

**A study on correlation of detrusor wall thickness with international prostate symptom score in men presenting with lower urinary tract symptoms**

<sup>1</sup>Shanmugha Das, M.Ch, Additional Professor, department of Urology, Government Medical College, Calicut, Kerala, India.

<sup>2</sup>Rakesh P, M.Ch , Senior Resident, Department of Urology, Government Medical College, Calicut, Kerala, India.

<sup>3</sup>Venugopalan AV, M.Ch, Professor and Head, Department of Urology, Government Medical College, Calicut, Kerala, India.

**Corresponding Author:** Rakesh P, M.Ch, Senior Resident, Department of Urology, Government Medical College, Calicut, Kerala, India.

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**Abstract**

**Aim:** To examine the potential correlation between detrusor wall thickness (DWT) and international prostate symptom score (IPSS) in men presenting with lower urinary tract symptoms (LUTS).

**Methods:** One hundred consecutive male patients aged >40 years with complaints of LUTS attending Urology OPD in GMC, Kozhikode, India, were included in the study. Severity of LUTS and Quality of life (QoL) score were assessed using a validated IPSS questionnaire. All patients underwent sonographic examinations using real-time ultrasound scanner using a 7.5 MHz transducer ultrasound probe. DWT measurement was done at dome, anterior wall and lateral wall with a bladder volume above 250 ml and mean value taken for further analysis.

**Results:** Pearson correlation between study variables is performed to find the degree of relationship. The average detrusor wall thickness correlated strongly with the International Prostate Symptom Score with correlation coefficient  $r = 0.740$ ,  $p < 0.001$  and duration of symptoms with a correlation coefficient  $r = 0.667$ ,  $p = <0.001$ .

**Conclusion:** The finding of a strong positive correlation between DWT and IPSS score in this study has demonstrated Detrusor wall thickness measurement as an inexpensive, non-invasive and reproducible means of assessing the severity of lower urinary tract symptoms in men with bladder outlet obstruction. It was also found that there was a strong positive correlation between Detrusor wall thickness and duration of lower urinary

tract symptoms. With standardization of DWT measurement, DWT assessment holds a significant role in non-invasive evaluation of bladder outlet obstruction in patients with BPE.

**Keywords:** Detrusor wall thickness; International prostate symptom score; Lower urinary tract symptoms; Bladder outlet obstruction; Benign prostatic hyperplasia.

### **Introduction**

Benign prostatic hyperplasia (BPH) is a common disease in ageing men and is often associated with enlargement of the prostate gland leading to lower urinary tract symptoms (LUTS)<sup>1</sup>. The incidence of BPH increases with age, and it affects 50% of men at age of 50 years and above.<sup>1</sup> Bladder outlet obstruction has been shown to be the key factor in the mechanism by which BPH causes urinary symptoms, and the relief of obstruction to improve LUTS is the main aim of most treatment strategies whether surgical or pharmacological<sup>6,7</sup>.

Since morphologic and functional abnormalities of the bladder detrusor are frequent in patients with Benign prostatic enlargement (BPE), measurement of detrusor wall thickness (DWT) may have a more direct role in the diagnosis of LUTS. Studies conducted in men or in animal models with partial Bladder outlet obstruction (BOO) have shown that such detrusor abnormalities can be regarded as a consequence of BOO<sup>14,15,16</sup>. Although DWT is known to increase with age<sup>17</sup> even in asymptomatic individuals, an increased DWT has been associated with LUTS and BOO, and the degree of increase in DWT seems to depend on the severity of obstruction<sup>17,18</sup>. The cause-and-effect relationship between BOO and DWT is also confirmed by the finding of a significant reduction of DWT after surgical and pharmacological relief of obstruction<sup>14,19</sup>.

Pressure flow study (PFS) is a viable option of diagnosing urodynamically and clinically significant BOO, but the major setback to its use is that it is expensive, invasive and time-consuming<sup>18,19</sup>. As a result of the invasive nature of PFS, the search continues for a non-invasive alternative that is cheap and easily reproducible. Detrusor wall thickness (DWT) may emerge in the near future as an alternative for non-invasive diagnosis of BOO. Several authors have found that among noninvasive diagnostic modalities including uroflowmetry, post-void residual urine volume (PVR) and prostate volume, DWT was the most accurate to determine BOO<sup>37</sup>. Therefore, routine measurement of DWT sonographically in men with LUTS may help in early detection of BPH patients with clinically significant BOO who are at risk of disease progression. The objective of his study is to validate and authenticate the clinical usefulness of DWT measurement in diagnosis of BOO.

### **Methods**

This was a hospital- based prospective observational study conducted from 1<sup>st</sup> June 2019 to 31<sup>st</sup> May 2020. New consecutive patients aged  $\geq 40$  years presenting to urology department with lower urinary tract symptoms, in the Department of Urology and Renal transplantation, Govt. Medical College, Kozhikode, India, were included in the study after taking consent.

#### **A. Exclusion criteria:**

- a) Patients with in-dwelling catheterization.
- b) Patients with suprapubic cystostomy.
- c) Patients with history of previous bladder surgeries.
- d) Patients with concomitant urethral stricture or vesical diverticulae.
- e) Patients on medical treatment for BPH.

f) Patients who have systemic disorders that could influence bladder function such as neurological disorders, Diabetes mellitus etc.

Each participant was interviewed with a structured questionnaire. Information about the patients including the bio-data as well as past medical and surgical history were obtained. Severity of LUTS and Quality of life (QoL) score were assessed using a validated International Prostate Symptom Score (IPSS) questionnaire. Physical examination was done for each patient including digital rectal examination (DRE). Relevant laboratory investigations were done. Transrectal digitally guided prostate biopsy was done when indicated by a suspicious DRE finding and elevated serum PSA level, using Tru-cut biopsy needle size 16G. All patients included in the study were evaluated by using IPSS questionnaire. Following evaluation of symptom severity by IPSS, patients underwent ultrasound scan. All sonographic examinations were done using real-time ultrasound scanner (SonoScope SSI 5000), using a 7.5 MHz transducer ultrasound probe. Before examination, each patient was instructed to drink plenty of water until first intense urge to void is experienced.

All DWT measurements were done at bladder volume  $\geq$  250ml as it has been shown that DWT decreases with bladder filling until volume of 250ml and then remains fairly constant until maximum volume is attained. DWT was measured at the three different anatomical sites (dome, anterior and lateral wall) with the integral equipment of the ultrasound system. Electronic measurement caliper was placed on the outer and inner hyperechogenic lines to measure the DWT. To increase the accuracy of measurement, the mean value of DWT

(anterior all, dome and lateral wall) was calculated and used for further data analysis.

Statistical analysis: Descriptive and inferential statistical analysis has been carried out in the present study. Chi-square/ Fisher Exact test has been used to find the significance of study parameters on categorical scale between two or more groups, Non-parametric setting for Qualitative data analysis.

Pearson correlation between study variables is performed to find the degree of relationship, Pearson correlation co-efficient ranging between -1 to 1, -1 being the perfect negative correlation, 0 is the no correlation and 1 means perfect Positive correlation.

### Results

This study was carried out over a period of 12 months, from 1<sup>st</sup> June 2019 to 31<sup>st</sup> May 2020. A total of 100 patients were recruited into the study.

The age ranged from 49.00 to 82.00 years with a mean age of  $63.73 \pm 6.7$  years. The peak age group was in the range of 61.00 to 70.00 years. Majority of patients presented with moderate symptoms (IPSS 8-19) and belonged to age more than 60 years. Duration of LUTS in the patients enrolled into the study ranged from 1 month to 26 months with a mean of 8.7 months  $\pm$  5.54. Majority of patients presented with a duration of 6-10 months (36%). 33% of patients presented with 1 – 5 months, 20% with 11-15% months and upto 11% of patients presented with a duration of more than 15 months. Association of baseline clinical variables including age and duration of LUTS are summarized in Table 1.

Table 1: Association of baseline clinical variables with IPSS score

Variables	IPSS <sup>a</sup>			Total	P Value
	(0-7)	(8-19)	(20-35)		
Age	Mild (0-7)	Moderate (8-19)	Severe (20-35)		
<60	100	29.5	18.2	24	0.261
60-70	0	54.5	67.3	61	
>70	0	15.9	14.5	15	
Duration of LUTS <sup>b</sup>					
1-5	100	59.1	10.9	33	<0.001
6-10	0	31.8	40	36	
11-15	0	9.1	29.1	20	
>15	0	0	20	11	
Total	100	100	100	100	

a-IPSS: International prostate symptom score, b-LUTS: lower urinary tract symptoms

The International Prostate Symptom Score (IPSS) ranged from 07.00 to 31.00 with a mean of  $19.82 \pm 5.40$  with majority of the respondents having IPSS in the range 16-20. Fifty-five patients (55.00%) and forty-four patients (44.00%) had severe (IPSS=20-35) and moderate (IPSS=8-19) LUTS respectively. one of the respondents had mild LUTS (IPSS=0-7). The Quality of life (QoL) score ranged from 3.00 to 6.00 with mean of  $4.16 \pm 0.8$  with majority (52.00%) of respondents having QoL score of 5. Frequency distribution of IPSS score among study patients are summarized in Table 2.

Table 2: Frequency distribution of IPSS of patients

IPSS	No. of Patients	%
Mild (0-7)	1	1.0
Moderate (8-19)	44	44.0
Severe (20-35)	55	55.0
Total	100	100.0

The mean value for the anterior, lateral and dome DWT were  $3.00 \pm 1.08\text{mm}$  (Range: 0.80 to 5.80 mm),  $3.06 \pm$

$1.08\text{ mm}$  (Range: 1.00 to 5.60 mm), and  $3.07 \pm 1.16\text{ mm}$  (Range: 0.70 to 5.60 mm) respectively while the average DWT (avDWT) measurements was  $3.01 \pm 1.13\text{ mm}$  (Range: 0.90 to 5.60 mm). Ninety-seven respondents (97.00%) had DWT  $\geq 2\text{mm}$  while only 3 had DWT less than 2 mm. The mean bladder volume at which DWT measurements were made was  $318.81 \pm 127.11\text{ ml}$  (Range: 251.00 to 450.20 ml).

The average DWT correlated strongly with the International Prostate Symptom Score (IPSS) with pearson correlation coefficient  $r = 0.740$  and  $p < 0.001$ . There was also a strong and statistically significant correlation between average Detrusor wall thickness and duration of symptoms with a pearson correlation coefficient  $r = 0.667$  and  $p = <0.001$ .

Correlation of age of patients with the detrusor wall thickness was found to be weakly positive and statistically non-significant with a pearson correlation coefficient of  $r = 0.047$  and  $p = 0.644$ .

It was also noted that, there was a moderate degree of positive correlation between detrusor wall thickness and quality of life score, with pearson correlation coefficient of  $r = 0.445$  which was statistically significant,  $p = <0.001$ . Table 3 summarizes correlation of DWT with IPSS and other variables.

### Discussion

The mean International Prostate Symptom Score (IPSS) in this study is  $20.94 \pm 6.13$ . This is similar to mean IPSS of  $20.70 \pm 6.43$  obtained by Yilmaz et al<sup>23</sup> in their study but at variance with a mean IPSS of  $14.60 \pm 5.00$  noted by Kamyar et al<sup>24</sup> in their work. Severity of symptoms experienced by the patients ranged from moderate to severe with 44 patients (44.00%) and 55 patients (55.00%) having moderate (IPSS=8-19) and severe (IPSS=20-35) LUTS respectively. Onlyone

among the study patients had mild LUTS (IPSS=0-7). Kamyar et al<sup>24</sup> in their study also noted similar finding of majority of the patients having moderate to severe LUTS with 34 (77.3%) patients having moderate LUTS and 9 (20.5%) severe LUTS while 1 (2.3%) had mild LUTS.

Majority of patients presented with a high Quality of life (QoL) score of 4-5 suggesting that all the patients presented with moderate-to-severe LUTS experienced significant negative impact on their QoL thereby necessitating their presentation to hospital. Very commonly symptoms are attributed as part of normal ageing process thereby presenting late when the symptoms are severe and very bothersome.

In this study, it was found that the average DWT correlated positively with the International Prostate Symptom Score (IPSS) which was statistically significant with Pearson correlation coefficient  $r = 0.740$  and  $p < 0.001$ . This finding is similar to the result demonstrated by Oelke et al<sup>20</sup>, Casado et al<sup>22</sup> and Manieri et al<sup>25</sup> in their respective studies. Oelke et al<sup>20</sup> in assessing diagnostic accuracy of noninvasive tests in evaluation of 160 men aged  $> 40$  years with LUTS secondary to BPH, found a statistically significant correlation between the DWT and IPSS with Spearman correlation coefficient  $r^2 = 0.70$  and  $< 0.001$ . Casado et al<sup>22</sup> in a prospective cross-sectional study of correlation of DWT with clinical and urodynamic data in 74 males with symptomatic benign prostatic hyperplasia, also found a statistically significant correlation between the DWT and IPSS with Spearman correlation coefficient  $r^2 = 0.38$  and  $p < 0.0001$ . Manieri et al<sup>25</sup> in their study of 174 patients with LUTS secondary to prostate pathologies equally found a statistically significant

correlation between the DWT and IPSS with Spearman correlation coefficient  $r^2 = 0.60$  and  $p < 0.007$ .

However, the work done by Yilmaz et al<sup>23</sup> has demonstrated a positive but statistically insignificant correlation between the IPSS and DWT ( $r^2=0.023$ ,  $p=0.812$ ) while the work done by Kamyar et al<sup>24</sup> found no correlation between the pre-treatment DWT and IPSS ( $r^2=0.0045$ ,  $p=0.9769$ ). The study done by Hakenberg et al<sup>17</sup> was equally at variance with this study and demonstrated a weak but statistically insignificant correlation between the DWT and IPSS with Spearman correlation coefficient  $r^2=0.0075$ ,  $p=0.6728$ .

work done by Yilmaz et al<sup>23</sup>. The shorter duration of symptoms ( $8.70 \pm 5.54$  months) in this study compared to longer duration of symptoms ( $33.96 \pm 32.35$  months) noted by Yilmaz et al<sup>23</sup> may account for the differences in the correlation between the DWT and the duration of symptoms. This may be corroborated with the observation that there may be time-dependent de-compensatory changes in bladder wall following long-term unrelieved BOO<sup>29</sup>.

This study was able to demonstrate a weakly positive and statistically not significant correlation between the average DWT and the age of the patients with Pearson correlation coefficient  $r = 0.004$  and  $p < 0.0001$ . Casado et al<sup>22</sup> also demonstrated a positive but statistically insignificant correlation between the DWT and age with Spearman correlation coefficient  $r^2 = 0.12$  and  $p < 0.318$ . However, Oelke et al<sup>20</sup> noted that there was no significant correlation between the DWT and the age of the patients amongst young adults. However, they were able to demonstrate a positive but weak correlation between the average DWT and the age of the patients in individuals older than 40 years of age. Hakenberg et al<sup>16</sup>

had also observed small increase in DWT which tends to occur with age in both genders. They noted a weak positive correlation between DWT and age for both men ( $r=0.12$ ,  $P<0.014$ ) and women ( $r=0.17$ ,  $P=0.013$ ).

### Conclusions

In conclusion, the finding of a strong positive correlation between Detrusor wall thickness and International prostate symptom score in this study has demonstrated Detrusor wall thickness measurement as an inexpensive, noninvasive and reproducible means of assessing the severity of lower urinary tract symptoms in men with bladder outlet obstruction. It was also found that there was a strong positive correlation between Detrusor wall thickness and duration of lower urinary tract symptoms. However, there was a positive but weak correlation between DWT and the age of the patients. With standardization of DWT measurement, DWT assessment holds a significant role in non-invasive evaluation and may likely replace other invasive tests in the evaluation of patients with LUTS.

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