

Correlation of Subjective and Objective Findings of Bladder Outlet Obstruction with Those of Ultrasound Cystodynamogram at a Tertiary Care Hospital

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ABSTRACT

Background: Lower urinary tract symptoms (LUTS) are storage, voiding and postmicturition symptoms affecting the lower urinary tract. The present study was conducted to correlate subjective and objective finding of bladder outlet obstruction with ultrasound cystodynamogram.

Materials and Methods: The 51 patients for this prospective observational study of bladder outlet obstruction were selected from the cases admitted to surgical wards of Saraswathi Institute of Medical Sciences, Hapur, Anwarpur, Uttar Pradesh, India. All the patients included in this study were subjected to standard diagnostic criteria including detailed history, International prostatic symptom score (IPSS), physical examination, digital rectal examination (DRE), Complete blood counts (CBC), renal biochemistry, complete urine analysis, culture and sensitivity (C/S), uroflowmetry and ultrasonography. The results were correlated with each other and subjected to statistical analysis.

Results: USG gave a fair evidence about: Prostate size – 40 cases (78.4%) had the prostate of more than 30gms, Intravesical protrusion of prostate – 31.4% had median lobe protrusion into the bladder, Presence of bladder calculus - 2 patients had bladder calculus, Presence of diverticula – only 1 out of 51 had bladder diverticulum while 2 had trabeculations visible on USG, Bladder wall thickness - most of the patients had the thickness of 6mm or 5.5mm, 39.2% and 35.3% respectively, Post void residual – 54.9% of cases had significant amount of post void residual. Maximum urinary flow

of the study group ranged from 33ml/sec to 3ml/sec, with the mean flow of 12.76ml/sec. 72.5% of cases showed the maximum urine flow rate of lower than 15ml/s. The flow pattern of uroflowmetry also gave fair idea about the cause of symptoms and was given due importance along with the other subjective study findings.

Conclusion: After the completion of this study, we believe that ultrasound cystodynamogram is an excellent, non-invasive, easy and cheap investigation for evaluation of lower urinary tract symptoms.

Keywords: Ultrasound Cystodynamogram, Lower Urinary Tract Symptoms.


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INTRODUCTION

Urodynamics can trace its roots to the 1800s, when instrumentation was first developed and described for the measurement of bladder pressure and urine flow rate; however, the term urodynamics was only recently coined by Davis.^{1,2} The prevalence of lower urinary tract symptoms in men increases with age. LUTS often has a significant negative impact on a patient's quality of life. A survey of over 5000 community-dwelling men age ≥ 65 in the US without history of prostate cancer found that 46 percent reported moderate to severe symptoms of LUTS.³ Another community-based study found that the prevalence of LUTS increases steadily with age into the 10th decade, affecting 70 percent of men older than 80 years.⁴

The International Continence Society (ICS) have broadly categorized LUTS into three groups related to their timing within the bladder (voiding) cycle. The three stages of the bladder cycle are: Storage – During which passive filling of the bladder occurs naturally from urine produced by the kidneys, Voiding – During which the vesico-urethral unit actively expels the bladder contents, Post-micturition – Immediately after voiding when the bladder returns to storage function.⁵ The following are the important factors responsible for lower urinary tract symptoms⁶: BPH with obstruction, Age related detrusor muscle weakness and/or instability, Urinary tract infection and Chronic prostatitis, Lower urinary tract stones (Vesical, Urethral), Urethral stricture,

Malignancy: prostate cancer or bladder cancer, Neurological disease - eg, Parkinson's disease, multiple sclerosis, spinal cord injury, cauda equina syndrome, stroke, dementia, Bladder Sphincter Dysnergia, Polyuria (eg, secondary to diabetes mellitus, excessive fluid intake, diuretics, etc), Bladder diverticula. The present study was conducted to correlate subjective and objective finding of bladder outlet obstruction with ultrasound cystodynamogram.

MATERIALS AND METHODS

The 51 patients for this prospective observational study of bladder outlet obstruction were selected from the cases admitted to surgical wards of Saraswathi Institute of Medical Sciences, Hapur, Anwarpur, Uttar Pradesh, India.

Patients of all age groups and male gender, well informed patients, willing to comply with the study protocol were included in this study. Patients who had undergone previous surgery, patients who could not void due to urinary retention. patients whose voided volume repeatedly did not exceed 125mL were excluded from the study.

All the patients included in this study were subjected to standard diagnostic criteria including detailed history, International prostatic symptom score (IPSS), physical examination, digital rectal examination (DRE), Complete blood counts (CBC), renal biochemistry, complete urine analysis, culture and sensitivity (C/S), uroflowmetry and ultrasonography. In digital rectal examination size of the prostate was estimated along with its consistency and fixity of rectal mucosa with the gland. In addition, examination of external genitalia was done to exclude meatal stenosis or a palpable urethral mass. A case history was recorded in detail as per the proforma and IPSS scoring system and any salient feature of the cases were recorded. A note was recorded regarding the previous history of similar illness, previous operations or any instrumentation, urinary infection, and treatment. The following necessary investigations were done after a thorough clinical examination of the patient.

Urine

Midstream urine was collected in a sterilized wide mouthed container after necessary precautions. After physical examination for colour, a commercially available reagent strip (Multistix SG,

Siemens Ltd) was used for the detection of pH, proteins and sugar in urine. Then microscopy was done for the detection of pus cells, red blood cells, epithelial cells and crystals.

Blood

A routine blood examination was done, such as Hb%, W.B.C.count (Total and Differential). Also blood urea, serum creatinine and random blood sugar levels were done using VITROS 250 dry chemistry auto analyser and noted.

Ultrasound Cystodynamogram Findings

Patients were advised to take fluids per orally and hold on the act of micturition to the appropriate limit of urge to pass the urine. Who were then ultrasonographically evaluated, which was performed using a 5-MHz curved-array transducer positioned suprapubically, and the following parameters were noted in a state of full bladder.

- Bladder wall thickness
- Bladder volume
- Presence of diverticula
- Distal ureteric anatomy
- Prostatic volume
- Intravesical prostatic protrusion (median lobe enlargement)
- Presence of intra-vesical pathology (carcinoma or calculi)

This was followed by uroflowmetric measurement, which was performed using gravimetric/weight transducer type uroflow meter. The following parameters were observed in the uroflowmetry examination.

- Total volume voided
- Flow time
- Voiding time
- Rate of flow of urine
 - Maximum Flow
 - Average Flow

And a review ultrasound examination was done to assess the amount of postvoid residual urine, using the same ultrasound machine. The results of IPSS score, clinical findings, and ultrasound cystodynamogram were reported independently and in combination. The results were correlated with each other and subjected to statistical analysis. Chi square test was applied to calculate the p values for the associations between the variables studied.

Table 1: Distribution of prostate size in BPH group

BPH	USG estimated size of prostate			Total	p value 0.000
	< 40gms	40-60 gms	> 60gms		
No	18	5	0	23	
Yes	7	16	5	28	

Table 2: Presence of Median lobe in BPH group

BPH	Median Lobe			Total	p value 0.005
	1cm	2cm	No		
No	2	0	21	23	
Yes	8	6	14	28	

Table3: Distribution of thickness of bladder wall in BPH group

BPH	Bladder wall thickness				Total	p value 0.004
	5mm	5.5mm	6mm	6.5mm		
No	10	5	8	0	23	
Yes	1	13	12	2	28	

Table 4: Distribution of PVRU in BPH group

BPH	PVRU			Total	p value 0.001
	<50	>50			
No	16	7		23	
Yes	7	21		28	

Table 5: Distribution of Max flow in BPH group

BPH	Max flow			Total	p value 0.032
	<15ml/s	15-25ml/s	>25ml/s		
No	14	4	5	23	
Yes	23	5	0	28	

Table 6: Distribution of Max flow in UTI group

UTI	Max flow			Total	p value 0.003
	<15ml/s	15-25ml/s	>25ml/s		
No	34	4	3	41	
Yes	3	5	2	10	

Table 7: Distribution of max flow in stricture group

Stricture	Max flow			Total
	<15ml/s	15-25ml/s	>25ml/s	
Absent	29	9	5	43
Present	8	0	0	8

	USG estimated size of prostate			Total
	< 40gms	40-60 gms	> 60gms	
Absent	19	19	5	43
Present	6	2	0	8

Table 8: Distribution of bladder wall thickness in weak detrusor group

Weak Detrusor	Bladder wall thickness				Total	p value 0.000
	5mm	5.5mm	6mm	6.5mm		
No	6	18	20	2	46	
Yes	5	0	0	0	5	

Table 9: Distribution of size of prostate in weak detrusor group

Weak Detrusor	USG estimated size of prostate			Total	p value 0.327
	< 40gms	40-60 gms	> 60gms		
No	21	20	5	46	
Yes	4	1	0	5	

Table 10: Distribution of Max flow in weak detrusor group

Weak Detrusor	Max flow			Total
	<15ml/s	15-25ml/s	>25ml/s	
No	32	9	5	46
Yes	5	0	0	5

RESULTS

In the present study the mean age of the patients was 60yrs. So overall 7th and 8th decade was the most common age group in which LUTS were found. Amongst the studied patients (n= 51), most commonly reported symptom was frequency of micturition, found in 47 patients. While nocturia was the second most common LUTS subtype. In this study group most (56.8%) of the patients were farmers i.e; 29 out of 51. The distribution of patients according to the total IPSS score, where 47.1% of the patients had a total score of 8–19 and 20-35 each, while only 5.8% of patients were mildly symptomatic with a score less than 7. On

comparing the IPSS score with the prostate size, which was evaluated on ultrasonography, did not show significant results with a p value of 0.379. As 81.9% of patients with IPSS score more than 7 had a prostate size of less than 30gms. Digital rectal examination of these cases also showed significant correlation (p= 0.008) amongst the study group, when were compared with the different IPSS scores. Most of the patients had bladder wall thickness of 6mm or 5.5mm, 39.2% and 35.3% respectively. During the uroflowmetry study, 72.5% of cases showed the maximum urine flow rate of lower then 15ml/s. The mean of

maximum flow of all patients was 12.76ml/s. While this peak flow rate ranged from the maximum of 33ml/s to the minimum of 3ml/s. On comparing the max flow with the IPSS score of study population, it showed significant correlation between the two (p value 0.000). As the patients with higher symptom score had lower maximum flow rates. The percentage distribution of the maximum flow rate of the ultrasonographic findings of prostate size, protrusion of median lobe and bladder wall thickness, depicting insignificant correlation between all with p values of 0.016, 0.066 and 0.491 respectively. While max flow did show significant correlation with the time taken for the act of voiding (voiding time) p value 0.002. On comparing the final diagnosis 'made using ultrasound cystodynamogram' with the different ultrasonographic and uroflowmetry parameters used in the study, many significant correlations were reported.

Table 1 shows that out of the 28 patients who were finally diagnosed of having BPH, 16 had prostate size between 40-60gms and 5 had the size of >60gms (p value 0.000) i.e; 75% of BPH patients had prostate size >40gms.

Table 1 shows that in BPH diagnosed patients 50% of cases had median lobe protrusion while in non BPH patients only 8.7% of cases had protruding median lobe, of about 1cm.

Table 2 also shows significant correlation between BPH group and bladder wall thickness (p value 0.004). As 96.4% of the patients with BPH had either normal thickness or thicker bladder wall, while amongst non BPH patients 65.2% of patients had either normal or thinner bladder wall.

Similarly, even post void residual urine was found significantly raised among the BPH group (p value 0.001).

On comparing the final diagnosis made using ultrasound cystodynamogram with the uroflowmetry findings BPH group and UTI group showed significant correlation with the max flow with p values of 0.032 and 0.003 respectively.

In BPH group 82.1% of the cases had significantly low max urine flow of <15ml/s, while in the UTI group 50% had normal max flow, 20% had overactive bladder, and 30% who had low max flow were also suffering from BPH. Similarly, even the voiding time was found prolonged in BPH group and reduced in the UTI group with significant results in chi square test (p value 0.006).

In the stricture group all 8 cases showed the max flow lower than 15ml/s with significantly prolonged voiding time (p value 0.001) and a plateau on uroflowmetry graph, even when in 75% of cases of this group the prostate size was <40gms.

Amongst the patients who were diagnosed of having weak detrusor muscle, all 5 cases had bladder wall thickness of 5mm showing a significant correlation between the two, while the prostate size of this group was <40gms in 80% of the cases and 100% of cases showed the max flow of <15ml/s, also prolonged voiding time with intermittency towards the end of the curve was noted on uroflowmetry graph.

DISCUSSION

According to A Abdul-Rahman, S Al-Hayek et al.⁷, approximately one third of older men with LUTS do not have urodynamic evidence of obstruction. Similarly, a low flow rate is not diagnostic of BOO because 25-30% of patients with low flow rate have detrusor hypocontractility as their main problem, whereas a normal or high flow rate does not rule out obstruction as 7% of symptomatic men with a Qmax greater than 15 ml/s are

obstructed. Ideally two flow rates should be obtained, both with a volume greater than 150 ml voided urine. If such voided volume cannot be obtained by the patient despite repeated recordings, the Qmax results at the available voided volumes should be considered.

The Relationship Between Symptoms and Uroflowmetry Variables

The Qmax of our study correlated well with the symptom score, higher was the symptom score, lower was the Qmax. All 37 patients with Qmax<15ml/sec had IPSS scores of >7, of which 35.1% were moderately symptomatic and 64.9% were severely symptomatic, while all those who had normal Qmax (>15ml/sec) scored <19 on their IPSS, which is similar to the observations quoted in other literatures.

J.M. Reynard et al. reported that, patients who felt that their flow was poor were more likely to have a low Qmax. Also the mean Qmax in those who thought their flow was normal (16.2 mL/s) was significantly higher than in those who felt their flow was not normal (12 mL/s).⁸

Kaplan⁹ and Jensen KME¹⁰; in 1995 by their research work on lower urinary tract symptom due to BPH with the help of uroflowmetry and urodynamic proves that in BPH patients flow rate is decreased and flow time is increased.

Ultrasonography

Prostate Size

Autopsy data, summarized by Berry et al indicate that anatomic evidence of BPH is seen in approximately 8% of men in their 30s, more than 40% at 50-60 years of age, more than 70% at 61-70 years of age and more 80% above 80 years of age.¹¹

According to Walsh PC et al. hyperplasia of the prostate gland is a progressive condition with an onset in the early thirties and worsening with age. There are no good epidemiological studies of the incidence of clinical prostatism at different ages. However, it has been shown that 50% of men aged 51-60 years and 90% of men over age of 80 years have histological evidence of benign prostatic hyperplasia.¹²

In the present study 33.3% of symptomatic patients in the age group of 40-49 had enlarged prostate (>30gms), while the size was seen to increase progressively with age. In 7th and 8th decade of life 15.4% and 21.4% of the studied cases had prostate size more than 60gms respectively.

Although a poor correlation has been observed between symptoms and prostate size. About 19% of moderate and severely symptomatic patients had a prostate size of less than 30gms.

Guess HA et al. also observed a poor correlation between symptoms and prostate size or histology in individual patients. They commented that, the proportion of the male population with clinically recognizable prostatism by a given age is about the same as the proportion with pathologic evidence of benign prostatic hyperplasia.¹³

Bladder Wall Thickness

The chronic effect of the sustained high intravesical pressure due to the increased outflow resistance that leads to the bladder wall thickening, diverticula and dearrangement of the ureterovesical junction was well studied in the animal model but is still not completely understood in humans.¹⁴

Kojima and coauthors correlated the histologic cross section of the bladder wall with ultrasonography and observed that the detrusor

was represented ultrasonographically as the middle hypoechogenic layer.¹⁵

Oelke et al.¹⁶ conducted a prospective study to find non-invasive tests for the evaluation of BOO; they suggested ultrasound measurements of detrusor wall thickness was better than the Qmax, postvoid residual volume or prostate volume for the diagnosis of BOO.

We measured the hypoechogenic layer of the bladder wall after the peroral hydration approximately at the maximal bladder capacity in order to standardize the examination.

In our study bladder wall thickness of the studied group ranged from 5mm to 6.5mm, with most patients having a thickness of 5.5 and 6mm, n= 18 and 20 respectively.

Also it was seen that most patients of the BPH group had a wall thickness of greater than 5.5mm, while those diagnosed of having detrusor weakness had a thin bladder wall. Although bladder wall thickness did not show much correlation with the presence of residual urine or max flow.

Intravesical Prostatic Protrusion (IPP)

KeongTatt Foo MD et al.¹⁷ noted that, a low-grade IPP is generally associated with good Qmax (>12 mL/s), however if the Qmax is low, then further investigations such as flexible cystoscopy or pressure flow study would need to be done in order to rule out other differential diagnoses such as urethral stricture or detrusor dysfunctions. If there is a high-grade IPP (>10 mm), even if there is a good Qmax of >12 mL/s, there is still a 65% chance that the patient is obstructed on pressure flow studies.¹⁸ In other words IPP is a better predictor of urodynamics obstruction than Qmax.

In the study done by Hyoungn Keun Park et al.¹⁹, IPP showed a significant correlation with several voiding parameters, including IPSS, prostate volume, Qmax and PVR. Also the IPP group in there study showed higher age and larger prostate volume than the non-IPP group, and showed higher IPSS and storage score than the non-IPP group.

Damir Aganovic et al.²⁰ concluded that, a combination of non-invasive parameters as intravesical prostatic protrusion and bladder outlet obstruction number (BOON) for predicting benign prostatic obstruction provides higher accuracy in diagnosing bladder outlet obstruction at the individual level, resulting in a more accurate selection of diagnostic modalities and optimization of treatment of this group of patients.

In the present study 31.4% of cases had median lobe enlargement. IPP also showed positive correlation with age, as the age increased percentage of presence of median lobe also increased. When compared with the symptom score (IPSS), IPP showed positive correlation, as 16.7% of moderately symptomatic patients and 50% of severely symptomatic patients did show median lobe enlargement, while none of the mildly symptomatic patient had IPP.

Although amongst the noninvasive parameters of our study such as prostate size, did show significant correlation with the presence of median lobe but Qmax, bladder wall thickness, and PVR did not significantly correlate with IPP.

The Relationship Between IPSS, Uroflow Variables and Other Non-invasive Variables

In the present study Qmax did not show significant correlation when compared with ultrasound estimated size of prostate, presence of median lobe, bladder capacity, thickness of bladder wall or with the presence of significant PVR.

Neyas Mohammed et al. reported that prostate volume is an important contributing factor to decrease peak flow rate. In their study 30% of the total patients showed a peak flow rate of more than 15 ml/sec. Seventy percent of the patients had peak flow rate less than 15 ml/sec signifying abnormal peak flow rate. This study demonstrated a highly significant correlation between peak flow rate and transrectal ultrasonography (TRUS) determined prostate volume.²¹

According to Bosch JL et al.²², There was a weak correlation between the IPSS and total prostate volume, and between the IPSS and physiological measures such as peak flow rate and post-void residual urine volume.

Ultrasound Cystodynamogram / Ultrasound Cystodynamics (USCD)

Schafer W, in 1995 said, the gold standard to evaluate grade of lower urinary tract symptoms is urodynamic study with pressure flow analysis.²³

Sonkeet al.²⁴ demonstrated that frequently used diagnostic parameters such as prostate volume, postvoid residual volume and I-PSS were not useful for the prediction of BOO, and the correlation between these parameters and the PFS findings was poor.

The only study found on USCD done by Boothroyd AE et al²⁵ showed the diagnostic capability of USCD was studied in 116 consecutive cases 46 of whom had also had VCMG. Comparison of the data obtained using both techniques revealed no significant difference. USCD has proved to be accurate, safe and reproducible and is of particular value in patient follow-up.

CONCLUSION

Simple urodynamic tests such as uroflowmetry and PVR although are considered very helpful and are incorporated in most international guidelines on LUTS. But more invasive detailed urodynamic tests such as filling cystometry and PFSs are indicated, especially before surgery. After the completion of this study, we believe that ultrasound cystodynamogram is an excellent, non-invasive, easy and cheap investigation for evaluation of lower urinary tract symptoms.

LIMITATIONS

- The sample size was too small to conclusively demonstrate a relationship between IPSS and all the variables of USCD.
- Another important defect is that patients who attended the clinic with urinary retention had to be excluded from the study.
- We did not check PSA routinely in patients, so there is a possibility of prostate cancer in our study population.
- Finally, we did not perform a pressure flow study, so we do not have data on urodynamic change to verify our final diagnosis in patients who complained of persistent storage symptoms. This is another interesting topic and should be clarified in future studies.

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