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Original Research Article

USG evaluation of prostate volume and its correlation with international prostatic symptom score and prostate specific antigen level in blood

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Abstract

Enlarged prostate is one of the most common urinary tract illness encountered in elderly males. Prostate volume is a well-established single most important predictor for management of patients with prostatomegaly, presenting with lower urinary tract symptoms. The aim of this study is to find a correlation between IPSS, PSA and prostate volume measured by transrectal ultrasound and its impact on patient management. A total of 120 men >40 years of age with lower urinary tract symptoms underwent transrectal ultrasound for the estimation of prostate volume after the laboratory investigation for prostate specific antigen levels in blood and response to clinical questionnaire for International Prostate Symptoms Score. The prostate ranged from 10 cc to 130 cc, mean being 37.04 cc $\pm$18.81. As per grading by IPSS, 52 patients (43.3%) had severe symptoms, followed by moderate symptoms in 44 patients (36.6%) and only 24 patients (20%) were having mild symptoms. PSA values ranged from .04 to 19.5 ng /ml. with a mean value of 4.2 $\pm$ 1.89 ng / ml. Significant correlation is found between prostate volume, IPSS and PSA with moderate but statistically significant correlation between IPSS and PSA. Thus, combined parameters of prostate volume, IPSS and PSA could serve as an eminent tool for making clinical decisions and surgical management of patients with lower urinary tract symptoms due to enlarged prostate.

Keywords: International Prostatic Symptom Score, Prostate Specific Antigen, Lower urinary tract symptoms, Benign Prostate Hyperplasia.

1. INTRODUCTION

Prostate enlargement is common among ageing men causing significant morbidity. Enlarged prostate is one of the most common urinary tract illness encountered in elderly males. Benign Prostatic Hyperplasia begins before 30 years and approximately 8% of men have histological evidence of benign prostatic hyperplasia by 40 years, 50% by 60 years and 90% by 90 years of age [1]. The morbidities of prostate disease have increased sharply all over the world. BPH presents with lower urinary tract symptoms (LUTS) related to voiding (slow stream, splitting or spraying, intermittency, hesitancy, straining and terminal dribble), storage

(increased daytime frequency, nocturia, urgency and urinary incontinence), and post-micturition (feeling of incomplete emptying, post-micturition dribble) consequently decreasing the quality of life, The severity of LUTS can be evaluated by International Prostate Symptom Score (IPSS). It consists of seven questions involving LUTS related to voiding and storage and also incorporates one additional question about the affect of LUTS on overall quality of life. This study is to correlate and establish relation among Transrectally measured prostate volume, lower urinary tract symptoms graded by International Prostatic Symptom Score (IPSS) and Prostate Specific Antigen (PSA) levels in Blood and its impact on patient management.

2. MATERIAL AND METHODS

A time bound, hospital based Cross-Sectional study, was conducted in the Department of Radio-Diagnosis, M.G.M. Medical College and M.Y. Hospital, Indore, after receiving approval from Institutional Scientific and Ethical Committee. The duration of the study was from April 2021 to August 2022. A total of 120 patients referred with the symptoms of lower urinary tract for transrectal ultrasound evaluation for prostate were referred to the Department of Radiodiagnosis were included in the study. All patents underwent clinical questionnaire and interview regarding International Prostate Symptoms Score, laboratory investigation for prostate specific antigen levels in blood and after that prostate volume was assessed using transrectal ultrasound.

- **INCLUSION CRITERIA -**
- Male patients aged >40years of age.
- Male patients with clinically suspected Prostatomegaly or lower urinary tract symptoms.
- **EXCLUSION CRITERIA -**
- Patients who have undergone previous prostatic surgery.
- Patients who denied consent.

Aim:

- To assess prostatic volume by Trans Rectal Ultrasound and correlate the findings with International Prostate Symptom Score and Prostate Specific Antigen levels in blood.
- To determine relation of prostate volume, IPSS and PSA with age and determine correlation of prostate volume and PSA with individual symptoms of IPSS.

Study Protocol:

Patients were selected according to inclusion criteria. A detailed history was taken which include medical history, surgical history. The International Prostate Symptoms Score was obtained by a clinical questionnaire and personal interview with the patient on the lower urinary tract symptoms which they experienced over the past one month.

International Prostatic Symptom Score (IPSS) [2]

Patient's Name
Date of Birth
Date Completed

	Not at all	Less than 1 time in 5	Less than half time	About half the time	More than half the time	Almost always	Patient score
1. Incomplete emptying Over the past month, how often have you had a sensation of not emptying your bladder completely after you finished urinating?	0	1	2	3	4	5	
2. Frequency Over the past month, how often have you had to urinate again less than two hours after you finished urinating?	0	1	2	3	4	5	
3. Intermittency Over the past month, how often have you found you stopped and started again several times when you urinated?	0	1	2	3	4	5	
4. Urgency Over the past month, how often have you found it difficult to postpone urination?	0	1	2	3	4	5	
5. Weak stream Over the past month, how often have you had a weakurinary stream?	0	1	2	3	4	5	
6. Straining Over the past month, how often have you had to push or strain to begin urination?	0	1	2	3	4	5	
	None	1 time	2 times	3 times	4 times	5 times or more	
7. Nocturia Over past month, how many times did you most typically get up to urinate from the time you went to bed at night until the time you got up in the morning?	0	1	2	3	4	5	

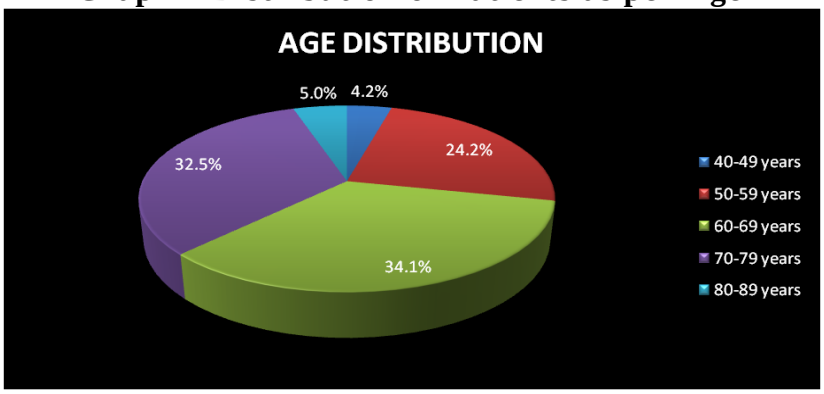
Total IPSS Score _____

Quality of Life Due to Urinary Symptoms	Delighted	Pleased	Mostly satisfied	Mixed about equally satisfied and dissatisfied	Mostly dissatisfied	Unhappy	Terrible
If you were to spend the rest of your life with the urinary condition just the way it is now, how would you feel about that?	0	1	2	3	4	5	

The PSA levels were obtained by quantitative measurement of prostate specific antigen levels in serum via chemiluminiscent immunometric assay done in MYH INDORE. Proper consent from the patient was taken before performing ultrasound. Ultrasound examination was done with emphasis on the prostate gland. The prostate gland was evaluated for the echotexture, morphology, focal lesions, median lobe enlargement and prostate volume. The Ultrasound probe was covered with sterile probe cover and then after applying the lignocaine gel at anal verge, the probe was gently inserted for prostate assessment. The prostate volume was calculated by using Prostate Ellipsoid Formula = Anteroposterior x Transverse x Cranio-caudal x 0.52. The grading of the prostate gland enlargement was done as follows:
Grade – I - 25 – 30 cc. Grade – II - 31 – 50 cc. Grade – III – 51 – 80 cc. Grade – IV – 80 and above.
Method of Statistical Analysis:
Data was entered in Microsoft excel spread sheet and analysed using Open Sources Software. Continuous data was expressed in terms of mean and SD. Categorical data was expressed in form of proportion and percentage. Appropriate test of significance was applied wherever necessary and “p” value of <.05 was considered as statistically significant.

3. RESULT

Graph 1 Distribution of Patients as per Age



Graph 2 Distribution of patients as per IPSS grading

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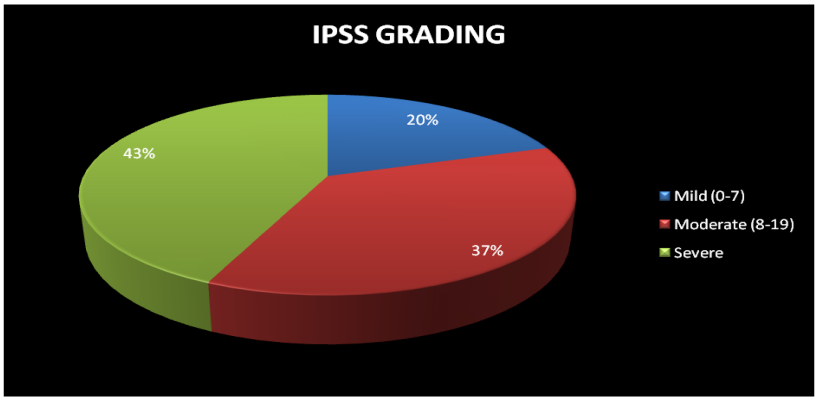

Majority of the patients in our study turned out to be having severe symptoms with 52 patients (43.3 %). 44 patients (36.6 %) were having moderate symptoms and 24 patients (20 %) with mild symptoms as per IPSS grading.

Table 1 Distribution of patients as per clinical symptoms

Clinical History	Number of Patients	Percentage (%)
Incomplete Emptying	57	47.5
Increased Frequency	96	80.0
Intermittency	58	48.3
Straining	68	56.6
Weak Stream	59	49.1
Urgency	90	75.0
Nocturia	72	60.0
Burning Micturition	77	64.1
Dribbling	53	44.1
Acute Retention of Urine	1	0.52

Increased frequency of micturition was the commonest clinical symptom observed in 96 patients (80.0 %), closely followed by Nocturia in 90 patients (75 %). The least common mode of presentation was acute urinary retention with a single patient.

Table 2 Distribution of patients as per PSA level

PSA Level	Number of Patients	Percentage
<=4 ng/ml	18	15.0
4-10 ng/ml	87	72.5
>10 ng/ml	15	12.5
Total	120	100.0

87 patients (85 %) had PSA level between 4-10 ng/ml, 18 patients had PSA below 4 ng/ml and 15 patients had PSA level >10 ng/ml.

Table 3 Distribution of patients as per prostate volume

Prostatomegaly Grading	Number of Patients	Percentage (%)
<25cc	18	15.0
25-30cc	36	30.0
31-50cc	23	19.1
51-80cc	18	15.0
>80cc	25	20.9
Total	120	100.0

Table 4 Correlation of Median lobe enlargement with IPSS

Median Lobe Enlargement	N	Min.	Max.	Mean IPSS	Standard Deviation	"t" value	"p"value
Yes	47	2	35	25.5	9.52	10.215	0.002
No	73	2	35	17.17	9.69		
Total	120	2	35	18.33	10.05		

Maximum number of patients with median lobe enlargement noted in severe grade of IPSS.

Table 5 Correlation of Mean prostate volume and PSA with lower urinary tract symptoms

	Frequency of Symptoms	Mean Prostate Volume (cc)	Mean PSA (ng/ml)	"p" value (PV,PSA)
Incomplete Emptying	Not at all	31.67	2.33	0.028
	Less than 1 time in 5	34.32	4.26	
	About half the time	40.65	4.79	
	More than half the time	45.11	5.10	0.022
	Almost always	49.69	5.39	
Intermittency	Not at all	32.51	2.54	0.085
	Less than 1 time in 5	39.17	4.18	
	About half the time	41.54	4.82	
	More than half the time	46.44	5.16	0.018
	Almost always	48.96	5.33	
Increased Frequency of Micturition	Not at all	30.95	2.58	0.036
	Less than 1 time in 5	35.36	4.16	
	About half the time	40.47	4.73	
	More than half the time	45.69	5.46	0.089
	Almost always	50.39	5.98	
Urgency	Not at all	29.65	2.45	0.020
	Less than 1 time in 5	33.26	3.96	
	About half the time	39.48	4.59	
	More than half the time	44.29	5.23	0.105
	Almost always	49.11	5.74	

Weak Stream	Not at all	31.61	2.50	0.189
	Less than 1 time in 5	35.28	4.09	
	About half the time	41.25	4.68	
	More than half the time	44.29	5.11	0.004
	Almost always	47.84	5.26	
Straining to pass urine	Not at all	30.96	2.69	0.018
	Less than 1 time in 5	33.48	4.65	
	About half the time	39.62	4.89	
	More than half the time	44.66	5.36	0.005
	Almost always	49.21	5.82	
Nocturia	Not at all	29.69	2.22	0.813
	Less than 1 time in 5	33.45	3.94	
	About half the time	38.46	4.19	
	More than half the time	43.82	4.87	0.300
	Almost always	48.69	5.27	

Table 6 Formula showing relationship of prostate volume with IPSS and PSA

	Coefficients(a)				
Model (Constant)	Unstandardized Coefficients		Standardized Coefficients	t	P
	B	Standard Error	Beta	6.185	0.000
	20.89	3.377			
IPSS	0.482	0.164	0.258	2.945	0.004
PSA	3.295	0.868	0.332	3.797	0.000

Prostate Volume = 20.89 + 0.258 * IPSS + 0.332 * PSA

Above described equation showing the inter-relationship of prostate volume with IPSS and PSA.

0.258 and 0.332 being the multiplying factor for IPSS and PSA respectively.

20.89 is the constant used for calculation of prostate volume with PSA and IPSS being used as constant variables.

Table 7 Correlation of prostate volume, IPSS, PSA and age

		PSA	**Prostate Volume**	**IPSS**
Prostate Volume	**Pearson Correlation**	0.415	--	0.365
	"p" value	<0.05	--	<0.05
	N	120	--	120
Age	**Pearson Correlation**	0.189	0.145	0.062
	"p" value	<0.05	0.122	>0.05
	N	120	120	120

IPSS	**Pearson Correlation**	0.321	--	--
	"p" value	<0.05	--	--
	N	120	--	--

Statistically significant correlation was found between prostate volume with serum PSA (r-0.415) and IPSS (r-0.365) with a "p" value of <0.05 There is no correlation found between prostate volume and age (r-0.145) and age with IPSS (r-0.062) with a "p" value of >0.05 Statistically significant correlation found between IPSS and serum PSA (r-0.321) with a "p" value of <0.05 Statistically significant correlation found between age and PSA (r-0.189) with "p" value of <0.05.

4. DISCUSSION

In our study, mean age of the patients was 65.71 years, 34.1 % of the patients in the eighth decade followed by 32.5 % of the patients in seventh decade and 24.2 % of patients noted in sixth decade signifying that prostate volume increases with increasing age. Our study is comparable to a study by MA Hossain (2019) with a mean age of 66.7 years [3] and a study by D Parikesit (2018) with mean patient age of 67 years [4].

Commonest clinical presentation in our study was increased frequency of micturition, observed in 96 patients (80.0 %), followed by Nocturia in 90 patients (75%). Acute urinary retention was the least common mode of clinical presentation observed in only 1 patient. The probable cause for increased frequency is due to irritative effect by enlarged prostate. SO Andersson et. al (2004) study with larger number of patients also showed that increased frequency of micturition is the common mode of presentation in the patients with age group of less than 70 years and nocturia is the next common mode of presentation in the patients with more than 70 years of age [5]. An Indian study by Ganpule et al (2004) showed nocturia is the most common clinical symptom in the patients with history of lower urinary tract symptoms [6]. Our study is comparable to Andersson et. al. (2004) study for the common mode of clinical presentation in patients with lower urinary tract symptoms [5].

In our study, as per grading by IPSS, maximum number of patients were having severe symptoms i.e. 52 patients (43.3%), followed by moderate symptoms in 44 patients (36.6%) and only 24 patients (20%) were having mild symptoms. Our study is comparable to EA Nugroho et. al (2021) who conducted a similar study on 303 BPH patients, and obtained 63.4% of the people with severe IPSS grading and 36.6 % of the people with moderate IPSS degrees [7]. In our study the probable cause for more number of the patients with severe symptom score may be due to the habit of postponing health solutions and late presentations.

In this study, PSA values ranged from .04 to 19.5 ng /ml. with a mean value of 4.2 $\pm$ 1.89 ng / ml. 87 Patients (72.5%) had PSA volume between 4-10 ng/ml. where as 15 patients (12.5%) had PSA less than 4 ng/ml and 15 patients had PSA >10 ng/ml. The exact cutoff value for an abnormal PSA remains controversial. Generally a serum value of less than 4.0 ng/ml is accepted as normal. Between 4 to 10 ng / ml PSA value is mostly due to benign prostatic hyperplasia. CA Mochtar (2018) did a study on 1859 patients and observed a mean PSA of 4.1ng/ml, which is quite similar to our study [4].

In our study , maximum number of patients had the prostate volume measuring 25–30 cc, observed in 36 patients (30%) followed by 25 patients (20.9 %) who had the prostate volume of more than 80 cc and 23 patients (19.1%) had prostate volume between 31-50 cc, and 18 patients (15%) had prostate volume between 51-80 cc. The lowest prostate volume was 10 cc

and the maximum prostate volume was 130 cc, mean being 37.04 cc ±18.81. The possible explanation for above distribution could be due to improvement in health care services with patients approaching health facilities relatively earlier when the prostate enlargement has not progressed to higher grades. Another explanation might be due to wide variation in prostate volume and lower urinary tract symptoms among different study population. A study by M Okuja (2021) in 277 patients showed the maximum number of patients having the prostate volume ranging between 25 to 50 cc [8]. The size of the prostate is very important because it helps in the decision making. Therefore, the diagnosis and grading of enlarged prostate is very important for treatment planning.

The total number of patients with median lobe enlargement in our study was 47 out of 102 patients with enlarged prostate. Maximum number of 26 patients with median lobe enlargement were observed with severe grade of IPSS. The correlation between median lobe enlargement and IPSS was found to be statistically significant ($p < 0.05$). This indicates when there is median lobe enlargement there will be significant increase in the international prostate symptom score likely due to obstruction in urinary outflow. Similar findings were observed by MA Hossain (2019) who conducted a study on effects of intravesical prostatic protrusion on IPSS [3].

In this study we found that there is statistically significant correlation between prostate volume and following Symptoms of IPSS: Incomplete emptying ($p<0.05$), increased frequency of micturition ($p<0.05$) and urgency ($p<0.05$), but no statistically significant correlation was found between the prostate volume and other parameters of International prostate symptoms score like intermittency ($p>0.05$), weak stream ($p>0.05$), straining ($p>0.05$) and nocturia ($p>0.05$). These findings in our study indicates that increased prostate volume is associated with increased frequency of micturition, incomplete emptying and urgency to pass urine.

In our study there is statistically significant correlation between PSA and following Symptoms of IPSS: Incomplete emptying ($p<0.05$), intermittency ($p<0.05$), weak stream ($p<0.05$) and straining ($p<0.05$), But there is no correlation of PSA with other parameters of International prostate symptoms score like increased frequency of micturition ($p>0.05$), urgency to pass urine ($p>0.05$) and nocturia ($p>0.05$). This findings indicates that storage (irritative) symptoms of IPSS are not associated with increased PSA value.

However further research is required to determine the interrelationship of prostate volume, PSA and individual IPSS symptoms according to population, geography, ethnicity etc. Since, we have not found any other studies where individual symptoms of IPSS have been compared individually with prostate volume and PSA, therefore our study can serve as a comparable study for further research.

In this study, we found that there was increase in mean prostate volume as per increase in IPSS grading, the correlation being statistically significant ($p < 0.05$). Our study is in concordance with a study done by EA Nugroho (2021) who found significant correlation between mean prostate volume and IPSS [7].

When PSA levels of the patients in this study were assessed, 87 (72.5%) patients had PSA between 4-10 ng/ml with a mean prostate volume of 40.73 ml. In this study, we found that there was increase in mean prostate volume with increase in PSA level, the correlation being statistically significant ($p < 0.05$). Our study is comparable to study done by T Antony (2019) who observed significant correlation between prostate volume and PSA [9].

In this study, an interrelationship among prostate volume, PSA, IPSS and age of the patient was assessed and following results were obtained:

In our study there is significant correlation of prostate volume with PSA (r– 0.415) ‘p’ value

of <0.05. There is significant correlation of prostate volume with international prostate symptom score (r – 0.365) 'p' value of <0.05. There is no correlation of prostate volume with age (r – 0.145) 'p' value of >0.05. There is moderate but statistically significant correlation of international prostate symptom score with Blood PSA (r – 0.321) 'p' value of <0.05. There is no correlation between age and international prostate symptom score (r – 0.062) 'p' value of >0.05. There is weak but statistically significant correlation between age and PSA (r – 0.189) 'p' value of <0.05.

5. CONCLUSION

Lower urinary tract symptoms (LUTS) are quite prevalent among men, with enlarged prostate being the most common etiology of LUTS in men above fourty years of age. In our study, it was found that there is statistically significant correlation between prostate volume, IPSS and PSA, which shows that prostate volume along with assessment of lower urinary tract symptoms as per graded by International Prostatic Symptom Score and Prostate Specific Antigen levels in blood could serve as an eminent tool for making clinical decisions and surgical management of patients with lower urinary tract symptoms due to enlarged prostate.

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