Correlation of Uroflowmetry with Prostate Volume and International Prostatic Symptom Score (IPSS)

Iffat Raza, Nausheen Jamshed, Mubina Lakhani, Maria Mohiuddin, Syeda Bushra Ahmed, Sahrish Mukhtar

ABSTRACT

Objective: To correlate Uroflowmetry with Prostate volume and International Prostatic Symptom Score in BPH patients and healthy adults in a subset of Karachi Population.

Study Design and Setting: This is a crossectional study carried out at Ziauddin Hospital, Karachi over a period of 6 months.

Methodology: In this study 100 Samples were taken through non probability convenience sampling. Inclusion criteria includes 40years and above. Sample initially was taken on the basis of International Prostatic Symptom Score i.e., less than 8 and greater than 8 score. Ultrasonography was performed. 65 Individuals with International Prostatic Symptom Score > 8 and Prostate volume <25 and individuals having symptom index < 8 and Prostate volume > 25ml went for Uroflowmetry. Mean and standard deviation was taken out for quantitative variables. Univariate analysis and Multiple Linear Regression applied to assess relationship between Uroflowmetry with Prostate volume and International Prostatic Symptom Score.

Result: Mean age of patients was found to be 58±6 years. Mean International Prostatic Symptom Score was 11±4. Mean Prostate Volume was 28ml±5, mean Qmax was 14ml/s ±4. The correlation between Qmax and International Prostatic symptom score was found to be negative (-0.78) and statistically significant. No correlation was found between Prostate volume and Qmax.

Conclusion: Qmax and International Prostatic Symptom Score are reliable tool for assessing Benign Prostatic Hyperplasia patients concluding that as Symptom Score increases Qmax decreases. Qmax showed no correlation with Prostate volume. Prostate volume assessed on Ultrasonography is not an authentic parameter for diagnosing BPH patients.

Keywords: International Prostatic Symptom Score (IPSS), Prostate volume (PV), Lower Urinary Tract Symptoms (LUTS), Uroflowmetry (UFM), Qmax (peak flow measurement)

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INTRODUCTION:

Benign Prostatic Hyperplasia, the most frequently occurring disease among aged males of 40 to 80 years[1]. It is important to evaluate prostate volume of individuals with BPH that have symptoms of lower urinary tract as if it is not treated timely will worsen the condition leading towards Urinary Retention. Prostate Volume (PV) is important predictor as well as prognostic factor for minimally invasive Transurethral Prostatectomy and open prostatectomy[2]. In order to diagnose BPH, prostate volume assessed by Transabdominal Ultrasonography (TAUS) was the most easily available and accessible parameter, however reliability was always a concern, thus Transrectal Ultrasonography (TRUS) is usually considered as gold standard for diagnosing BPH[3].

Uroflowmetry (UFM) is a simple, noninvasive procedure that measures the flow rate of voided urine. Its use has become clinically widespread. Turner Warwick was the first to demonstrate how I/V urogram can be replaced into a urodynamic study[4]. It measures the flow of urine during

urination. Patient urinates in a funnel or commode that is connected to an instrument that measures urinary flow. It is converted into a graph and doctor interprets its report. UFM gives interpretation of peak flow rate, average flow rate, time to peak flow, flow time, voiding time and voided volume is calculated as milliliters of urine passed per second[5]

McConnell's practice guidelines have described that 125 to 150 ml minimum should be the voided volume to have accurate   Uroflowmetry readings. Peak flow measurement (Qmax) of <10 ml/s is diagnosed as 'clinically obstructed Benign Prostatic Hyperplasia (BPH) patient[6]. The most characteristic finding in Uroflowmetry of Benign Prostatic Hyperplasia is decreased maximal flow rate (Qmax) that results in decreased urinary flow causing urinary retention that consequence to bladder stone formation and infections of urinary tract.

According to another study, maximal flow rate (Qmax) is the single best criterion for evaluating patients with BPH before embarking on any medical or surgical treatment[7]. Uroflowmetry is performed using a flow meter to measure the quantity of fluid voided per unit of time (expressed in milliliter per second (ml/s)[7]. Uroflowmetry is performed in a routine clinical practice to early diagnose BPH in an OPD setting but its result might vary with aging, washroom settings for UFM machine, cultural background, psychosocial issues and detrusor muscle instability. The gold standard for evaluating grade of lower urinary tract symptoms is urodynamic studies with pressure-flow analysis. Flow rate measurements like Uroflowmetry are nowadays used in clinics along with ultrasonography of the LUT[8].

International Prostatic Symptom Score (IPSS) is definitive questionnaire for initial assessment of inpatients having LUTS. This score is beneficial after TURP for post treatment monitoring of symptoms[8] and can be used as a tool for selection of treatment modalities, to assess treatment response and follow up after open prostatectomy or after alpha blockers administration[9]. "IPSS is based on the answers to 7 questions (Frequency, Urgency, Nocturia, Incomplete emptying, Intermittency, Weak stream and Straining). The answers are from 0 to 5. The total score ranges from 0 to 35 (asymptomatic to symptomatic). The Symptom index is categorized as mild (≤7), moderate (8-19) and severe (≥20)". Each question is further divided into 5 question 0. Not at all symptoms occurs, 1.less than 1 in 5 times 2. less than half the time 3.about half the time 4.More than half the time 5.Almost always , these symptoms are scored as zero to five[10].

The basic objective of this study was to determine that Uroflowmetry correlation (Qmax) with Prostate volume is more reliable, authentic and better than with UFM correlation with IPSS as questionnaire is readily available, being widely used by urologists in urology clinics for assessing Benign Prostatic Hyperplasia patients and healthy adults coming with lower urinary tract symptoms.

METHODOLOGY:

This study was conducted at Ziauddin University Hospital, Clifton Karachi for a period of six months from January to March 2018 after taking permission from ERC# 0010115I-RANA. The target population was 40 years and above. 100 Individuals were selected through nonprobability convenience sampling. Inclusion criteria includes male, 40 years and above. Exclusion criteria includes prostatitis, prostatic carcinoma, urinary retention, already taking prostatic medicine.

Sample size was calculated, keeping prevalence at 40%, confidence level of 95% and bound of error at 0.07%. $n=z^2 P(1-P)/B^2$

Participants were asked to fill biodata and IPSS questionnaire. On the basis of IPSS questionnaire, two groups were made i.e IPSS < 8 and IPSS >8. IPSS<8 was labeled as healthy adults and IPSS > 8 were labelled as patients along with already prior evidenced medical report of BPH were also included in >8 IPSS group.

After filling biodata and IPSS forms, respective individuals were sent for Transabdominal Ultrasonography on Ultrasound machine,Toshiba Xario version 0.09 ^{0}. Two groups were made on the basis of Prostate volume ,first group includes less than 25ml volume second group includes greater than 25 ml volume. After ultrasonography there were 65 individuals with IPSS > 8 and PV <25ml and 35 individuals with IPSS <8 and PV >25ml. These two groups included 100 patients falling in gray area zone were then referred for Uroflowmetry to assess the prognosis of BPH that is whether prostate volume is a diagnostic criterion or International Prostatic Symptom Score itself. PSA was not performed.

Uroflowmetry is performed in a urinal that is connected to a measuring device, it measures the flow and speed of urine coming out of the body and how much time is required for emptiness of bladder.

STATISTICAL ANALYSIS: It was a crossectional study and analyzed on SPSS version 23. Mean and standard deviation were taken out for the quantitative variables. Multiple linear regression test was done to find out linear relationship among the Qmax and prostate volume along with Qmax and IPSS. Bivariate Correlate was done to see correlation between Qmax and IPSS, Qmax with PV. p-value < 0.05 was considered statistically significant.

RESULT:

In present study mean IPSS was found to be 11.1, mean PV was found to be 28, mean Qmax was found to be 14 of 100 individuals that includes with PV less than 25 ml and IPSS greater than 8 and prostate volume greater than 25ml and IPSS less than 8 as shown in Table 1. Results obtained in correlation of UFM with International Prostatic Symptom

score and prostrate volume A Univariate analysis was conducted among Uroflowmetry variable Qmax and International Prostatic Symptom Score and between Qmax and Prostate Volume. r was determined using Pearson's correlation coefficient and p value was determined using ANOVA. We found a negative strong correlation of Qmax with IPSS with -0.782 with p value of 0.001 and found a positive moderate correlation between Qmax and Prostate volume with 0.315 with significant p value. Regression square linear variable came out to be 0.612. In this study mean value of peak flow rate (Qmax) was found to be 15ml/s, with a minimum recording of 6ml/s and maximum of 21ml/s. The mean average flow rate (Qmed) was found to be 7.1 ± 2 ml/s.

In this study, Pearson correlation test was applied between International Prostatic Symptom score with Qmax and significant negative correlation was found with Total IPSS whereas individual questions included in IPSS questionnaire were i.e Q.1 Incomplete emptying, Q2 Frequency, Q3, Intermittency, Q4 Urgency, Q5 Weak Stream, Q6 Hesitancy or Straining, Q7 Nocturia also showed correlation with Qmax.

Q4 urgency showed weak negative correlation with Qmax where moderate negative correlation coefficient was found to be r = -0.381 with significant p value = 0.00 , Q3 Intermittency also showed weak negative correlation with Qmax r = -0.106, p = 0.00 also found to be significant and Q7 Nocturia also showed significant moderate negative correlation with Qmax r= -0.461 and p = 0.00 also statistically significant .Rest of the questions of IPSS were statistically significant with Qmax but showed positive correlation.
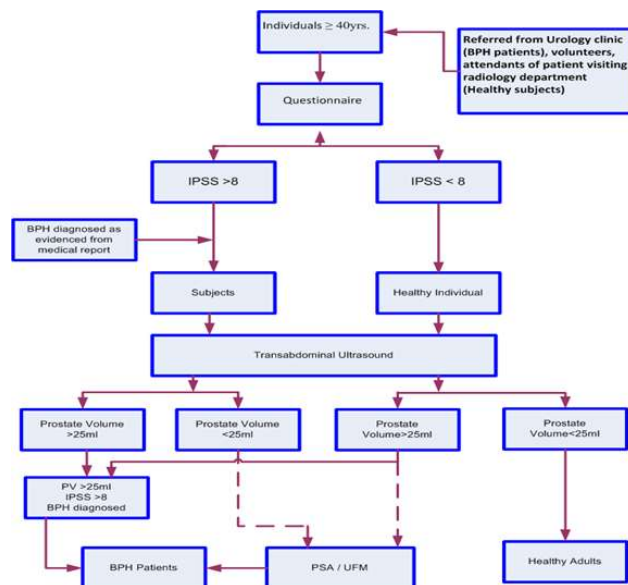
Figure 01: Flow chart of Methodology of Study

Table No 01: Descriptive Statistics

Total Uroflowmetry performed	PV <25ml, IPSS >8	65 individuals
N=100	PV > 25 ml, IPSS <8	35 individuals
Variable	Mean	St. Deviation
Age (years)	58	6
IPSS	11	4.3
Prostate Volume (ml)	28	5.4
Qmax (ml/s)	14	4

Table 02: Univariate analysis Of Qmax with IPSS & Prostate Volume

Qmax	I P S S	Prostate volume
Pearson Correlation (r)	-0.782	0.509
p-value	0.00	0.40

r was determined by Pearson correlation coefficient. R2 linear variable: 0.612
p value <0.05 considered statistically significant

Figure 02 : Graphical representation of Uroflowmetry

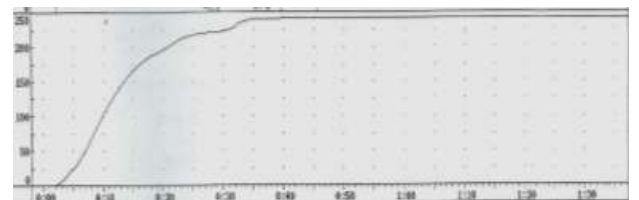Figure 03: Showing peak flow rate = 17.5 ml/, voided volume =241m

Table 3: IPSS correlation with Qmax

S.no	IPSS	r value	p-value
Q 1 .	Incomplete emptying/Qmax	.381	0.00
Q 2 .	Frequency/Qmax	0.461	0.00
Q 3 .	Intermittency/Qmax	-0.106	0.00*
Q 4 .	Urgency/Qmax	-0.318	0.00*
Q 5 .	Weak Stream/Qmax	0.11	0.413
Q 6 .	Hesitancy/Qmax	0.472	0.00
Q 7 .	Nocturia/ Qmax	-0.461	0.00*

r= Pearson correlation coefficient and p= <0.05 significant

DISCUSSION

In present study, 100 individuals were included BPH and healthy adults. Mean age found in our study was 58 ± 6 years (Table 1) which was also found in another study as Lower Urinary tract symptoms are common in this age group[12].

Mean International Prostatic Symptom Score found in our study was 11 ± 4 which came under moderate symptoms of lower urinary tract, this was also in accordance to other studies[13].

Mean Qmax obtained by Uroflowmetry was 14ml/s which was also seen in other studies and thus explaining unobstructed prostate[14].

In this study, we aimed to find out the reliability of IPSS with Qmax and also with PV at the same time in individuals suffering from lower urinary tract symptoms. Prostate volume less than 25ml and IPSS greater than 8, there were 65 individuals (Table 01) falling in this category where UFM was performed on these individuals to see whether Qmax itself standalone in diagnosing benign prostatic obstruction and also enables us to identify lower urinary tract symptoms in urology clinics. We found out that correlation of Qmax with IPSS and p value was statistically significant with r= -.782 respectively. In our study we found negative relationship of Qmax with IPSS (Table 3) therefore substantial the size of gland lower was the Qmax and greater the IPSS lower was peak flow rate. Our results were in consensus with Zamboan et al they also observed negative relationship between Qmax with prostate volume and IPSS[15] Singla et al also found negative correlation of Qmax with prostate volume as prostate enlarges Qmax is increasing rather instead of decreasing values and going towards obstruction however Qmax showed no correlation with prostate volume in our study. According to recent study published in 2022 they could not find any correlation between prostate volume and Qmax[16]. Another Nigerian study published in 2021 showed discordance and found out negative and statistically significant correlation between Qmax and prostate volume.

The 35 individuals having IPSS <8 and PV > 25ml these individuals underwent for UFM their Qmax came out to be greater than 15ml/s , these individuals were advised for follow up visit. These individuals were asked for further urodynamic testing after 2 weeks. Thus, prostate volume measured by ultrasonography is not a good measurable indicator to diagnose patients as benign prostatic hyperplasia. The most important parameter in uroflow study is the *Qmax*[17]. Shoukry *et al.* in their study, concluded that *Qmax* correlated well with the degree of prostatic obstruction[9]. The average flow rate is less reliable and the other values are immaterial. Traditionally, *Qmax* less than 10 mL/s indicates an obstruction and a *Qmax* greater than 15 mL/s indicates no obstruction[9]. The Qmax and the Qave are also used in identifying patients with Bladder Outlet Obstruction[18].

In this study most common clinical presentation as asked in IPSS questionnaire was urgency, intermittency and nocturia. We also found out in this study that IPSS correlated with Qmax. These findings were similar to another study[19] which observed that nocturia as the only most occurring , repeatable symptom also correlated with UFM i.e Qmax.

Thus, we find inverse relationship of IPSS with Qmax[20]. Symptoms like urgency, intermittency and nocturia significantly correlated with Qmax and depict the most commonly occurring symptoms in BPH patients. According to study conducted in Abdul Wahab Hospital most commonly occurring symptoms were Incomplete Emptying occurring in 85% of patients visiting Clinics and 90% of patients had complaints of Nocturia[21]. Nocturia usually occurs in elderly as urinary bladder, prostate have more excitatory stimulation of parasympathetic innervation at night and decreased sympathetic inhibition resulting in contraction of urinary bladder along with prostatic enlargement and weak urethral muscle leads to frequent urination at sleeping hours. According to the study conducted in Turkish population, a negative correlation coefficient was found between Qmax and Urgency[22]. Urgency occurs when there is contraction of already contracted bladder also leading to incomplete emptying or residual volume.

According to the study conducted in 2017, intermittency was also one of the symptoms observed in patients with benign prostatic hyperplasia and bladder outlet obstruction[23]. Whereas, some studies on Asian men explains that lower urinary tract symptoms are most of the time associated with bladder outlet dysfunction, detrusor muscle instability and small prostate size and high peak flow rate (Qmax)[24]. Same results were observed in studies conducted in Japanese population and in Caucasian men where prostate volume was not significantly greater as compared to symptoms observed[24]. However, some studies do explain the benefit of transurethral prostatectomy even size of prostate is not larger enough thus helping patient in relieving their symptoms along with lowered IPSS[25]. Therefore, prostate volume can be one of the parameter to diagnose LUTS but prostate volume alone is not at all a reliability index for diagnosing BPH, instead Qmax can be beneficial.

Uroflowmetry provides a strong diagnostic tool and meaningful guidance for the surgeons and urologist so that necessary therapeutic medical and surgical procedures can be carried out on BPH patients and also helpful for individuals visiting clinics for lower urinary tract symptoms[25]. Regarding medical treatment, uroflowmetry of BPH patient if appears to be 15ml/s or below, then Initially alpha blockers are being prescribed but if patient is having erectile dysfunction along then phosphodiesterase inhibitors are prescribed instead. If symptoms do not improve and Qmax declines to <15ml/s then 5 alpha reductase inhibitors are recommended. Patient with Bladder Outlet Obstruction beta 3 agonist and anticholinergics are treatment of choice. If Qmax is <10ml/s then urodynamics test such as Cystoscopy and Uroflowmetry is mandatory and after that surgical intervention Transurethral resection of Prostatectomy(TURP) is carried out in these patients.

This study is done in a subset of a local population of Karachi representing the same results as with other international

population. However, there are emerging trends of Uroflowmetry internationally and our country is lacking behind in these, such as Acoustic Uroflowmetry mobile app available in which patient can monitor their readings in a diary. Visual Prostate Symptom Score(VPSS) is also readily available in urological clinics but not available in Pakistan for elderly and men with low education background.

The Professional significance of this study is based on IPSS cannot be alone used to assess lower Urinary tract Symptoms but instead Uroflowmetry is a diagnostic tool for assessing obstructive objective symptoms in Benign Prostatic Hyperplasia patients. Uroflowmetry helps urologist to decide therapeutic intervention in patients. IPSS and Uroflowmetry are affordable, readily available parameters and should be available in every urology clinic.

However, there were few limitations of this study. Transrectal ultrasonography (TRUS) is a newer technique and gold standard for diagnosis of prostate cancer. It provides clear image of organs in the pelvis, however we used Transabdominal sonography (TAUS) because TRUS requires patient tolerance and it is difficult to get consent from patient, due to our cultural norms. Disproportionate sample size for different groups, therefore our study sample might have been affected by selection bias.

Some of the future recommendations in this study includes that a large sample size cohort study should be conducted in order to get beneficial substantial results regarding individuals with higher IPSS and low prostate volume as there could be nonobstructive neurogenic mechanisms other than Benign prostatic hyperplasia. Other parameters of Uroflowmetry should be assessed which can help in making diagnostic tool easier.

CONCLUSION:

Uroflowmetry has been used to measure the peak flow rate (Qmax) which is the most important parameter in Uroflowmetry and one of the best options for assessing lower urinary tract symptoms (LUTS). IPSS is a quick assessment parameter in diagnosing BPH patients and showed significant inverse correlation with UFM that signifies that as Qmax decreases IPSS increases. Intermittency, Urgency and Nocturia are the most frequently occurring symptom that best correlated with Qmax. However, Qmax showed no correlation with prostate volume. The inexplicit details of prostate volume cannot help urosurgeons for decision making for TURP or open prostatectomy.

Authors Contribution:
Iffat Raza: Study Conduction and Manuscript writing
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