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Urethral function studies and urodynamics in women

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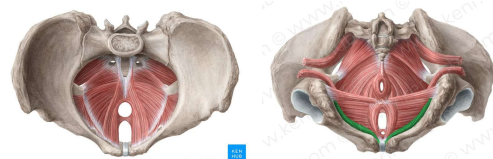
Outline

- Stress urinary incontinence
 - Risk factors
 - Anatomy and applied clinical relevance
 - History and physical examination
 - Investigations
 - Urodynamic evaluation
 - Controversy
 - Urethral function studies
- Pelvic organ prolapse
 - Assessment
 - Urodynamic evaluation
- Urinary retention

Risk factors for stress urinary incontinence

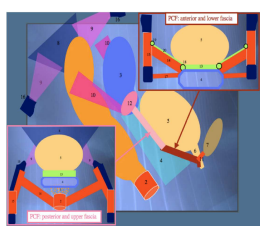
- Age, menopause
- Obesity
- Vaginal delivery
- Pregnancy
- Radiation

Pelvic floor anatomy



Pelvic floor anatomy


• Fascio-ligamentous support: Petros integral theory



1: Rectum, 2: Anal canal, 3: Uterus, 4: Vagina, 5: Bladder, 6: Urethra, 7: Pubic bone, 8: Coccygium, 9: Sacrospinous ligament, 10: Uterosacral ligament, 11: Pubourethral ligament, 12: Cervical ring, 13: Puboanovaginal fascia, 14: Levator ani muscle, 15: Internal obturator muscle, 16: Ischial spine, 17: Perineal membrane, 18: ATFP, 19: ATLA, 20: Endopelvic fascia

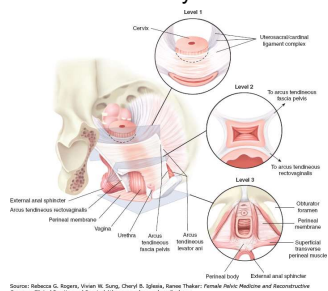
Pelvic floor anatomy

• Compartments: Delancey's hammock theory



Pelvic floor anatomy

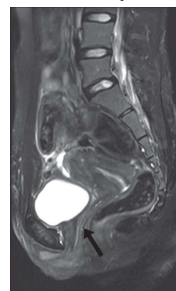
- Compartments: Delancey's hammock theory



Source: Rebecca C. Rogers, Vivian H. Sung, Cheryl B. Spinks, Ramon Thaler. Female Pelvic Medicine and Reconstructive Surgery: Clinical Practice and Surgical Atlas. www.accessmedicine.com

Pelvic floor anatomy

- Compartments: Delancey's hammock theory



History taking

- Rule out other pathology: infection / malignancy
- Differentiate storage / voiding symptoms
- Obstetric history / surgical history
- Risk factors
- Bowel function / sexual function
- **Expectation**
- **Bother**

Physical examination

- Demonstrate urinary leakage
- Pelvic organ prolapse
- Palpate pelvic floor muscles
- Assess muscle strength

Questionnaires

Table 1: Summary of the ICUD review 2012*

	Category A (all 3 criteria fulfilled)*	Category B (2 criteria fulfilled)*	Category C (only 1 criterion fulfilled)*
Symptom measures and health-related QoL measures	ICIQ-UI Short Form, ICIQ/LUTS, ICIQ-MILUTS, IQ and IQ-7, I-CQL, ICIQ-Urinal, ISS, WHO, LIS (7-interview), N-QoL, OAB-q SF, OAB-q, ICIQ-Diapp, PFDI and PFDI-20, PFIQ and PFIQ-7, PFIQAB, LISS	Constix, EPQ, LUTS tool (OQ)/VPS	ABSSQ, ISL, ISQ, UIH, UIQ
Measure of patient satisfaction (patient's measure of treatment satisfaction)	SRW, OAB-q, OABSAT-q, TBS	PPQ	EPI, GPI, PSQ
Goal attainment scales		SAGA	
Screening tools (used to identify patients with UI)	B-SAQ, OAB-SS, OABWS, OAB-VS, QUIP	ISQ, USP	SIQ, CLSS, MESA, PUF
Patient symptom scale			
Assessment of symptom bother and overall bother	PFBC, UII or UII-6, LUIS, PFI and PFI-5	PFBC, SSI and SII	PMSES, POSQ, UI-4
Assessment of the impact of urgency	LUIS, U-IQ, UIU Scale, U-UII	PPUIS, SUIQ, UPIScore, UPIScale, UQ, USIQ-QOL, USIQ-S, USS	
Questionnaires to assess sexual function and urinary symptoms		FSFI, ICIQ-VS, PISQ, SCoL-F	SFQ
Treatment adherence Measures		MASRI	

Other investigations

- Bladder diary
- Uroflowmetry
- Urine analysis
- Imaging (X)
- Cystoscopy (X)

Urodynamic evaluation

- Controversy
- Value of leak point pressures
- Value of urethral function evaluation
- Techniques

“should all women have urodynamic evaluation before undergoing continence surgery?”

Aims of urodynamic evaluation

- To **define**: bladder function and urethral function
- To **reproduce**: identify the pathophysiology behind the symptoms
- To **diagnose**
- To **select**: appropriate management option
- To **predict**: worse outcomes (detrusor overactivity / voiding dysfunction)

“Urodynamic study identifies incontinence mechanism”

- Able to differentiate USI, DOI, MUI, etc
- SUI diagnosed by visualising urine leakage on bedside cough tests
- Careful history taking able to reveal cough-induced detrusor overactivity
- Urodynamic study sometimes fail to reproduce symptoms

“identifying DO can predict worse outcome”

- Detrusor overactivity may worsen after surgery
- Doesn't affect the management (surgery plus medical treatment)
- Several studies suggest DO may improve after surgery

“identifying voiding dysfunction predicts worse outcome”

- Provide better counselling before surgery
- Diagnosis of voiding dysfunction is uncertain, As there is no agreed definition
- Normal voiding function cannot preclude voiding dysfunction after surgery

What do the guidelines say?

NICE 2019

- Do not perform urodynamic evaluation before primary surgery if SUI is diagnosed based on detailed clinical history and demonstrated SUI at examination

AUA 2017

- Physicians may omit urodynamic evaluation for the index patient desiring treatment when SUI is clearly demonstrated
- “Index patient” : otherwise healthy female considering surgical treatment for the correction of SUI

EAU 2019

- Perform urodynamic evaluation if findings may change the choice of invasive management

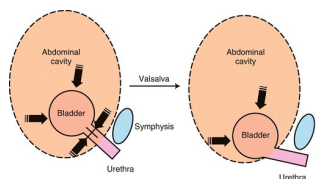
“should all women have urodynamic evaluation before undergoing continence surgery?”

Mechanism of stress urinary incontinence

Urethral hypermobility
vs
Intrinsic sphincter deficiency

Urethral hypermobility

- Downward displacement of bladder neck and / urethra during an increase in abdominal pressure
- Decreases pressure transmission to urethra
- Delancey's hammock theory



Intrinsic sphincter deficiency

- Inability of urethra to generate enough outlet resistance to keep it closed
- Nerve, muscle, mucosa, scarring etc

Blaivas classification of USI

Classification	Findings	Fluoroscopic Image
Type 0	A. Rest: flat bladder base above symphysis pubis B. Cough: rotational descent of urethra and bladder base; no leakage	
Type I	A. Rest: flat bladder base above symphysis pubis B. Cough: bladder base descends; vesical neck and urethra open with leakage	
Type IIA	A. Rest: flat bladder base above pubis B. Cough: marked descent and rotation of bladder and urethra below pubis; urethra opens widely with leakage	
Type IIB	A. Rest: flat bladder base below pubis B. Cough: further descent and rotation of bladder and urethra below pubis; urethra opens widely with leakage	
Type III	A. Rest: bladder base above pubis; vesical neck and urethra are open B. Cough: bladder base above pubis; vesical neck and urethra are open	

Adapted, with permission, from Blaivas JG, Olson CA. J Urol. 1988;139:727-731.*

Urethral function studies

- Fluoroscopy during video urodynamic study
- Abdominal leak point pressure
- Urethral pressure profilometry

Abdominal leak point pressure

- What is it?
- How to measure it?
- How to interpret?
- Limitations
 - Not able to demonstrate in everybody
 - Visualisation of leakage
 - Catheter size and urethral obstruction
 - Variable baseline intravesical pressure
 - Patient position and bladder filling

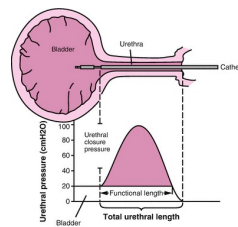
Urethral pressure profilometry

- What is it?
- Urethral pressure is the fluid pressure which is required to just open a closed urethra
- Profilometry describes the change in intraluminal pressure along the length of urethra

Urethral pressure profilometry

- How is it measured?
- Brown and Wickham method
- Measures the pressure needed to perfuse a catheter at constant rate, while the bladder catheter is drawn at a steady speed (2mm/sec)
- Perfusion at a constant rate can be achieved by a syringe pump (or sometimes a pressure bag)

Urethral pressure profilometry



- Interpretation:
- Maximal urethral closure pressure
- Functional urethral length

Urethral pressure profilometry

- Normal values:
- 92 - age (Edwards 1974)
- >30 (<20 being diagnostic of ISD)
- Highly variable
- Bladder filling
- Patient position
- Method to produce constant rate of filling
- Catheter size

Urethral function studies

- Fluoroscopy during video urodynamic study
- Abdominal leak point pressure
- Urethral pressure profilometry
- Conclusion:
- No one single study is effective to make a diagnosis of underlying mechanism of urodynamic stress incontinence
- Use in conjunction with standard urodynamic study to give more information to enable better counselling

Techniques during urodynamic study

- Patient positioning
- Provocative tests
- Role of video urodynamic
- Role of ambulatory urodynamic

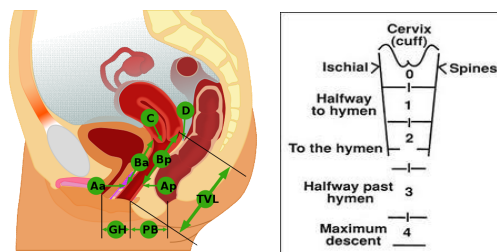
Pelvic organ prolapse

- Presentation
- Assessment
- Relationship between Delancey's level and POP
- Terminology
- Association of POP and UI
- Effect on POP on urodynamic parameters

Presentation of POP

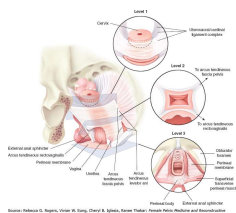
- Asymptomatic
- dragging sensation
- Mass felt / seen
- Urinary incontinence
- Voiding dysfunction
- Pain (uncommon unless associated with mucosal ulceration)

Assessment of POP



Delancey's level of support

- Anterior Wall Defects :
 - Cystocele - Level 2
 - Urethral hypermobility (SUI) - Level 3
- Posterior Wall Defects :
 - Rectocele - Level 2
- Apical Defects:
 - Uterovaginal Prolapse -Level 1
 - Vaginal Vault Prolapse-Level 1
 - Enterocele - Level 1



Terminology - pelvic floor dysfunction

- Lower urinary tract symptoms: urinary incontinence, voiding dysfunction
- Defecatory dysfunction
- Sexual dysfunction
- Pelvic organ prolapse (anterior wall defect, posterior wall defect)

Association of POP and UI

- In all grade POP, SUI reported in up to 40%
- In grade IV POP, 60% has urinary incontinence

'should all women planning for POP repair undergo urodynamic study?'

Effect of POP on urodynamic parameters

- Qmax & RU are not affected
- Not associated with voiding dysfunction or detrusor overactivity
- DLPP and MUCP decrease with reduction of prolapse
- So how to do a urodynamic study in patients with POP?
- How to reduce the POP at the study

Urinary retention in women

- What is retention?
- Transient causes
- Causes for persistent urinary retention
- Assessment
- Definition of BOO in women
- Management of urinary retention

Urinary retention

- Complete retention
- Incomplete emptying / elevated post void residue
- Symptomatic / asymptomatic
- Acute / chronic
- Bladder dysfunction / bladder outlet dysfunction

Transient causes

- Immobility (esp post operation)
- Fecal impaction
- Urinary tract infection
- Delirium
- Post partum urinary retention
- ~30% no identifiable cause
- ~50% void normally without treatment

Bladder dysfunction

- Acontractile detrusor
- Detrusor underactivity
- Neurogenic: lower motor neuron
- Myogenic: chronic distension / diabetes
- Aging

Bladder outlet dysfunction

- Anatomical
- Stricture: iatrogenic (catheterization, surgery, radiation, pelvic fracture)
- Post continence surgery
- POP
- Urethral diverticulum
- Ureterocoele
- Functional
- Dysfunctional voiding
- Primary bladder neck obstruction
- Detrusor external sphincter dyssynergia

Assessment

- Transient causes
- Focal neurological examination (no urological evaluation can tell neurogenic or not)
- Uroflowmetry and post void bladder scan
- Urodynamic study (surface EMG not always helpful)

Problems of urodynamic study

- Many women cannot void at CMG suite
- Unnatural environment
- Women empty their bladders by relaxing pelvic floor, sometimes with aid of abdominal muscles, without generating a strong detrusor contraction
- BOOI & BCI formulae don't apply
- Difficult to diagnose detrusor underactivity
- Small changes in Pdet may define BOO

Assessment of BOO in women

- Absolute cut-off values
- Fluoroscopy identifying radiological evidence
- Nomograms

Definition of BOO in women

- Massey & Abrams: 2 out of 3
 - $Q_{max} < 12$
 - $P_{det} > 50$
 - Urethral resistance (P_{det} / Q_{max}) > 0.2
- Axelrod & Blaivas: $Q_{max} < 12$ & $P_{det} > 20$
- Chassagne et al: $Q_{max} < 15$ & $P_{det} > 20$
- Lemack & Zimmern: $Q_{max} < 11$ & $P_{det} > 21$
- Groutz et al: $Q_{max} < 12$ & $P_{det} > 20$

Definition of BOO in women

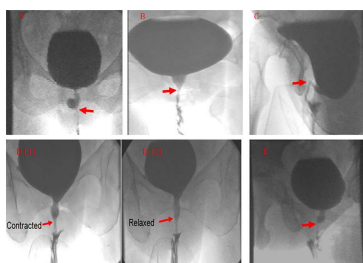
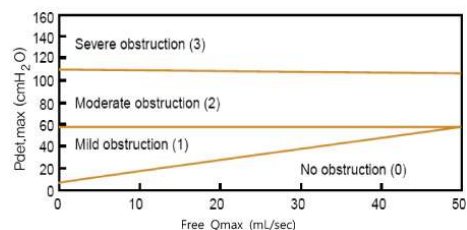


FIGURE 1 Characteristic radiographic presentation of A) urethral diverticulum, B) stricture, C) cystocele causing urethral kinking (oblique view), D) non-relaxing sphincter in contracted and relaxed forms, E) post-TVV BOO

Definition of BOO in women



- Blaivas & Groutz N&U (2000) 19:553-564

Definition of BOO in women

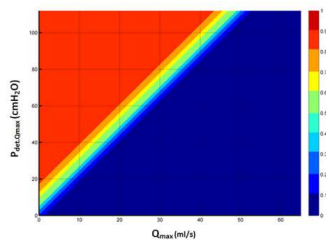


FIGURE 4 Binary logistic regression analysis derived color map that indicates the probability of BOO for a combination of $P_{det, Q_{max}}$ and Q_{max} values. The decision boundary ($P=0.5$) is given by the axis with the equation $P_{det, Q_{max}} = 2.2 \times Q_{max} + 5$.
(The Solomon-Greenwell Nomogram) *Neurourol Urodyn.* 2018 Jan;37(1):368-378

Take home messages

- When empirical or conservative management does not provide adequate symptom relief, urodynamic study is indicated
- Urodynamic study should always be performed in women with SUI with other LUTS prior to invasive treatment
- Urodynamic study may guide the options of surgery
- Urodynamic study has not been shown to affect treatment outcome