Urodynamics

Karen Mc Kertich

This article forms part of our 'Tests and results' series for 2011 which aims to provide information about common tests that general practitioners order regularly. It considers areas such as indications, what to tell the patient, what the test can and cannot tell you, and interpretation of results.

Urodynamics is the study of lower urinary tract function and how this relates to a patient's urinary symptoms. The aim is to reproduce the patient's lower urinary tract symptoms to provide a pathophysiological explanation and to guide treatment. This article, and the accompanying patient information, focus particularly on invasive urodynamic studies.

Keywords: urinary incontinence; urodynamics

Urodynamics is the study of lower urinary tract function and how this relates to a patient's urinary symptoms. The aim is to reproduce the patient's lower urinary tract symptoms to provide a pathophysiological explanation and to guide treatment.

Types of urodynamic studies

- Noninvasive urodynamic assessment includes free uroflowmetry (measurement of urinary flow rate without catheterisation) and measurement of postvoid residual volume. These are performed before invasive urodynamic studies
- Invasive urodynamic studies (involving catheterisation) include filling cystometry and pressure flow studies
- Invasive urodynamic studies combined with imaging:
  - fluroscopic urodynamic studies (also known as videourodynamics) are performed on a tilt table with an image intensifier while the bladder is filled using radio-opaque contrast to allow anatomical definition. This is particularly useful in assessing bladder outlet obstruction, patients with neurological disorders and postoperative complications
  - ultrasound: transabdominal or transvaginal ultrasound can assist prolapse assessment and bladder neck hypermobility in women
- Ambulatory urodynamics – uses air rather than fluid filled catheters, utilises natural bladder filling and allows freedom of patient movement. This technique is only available in some academic centres.

When are urodynamic studies useful?

Urodynamic studies must be preceded by a full clinical assessment and basic investigations – urodynamics are NOT part of the initial assessment. *Table 1* highlights the key assessments required before urodynamic studies are considered.

Noninvasive uroflowmetry is commonly used but only selected patients with lower urinary tract

Table 1. Key features of urological assessment

- History – including urinary frequency, urgency, symptoms of urge and stress incontinence, urinary stream, difficulties with emptying, symptom severity, neurological disorders, prior urinary tract surgery, prolapse in women
- Physical examination – including pelvic exam for prolapse in women with assessment of pelvic floor muscle strength; digital rectal examination in men for prostatic assessment; perineal neurological examination
- Bladder diary – a chart of urinary frequency incorporating voided volumes and incontinence episode frequency provides an objective measure of voiding patterns
- Urinalysis – with midstream urine
- +/– pad weight testing for an objective measurement of urinary incontinence severity

symptoms require invasive urodynamic studies.

Invasive urodynamics are NOT indicated if the result is unlikely to change initial management. This includes common situations such as:

- conservative management of stress incontinence or the overactive bladder
- medical management of obstructive voiding symptoms in men
- medical management of overactive bladder symptoms.

Indications for invasive urodynamics

- Unclear diagnosis
- Invasive surgical interventions are being considered, as choice of procedure is influenced by urodynamic results
- Coexisting pathologies to determine which should be treated first, such as obstruction and detrusor overactivity or stress incontinence and detrusor overactivity
- Complex problems such as recurrent incontinence, neurological pathology, previous lower urinary tract surgery, pelvic surgery or pelvic radiation.

Contraindications

- Inability to comply with instructions and provide feedback on bladder sensation, eg. in severe cognitive impairment
- Inability to catheterise the bladder, eg. urethral stricture disease
- Concurrent urinary tract infection
- If urodynamic study is unlikely to change decision making, patient management or treatment outcome.

Precautions

- Urodynamic testing is generally very safe, as it is minimally invasive and performed on an awake patient
- There is a low incidence of urinary tract infection after urodynamic studies (1–2%) especially with the use of prophylactic antibiotics
- Renal impairment is not a contraindication but severe contrast allergy prohibits the use of intravesical contrast during fluoroscopic urodynamic studies
- As urodynamics are interpreted in the context of an individual's symptoms, the clinician performing the test should be fully conversant with the patient's problems
- Urodynamic studies provide a 'snapshot' of the bladder's dynamic function, hence abnormalities may occasionally be missed
- Technical artefacts are common and should be accommodated in interpretation
- The results must be interpreted with caution if the study does not reproduce the patient's symptoms or the patient is unable to void during the study. A 'bashful bladder' can result in a false negative result
- Significant technical expertise is required and the clinician involved should be properly trained in study performance, troubleshooting and interpretation.

What should I tell the patient?

Urodynamics is performed without sedation as patient feedback and cooperation (eg. with voiding) is required; however, local anaesthetic gel eases catheter insertion. Fasting is not required. Regular medications, including anticoagulants, can continue with the exception of anticholinergic medications, which should be ceased 5 days before the study.

Urodynamic studies can be performed in elderly and disabled patients.

Patients should attend with a comfortably full bladder, having completed a bladder diary and midstream urine (MSU) specimen beforehand.

Medicare eligibility and/or costs to the patient are dependent on whether the procedure is performed on an inpatient or outpatient basis, and whether it is combined with another procedure such as cystoscopy.

What to expect

The study usually takes 30–45 minutes, although patients should allow up to 2 hours in total. The patient first urinates into a special toilet that measures flow. Next, a small (eg. 2.7 mm wide) urodynamic catheter is inserted via the urethra into the bladder and a smaller (eg. 2 mm) catheter is inserted into the rectum. Patients often find the test embarrassing but there is usually minimal discomfort once the catheters are in position. The aim of the urodynamic test is to reproduce their symptoms, so urinary leakage during the test is a 'good' thing, and patients should not to be embarrassed or worried about this.

How does urodynamics work?

The aim is to reproduce the patient's symptoms and relate them to synchronous urodynamic events. Hence, continuous dialogue between the clinician and patient is necessary during the study. Insertion of a dual lumen catheter into the bladder via the urethra allows both fluid to be pumped in and vesical pressure to be measured. The bladder is filled at a fixed rate via the catheter and the patient voids around the catheter. The test is divided into different phases and allows measurement of several physiological pressures measured in centimetres of water (cm H_2O).

Pressure measures

Intravesical pressure (p_{ves}) is the pressure within the bladder and is measured by the bladder catheter. It is the sum of the pressure generated by the bladder (detrusor pressure p_{det}) and the intra-abdominal pressure (p_{abd}).

Abdominal pressure (p_{abd}) is measured by the rectal catheter.

Detrusor pressure (p_{det}) is the pressure generated by the bladder muscle. In 'subtraction' urodynamics (the commonest type) it is calculated electronically using the equation: $p_{det} = p_{ves} - p_{abd}$.

Phases of urodynamics

The filling phase assesses bladder sensation and presence of detrusor overactivity (an involuntary contraction of the detrusor muscle) as well as bladder compliance (the ability of the bladder to store urine at low pressures).

The voiding phase uses pressure-flow measurements to assess detrusor function and identify obstruction. Pressure flow nomograms can be used and a high pressure/low flow voiding pattern indicates obstruction in both genders. Urine flow rate is measured in mL/sec by a urine flowmeter.

Other measures

Bladder sensation is assessed by recording the volume at which the patient experiences:

- the first sensation of bladder fullness
- the first desire to void, and
- a strong desire to void and urgency.

Other optional measurements may be made during cystometry. These include bladder volume,

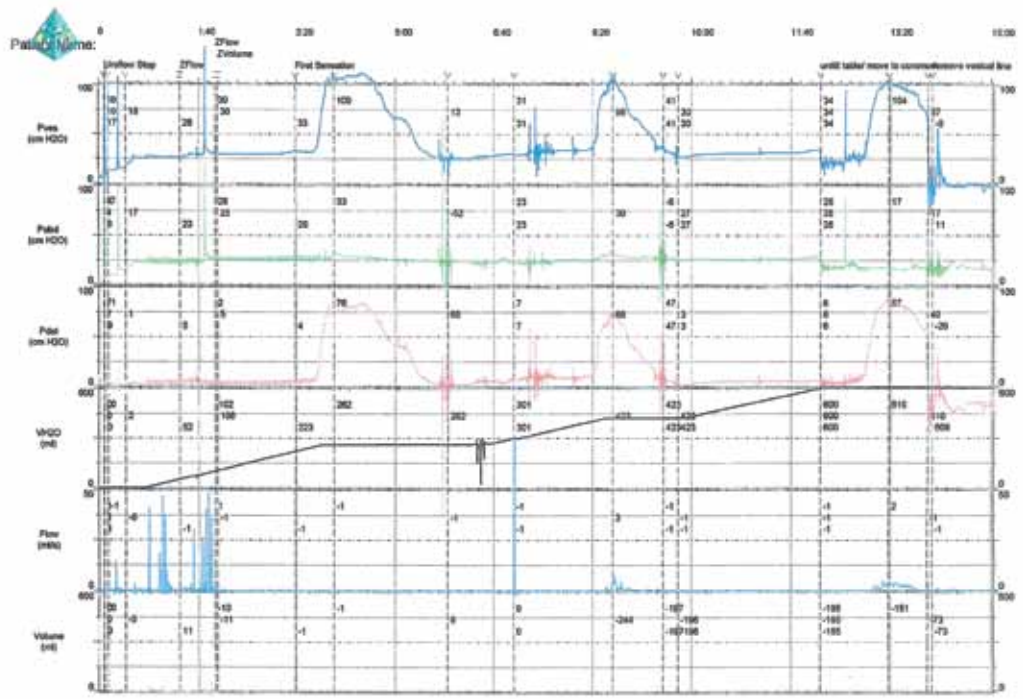

Figure 1. Study results of a man with secondary detrusor overactivity due to bladder outlet obstruction

simultaneous videocystography (videourodynamics using image intensifier), electromyography (using surface or needle electrodes to assess sphincteric muscle activity) and bladder compliance (a measure of the bladder wall elasticity calculated by measuring the change in bladder volume divided by the change in bladder pressure).

Urethral function studies

Leak point pressure is estimated by valsalva or cough. This represents the lowest bladder pressure (p_{ves}) that causes urine leakage with a rise in intra-abdominal pressure. It is a measure of urethral sphincter weakness and a lower leak point pressure indicates worse urethral function.

Urethral pressure profilometry (UPP) measures the pressure within the urethra relative to the bladder when the vesical catheter is passed into the urethra. A lower UPP indicates worse urethral function.

What do the results mean?

The results must be interpreted in the clinical context. Three common scenarios are:

- assessment of a female patient before invasive surgery for incontinence helps:
  - confirm urinary incontinence, its cause and severity (eg. stress incontinence, detrusor overactivity or mixed incontinence)
  - assess detrusor voiding function
  - assess degree of sphincter weakness
  - assess pelvic floor function
- assessment of lower urinary tract symptoms in men allows a diagnosis of:
  - detrusor overactivity (and defines whether it is a primary problem or secondary to obstruction)
  - bladder outlet obstruction (*Figure 1*) – cause and severity
  - detrusor underactivity
  - incontinence postsurgery – cause and severity
- assessment of patients with neurological disorders in whom other disorders exist such as:
  - neurogenic detrusor overactivity
  - functional bladder outlet obstruction due to urethral overactivity (eg. due to detrusor-sphincter dyssynergia)
  - poor bladder compliance (or elasticity).

What can't urodynamics diagnose?

Urodynamic studies do not give information about bladder mucosal pathology such as bladder tumour. Interpretation may be limited if the patient is unable to void during the study or if the patient's symptoms are not reproduced during the study.

What are the next steps?

Management varies with diagnosis. Guidelines for the assessment and management of adult urinary incontinence and lower urinary tract dysfunction are available at www.uroweb.org/guidelines/online–guidelines/.

Author

Karen Mc Kertich MBBS, FRACS(Urol), Australian Urology Associates, Cabrini Medical Centre and The Alfred Hospital, Melbourne, Victoria. reception@aua.com.au.

Conflict of interest: none declared.

correspondence **afp@racgp.org.au**