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Detrusor Wall Thickness an Adjunct or Alternative in the Diagnosis of Bladder Outlet Obstruction in Men - Prospective Controlled Study

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Abstract

Introduction and objectives: The Objective of the study is to obtain the accuracy of Detrusor Wall Thickness (DWT) in comparison to other non-invasive tests and with the help of pressure-flow study as standard in the diagnosis of bladder outlet obstruction in Men with Lower Urinary Tract Symptoms (LUTS).

Methods: Men over 50 years presenting with obstructive LUTS in the Department of Urology at Stanley Medical College, Chennai were studied for BOO using detrusor wall thickness (7.5Mhz transabdominal probe) along with tests such as flowmetry, prostate volume and Post-Void Residue (PVR) which was then compared to pressure flow study as the gold standard.

Results: The DWT was ranging from 0.6mm to 6.4mm. Among the 53 patients studied 22 were diagnosed as BOO with DWT≥2mm . Based on the pressure-flow test (reference standard), 25 patients had BOO. Detrusor wall thickness had the highest specificity (96.43%), positive predictive value (95.45%) and accuracy (90.57%) as a non-invasive test in diagnosing BOO. Whereas Q max<15 had the highest sensitivity (96%) and negative predictive value (90.91%).

Conclusion: Detrusor wall thickness has a better specificity, accuracy and positive predictive value compared to other tests. Due to the ready availability of USG machines in the present-day setting, measuring DWT as an additional parameter along with other non-invasive tests can greatly increase the accuracy of diagnosing BOO. Hence we advocate the use of DWT with other non-invasive tests for the diagnosis of BOO.

Keywords: Bladder Outlet Obstruction (BOO); Detrusor Wall Thickness (DWT); Non-invasive uro-dynamics

Introduction

Bladder Outlet Obstruction (BOO) remains a common cause for Lower Urinary Tract Symptoms (LUTS) in a large section of men [1]. While pressure-flow Urodynamics is the investigation of choice in the diagnosis of BOO [2]. In our routine practice especially in developing countries we depend on lesser invasive methods including flowmetry, prostate volume, and PVR. In the last few years, there are many newer non-invasive methods for diagnosis of BOO, a promising one among them is measuring DWT using ultrasonography. In the current study, we compare the accuracy of Detrusor Wall Thickness (DWT) to other non-invasive tests and PFS (as a reference) in the assessment of BOO in men presenting with LUTS.

Materials and Methods

Between the period March 2018 and May 2019, men 50 years or older, presenting to our institute with LUTS, were taken as potential candidates. Initially, patients were evaluated by complete history taking and physical examination. The patients undergoing treatment for BOO/LUTS, previous history of the lower urinary tract or prostate surgery, stricture disease of the urethra, and suspicion of prostate cancer on DRE or PSA >4 ng/dL were excluded. We obtained the ethical committee approval from our institute, written and informed consent was taken for eligible patients (53), who were further investigated with transabdominal ultrasound. The patient was told to hold urine until he had a strong urge to void, then the bladder was scanned using a 3.5 MHz probe to calculate the bladder dimension and capacity. The detrusor wall thickness was measured subsequently using a 7.5 MHz probe at the anterior wall, the average of three was considered taken 1 cm

apart (DWT≥2mm was considered obstructed). The detrusor layer is the central hypoechoic layer of the bladder wall, separated by the thin hyperechoic layers on either side representing the mucosa and subserosal tissues. Prostate volume was calculated with the formula: anteroposterior height x transverse width × cephalo-caudal length x Pi_/6. (above 25 g considered abnormal).

The patient was then asked to void into a free flowmetry apparatus and the following readings were taken: maximum flow rate [Q-max] or average flow rate [Q-ave]. A post-void scan with a 3.5 MHz probe was then obtained and a post-void residual urine volume of >50 ml considered abnormal. Patients were asked to review at our institute after 1-2 weeks, a urodynamic pressure-flow study was performed according to good urodynamic practice [3] that was carried out and reported by another team. Pressure Flow Studies (PFS) were reported using the standard International Continence Society (ICS) nomogram, and Bladder Outlet Obstruction Index (BOOI) was calculated according to the formula: BOOI = PdetQmax – 2(Qmax). Patients were divided according to the Pressure-Flow Study (PFS) analysis into obstructed (BOOI of 40 cm H2O or greater) and non-obstructed. The data were analyzed using SPSS software version 25.

Results

Fifty-three patients were enrolled in the study aged 51-81 (mean age 62.1). Detrusor Wall Thickness (DWT) was measured in all patients at bladder volume > 250ml. The DWT for our patients ranged from 0.6 mm to 6.4 mm with a mean (±SD) of 2.21(±1.51) (Table 1). shows the Comparison of Bladder Outlet Obstruction (BOO) based on the results of different non-invasive tests. On Urodynamic evaluation using pressure-flow studies, 25 patients were diagnosed with bladder outlet obstruction while 28 patients were non-obstructed. (Table 2). compares various non-invasive parameters in comparison to the pressure-flow study (standard). DWT had the highest accuracy (90.57%), the highest specificity (96.43%) and the highest positive predictive value (95.45%) among the non-invasive tests, while the maximum flow rate (Q-max-15) was the most sensitive (96%) but had a specificity of 35.71%.

Index Test	Normal/Abnormal	Patient with Normal Results	Patients with Abnormal Results
DWT	<2mm/≥2mm	31	22
Q max	≥15/<15 ml/sec	11	42
Q max	≥10/<10 ml/sec	29	24
Q avg	≥7/<7 ml/sec	16	37
PVR	≤50/>50 ml	19	34
Prostate Size	≤25/>25 cc	11	42

Table 1: shows the Comparison of Bladder Outlet Obstruction (BOO) based on the results of different non-invasive tests.

Test	PFS			PPV%	NPV%	Sens%	Spec%	Acc%	LR+	LR-
		BOO (25)	No BOO (28)							
DWT	BOO	21	1	95.45	87.1	84	96.43	90.57	23.52	0.17
	No BOO	4	27							
Q max (15)	BOO	24	18	57.41	90.91	96	35.71	64.15	1.49	0.11
	No BOO	1	10							
Q max (10)	BOO	17	7	70.83	72.41	68	75	71.7	2.72	0.43
	No BOO	8	21							
PVR	BOO	18	16	52.94	63.16	72	42.86	56.6	1.26	0.65
	No BOO	7	12							
Q avg	BOO	23	14	62.16	87.5	92	50	69.81	1.84	0.16
	No BOO	2	14							

Prostate Vol	BOO	21	21	50	63.64	84	25	52.83	1.12	0.64
	No BOO	4	7							

Table 2: compares various non-invasive parameters in comparison to the pressure-flow study (standard).

Discussion

Although it has been established the pressure-flow study is the gold standard in the diagnosis of BOO. But the fact PFS being invasive, expensive and lack of availability has limited its use Hence there was a need for alternatives that included symptom score, PVR, USG measurements (Intra Prostatic Protrusion, bladder wall thickness, and volume of the prostate) and flowmetry. In our study, we compared Detrusor Wall Thickness (DWT) to other commonly used non-invasive tests with PFS as a reference in the diagnosis of BOO. The rationale for the use of DWT for diagnosis of BOO is because detrusor hypertrophy is a frequent result of BOO in animals as well as human studies [4-7]. A study by Oelke et al. found out that there was a statistically significant increase in the DWT as the degree of obstruction increases on PFS, with mean DWT of 1.33, 1.62, 2.4 and greater than 3mm in unobstructed, equivocal and obstructed groups [8]. Similar studies by Kessler et al. and Franco et al. also had comparable results [9,10]. There are many oppositions with using DWT. The most important being the relation between bladder filling and DWT (i.e. as the bladder wall stretches with increasing volume there should be a decrease in DWT). But Oelke et al. have clearly shown that beyond 250 ml bladder volume DWT has remained stable [11]. Another study by Kuo showed there was a decrease in DWT up to bladder volume 250ml following which it showed a very slow fall in DWT [12]. Hence to avoid this factor we have measure DWT in all our patients with a bladder volume of more than 250ml as suggested by other studies [13,14]. Other problems with measuring DWT include operator dependence, probe frequency used, site of measurement and whether DWT or BWT (Bladder wall thickness) was measured. In the case of operator dependence, studies have shown that intra and inter-observer variability are in the acceptable range, <5.1% and <12.3% respectively when measuring DWT. We have used 7.5MHz for the measurement of DWT due to better image clarity and quality. We used 2mm DWT as the cut off for obstructed as suggested by Oelke et al.[15] while other authors have used 2.5mm as the cut off range. As there is no clear cut off for DWT further studies will be needed to conclude. When comparing the cut off for other non-invasive tests we used the values suggested by Oelke et al and Koyanagi et al in the evaluation of men with LUTS [15,16]. who report that among 160 men with clinical BPH or LUTS, DWT was the most accurate test to determine BOO with a positive predictive value of 94% and specificity of 95%. Similar findings were seen in our study, with DWT performing better than other tests and showing the highest accuracy (90.57%), the highest specificity (96.43%) and the highest PPV (95.45%) when measured against the reference PFS. The fact that it is easily available, cheap and all urologists are trained with it during their residency itself and with no additional cost makes it a very useful test.

Conclusion

Detrusor wall thickness has a better specificity, accuracy and positive predictive value compared to other tests. Due to the ready availability of USG machines in the present setting, measuring DWT as an additional parameter along with other non-invasive tests can greatly increase the accuracy of diagnosing BOO. Thereby we advocate the use of DWT with other non-invasive tests for the diagnosis of BOO with an accuracy reaching that of Pressure flow study.

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