Neurogenic Urodynamic Technique

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The normal micturition cycle

**STORAGE PHASE**

Bladder filling
- Bladder relaxes
- Urethra contracts
- Pelvic floor contracts

**VOIDING PHASE**

First sensation to void
- Bladder relaxes
- Urethra contraction increases
- Pelvic floor contracts

Normal desire to void
- Bladder contracts
- Urethra relaxes
- Pelvic floor relaxes
- Micturition

Bladder filling
- Bladder relaxes
- Urethra contracts
- Pelvic floor contracts
Pressure – volume curve during micturition cycle

**STORAGE PHASE**
1. Accommodation
2. First sensation
3. Postponement

**VOIDING PHASE**
4. Initiation of voiding
5. Isometric Detrusor contraction
6. Sustained Detrusor contraction
7. Relaxation phase
**Voiding phase**

- Cortical facilitation
- Co-ordination of Micturition motor function
  - Parasympathetic Stimulation (M3)
  - Somatic N inhibition
    - Urethral Sphincter & PFM relaxation
- Detrusor contraction

**Storage phase**

- Cortical inhibition
- Co-ordination of bladder storage function
  - Sympathetic N Stimulation (β3)
  - Somatic N stimulation
  - Detrusor relaxation
- Urethral Sphincter & PFM contraction
The bladder cycle

FILLING PHASE

• Compliant organ – dependant on elastic properties of the bladder wall

• Fills with minimal ↑ in pressure – “accommodation”

• Urethra remains closed during filling
The bladder cycle

VOIDING PHASE
• Voluntary action

Desire to void

Relaxation of pelvic floor/
Descent of bladder base
& ↓ intraurethral pressure

Contraction of the bladder

Intravesical pressure > intraurethral pressure
→ void
The bladder cycle

**NEURAL CONTROL**

- Infrasacral – peripheral nerves
- Suprasacral - spinal cord
- Suprapontine - intracranial
Neurological Lesions

• Loss of function – "areflexia" or denervation

• Release of reflex function – "over activity" or hyperreflexia
Neurogenic detrusor overactivity

Incomplete/non-traumatic spinal cord lesions

- Sprouting of new pathways
- Increased detrusor contractions
Detrusor sphincter dyssnergia

• 70-100% of supraspinal cord lesions

• Contraction of the external urethral sphincter during an involuntary detrusor contraction

• Can be diagnosed with sphincter EMG findings or simultaneous urethral and detrusor pressure measurements

• Videourodynamics better at getting diagnosis

• Large residuals, recurrent UTI’s, high voiding pressures and hydronephrosis
Detrusor sphincter dyssynergia (DSD)

- Diagnosis crucial as 50% chance of urological problems within 5 years
- Treatment directed at bladder sphincter dysfunction
Detrusor Overactivity & Detrusor sphincter dyssynergia (DSD)

Lesions between sacral spinal cord & pons 
e.g thoracic & cervical cord injury

• 10-20% SCI pts with DSD have dyssynergia of urethral sphincter
• Manage with ISC or sphincter ablation to ↓ detrusor pressures
**Detrusor sphincter dyssynergia (DSD)**

Sacral & lumbar injury
- Low pressure urine storage system
- Manage with ISC

Upper motor neurone injury
- Increased bladder tone & decreased compliance
- May lead to upper tract damage
Conditions affecting the brain

- CV accident
- Parkinson’s Disease
- Brain neoplasms
- Dementia
- Shy-Drager syndrome (Multiple System Atrophy) (SDS)(MSA) is a rare degenerative condition resulting from degeneration of certain nerve cells in the brain and spinal cord.
Conditions affecting spinal cord

- Spinal cord injury
- Multiple sclerosis
- Intervertebral disc lesion
- Ankylosing spondylitis
- Guillan-Barré syndrome
- Tabes dorsalis
- AIDS
- Lyme disease
- Poliomyelitis
- Herpes zoster
Conditions affecting peripheral nervous system

- Pelvic plexus injury
- Abdominoperineal injury
- Hysterectomy
- Diabetic neuropathy
Neurological evaluation

- History
- Physical examination
- Urine bacteriological samples
- Renal function studies
- Radiological evaluation – upper tracts
  - lower tracts
- Endoscopic examination
- Urodynamic/video-urodynamic evaluation
History

- Neurological disease
- Surgery
- Trauma
- Urinary infection
- Incontinence
- Medication
Examination

Assessment of sacral reflexes

• Bulbocavernosus reflex (S3 and 4)
• Cough reflex (S2 – 4)
• Anal skin reflex (S5)
Bacteriological studies

UTI can worsen or cause symptoms of storage failure

- Major cause of morbidity & mortality in patients with neuropathic bladder
- Pyuria $\geq 10^4$ WBC suggests infection
- Treat if symptomatic or pyuria
- No consensus on management
Renal function studies

Abnormal renal function studies suggests

• High-pressure storage
• High-pressure emptying
• Infection with reflux
• Intrinsic renal or pre-renal disease

Need to modify techniques to account for muscle wasting
Radiological studies

Upper tract evaluation

• Voiding cystourethrogram
• IVP
• Renal USS and urogram
Endoscopic examination

- Primary & secondary urethral anatomic pathology
- Areas suggestive of malignant change
Residual urine

• Do not drain on catheterisation in patients with detrusor hyperreflexia and high residual volumes

• Sudden and complete bladder emptying alters pattern of reflex detrusor activity/detrusor-sphincter dyssynergia

• Check residual with ultrasound or catheter at another time
Postvoid residual

- PVR suggests outlet resistance +/- or detrusor Contractility

- Areflexic bladder
- Detrusor sphincter dyssynergia
Why perform urodynamics?

- Symptoms of neurogenic bladder often not specific
- Urodynamics aids diagnosis and therapy

**BUT**

- Correlation of urodynamics and symptoms is only \(~50\)%
Why perform urodynamics?

• Symptomatic treatment of patients with multiple sclerosis and lower urinary tract dysfunction cure/improves 28%
• Treatment led by urodynamics of patients with multiple sclerosis cure/improves 83%

Blaivas 1980
Neurogenic bladder dysfunction

Urodynamics describes

- Dysfunction of bladder, urethra & pelvic floor
- Co-ordination during filling and voiding
- Influence on other pathology (autonomic dysreflexia)
Basic principles

• Not deliberately provocative

• May need several voiding cycles

• Perform 3-6 months after spinal injury
To image or not to image?

- Anatomical abnormalities: bladder diverticula, trabeculation, vesicoureteric reflux, dyssynergia
- Best shown using videocystourethrography
Filling rate

- Start at 10 ml/min
- Slowly increase up to 20 or 30 ml/min
- Stop filling temporarily if detrusor pressure starts to rise
- Restart once filling falls or equilibrates

ICI 1998
Voiding cycles

- First voiding sequence unrepresentative after catheterisation
- 2 or 3 voiding cycles needed
- Use dual lumen catheter
Indications for repeat urodynamics

• Recurrent UTIs

• Development of upper tract dilatation

• Onset of autonomic hyperreflexia

• Change in voiding patterns
EMG recordings

- Needle electrodes in external anal sphincter, levator ani and striated urethral sphincter

- Superficial electrodes on anal plug

- Variations between 3 sites in partial cauda equina lesions
EMG recordings

- Perineal floor innervation & control
- Integrity of innervation
- Diagnosis of neuropathy
- Co-ordination of detrusor & striated sphincter during filling & voiding
EMG recordings

Normal EMG

• Voluntary contraction, reflex activation & bladder filling → ↑ EMG activity

• Voiding → ↓ EMG activity

• Polyphasic potentials rare
EMG recordings

Neurological lesions

- Infrasacral lesions → absent EMG & ↑ polyphasic potentials

- DSD → Presence/persistence of EMG activity during a detrusor contraction
Special problems

• Intact conus reflexes and suppositories

• Asymptomatic bacteriuria and prophylactic antibiotics

• Positioning - if paralysed examine supine in right oblique position
Special problems

- Catheterisation may cause spasm
- Catheters may difficult to pass as urethral sphincter spasm
- Abdominal and limb spasm
Autonomic dysreflexia

- Occurs during filling phase
- Patients with neuropathy and high spinal cord injuries
- Excessive sweating, pounding headache, hypertension, tachycardia or bradycardia
- Blood pressure monitoring throughout filling
- If blood pressure rises stop test immediately and empty bladder
Conclusion

- Investigation of the neurological patient requires time
- Different techniques of emptying and filling
- Care should be taken of possible complications