

## Clinical, urodynamic and ultrasound study for the evaluation of urinary incontinence associated with genital prolapse

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### Abstract

**Objectives:** Urodynamic and ultrasound study for the evaluation of urinary incontinence associated with genital prolapse. Comparing the accuracy of clinical assessment versus ultrasound study in detecting stress urinary incontinence.

**Study Design:** A prospective study.

**Setting:** Obstetric-Gynecologic Outpatient Clinic, Al-Elwiya Maternity Teaching Hospital, Baghdad –Iraq.

**Patients and Methods:** The study was conducted for a period of one year, from the first of December 2014 to the end of November 2015, included 69 women with urinary incontinence associated with genital prolapse. Detailed history looking for risk factors and symptoms of urinary incontinence and genital prolapse; clinical examination including complete bimanual pelvic examination, stress test, Bonney test and Q-tip test, then ultrasound and urodynamics study were performed for them

**Results:** nocturia and urgency were significantly more common in those with DI or mixed incontinence than those with GSI. Both Q-tip test and ultrasound were used to assess BNM and so can detect stress incontinence with sensitivity (81.8% versus 36.4%), specificity (50% versus 50%), positive predictive value (81.8% versus 66.7%), negative predictive value (50% versus 22.2%), and accuracy (73.3% versus 40%). From 30 women who underwent urodynamics study, 60% had GSI and 40% had detrusor instability or mixed incontinence.

**Conclusions:** Q-tip test is a useful clinical test and more accurate than ultrasound in detecting bladder neck mobility. Urodynamics study is expensive and time consuming so limit its use to those with urinary incontinence, urgency and nocturia as they are more likely to have detrusor instability or mixed incontinence.

**Keywords:** urinary incontinence, genital prolapse, ultrasound

### 1. Introduction

UI is defined by the International Continence Society as the involuntary loss of urine which is objectively demonstrable and a social or hygienic problem. The prevalence of UI is 6-10 times greater in women than in men. In both men and women, the prevalence of UI increases with age, parity, and obesity, an estimate of prevalence range from 8-51% for community-dwelling individuals [1, 2]. The main function of the bladder is to store the urine which continuously enters it, in order to achieve convenient intermittent voiding. Thus, the bladder must act as an efficient low pressure continent reservoir. During filling the bladder pressure should not normally rise by more than 10 cm water at 300 ml and should be less than 15 cm water at 500 ml capacity. In order to maintain continence, the maximum urethral pressure must exceed the bladder pressure at all times except during micturition. Thus, for continence to exist, it is not only essential that the intravesical pressure remains low but also that the urethral lumen should seal completely [3].

Types of Urinary Incontinence: 1. Genuine stress incontinence (GSI): is defined as the involuntary loss of urine when the intra-abdominal (and therefore intravesical) pressure exceeds the maximum urethral closure pressure in the absence of detrusor activity. The amount of urine lost at any one time is usually only few drops and this is a feature important in the diagnosis [2, 3, 4]. This can result from hypermobility of the bladder neck (HBN) or intrinsic sphincter deficiency (IDS). The former accounts for 75% of these cases, and the latter for the remaining 25% [5]. GSI is the commonest cause of UI in women; its prevalence is 50%

[6]. Cases of uncomplicated pure stress incontinence are rarely referred for urodynamics and if a woman has no symptoms of urgency and incontinence is observed to occur instantly on coughing then no further functional testing is necessary, GSI is best treated surgically [7]. 2. Detrusor Instability (urge incontinence) (DI): is defined as the presence of spontaneous or provoked detrusor contractions during the filling phase when the patient is attempting to inhibit micturition, that cause a sudden urge to urinate, followed by loss of a large volume of urine. It is the second commonest cause of UI in women & accounts for 30-40% of cases while its incidence in the general population varies from 10% to 15%. However, amongst the elderly population it is commonest cause and had been shown to exist in up to 80% of those who present for urodynamics assessment [6, 8, 9]. In the majority of cases the actual cause of DI is unknown (idiopathic or non-neuropathic), occurring when there is a failure of adequate bladder training in childhood or when the bladder escape voluntary control in adult life, also emotional or other psychosomatic factors are involved. DI may be secondary to neurological disorders (neuropathic) and in such cases it is known a detrusor hyperreflexia [2, 3, 8]. The symptoms of DI are usually multiple, including frequency, urgency, urge incontinence & stress incontinence. The diagnosis of DI is confirmed by cystometric demonstration of involuntary detrusor contractions at rest during bladder filling or following provocative maneuver such as coughing & others. DI is best treated medically [10]. 3. Mixed Incontinence: as its name implies, mixed incontinence includes some degree of both

stress & urge incontinence [3]. 4. Retention with overflow incontinence: occurs when the patient cannot excrete urine against normal urethral resistance. It occurs when the volume of urine causes increased pressure that exceeds urethral sphincter pressure. Involuntary loss of urine occurs following over-distension of the bladder [2, 3, 11]. 5. Congenital: e.g. epispadias, spina bifida occulta, ectopic ureter ...etc [11]. 6. Functional incontinence: this is often a diagnosis of exclusion, & the results of all tests may have been normal [2, 12]. 7. Miscellaneous: e.g. urinary tract infection (UTI), urethral diverticulum [11]. 8. Fistulas: give rise to incontinence which is continuous occurring both day & night. It is either ureterovaginal, vesicovaginal, urethrovaginal, or complex fistula [3]. Clinical Evaluation and Diagnosis of UI: The basic evaluation includes history, physical examination, local neurologic, gynaecologic examination, cough stress test, Bonney test, Q-tip test, urinalysis, 24 hr voiding diary, pad test, and estimation of post void residual urine.

#### The purpose of this evaluation is to

- On firm the presence of UI.
- To identify potentially reversible factors e.g. UTI, drugs etc.
- To identify potentially serious underlying conditions or conditions that may require further urologic, gynaecologic or urodynamic evaluation e.g. voiding dysfunction, surgical intervention, etc. [12, 13].

#### Estimation of postvoid residual volume (PVR)

The purpose of this test is to rule out overflow incontinence or evaluate symptoms associated with incomplete bladder emptying [12].

Nowadays ultrasound can non-invasively measure residual urine volume with reasonably good accuracy in incontinent patients [13, 14]. Different formulas have been proposed to be used to calculate bladder volume, e.g. Ellipsoid formula:  $V = 1/2 (L \times Ap \times W)$  where  $V$  = volume,  $L$  = length,  $Ap$  = anteroposterior diameter and  $W$  = width [14], which is similar to the formula of bladder volume calculation available as software embedded in the ultrasound scanner [16] which is used in our study.

**Advanced evaluation:** includes urodynamics, imaging, endoscopy and electromyography.

**Criteria for advanced evaluation:** Uncertain diagnosis, failure of response to initial therapy, surgical intervention, hematuria, incontinence with coexisting condition e.g. recurrent symptomatic UTI, severe or symptomatic POP, neurologic conditions and others [12]. Because these special procedures are relatively expensive, involve some discomfort and requires specialized equipment and trained personnel, they should only be done in incontinent patients for whom the results are necessary to determine an appropriate treatment plan [13].

**Urodynamic study:** These tests are designed to determine the functional status of the urinary bladder and urethra. They offer greater sensitivity in assessing detrusor stability and voiding function. Urodynamics is considered as a preoperative evaluation especially for general obstetricians and gynaecologists [1, 12]. Also the significance of urodynamics in management has been related more to the

evaluation of treatment than to selection of patients for specific therapy [7]. It includes the following procedures:

- **Cystometry:** involves the measurement of the pressure-volume relationship of the bladder.
- Leakage without a rise in detrusor pressure is diagnostic of GSI. Detrusor contractions during filling which the patient can not suppress indicates DI [7, 11].
- **Uroflowmetry:** is the measurement of urine flow rate, it provides objective measurement of voiding function [11, 12].
- **Urethral pressure profilometry:** assess the function of the urethra; it is a record of the pressure along the urethral lumen. The profile best made at rest and stress [11].
- **Valsalva Leak-point pressure:** it determines the absolute ability of the urethra to resist expulsive forces transmitted to the bladder as a result of increased intraabdominal pressure [12].
- **Imaging: - Video Cystourethrography (VCU):** provides valuable information regarding bladder size and the competence of the bladder neck during coughing [8, 11, 12].
- **Radiological studies:** includes intravenous urography and plain radiograph of the abdomen (kidneys, ureter and bladder) is useful in the diagnosis [4].
- **Ultrasound:** is useful in estimating PVR volume, and assessing mobility and funneling of the ureterovesical junction, both at rest and with a valsalva maneuver [4, 8].
- **Magnetic resonance imaging (MRI):** produces accurate anatomical pictures of the pelvic floor and lower urinary tract and demarcate compartmental prolapse [5, 11].

**Endoscopy:** establishes the presence of disease in the urethra or bladder. It is indicated in patients with recurrent incontinence, suspected fistula and evaluation of irritative urinary symptoms, and hematuria [11, 12].

**Electromyography:** This can be used to assess the pelvic floor muscles. Denervation of these muscles commonly follows delivery and is associated with incontinence [4].

## 2. Materials and Methods

### 2.1 Patients and Methods

This study includes 69 patients with urinary incontinence associated with female genital prolapse, who were selected from patients attending Al-Elwiya Maternity Teaching Hospital during the period from the 1<sup>st</sup> of December 2014 through the end of November 2015. Those with neurologic diseases (e.g. multiple sclerosis, spinal cord injury, etc), pelvic cancer, pregnant patients or within 6 weeks postpartum and those with previous surgical treatment for UI, uterovaginal prolapse or hysterectomy were excluded. Detailed history and physical examination were performed looking for the risk factors and symptoms suggestive of urinary incontinence and genital prolapse. The symptoms include (feeling of lump, backache, local discomfort, vaginal discharge, dyspareunia, frequency, urgency, nocturia, dysuria, leak of urine and wearing of pads for protection.

All patients were asked objectively on urinary incontinence:

- a. Whether urinary leakage is occurring in conjunction with coughing, sneezing, lifting or other activities that increase intraabdominal pressure.
- b. Whether urgency to void was strong enough leading to leakage of urine if she did not reach the bathroom in time.

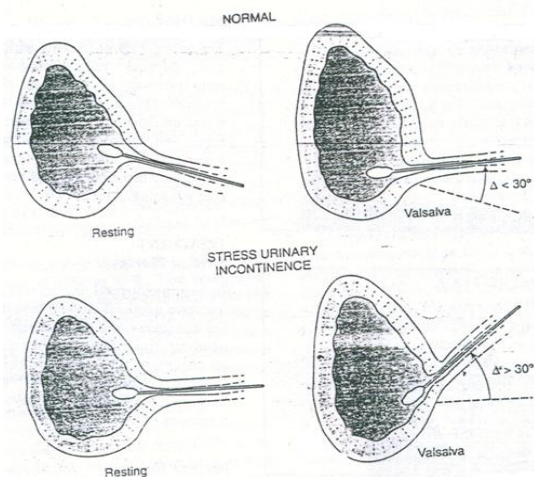
- c. Whether wetting of the bed occurred in the previous year.
- d. The need for protection pads.

Mental or neurological status was recorded including mobility and gait. A basic evaluation was done for the patient's lower thoracic, lumbar and sacral nerves to rule out sensory or motor dysfunction that may affect the bladder, urethra and the pelvic muscles. Evaluation of the motor function was done by asking the patient to flex and extend against resistance at the hip, knee, and ankle. Assessment of the sensory reflexes by examining the bulbocavernosus muscle (stroking lateral to the labia minora) and checking the clitoral reflex (tapping the clitoris), both of which cause contraction of the anal sphincter. The pelvic musculature was evaluated by inserting the examiner's fingers in the vagina and asking the patient to squeeze and assessing the tone of the muscles [1, 12].

Informed consent was taken from the patient before starting the physical examination. The type of uterovaginal prolapse is assessed by examining the patient in dorsal position with a relatively full bladder on a gynecological couch using Sim's speculum to retract the posterior then the anterior vaginal wall and ask the patient to strain. Combined rectal and vaginal digital examination was performed to aid the differentiation of rectocele from enterocele. Complete bimanual pelvic examination was performed to exclude abdomino-pelvic masses, to assess irritation related to urinary leakage or from protection pads, and the vagina was observed for estrogen effect.

**2.2 Clinical assessment of UI**

For all women urine was sent for microscopic examination, culture and sensitivity and UTI was treated if present. The patient was asked to cough vigorously while in the same position, if urine leakage was observed, an uplift of the ureterovesical junction was applied [4], when it control the leak, it was considered as positive Bonney test, while if no urine leaked in dorsal position, the test is repeated in standing position. While the patient in dorsal position, a lubricated sterile cotton-tipped swab was passed through the urethra into the bladder and then withdrawn to the level of the ureterovesical junction. The angle between the axis of the ureterovesical junction and the horizontal line was measured using goniometer both at rest and during straining. Upward movement of the swab > 30° during straining indicate urethral hypermobility [8] as shown in fig. 1.



**Fig 1:** Diagrammatic representation of Q-tip test [8].

**2.3 Ultrasound scan**

Was performed using (Siemens, Sonoline Versa prosystem) scanner. A 5 MHz mechanical convex probe was used. Ultrasound was used to assess bladder neck mobility (BNM) and post voiding urine volume in women who have clinical evidence of UI, as follows:

- **Bladder neck mobility:** The women lie in supine position with average 300 ml urine filling the bladder was examined using the perineal approach; the probe was put on a sagittal plane to identify bladder, urethra, bladder neck, the long axis of symphysis pubis and its lower border in the same image. The reference line was a straight line drawn perpendicular to symphysis axis. The distance between the bladder neck and this line is measured at rest and during straining. At rest the bladder neck is normally above or at the level of the reference line, ≥ 1 cm of bladder neck descent on maximum straining is considered a cutoff value that indicates hypermobility of bladder neck. If the bladder displaces but remains above the pubic symphysis, the amplitude of the displacement is the subtraction of these measurements, but if it displaces below the pubic symphysis, the result will be the addition of these measurements [5].
- **Postvoiding residual urine volume:** The patient was asked to empty her bladder; the residual urine volume was obtained by transabdominal ultrasound with the same probe. On longitudinal section the height and depth of bladder were measured, while the width measured through transverse section. The ultrasound bladder volume calculation using these three dimensions available as software embedded in the ultrasound scanner, taking > 50 ml as significant residual urine volume [11, 17].

**2.4 Urodynamic evaluation**

urodynamic evaluation was advised for the sixty nine patients with UI as assessed clinically, only 30 did the test, after obtaining their informed consent, using the urosystem (Life Tech. Urolab./urovision system V, primum configuration). The woman was asked to empty her bladder and then examined in the supine position. A complete urodynamic evaluation was performed (subtraction cystometry and uroflowmetry).

**2.4.1 Cystometry**

Double lumen urethral catheter 6 F was introduced using aseptic technique, in female patient who have a short straight urethral local anesthetic is probably unnecessary, adequate lubrication being all that is needed to ensure patient comfort. Rectal catheter was also introduced and on each catheter a transducer is mounted. Sterile normal saline was infused at rate of 60 ml/min, zero reference for all pressure measurements is the level of the superior margin of the symphysis pubis. All pressures are expressed in centimeters of water.

The following measurements were done: Vesical pressure (cm H<sub>2</sub>O), abdominal pressure (cm H<sub>2</sub>O) which is reflected through the rectal catheter, detrusor pressure calculated from the subtraction of abdominal pressure from the vesical pressure (significant detrusor pressure > 15 cm H<sub>2</sub>O) [8, 11, 12].

- Bladder capacity at 1<sup>st</sup> desire (N. 50-150 ml)
- Bladder capacity at normal desire (N. 200-400 ml)

Bladder capacity at strong voiding desire (N. 400-600 ml) <sup>(1)</sup>  
 In addition to maximum bladder capacity (ml), compliance calculated from the formula = the change of bladder volume to the change in detrusor pressure. At 300 ml of saline infusion, these patients were asked to cough, when urine leaked, pressures were recorded.

**2.4.2 Uroflowmetry**

Catheters were removed, the woman void in the sitting position, the following were measured. Flow time (s), voiding time (s), time to maximum flow (s), voided volume (ml) were measured then maximum flow rate (ml/s) (normally > 15 ml/s) <sup>[7]</sup>, average flow rate (ml/s) were calculated.

**2.5. Statistical analysis**

Analysis of data was through the use of personal computer Microsoft Excel program. Results were presented as frequencies, mean and standard error of the mean (M ± SE) was calculated. Student t-test and Chi-square test were used as tests of significance taking p value ≤ 0.05 as a significant value. Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy were calculated using 2 x 2 table.

**3. Results**

A total of sixty-nine women with UI associated with genital prolapse were included in this study. The mean age ± SE (year) for the 69 women with UI and prolapse was 41±0.79 (range 25-58) and BMI ± SE (kg/m<sup>2</sup>) for them was 32.6 ± 0.58 (range 23-51). It was found that 67.62% of the patients had cystocele, 64.17% had rectocele, 18.63% had uterine prolapse and 28.98% had enterocele. The mean PVR as assessed by ultrasound for the 69 women in this study was 15.1 ml. The severity of UI was assessed by frequency of urine leak per week, the need to wear protection pads and when the leak is evident in the supine position. In our study, 34 out of 69 women (49%) of those with prolapse and UI and had severe type of incontinence. From 69 women who

were advised for urodynamic study, only 30 women underwent the test, 18 (60%) were found to have GSI, while the others (40%) had DI or mixed incontinence as shown in table 3.1. GSI was diagnosed when there was stress incontinence evident from symptoms and signs and/or leak during urodynamic study; provided that all the parameters of the subtracted cystometry and the uroflowmetry were normal. Also table 3.1 showed a significant relation between urgency and nocturia and type of UI as they are more in those with DI or mixed incontinence than those with GSI. Both Q-tip clinical test and ultrasound were used to assess BNM, it was found in table 3.2 and figure 3.1, that BNM as assessed by Q-tip test was present in 83% of those with GSI, and in 58% of those with DI or mixed incontinence, while BNM as assessed by ultrasound was present in 28% of those with GSI, and in 58% of those with DI or mixed incontinence. Q-tip test had a statistical significance in assessing BNM in those with GSI, more than ultrasound (p value 0.0025).

It was found from table 3.3 that sensitivity, specificity, PPV, NPV and efficiency of Q-tip were 81.8%, 50%, 81.8%, 50% and 73.3% respectively.

From table 3.4 sensitivity, specificity, PPV, NPV and efficiency of ultrasound were 36.4%, 50%, 66.7%, 22.2% and 40% respectively.

Table 3.5 and figure 3.2 show that the Q-tip test had higher sensitivity, PPV, NPV, and efficiency than ultrasound. Note, during the urodynamics study, only 2 out of 30 women found to have attenuated maximum flow rate while all others 28 had normal voiding phase.

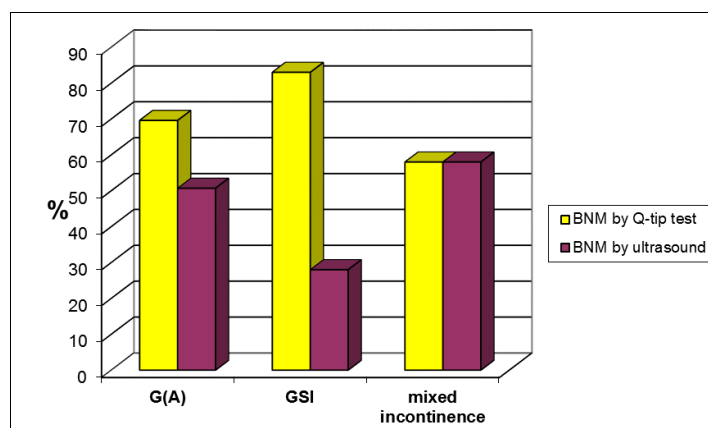
**Table 1:** Type of UI in the 30 women, as assessed by urodynamics

Type of UI	No. of patients		Urgency and/or nocturia	
	No.	%	No.	%
1. Genuine stress incontinence	18	60	5	27.8
2. DI or mixed incontinence	12	40	9	75
X <sup>2</sup> test (p value)			0.0303*	

\*significant

**Table 2:** Evaluation of BNM by Q-tip test and ultrasound

Studied women	BNM by Q-tip test		BNM by U/S		X <sup>2</sup> test (p value)
	No.	%	No.	%	
Women with prolapse and UI (n=69)	48	69.6	35	50.7	0.0369
Women with urodynamics study (n=30) - GSI	15	83	5	28	0.0025
- DI or mixed incontinence	7	58	7	58	0.6788



**Fig 2:** Evaluation of BNM by Q-tip test and ultrasound

**Table 3:** The relation between urodynamics study and BNM as assessed by Q-tip test

		Urodynamics study		Total
		Leak	No leak	
Q-tip	BNM	18	4	22
	no BNM	4	4	8
Total		22	8	30

Sensitivity = 81.8%, specificity = 50%, efficiency = 73.35, positive predictive value 81.8%, negative predictive value 50%

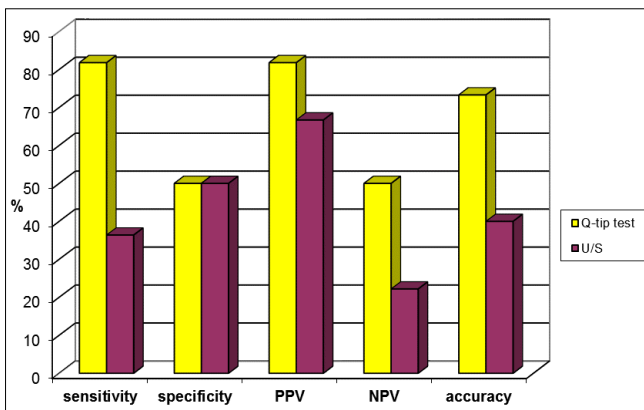
**Table 4:** The relation between urodynamics study and BNM as assessed by ultrasound

		Urodynamics study		Total
		Leak	No leak	
U/S	BNM	8	4	12
	no BNM	14	4	18
Total		22	8	30

Sensitivity = 36.4%, specificity = 50%, efficiency = 40%, positive predictive value 66.7%, negative predictive value 22.2%

**Table 5:** Comparison of the accuracy of clinical Q-tip test and sonographic measurement of BNM in predicting stress incontinence.

	Q-tip test	U/S
Sensitivity	81.8%	36.4%
Specificity	50%	50%
PPV	81.8%	66.7%
NPV	50%	22.2%
Efficiency	73.3	40%



**Fig 3:** Comparison of the accuracy of clinical Q-tip test and sonographic measurement of BNM in predicting stress incontinence

**4. Discussion**

Female genital prolapse is a common problem, when it is associated with UI; it become a distressing condition which although rarely life threatening severely adversely affects all aspects of a woman's quality of life. Ellerkmann *et al*, found in his 237 studied patients in Baltimore that 33% of the patients had anterior compartment prolapse, 19% had posterior compartment prolapse (rectocele and enterocele) and 11% had uterine prolapse [18], while in our study 67.62% of the patients had cystocele, 64.17% rectocele, 28.98% enterocele and 18.63% had uterine prolapse. Cystocele and rectocele appear to coexist in our patients which probably reflect the same underlying aetiology that is in our society include high parity and the obstetrical malpractice by midwives and in rural area. More cases of enterocele were diagnosed in our study which may be due to that we have

applied a specific maneuver to differentiate between rectocele and enterocele. Haylen *et al*, found in his study in Australia on 250 women with symptoms of lower urinary tract dysfunction that most urogynecology patients, have no or small residual urine volume and the mean residual for his patients was 14.8 ml and this comparable to our results where the mean residual was 15.1 ml [19].

Forty-nine percent of women with prolapse and UI in our study had severe type, while in a study conducted across four countries and including 4800 men and 3674 women, showed that 35.6% of women had UI and in 3.5-12.1% the incontinence was severe [20], this variation in the results may be due to that our sample of patients not reflect the general population but include women with symptomatic genital prolapse and because of low number of patients and also may be due to the difference in the criteria chosen to determine the severity of UI. Urgency and nocturia in this study were found to be more common in those with DI or mixed incontinence than those with GSI and this is comparable to what is found in the medical literature, where the relative incidence of instability of the bladder increases with prominence of urgency and nocturia [7]. In our study, the incidence of GSI by urodynamics study was 60% and DI or mixed incontinence was 40% and these results are close to those described by Pinto *et al*, study which was conducted on 126 patients with UI, where the incidence of GSI is 76.2% and that for DI or mixed incontinence is 23.8% [21]. Anatomically BNM has important aspect in the mechanism of UI, so widely accepted that preoperative evaluation of women with UI should include BNM which is assessed in our study by Q-tip test and ultrasound.

Q-tip test is abnormal in 95% of patients with GSI [22], while in our study, Q-tip test detect GSI in 83% of cases with a sensitivity, specificity, PPV, NPV, and accuracy of 81.8%, 50%, 81.8%, 50%, and 73.3% respectively. This is somewhat comparable to Joao *et al*. study that show that PPV and NPV of the clinical sign and test for the diagnosis of any type of UI were 97.1% and 26.7% respectively [23].

The method suggested for assessing BNM by ultrasound and which was followed in our study was found to be abnormal in only 28% of those with GSI, its sensitivity was only 36.4%, specificity 50%, PPV 66.7% while in a study done by Pregazzi *et al*, they had assessed the reproducibility of ultrasound technique for the measurement of urethral angulation and BNM and its ability to predict GSI. The sensitivity, specificity and PPV were 87%, 68%, 55% respectively [24]. Also in a study done by Liqaa *et al*, showed that ultrasonic evaluation of BNM had important role in diagnosing patients with stress UI. [25]. This variation in the validity of the test may be due to different sonographic scan machines used and different sonographers i.e. inter-observer bias. So when comparing the accuracy of Q-tip test with ultrasonographic assessment of BNM, Q-tip test is more accurate.

**5. Conclusions**

Urgency and nocturia are specific symptoms related to bladder dysfunction. Q-tip test is a useful clinical test and more accurate than ultrasound in detecting bladder neck mobility. Urodynamic study is expensive and time consuming, so limit its use to those with UI and urgency and nocturia as they are more likely to have bladder instability or mixed incontinence.

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