Ul Trasound Assessment of Bladder Wall Thickness as a Screening Test for Detrusor Instability

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Abstract: Background: Overactive bladder is a symptom complex that includes urinary urgency with or without urge incontinence, urinary frequency (voiding eight or more times in a 24-hour period), and nocturia (awakening two or more times at night to void). The International Continence Society classified overactive bladder as a syndrome for which no precise cause has been identified, with local abnormalities ruled out by diagnostic evaluation. **Methods**: Fifty (50) females were recruited from the Jrogynecology clinic. They were divided equally into two groups: Study group: composed of 25 patients with urodynamic diagnosis of detrusor instability. Control group: composed of 25 patients with urodynamic diagnosis of stress incontinence. **Conclusion**: Measuring bladder wall thickness is a non invasive easy tool for the prediction and screening for over active bladder in females which can replace urodynamic study. **Keywords:** detrusor instability, Blader thickness.
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Keywords: Ul Trasound; Assessment; Bladder; Wall; Thickness; Screening; Test; Detrusor Instability

1. Introduction

Urinary incontinence is a distressing symptom that has a major impact on the quality of life. It is defined as an involuntary loss of urine, which is a social or hygienic problem **(1)**. It is a common health problem among women. The prevalence rate is' between 12% and 55% for having ever experienced urinary incontinence. It is associated with poor self-rated health, impaired quality of life, social isolation and depressive symptoms **(2)**.

Types of incontinence are Stress incontinence, urge incontinence, Detrusor instability, Mixed (SI and DI) and Overflow incontinence. Idiopathic detrusor overactivity is the new term used to replace derusor instability and is used when involuntary detrusor contractions occour "when there is no defined cause" **(3)**.

Overactive bladder (OAB) is a highly prevalent bladder dysfunction with an undefined pathogenesis. Patients with OAB present with urgency with or without urgency incontinence. Diagnosis of OAB is based on self-reported symptoms, which might have great variation in measurement. The search for a biomarker to assess OAB has been a subject of increasing interest to researchers in urology **(4)**.

The bladder has been described as "unreliable witness". Urodynamic studies are the gold-standard investigation for assessing women with urinary incon-tinence. However, they are invasive and unavailable in some hospitals **(5)**.

Also because conventional in-office urodynamic studies take place over a short window of time, it is not uncommon for them to inadequately demonstrate the cause of lower urinary tract symptoms, particularly in the case of urgency and urge incontinence. In general, about 18-23% of patient with OAB-type symptoms and incontinence may have normal urodynamic findings **(6)**. And other authors reports that urodynamic studies can miss up to 50% of unstable bladder diagnosis **(7)**.

Detrusor muscle thickness has been shown to be associated with symptoms of the irritable bladder and urodynamically diagnosed detrusor overactivity. It has been speculated that this is due to detrusor hypertrophy in women with bladder irritability although it remains unclear whether detrusor hypertrophy is the cause or effect of such symptoms. In either case, there are no data on the natural history of detrusor hypertrophy. The condition may be congenital or acquired, and symptoms may precede or follow the establishment of hypertrophy **(8)**.

The value of ultrasonography in the study of female urinary incontinence has been redefined over the last years. Ultrasound in general is in the process of becoming the standard diagnostic method in urogynecology. Its wide availability, the standar-dization of parameters, the possibility of evaluating the bladder contribute to this fact. It allows us to obtain data in a non invasive way before and after therapy **(9)**.

The Mean bladder wall thickness measurement of the empty bladder (<50ml) has been found to discriminate between women with diagnosed detrusor instability and those with genuine stress incontinence. The women with detrusor instability had thicker bladder walls than those with genuine stress incontinence. All the women with detrusor instability had a mean bladder wall thickness greater than 5mm **(10)**.

2. Patients And Methods This case-control study was done at Al Husien Hospital during the period between January 2015 and June 2016.

Fifty (50) females were recruited from the Urogynecology clinic. They were included if they have symptoms of urinary frequency, urgency and/or urge incontinence, nocturia.

They were divided equally into two groups:

- Study group: composed of 25 patients with urodynamic diagnosis of detrusor instability.
- Control group: composed of 25 patients with urodynamic diagnosis of stress incontinence.

All patients were interviewed for these exclusion criteria.

Exclusion criteria:

1. History of pelvic surgery.
2. History of radiatiom therapy.
3. With genital prolapse.
4. With advanced pelvic malignancy.
5. With uncontrolled DM or neurological disorders.

After approval of the ethical committee, the procedures were explained to all patients and a written informed consent was taken from each patient denoting her approval to participate in the study.

History taking:

Detailed history was taken from each patient regarding age, parity, the problem's onset, duration, progression, evolution, and precipitating factors (Valsalva maneuvers, change of position).

Symptoms of lower urinary tract was also asked about includes: urinary frequency (voiding eight or more times in a 24hrs period), urgency (a strong sudden desire to void), urge incontinence (Often women describe getting the sensation of the desire to void and not getting to the toilet in time) or nocturia (awakening two or more times at night to void).

Patients were questioned about the number of leakage episodes per day as well as the number and type of pads per day. The quantity of urine lost can be anything from a few drops to quite a large volume, and it is not uncommon for the patient to describe at least one occasion where the urine has poured down both legs uncontrollably.

In addition, questions regarding lifestyle changes such as decreasing fluid intake or avoiding physical activities reflect the impact of incontinence on the patient's quality of life. Patients were directly questioned about urinary symptoms including leakage with sexual activity.

Patients with Stress urinary incontinence usually complain of involuntary loss of urine with an increase in intra-abdominal pressure such as when coughing, sneezing, running, and lifting. There is no associated urgency. The urine is lost in small discrete amounts.

While, patients with urge urinary incontinence complain of involuntary leakage associated with an abrupt (urge) desire to void that cannot be suppressed or inhibited. It is usually idiopathic. However, other causes of unstable bladder, such as bacterial cystitis, bladder tumors, bladder stones, outlet obstruction, or neurological diseases, must be excluded before making this diagnosis.

Urge urinary incontinence may be triggered by changes in temperature, opening the front door, hearing running water, and occasionally during sexual intercourse at orgasm.

Important associated urinary symptoms was asked about such as pain, burning, hesitancy, postvoid dribbling, suprapubic pain or pressure, sensation of incomplete void, nocturnal enuresis, hematuria, constipation, fecal incontinence, dyspareunia.

Symptoms associated with pelvic organ prolapse was also discussed during the interview and include any introital bulge or mass, pelvic pressure, back pain, heaviness. Current medications were also discussed, history of recurrent urinary tract infections, surgical procedures that might have affected the lower urinary tract such as anti-incontinence surgery. If any of them was found, the patient was excluded from the study.

Clinical Examination:

General examination includes:

1. Vital data: pressure, pulse, temperature.
2. Weight and height to calculate BMI.

We used this Formula to calculate Body Mass Index: weight (in kilograms) and divide it by the height (in meters) squared

BMI = Kg/m^2

Abdominal examination: inspection, palpation and percussion for the presence of tenderness, palpable masses, suprapubic fullness (distended bladder), and hernias. Evaluation for costovertebral angle tenderness was done. Careful note was made of all surgical scars, which should be correlated with the history.

Local pelvic examination:

- External genitalia are examined for signs of chronic wetness (erythema, skin breakdown), atrophy (pale, shiny mucosa), and labial adhesions.
- Internal pelvic organs.

Urethral examination may demonstrate recess, stenosis, masses, or tenderness. Urethral hyper-mobility and stress incontinence, if present, was exhibited on Valsalva or cough maneuvers.

Vaginal examination can reveal atrophic vaginitis or discharge. vaginal narrowing or palpable scars (e.g., episiotomy or prior surgery). Bimanual examination can reveal any enlarged pelvic mass or a uterus enlarged by leiomyomas or adenomyosis which may prompt incontinence through increased external pressure transmitted to the bladder. A cough stress test was performed to evaluate for the presence of stress urinary incontinence.

For diagnosis of pelvic organ prolapse, half of a lubricated translucent vaginal speculum was inserted and examination of the anterior and posterior vaginal walls was performed both at rest and during Valsalva maneuvers. Cystocele, enterocele, and rectocele are defined as follows:

- Cystocele: herniation of the bladder into the anterior vaginal wall. Anterior vaginal wall deficiency leads to either an anterior cystocele (weakness of lateral supports) or a posterior cystocele (central defect).
- Enterocele: herniation of small bowel or omentum into the vagina. Apical vaginal wall weakness leads to an enterocele.
- Rectocele: herniation of rectum into the vagina. Posterior vaginal wall weakness can lead to a low, midvaginal, or high rectocele.

If a urethra is poorly supported, it may display hypermobility during increases in intra-abdominal pressures. The urethral hypermobility was measured by placing a Q-tip in the urethra to the level of the bladder neck while the patient is placed in the lithotomy position. This evaluation was uncomfortable and application of intraurethral analgesia was helpful. One percent lidocaine jelly is placed on the cotton swab prior to insertion. The patient was asked to cough and strain. A deflection of the Q-tip greater than 30° above the horizontal suggests significant urethral hypermobility. The absence of a hypermobile urethra based on the Q-tip test in the presence of incontinence with coughing or straining suggests intrinsic sphincteric deficiency.

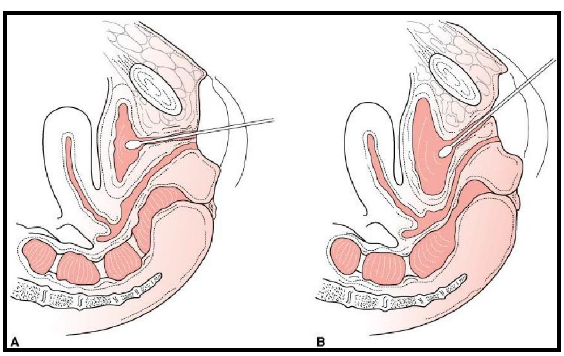


Fig. (1): A. Angle of the Q-tip at rest. **B.** Angle of the Q-tip with Valsalva maneuver or other increases in intra-abdominal pressure. The urethrovesical junction descends, causing upward deflection of the Q-tip.

Neurological exam:

Neurological Evaluation of the perineum begins with attempting to elicit a bulbocavernosus reflex. During this test, one labium majora is stroked with a cotton swab. Normally, both labia equally contract bilaterally. This reflex is integrated at the S2 to S4 spinal cord level. Thus, absence of this reflex may reflect central or peripheral neurologic deficits.

Secondly, a normal circumferential anal sphincter contraction "anal wink", should follow cotton swab brushing of the perianal skin. External urethral sphincter activity requires at least a degree of intact S2 to S4 innervation, and this anocutaneous reflex is mediated by the same spinal neurologic level. Thus, an absent wink may indicate neurologic deficits in this neurologic distribution.

Urinalysis: Urinalysis was performed for all cases to exclude pyuria, bacteriuria before urodynamics.

Urodynamic assessment:

All cases were subjected for urodynamic assessment prior to sonography of the bladder.

1- Cystometry:

Cystometry was done for all patients using a Duet logic machine from Dantek version 5.5. Multi-channel cystometry composed of two pressure transducers (to measure intra-abdominal and intra-vesical pressures), an electronic subtraction unit (to derive the detrusor pressure), an amplifying unit and a display and printout. All systems were zeroed to atmospheric pressure. All pressure measurements were made in cmH_2O.

The following details were followed:

1. Access: transurethral.
2. Fluid medium: saline.
3. Temperature of fluid: room temperature.
4. Position of patient: supine.
5. Filling method: continuous filling by a catheter at a flow rate 50-100ml/sec (medium fill cystometry).

Cystometric terminology is defined as follows:

1. 1^{st} desire to void: defined as the feeling that leads the patient to pass urine.
2. Intravesical pressure: is the pressure within the bladder. It is expressed as centimeters of water pressure (cmH_2O).
3. Abdominal pressure: is taken to be the pressure surrounding the bladder. In current practice it is estimated from rectal pressure. It is expressed as centimeters of water pressure (cmH_2O).
4. Detrusor pressure: is that component of intravesical pressure that is created by forces in the bladder wall (passive and active). It is estimated by subtracting abdominal pressure is essential for interpretation of the intravesical pressure trace. It is expressed as centimeters of water pressure (cmH_2O).

5. Bladder sensation: It is assessed by questioning the patient in relation to the fullness of the bladder during cystometry.

6. Capacity: Maximum cystometric capacity, in patients with normal sensation, is the volume at which the patient feels she can no longer delay micturition. It is expressed as milliliters per centimeters of water pressure (ml/cmH_2O).

7. Compliance: Indicates the change in volume for a change in pressure. Compliance is calculated by dividing the volume change (V) by the change in detrusor pressure (P_{det}) during that change in bladder volume (V/P_{det}). Compliance is expressed as milliliters per centimeters of water pressure. **(Abrams et al., 2002)**

Procedure:

Before inserting the pressure catheters, the residual urine was measured via urethral catheterization. The pressure catheters were then inserted (one intraurethral to measure Pves and the other was placed in rectum to measure Pabd) and calibrated.

Cystometry was done using medium filling at a rate of 50-100ml/min. The system was checked for adequate subtraction by asking the patient to cough at regular intervals. Once the integrity of the pressure reading had been checked and the system zeroed to atmospheric pressure, filling was started. During filling, the patient was asked to indicate her 1st desire to void (FDV) and when she experienced an uncontro-llably strong desire to void (SDV). The volume at which contractions occur and the presence of the contractions were recorded.

Any rise in detrusor pressure was noted and filling was ended once there was a sustained SDV. This volume was taken as cystometric bladder capacity.

The presence of any leakage was noted and any rise in detrusor pressure.

The presence of involuntary detrusor contractions during filling that the patient could not suppress were diagnostic for detrusor overactivity or sustained rise in bladder pressure >15cmH_2O.

A diagnosis of urodynamic stress incontinence was made if leakage was associated with an increase in intraabdominal pressure that causes the intravesical pressure to exceed the intra-urethral pressure in the absence of a detrusor contraction.

2- Urethral Pressure profile:

The urethral pressure and the urethral closure pressure represent the ability of the urethra to prevent leakage. The intraluminal urethral pressure was measured during coughing or straining. In the storage phase. All systems are zeroed at atmospheric pressure. Intravesical pressure was measured to exclude a simultaneous detrusor contraction. The subtraction of intravesical pressure from urethral pressure produces the urethral closure pressure profile. Urethral profilometry was done using an automatic device withdrawing the urethral catheter at a rate of 2mm/sec.

Terminology referring to profiles measured in storage phase:

1. Maximum urethral closure pressure is the maximum difference between the urethral pressure and the intravesical pressure. It is expressed as centimeters of water pressure (cmH_2O).

2. Functional profile length is the length of the urethra along which the urethral pressure exceeds intravesical pressure. It is expressed as millimetre (mm).

3. Pressure 'transmission' ratio is the increment in urethral pressure on stress as a percentage of the simultaneously recorded increment in intravesical pressure. For stress profiles obtained during coughing, pressure transmission ratios can be obtained at any point along the urethra. It is expressed as percentage (%).

3- Uroflowmetry:

Uroflowmetry was done while the patient was micturating freely in the seated position. Measures were automatically displayed from the hydrostatic pressure generated in the collecting cylinder. Flow rate is defined as the volume of fluid expelled via the urethra per unit time. It is expressed in milliliters per second.

Terminology referring to urinary flow is defined as follows:

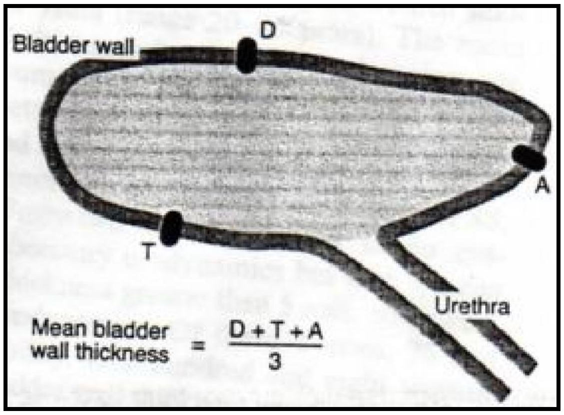
Maximum flow rate: is the maximum measured value of the flow rate. It is expressed as millilitre per second (ml/sec).

Transvaginal Ultrasonography:

Transvaginal ultrasound was then performed using a PieMedical Scanner 250 Plus device with a 5 MHZ probe. After asking patients to empty their bladder, they were asked to lie in the lithotomy position where the tip of the probe was lubricated with a coupling gel to prevent air trapping and placed in the digit of a disposable glove then introduced to the introitus.

The post micturation residual volume was checked to ensure that it was less than 50ml **(Khullar et al., 1996)**. It was measured by ultrasound.

The bladder was visualized in the sagittal (midline) plane. In this position the echo-poor central area of the urethra was visualized, casting an acoustic shadow across the dome of the bladder. Once this was found, the probe was then moved 1 cm laterally to achieve a clear view of the bladder and then directed cranially to continue imaging in the parasagittal plane. All measurements were made at maximum magnification.



The bladder wall thickness was measured in three places:

1. Perpendicular to the luminal surface of the bladder at the thickest part of the trigone (T).
2. At the dome of the bladder (D).
3. At the anterior wall of the bladder (A).

The mean bladder wall thickness was calculated by adding the sum of the three measurements divided by their number.

Data management:

Quantitative data were summarized as mean ($\bar{X}$) standard deviation (SD). Qualitative data were summarized as counts and percentages (%).

- Chi-Square test (χ^2) was used to compare between two groups for qualitative data.
- Independent sample t-test (t-test) was used to compare between two different groups for quantitative data.
- Pearson Correlation Co-efficient (r-test) was used to test the correlation (association) between two quantitative data for the same group of patient.
- Non significant 2-sided P- value was set at 0.05 or higher (>0.05).
- Significant 2-sided P- value was set at 0.05 or lower (<0.05).
- Highly significant 2-sided P-value was set at 0.01 or lower (<0.01).
- A receiver operating characteristic (ROC) curve was used to illustrate the diagnostic properties of a test on a numerical scale.
- All statistical analysis was performed using SPSS (version 16).

Results

This study was conducted at Al Husien Hospital on Fifty (50) women equally divided into two groups:

- Study group (A) (diagnosed as OAB by urodynamic)
- Control group (B) (diagnosed as SUI by urodynamic).

Our research included the following parameters:

1- The Patient characteristics:

- Age
- Parity
- BMI
- Duration of the disease

2- Symptomatolgy

- Urgency
- Frequency
- Urge incontinence
- Nocturia
- Coital incontinence

3- Bladder wall thickness measurd by ultrasound

- Trigone
- Dome
- Anterior wall

Urodynamic data

Table (1): Comparison between study and control groups as regards patient's demography

Demography	Group (A) N=50	Group (B) N=50	P value
Age	40.6±8.9	43.2±9.1	**P>0.05**
Parity	3.5±1.5	3.6±1.1	**P>0.05**
Duration of the disease (years)	3.4 ±2.2	4.2±2.8	**P<0.05**
Body mass index	29.8±4.12	30.1±3.3	**P>0.05**

Table (2): Comparison between study and control groups as regards symptomatolgy using Chi-square test

Symptomatolgy	Group (A) N=50	Group B N=50	t	P
Urgency	46(92%)	44(88%)	0.444	**P>0.05**
Frequency	43(86%)	19(38%)	24.448	**P<0.001**
Urge incontinence	42(84%)	19(38%)	22.236	**P<0.001**
Nocturia	39(78%)	6(12%)	44	**P<0.001**
Coital incontinence	3(6%)	31(62%)	34.938	**P<0.001**

Table (3) shows that there are no statistical significant difference between both groups as regard age, parity, BMI and statistically significant longer disease duration in group (B).

Table (4) shows that there are highly statistical significant difference between both groups as regard sympatomatolgy except for urgency, patients in group (A) were more positive to the symptoms of OAB then group (B) which was more positive as regard coital incontinence.

N.B: Nocturia was considered positive if the patient awakes two or more times at night to void.

Both the study group and the control group underwent transvaginal ultrasound measurement of BWT in three points: Trigone, Dome, Anterior wall. A comparison was made between the two groups as regards the mean trigone wall thickness, mean dome wall thickness, mean anterior wall thickness and the mean of the mean of the three sites.

Table (3): Comparison between study group and the control group as regards the mean trigone, dome, anterior wall and the mean thickness using T-test

	Study group (A) N=50		**Control group (B) N=50**		**t**	**P**
	Mean ±SD	Range	Mean ±SD	Range		
Trigone (mm)	5.91±1.81	2.8→9.2	4.38±1.32	2.2→6.7	4.821	**P<0.001**
Dome (mm)	6.12±1.76	2.9→9.2	4±0.99	2.7→6.6	7.414	**P<0.001**
Anterior wall (mm)	6.26±1.71	2.8→9.1	3.9±0.98	2.7→7.6	8.180	**P<0.001**
Mean	6.22±1.46	3.3→9.8	4.05±0.88	2.5→6.4	8.963	**P<0.001**

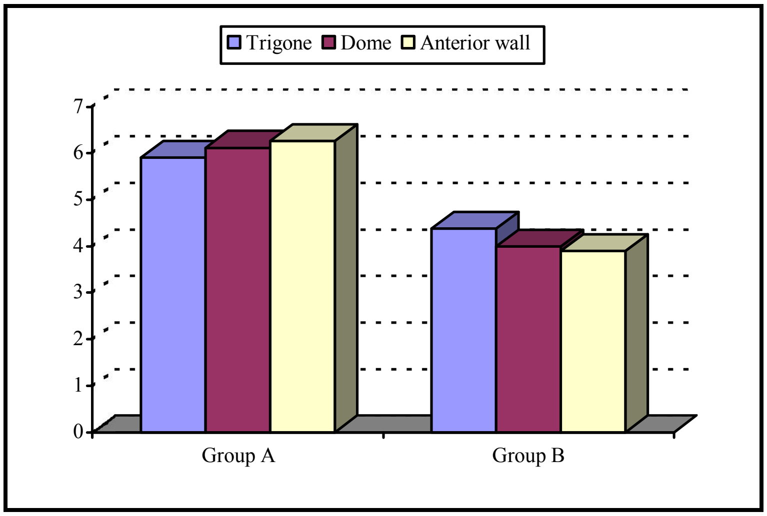


Fig. (2): Comparison between study group and the control group as regards the mean trigone, dome, anterior wall.

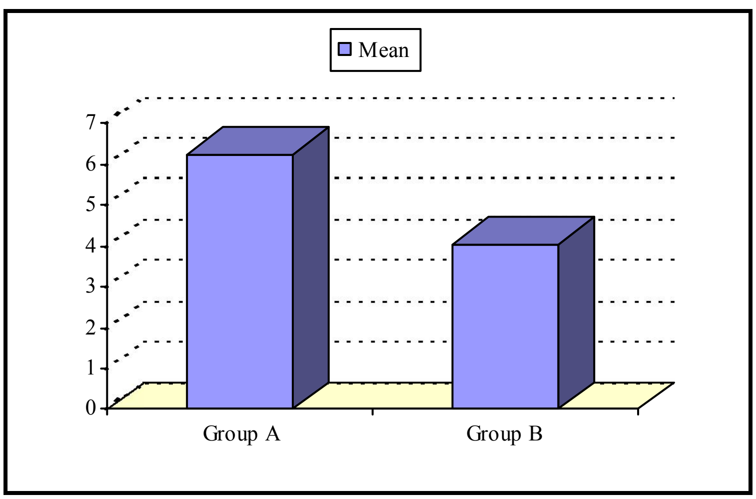


Fig. (3): Comparison between study group and the control group as regards the mean thickness.

Table (4): Comparison between both groups as regard urodynamic parameters using T-test

Urodynamic parameters	Group A N=50	Group B N=50	P-value
First desire (ml)	86.4±11.1	157±15.5	P<0.001
Cystometric capacity (ml)	279.3±39.7	411±68.5	P<0.001
Bladder compliance (ml/cm H_2O)	25.1±6.2	61.9±11.8	P<0.001
Maximum detrusor activity (Cm H_2O)	22.2±4.4	7.5±1.9	P<0.001
Maximum closure pressure (Cm H_2O)	94.3±9.6	57.8±11	P<0.001
Functional length (ml)	42.1±14.2	20.5±5.9	P<0.001
Maximum flow rate (ml)	40.7±7.3	30.2±6.2	P<0.001
Residual volume (ml)	5.1±2.8	14.4±6.5	P<0.001

Table (5) shows that There are a highly statistical significant difference between the two groups as regards the mean trigone, dome, anterior wall and the mean bladder wall thickness.

Table (5): Correlation between ultrasound measure-ments and cystometry in the study group

	Cystometric capacity	Bladder compliance	Detrusor pressure	1st desire to void
Trigone r =	-0.337	-0.193	0.459	-0.036
P=	0.017	0.179	0.001	0.804
Sig.	S	NS	HS	NS
Dome r =	-0.348	-0.143	0.408	-0.018
P=	0.013	0.321	0.003	0.901
Sig.	S	NS	HS	NS
Anterior wall r =	-0.374	-0.220	0.348	-0.066
P=	0.008	0.125	0.013	0.651
Sig.	HS	NS	S	NS
Mean r =	-0.358	-0.182	0.490	-0.090
P=	0.011	0.206	0.000	0.536
Sig.	S	NS	HS	NS

Pearson correlation coefficient, r: value of the test, P: probability, NS: not significant, S: significant, HS: highly significant.

Table (6) shows that there are highly statistical significant difference between both group as regard all urodynamic parameters.

Table (6): Correlation between ultrasound measure-ments and urethral pressure profile in the study group

	Functional profile length	Maximum urethral closure pressure	Pressure transmission ratio
Trigone r=	-0.100	0.085	-0.319
P=	0.491	0.559	0.42
Sig.	NS	NS	NS
Dome r=	-0.111	0.092	-0.301
P=	0.444	0.524	0.32
Sig.	NS	NS	NS
Anterior wall r=	0.048	0.006	-0.034
P=	0.739	0.969	0.816
Sig.	NS	NS	NS
Mean r=	-0.079	0.166	-0.150
P=	0.583	0.249	0.299
Sig.	NS	NS	NS

Pearson correlation coefficient, r: value of the test, P: probability, NS: not significant.

Table (7): Correlation between ultrasound measure-ments and uroflowmetry in the study group

	Maximum flow rate Q max	**Residual urine**
Trigone		
r=	0.492	-.0139
P=	0.000	0.336
Sig.	**HS**	**NS**
Dome		
r=	0.330	-0.174
P=	0.019	0.228
Sig.	**S**	**NS**
Anterior wall		
r=	-0.141	-0.006
P=	0.328	0.967
Sig.	**NS**	**NS**
Mean		
r=	0.321	-0.231
P=	0.011	0.106
Sig.	**S**	**NS**

Pearson correlation coefficient, r: value of the test, P: probability, NS: not significant, S: significant, HS: highly significant.

Table (8): Correlation between ultrasound measure-ments and cystometry in the control group

	Cystometric capacity	Bladder compliance	Detrusor pressure	1st desire to void
Trigone				
r=	0.009	0.036	0.035	-0.104
P=	0.949	0.001	0.244	0.472
Sig.	**NS**	**NS**	**NS**	**NS**
Dome				
r=	0.000	0.001	0.244	-0.144
P=	0.998	0.993	0.088	0.320
Sig.	**NS**	**NS**	**NS**	**NS**
Anterior wall				
r=	0.129	0.128	0.121	-0.020
P=	0.374	0.377	0.403	0.893
Sig.	**NS**	**NS**	**NS**	**NS**
Mean				
r=	-0.042	-0.020	0.256	-0.228
P=	0.774	0.888	0.73	0.112
Sig.	**NS**	**NS**	**NS**	**NS**

Pearson correlation coefficient, r: value of the test, P: probability, NS: not significant.

Table (9): Correlation between ultrasound measure-ments and urethral pressure profile in the control group

	Functional profile length	Maximum urethral closure pressure	Pressure transmission ratio
Trigone			
r =	0.205	-0.102	-0.075
P=	0.152	0.480	0.605
Sig.	**NS**	**NS**	**NS**
Dome			
r =	0.273	-0.198	-0.091
P=	0.055	0.169	0.530
Sig.	**NS**	**NS**	**NS**
Anterior wall			
r=	0.214	-0.268	0.005
P=	0.136	0.060	0.974
Sig.	**NS**	**NS**	**NS**
Mean	0.212	-0.142	-0.49
r =	0.140	0.324	0.734
P= Sig.	**NS**	**NS**	**NS**

Pearson correlation coefficient, r: value of the test, P: probability, NS: not significant.

Table (10): Correlation between ultrasound measure-ments and uroflowmetry in the control group

	Maximum flow rate Q max.	Residual urine
Trigone r = P= Sig.	-0.035 0.808 **NS**	-0.274 0.054 **NS**
Dome r = P= Sig.	0.063 0.664 **NS**	-0.235 0.101 **NS**
Anterior wall r = P= Sig.	0.074 0.609 **NS**	-0.299 0.035 **S**
Mean r = P= Sig.	-0.42 0.773 **NS**	-0.253 0.076 **NS**

Pearson correlation coefficient, r: value of the test, P: probability, NS: not significant, S: significant.

A receiver operating characteristic (ROC) curve was plotted to describe the sensitivity and specificity of different cut-points. The best point lies at the elbow of the curve (its highest points to the left). the area under the curve represents the diagnostic or predictive ability of the test.

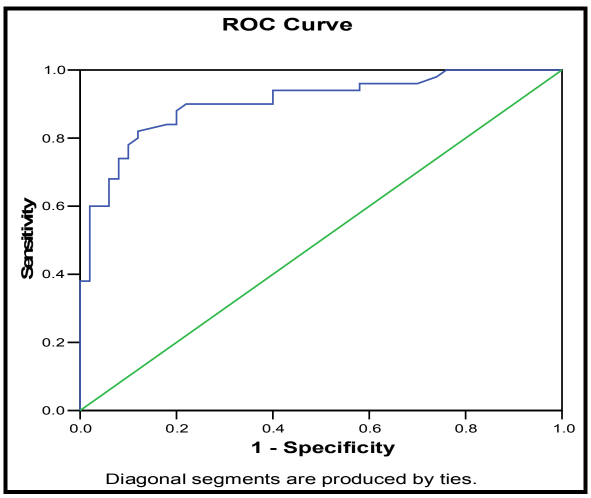


Fig. (4): Diagram illustrates Receiver operator characteristic (ROC) curve. Area under the curve is 0.905.

So the test is maximally accurate at the point closest to the upper left corner of the ROC curve (cut-off point) 4.78mm (mean of the three points). It was found that this cut-off point has sensitivity 90% and specificity 78%.

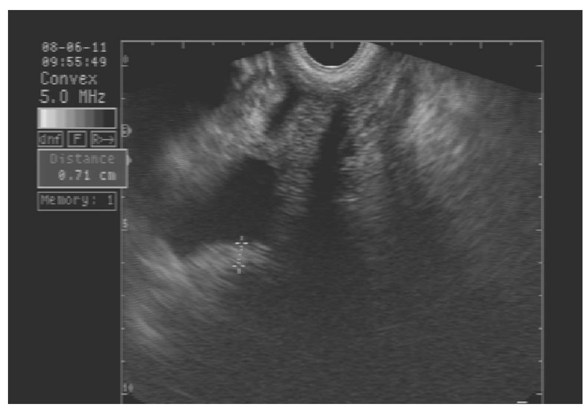
At cut-off point **4.71mm** the sensitivity was 90% and the specificity was 74%.

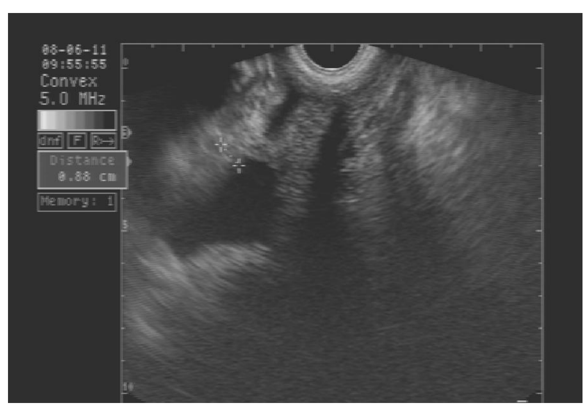
At cut point 4.85mm the sensitivity was 88% and the specificity was 80%.

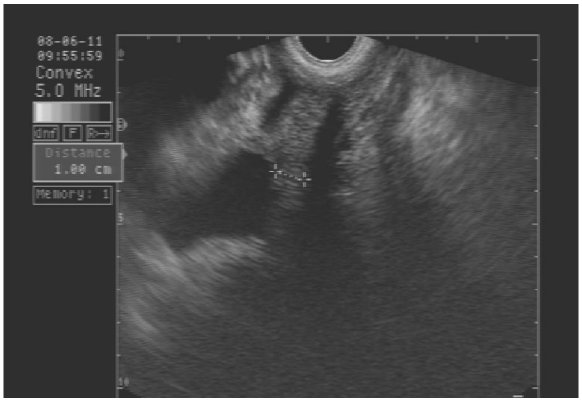
At cut point 5mm the sensitivity was 82% and the specificity was 88%.

So, 4.78mm, was considered the cut-off point as it showed the best sensitivity for detecting cases of OAB. Values below it show same sensitivity but less specificity, while values above it show less sensitivity and more specificity.

Example for Transvaginal ultrasound measure-ment of BWT in a case of OAB:







The mean BWT here was calculated as follows: 7.1+8.8+10=25.9, then we divided the sum by 3, so the mean was 8.6mm.

4. Discussion

Urinary incontinence is a silent epidemic severely affecting the quality of life of women. The bladder has been described as "unreliable witness". Urodynamic studies are the gold-standard investigation for assessing women with urinary incontinence. However, they are invasive and unavailable in some hospitals **(5).**

Also because conventional in-office urodynamic studies take place over a short window of time, it is not uncommon for them to inadequately demonstrate the cause of lower urinary tract symptoms, particularly in the case of urgency and urge incontinence. In general, about 18-23% of patient with OAB-type symptoms and incontinence may have normal urodynamic findings **(6).** And other authors reports that urodynamic studies can miss up to 50% of unstable bladder diagnosis **(7).**

Overactive bladder is defined by the ICS as a medical condition referring to the urinary symptoms of frequency and urgency, with or without urge incontinence, when appearing in the absence of local pathologic factors **(1).**

Overactive bladder (OAB) is a highly prevalent bladder dysfunction with an undefined pathogenesis. OAB is usually diagnosed based on subjective symptoms. Patients with OAB present with urgency with or without urgency incontinence **(4).**

Therefore other forms of non invasive investigations have been introduced for the assessment of lower urinary tract symptoms such as ultrasound and magnetic resonance imaging (MRI) **(5).**

Ultrasound was first introduced into medicine in 1942 by the Viennese neurologist Dussik for locating brain tumors. In 1958 Donald used this diagnostic method for intrauterine measurements of the fetus. Since then, ultrasonic investigation has become an indispensable part of the diagnostic repertoire in obstetrics and gynecology **(11).**

Women with (OAB) have thicker bladder walls than those with stress urinary incontinence, this change may be due to the hypertrophy of the detrusor muscle secondary to repeated detrusor contractions against a closed urethral sphincter leading to a mean bladder wall thickness greater than 5mm. Bladder wall thickness is best measured in the parasagittal plane after voiding with residual volume of (<50ml). Measurements are made at the maximum magnification, perpendicular to the inner surface of the bladder dome, anterior wall and trigone. The mean of the three measurements is used as a test for OAB with good intra-observer and inter-observer reproducibility **(5).**

A thick bladder wall is significantly associated with an abnormal bladder in nocturnal enuresis in children. BWT in children can provide useful predictive clues, which may be helpful to differentiate treatment subtypes, guide clinical management and minimize the need for invasive urodynamic studies **(4).**

This study was conducted in Ain shams university Maternity hospital Urogynecology Unit on 100 female patients to evaluate the role of ultrasound as a screening non invasive tool for the over active bladder by measuring the bladder wall thickness. The patients were divided into 2 groups according to the urodynamic diagnosis (study group (A) (diagnosed as OAB by urodynamics), Control group (B) (diagnosed as SUI by urodynamics). Each consisted of 50 patients. After establishing the diagnosis using urodynamic study all the patients had ultrasound and bladder wall thickness was measured for them at three sites (Dome, anterior wall, trigone).

As regard patients demography the mean age for the patients was 40.6, 43.2 for group (A), (B) respectively with no statistical significant difference between both groups. As regard parity the mean parity was 3.5 in group (A) and 3.6 in group (B) with no statistical significant difference. As regard Body mass index the mean was 29.8, 30.1 for group (A, B) respectively with no statistical significant difference between both groups. As for duration of the disease the mean was 3.4, 4.2 years for group (A, B) respectively which is short duration in comparison to the study preformed by **(12)** where the mean duration was 13 years.

So, in the current study the study group had a mean younger age in both groups than other studies to evaluate BWT e.g., **(10)** where the mean age was 53.8 years. Also, **(13)** reported mean age 52 years. **(14)** reported mean age 51.5 years, **(15)** reported mean age 48.1 years. **(4)** reported mean age 64 years As for other studies preformed for the management of incontinent females **(12)** had mean age 60 years and in another study by **(16)** the mean age was 60.6 years, 61.2 years. In the study done by **(17)** the mean age was 61.2 years This discrepancy in age can be attributed to the higher parity found in the current study in comparison to the results of **(13)** who reported mean parity 2.9 **(12)** where the mean parity was 2 and in the study done by **(18)** the mean parity was 2.4 as multiple vaginal deliveries was found to be a precipitating & aggravating factor for both pelvic organ prolapse and urinary incontinence **(19).**

Another explanation is the early age of marriage in Egyptian females which along with multiparty lead to early onset of the disease and the early presentation.

As regard symptomatolgy urgency was equally present in both groups as for frequency, urge incontinence, nocturia and coital incontinence were more evident in group (A) with statistically significant difference between both groups.

(20) reported that Urge incontinence constitutes 10% to 15% of urinary complains in younger women, and 30% to 40% in older women. Stress incontinence tends to be more common in women younger than 65 years. In patients older than 65 years, urge incontinence and mixed (i.e., urge and stress) incontinence is more common.

Also **(21)** reported that in an inquiry about different symptomatolgy of urinary incontinence involving 483 subjects with OAB symptoms and 191 controls. OAB patients with frequency only were 175, urgency only 80, and both frequency and urgency symptoms (43). So we can conclude that OAB is more symptomatic and have variable symptoms then Urodynamic stress incontinence.

As regard urodynamic parameters group (A) had earlier 1st desire, less bladder capacity, less bladder compliance, higher detrusor pressure, lower maximum urethral closure pressure, longer functional length, less residual volume and higher maximum flow rate with higher statistical significant difference between both groups.

In the study done by **(15)** to evaluate the role of ultrasound in measuring BWT on 492 patients with different lower urinary tract symptoms the mean maximum flow rate was 22.2ml/s, functional length 30.4mm, maximum urethral closure pressure 71 cm.H_2O.

As regard BWT it was measurd at 3 sites and the mean was obtained where the mean BWT at the trigone in the OAB group i.e. group (A) was 5.9mm ranging from 2.8 to 9.2mm, in the control group the mean thickness was 4.38mm with high statistical significant difference between both groups. As regard the BWT at the dome the mean was 6.12mm for group (A) and 4 mm for group (B) with high statistical significant difference between both groups. As for the anterior wall the mean was 6.26, 3.9mm for group (A, B) respectively with high statistical significant difference between both groups. Finally the mean of the 3 points was 6.22, 4mm with high statistical significant difference between both groups. So from these results we can assume that the BWT is thicker in OAB than SUI. When correlating the U/S parameters to the age, parity, BMI there was no significant correlation between BWT and this parameters. when evaluating the presence of either positive or negative correlation between BWT and urodynamic findings in the study group we found the following.

There was no significant positive or negative correlation between (BWT at the three sites and their mean) and (first desire), (bladder compliance), (urethral pressure profile parameters), (residual volume).

There was significant negative correlation between cystometric capacity and (trigone, dome, mean thickness of the three sites) and highly negative correlation for the mean of the anterior wall i.e., to say that as the BWT increases the bladder capacity decreases.

There was significant positive correlation between detrusor pressure and the anterior wall thickness, highly positive correlation between for the trigone, dome mean of the three sites i.e. to say that as the BWT increases the detrusor pressure increases and that BWT is an indicator of OAB. This can be explained by the fact that women with OAB have a thicker bladder wall than those with urodynamic stress incontinence suggesting that this change may be due to hypertrophy of the detrusor muscle secondary to repeated detrusor contractions against a closed urethral sphincter this was postulated by **(7).**

Also since patients with OAB may have frequent detrusor contractions during the storage phase, it is possible that sustained isometric detrusor contractions could result in increased muscle bulk and, hence, increased BWT **(4).**

As regard maximum flow rate it was significantly positive correlated to (dome, mean thickness of the three sites), highly significant correlated to trigone, not correlated anterior wall. When using ROC curve to determine the cut-off point for the BWT (mean of the three sites) for the diagnosis of OAB it was found that the test is maximally accurate at the point closest to the upper left corner of the ROC curve (cut-off point) 4.78mm (mean of the three points) and that this cut-off point has sensitivity 90% and specificity 78%. At cut-off point 4.71mm the sensitivity was 90% and the specificity was 74%. At cut point 4.85mm the sensitivity was 88% and the specificity was 80%. At cut point 5mm the sensitivity was 82% and the specificity was 88%.

So, 4.78mm, was considered the cut-off point as it showed the best sensitivity for detecting cases of OAB. Values below it show same sensitivity but less specificity, while values above it show less sensitivity and more specificity.

In the study by **(10)** the aim of their study was to determine whether transvaginal US measurement of BWT can be used as a screening test for detrusor instability in women with urinary symptoms. One hundred and eight women that were diagnosed as OAB by urodynamic underwent transvaginal US for measuring BWT. They were found to have mean BWT >5mm and when using BWT >5mm as cut-off point, the sensitivity was 84%, and specificity was 89%.

In the study by **(14)** 161 women were included they were classified according to the presence or absence of OAB into two groups. They compared the two groups for urodynaniic diagnosis and BWT. A mean BWT value ≥5mm was considered as cut-off value for unstable bladder.

In the study by **(7)** they aimed to discriminate between women with OAB and those with urodynamic stress incontinence as regarding measuring BWT using transvaginal US. They found that Mean BWT was >5mm in OAB cases. Also **(22)** reported that the cut off for the overactive bladder was >5mm. Tests were performed with an empty bladder (max 30cc). They correlated these measurements with presence of irritative symptoms (frequency. urgency, nocturia) and non-inhibited detrusor contractions. Then they correlated the volume of non-inhibited detrusor contractions with the mean bladder wall thickness. and found no correlation between (non-inhibited detrusor contraction, volume) and (mean bladder wall thickness). Also **(22)** found a clear difference between the mean BWT in women with urodynamic detrusor overactivity, women with OAB symptoms and asymptomatic normal controls.

So measuring BWT is a useful non invasive tool for the prediction of OAB in females. A cutoff value >4.78mm have 90% sensitivity and 78% Specificity.

Recently studies are performed to measure the detrusor wall thickness rather than bladder wall thickness in order to determine the cutoff point for the OAB **(4)**.

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