Urodynamics in Assessment of Urinary Incontinence

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Introduction

The International Continence Society (ICS) defines UI as ‘a condition where involuntary loss of urine is a social or hygienic problem and is objectively demonstrable’.

UI is a very common debilitating disorder similarly afflicts men and women in terms of quality of life and self esteem.

Classification of urinary incontinence

UI can be further classified according to ICS:

**Urge Urinary Incontinence (UUI)**

- Defined as the leakage of urine accompanied by a strong desire to void in the absence of raised intra-abdominal pressure.
- While 9-12% incontinent women reported UUI, 40-80% incontinent men were bothered by UUI.

**Genuine stress incontinence (GSI)**

- Demonstrable involuntary loss of urine when intravesical pressure exceeds the maximum urethral pressure due to an increase in intra-abdominal pressure in the absence of a detrusor contraction.
- GSI can be caused by either bladder neck/urethral hypermobility or intrinsic sphincter deficiency or a combination of them.
- 29-68% incontinent female reported GSI but less than 10% incontinent men have GSI.

**Mixed Urinary Incontinence (MUI)**

- The complaint of involuntary leakage with both features of UUI and SUI.
- 23-61% incontinent women suffered from this type of urinary incontinence.
- It affected 10-30% incontinent men.

**Nocturnal Enuresis**

- Any involuntary loss of urine occurring during sleep and it affected 4% children aged 4-12 years and 0.5% adult population.

Evaluation of urinary incontinence

- In general, self-administered validated questionnaire, a voiding diary, good history taking, neurological examination of the lumbosacral innervation, pelvic examination, determination of post-void residual urine volume, objective demonstration of urine loss and urinalysis enable presumptive diagnosis of UI to be made and subsequent management to be formulated.

- However, the symptoms and signs of incontinence do not always give a definite diagnosis and the aetiology of the incontinence and urodynamic study might help in such cases.

What is urodynamics?

Urodynamics is a dynamic study of the transport, storage, and evacuation of urine by the urinary tract to provide objective pathophysiological explanations for symptoms and/or dysfunction of the lower and upper urinary tracts.

The aim is to reproduce the patient’s symptoms and provide a pathophysiological explanation of the patient’s problems. It is essential that the diagnoses made at the time of urodynamic study are related to the patient’s symptoms and physical findings at the time of examination.

When to do urodynamics?

- It should be stressed that not every patient with UI needs to undergo urodynamic study particularly for whom UI can be managed well by conservative means e.g. pelvic floor exercise for mild stress UI.

- In the clinical work-up of an incontinent patient, urodynamic studies are indicated for the following reasons:-
  - to diagnose the cause and aetiology of the UI in patients having mixed symptomatology or contemplating surgical treatment, having prior failure of anti-incontinence surgical intervention or iatrogenic UI (e.g. after prostatectomy)
  - to study neuropathic vesicourethral disorder
  - to predict the consequence of the urinary tract dysfunction and outcome of different therapies and hence to help select rational therapy
  - to monitor the result of therapy

What to do with urodynamics?

Urodynamic studies comprise a series of tests. The appropriate test(s) should be selected to answer well-defined question(s) (Table 1). If urinary tract infection (UTI) is present, then the study should be postponed until it is treated.
### Table 1. Urodynamic Studies for Urinary Incontinence Assessment

<table>
<thead>
<tr>
<th>Urodynamic study</th>
<th>Target function to be evaluated</th>
<th>Indicated patients</th>
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<tbody>
<tr>
<td>1. Uroflowmetry, Residual urine measurement</td>
<td>global voiding function</td>
<td>any incontinent subjects (residual) or those suspected of voiding dysfunction (uroflow)</td>
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<tr>
<td>2. Urethral pressure measurement</td>
<td>urethral closing forces</td>
<td>subjects suspected of urethral incompetence</td>
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<tr>
<td>3. Cystometry</td>
<td>storage function and sensation of the bladder during the filling phase</td>
<td>any incontinent subjects to be investigated for their dysfunctional conditions</td>
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<tr>
<td>4. Leak point pressure measurement</td>
<td>urethral competence against pressure generated in the bladder from detrusor or abdominal forces. Video / fluoroscopy is not essential.</td>
<td>subjects suspected of neurogenic lower urinary tract dysfunction (A) or urethral incompetence (B)</td>
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<td>5. Pressure-flow studies</td>
<td>detrusor contractility and bladder outlet obstruction during the voiding phase</td>
<td>subjects suspected of voiding dysfunction</td>
</tr>
<tr>
<td>6. Videourodynamics</td>
<td>Simultaneous observation of the morphology and function of the lower urinary tract. It is essential if Blaivas classification of female stress incontinence is adopted.</td>
<td>subjects with suspected multifactorial aetiologies for incontinence or anatomical abnormalities of the lower urinary tract</td>
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<tr>
<td>7. Surface electromyography</td>
<td>coordinated relaxation of pelvic floor during the voiding phase</td>
<td>subjects suspected of dysfunctional or dyssynergic voiding</td>
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<tr>
<td>8. Ambulatory urodynamic monitoring</td>
<td>behaviour of bladder (and urethra) and leakage mechanisms during activities of daily living</td>
<td>subjects suspected but not proven to have incontinence or detrusor overactivity on conventional investigations</td>
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### Uroflowmetry and post-void residual urine

It is done at the start of the study to ensure that an unimpeded flow pattern can be studied and the bladder emptying function can be assessed in a more natural way. Residual urine volume can also be estimated by bladder ultrasound scan or by urethral catheterisation. They are important in determining the bladder emptying function as poor bladder emptying will complicate surgical therapy for urinary incontinence.

### Urethral pressure profile

Urethral pressure line is then passed through the urethra and the urethral pressure can be measured by Brown and Wickham perfusion techniques. Resting urethral pressure profile, maximal urethral closure pressure (MUCP) and stress urethral pressure profile (stress UPP) can then determined.

For female stress UI, studies have shown that patients with MUCP less than 20 cmH\textsubscript{2}O were 3 to 4 times more likely to have an unsuccessful outcome than those with higher values\textsuperscript{16, 17} and suggested that the patients have intrinsic sphincter deficiency (ISD). MUCP greater than 50 cmH\textsubscript{2}O suggested stress UI due to bladder neck / urethral hypermobility.

In evaluating stress UI, the patient is asked to cough 4-5 times during UPP measurement. At the cough spikes the ratio between intraurethral pressure and intravesical pressure can be determined. This ratio is called pressure transmission ratio (PTR) that is derived from Enhorning’s theory\textsuperscript{18}. Normally, the intra-abdominal pressure rise during coughing is transmitted to the bladder neck and proximal urethra to prevent the bladder from leaking. If the PTR is <70% urethral hypermobility might be present\textsuperscript{19}.

### Cystometry

Following urethral pressure profile study, cystometry can be done during which the rectal pressure line and the bladder pressure line are inserted. Filling should be kept at a rate of 20 – 50 ml/min in non-neurological cases and <10 ml/min in neurological cases.

In women with large cystoceles, filling cystometry and voiding cystometry (pressure flow study) should be performed with and then without cystocele reduction in order to detect stress UI which can be masked by the obstructive kinking effect of the cystocele on the urethra, and to determine whether the cystocele is affecting voiding pressure, maximal flow rate (Qmax) and / or bladder emptying.

Compliance of bladder, cystometric capacity, detrusor overactivity as shown by phasic uninhibitory detrusor contraction with or without associated urge sensation, urinary leakage, detrusor leak point pressure (DLPP) and Valsalva leak point pressure (VLPP) should be recorded.

Typically, in UUI the urodynamics show phasic waves (pdet >5 cm H\textsubscript{2}O) associated with urge sensation during filling phase spontaneously or on provocation. These contractions are defined as detrusor overactivity. Urge incontinence was associated with the urodynamic finding of detrusor overactivity in 70% of patients\textsuperscript{19, 20}. Adult nocturnal enuresis is frequently associated with detrusor overactivity\textsuperscript{21, 22}.

DLPP measures the degree of the compliance of the bladder\textsuperscript{23} particularly in patients with neuropathic
bladder. It is measured by filling the bladder and determining the detrusor pressure at which there is leakage from the urethra. DLPP of more than 40 cmH₂O determines the detrusor pressure at which there is leakage. Valsalva manoeuvre is asked to perform a Valsalva manoeuvre with patients with GSI. It is measured by filling the bladder to a pre-set volume (200-300 ml). After that, the patient is asked to perform a Valsalva manœuvre with progressively increase in abdominal pressure. DLPP is defined as the lowest pressure at which urethral leakage occurs. Intrinsic sphincter deficiency (ISD) is defined as DLPP less than 60 cmH₂O. In the presence of severe genital prolapse, ISD may be masked and it may be uncovered after manual reduction or treatment of the genital prolapse. DLPP of greater than 90 cm of water suggests urethral hypermobility due to bladder neck/urethral hypermobility.

**Video-ultrasonic study**

In selected patients, video-ultrasonic study is particularly valuable when details of urethral competence and support are required in the treatment of UI. Simultaneous evaluation of detrusor physiology (pressure and volume relationship), vesicourethral anatomy and vesicourethral reflux etc. can be achieved with the use of fluoroscopy.

The "minimum" indications for video are: -

a) suspected neurogenic dysfunction (to see detrusor-sphincter dyssynergia and also bladder anatomic abnormalities; b) female stress/urge/mixed incontinence (to see bladder base / urethral hypermobility and to detect leakage); c) in patients with suspected obstruction to locate the obstruction; d) in patient who have failure of prior anti-incontinence surgery

**Surface electromyography (EMG)**

It is used to test whether the incontinent patient can control the pelvic floor voluntarily and able to coordinate the pelvic floor relaxation and the bladder contraction during micturition. It is most useful in demonstrating detrusor external sphincter dyssynergia in patients with neuropathic bladder without the need of fluoroscopy. As to the value of surface EMG, it is still not convincingly helpful in improving the outcome of treatment of urinary incontinence.

**Ambulatory urodynamic study (AUS)**

Patients with incontinence inconclusive by conventional urodynamic study are eligible for AUS study. Micropip catheters are passed into the bladder and rectum, a small box of portable recorder and electronic diapers are also worn by the patients. During the ambulatory period, the patient will then record the time of urge sensation, urinary leakage, and bladder emptying. It should be noted that almost 50% women with urge incontinence will not demonstrate detrusor overactivity on single urodynamic testing. The test is also indicated in stress incontinent patients not leaking during stress test. However, it is prone to artifacts, and clinically difficult to interpret because of a high number of false-positive results noted in 38% asymptomatic volunteers. It is not widely available and still works more as a research tool.

**Summary**

Urinary incontinence is a symptom but not a diagnosis. Urodynamic investigation is useful in elucidating the cause of the incontinence and in predicting the outcome of therapy. However still, integration of symptoms, physical findings, information from voiding diary and urodynamic parameters and radiological features remains essential in making useful and sensible diagnosis to each individual patient, and hence in selecting the rational therapy for the patient.

**References**