)
Age Group	50-60 Years	32 (53.3%)	42 ± 5 mm	10 (33.3%)	15 (50.0%)	5 (16.7%)
Age Group	61-70 Years	28 (46.6%)	48 ± 6 mm	5 (16.7%)	15 (50.0%)	10 (33.3%)
Total		60 (100%)	45 ± 5.5 mm	15 (25%)	30 (50%)	15 (25%)

Table 3 demonstrated the correlation between the International Prostate Symptom Score (IPSS) and various uroflowmetric parameters in sixty patients (n=60) with Benign Prostatic Hyperplasia (BPH). There was an average amount of remaining urine 70.3 ± 25.4 (mL) and the p-value was less than 0.001 this showed that there exists a significant difference between IPSS scores, correlation coefficient = 0.60 with a positive moderate relationship frequently the EQ-5D and its dimension's table 3. The mean peak flow rate was 10.2 ± 3.1 mL/s there was a moderate negative correlation between IPSS scores and it with a correlation coefficient of -0.54. The mean flow rate was 6.5 ± 2.2 mL/s The correlation coefficient of -0.50 depicts a moderate negative association with IPSS scores ($p < 0.001$).

Table 3: Correlation between Uroflowmetric Variables and IPSS Scores (n=60)

Variables	(Mean ± SD)	Correlation Coefficient (r)	p-Value	Interpretation
Residual Urine (mL)	70.3 ± 25.4	0.60	<0.001	Moderate Positive Correlation
Peak Flow Rate (Qmax) (mL/s)	10.2 ± 3.1	-0.54	<0.001	Moderate Negative Correlation
Average Flow Rate (Qavg) (mL/s)	6.5 ± 2.2	-0.50	<0.001	Moderate Negative Correlation

The mean peak flow rate was 12.5 ± 2.0 mL/s, so this seems like a fairly decent urinary stream organization up to now. Qmax decreases substantially to 9.0 ± 2.0 mL/s with the increase in symptoms, indicative of an impairment in urinary function. The Qmax was still significantly reduced to a mean of 6.5 ± 2.1 mL/s suggesting very poor urinary

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flow. This demonstrated a statistically significant decline in peak flow rates with higher symptom severity, indicating that urinary flow was proportionally more restricted with increasing burden of symptoms in table 4.

Table 4: Uroflowmetric Variables by IPSS Symptom Severity (n=60)

Variables	Mild Symptoms (Mean ± SD)	Moderate Symptoms (Mean ± SD)	Severe Symptoms (Mean ± SD)	p-Value	Post-Hoc Test	Post-Hoc P-value
Peak Flow Rate (Qmax) (mL/s)	12.5 ± 2.0	9.0 ± 2.0	6.5 ± 2.1	<0.001	Mild > Moderate > Severe	<0.05 (Significant)
Average Flow Rate (Qavg) (mL/s)	8.0 ± 1.5	5.5 ± 1.5	4.0 ± 1.0	<0.001	Mild > Moderate > Severe	<0.05 (Significant)
Residual Urine (mL)	25.0 ± 10.0	65.0 ± 15.0	110.0 ± 20.0	<0.001	Mild > Moderate > Severe	<0.05 (Significant)
Voiding Time (Seconds)	15.0 ± 3.0	25.0 ± 5.0	40.0 ± 8.0	<0.001	Mild > Moderate > Severe	<0.05 (Significant)

DISCUSSION

This study was conducted to evaluate the correlation of uroflowmetric parameters with urinary symptom severity in Benign Prostatic Hyperplasia (BPH) patients. Further evidence of the severity of symptoms related to urine function was obtained by comparing these characteristics with the International Prostate Symptom Score (IPSS) in a significantly negative correlation. The analysis showed that the peak flow rate (Qmax) and average flow rate (Qavg) decreased significantly, and post-void residual urine volume as well as voiding time increased with an increase in the severity of urinary symptoms. These changes were important because they provide quantifiable markers of urinary function that closely track how patients feel [13]. The mean Qmax of patients with mild symptoms was 12.5 mL/s, suggesting normal urinary function. Those with mild symptoms had mean Qmax values of 9.2 mL/s, and those with moderate and severe symptoms had respective average Qmax values of 9.0 mL/s and 6.5 mL/s. Reduced Qmax indicates an obstruction the urine outflow was blocked [14]. In this regard, it was in line with previous studies by Mevcha and Napier-Hemy, in 2021 which show that reduced flow usually occurs in patients with more symptoms of urinary outlet obstruction and prostatic obstruction. In the same way, the peak flow rate also showed a similar trending by symptom severity (4.0 mL/s in severe urinary symptoms), and the rate of flow was significantly worse amongst more severely symptomatic patients [15]. Mean residual urine volume was significantly increased with worsening of symptoms such that, it rose from 25 mL in patients with mild symptoms to 110 mL in severe symptoms. Large residual volumes were problematic because they may cause UTIs and bladder dysfunction [16, 17]. Going on to say that this finding supports the previous study by Lopategui in 2024 touching off post-void residual urine in clinical practice, especially when patients present with moderate to severe symptoms. The correlation of increased residual volume with increased symptom scores reinforces the notion that these patients may need to be treated for urinary retention. The bladder ultrasonography was effective in measuring urinary volume after removal of the indwelling urinary catheter and and may contribute to the detection of urinary retention [18]. The average time of voiding was also correspondingly prolonged; the time being 15 s in mild, and 40 s in severe cases. Bladder outlet obstruction results not only impaired urological efficacy of urination but also can lead to patient discomfort and anxiety about the urinary function because voiding times were prolonged. The longer voiding times in patients with these symptoms, indicative of the enlarged effort exerted to start and finally stop urination, would lead to a significant drop in quality of life [19, 20]. Current findings underline the need for uroflowmetric parameters to be taken into account in a comprehensive management strategy for men with BPH. These associations were clinically relevant to the purpose of uroflowmetry in voiding function because data generated by uroflowmetry help to score the IPSS and aid diagnostic evaluation. Additionally, patients with pathological uroflowmetric findings may be identified, and the decision concerning further treatment or necessity of surgery made in clinical examination [21]. This study was also a reminder that healthcare providers should be monitoring changes in urinary symptoms, particularly in patients who report an increasing incidence of them. These early warning signs in patients of increased residual volume or decreased flow rate may allow urologists to intervene before downstream catastrophic complications from BPH, including acute urinary retention or irreversible bladder damage.

CONCLUSIONS

This study concluded that uroflowmetric parameters were significantly related to urinary symptom severity in patients with BPH. The prostate grows in an aging man, it manifests with irritative and obstructive symptoms in the form of reduced flow rates along with prolonged voiding time and an increase in post-voidal volume. Our results

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supported the structuring of uroflowmetry in everyday clinical practice thus improving the quality of life and managing patients with BPH.

Authors Contribution

Conceptualization: AHM
Methodology: HUR, AB
Formal analysis: MAC
Writing, review and editing: ZHB, HUR, SA, AB

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

Conflicts of Interest

All the authors declare no conflict of interest.

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