Urodynamic study-
Uroflowmetry, CMG, UPP and VUDS

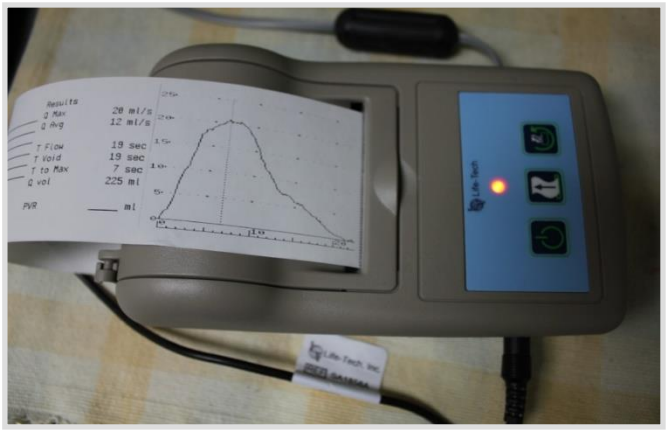
Urodynamics

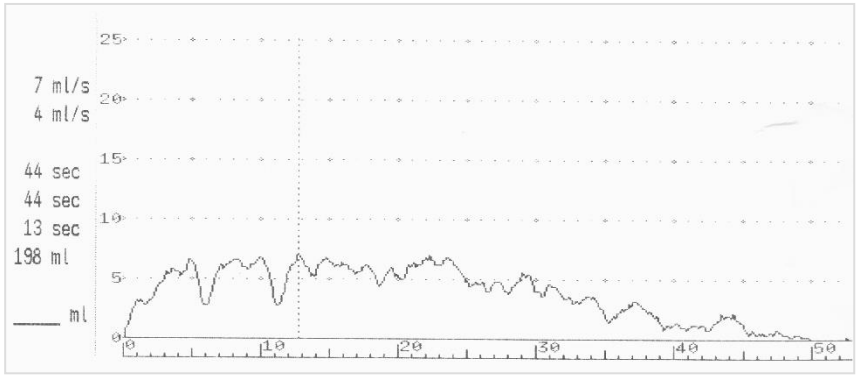
- The study of the function of the lower urinary tract, that objectively measures and documents the entire micturitions.
  - Storage phase + empty phase.
- Aim to reproduce the patient's symptomatic complaints during urodynamics, and obtain information of urinary tract function and dysfunction
  - To confirm clinical diagnosis
  - To compare treatment results
  - To investigate pathophysiology of urinary tract diseases

Urodynamic study focusing

UDS testing	Function investigated
Uroflowmetry	Voiding process
Cystometry	Storage phase
DLPP	Risk of upper tract deterioration
VLPP	Urethral competence
Pressure flow study	Voiding process
Urethral pressure profile	Urethral function (continence)
EMG	Pelvic floor muscle activity
Videourodynamics	Anatomical and functional details

Uroflowmetry (UFM)



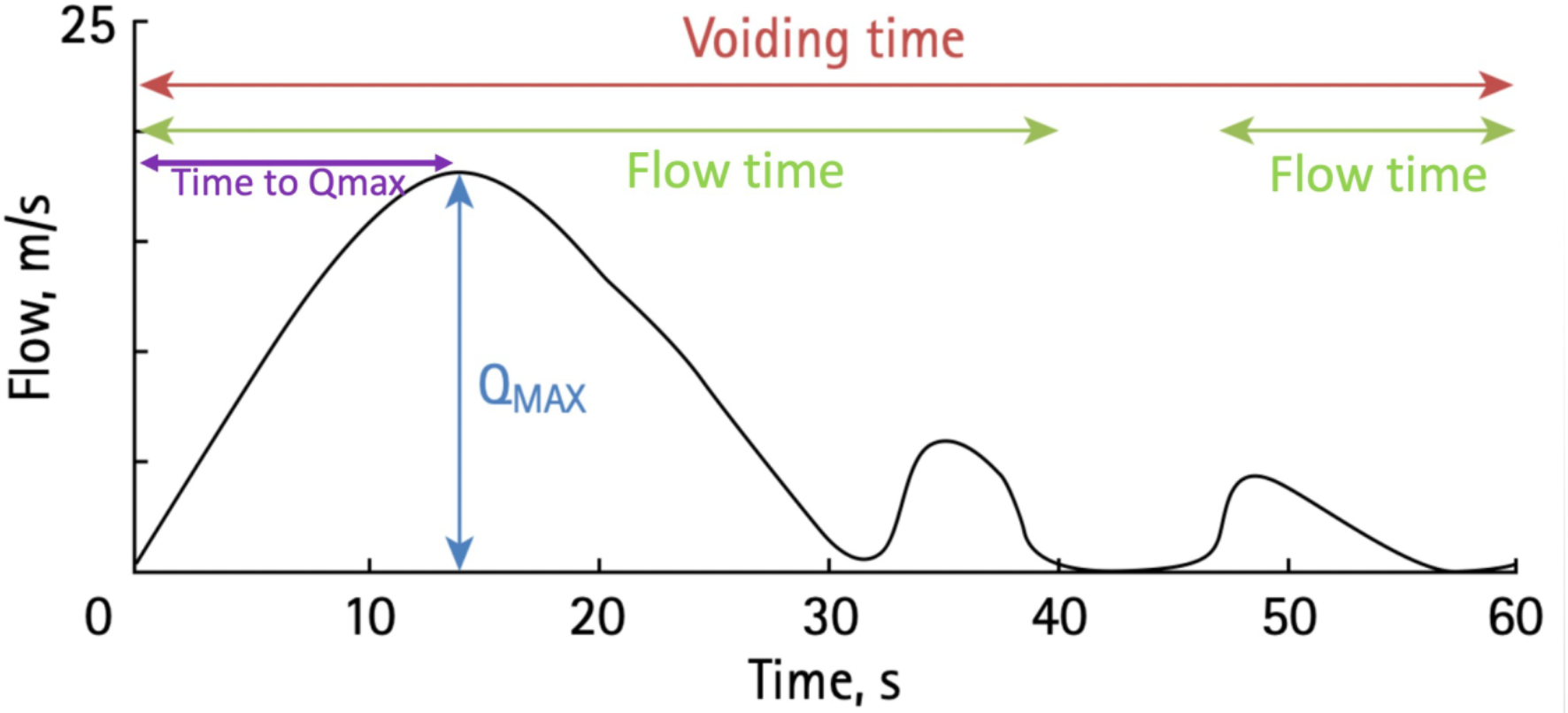


Uroflowmetry (UFM)

- A fast, simple, safe, inexpensive, and noninvasive exam
- Flow rate + flow pattern, recreate a patient's natural voiding pattern
- Indications: as initial evaluation and post-op f/u of
  1. BPH
  2. Urinary incontinence
  3. Urethral strictures
  4. Recurrent UTIs
  5. Neurogenic bladder dysfunction

Preparation for UFM

- Comfortable and silent room
- normal desire to void without urgency (preferably first desire to void);
- >=3 UFM measurements to confirm a reliable result theoretically
- Ideal voided volume 150 –550 ml for accuracy of testing



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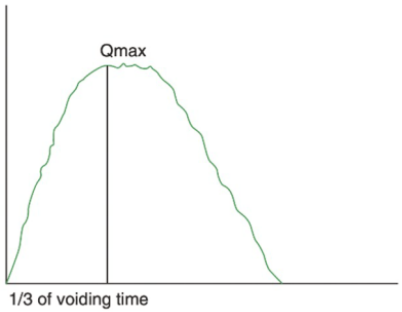
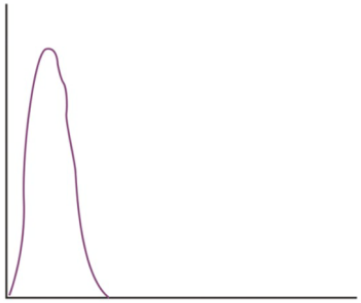
Continuous flow curves

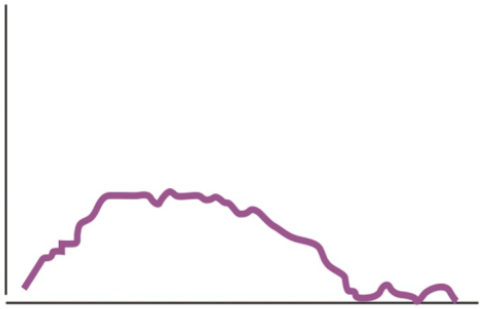


Normal bell shape



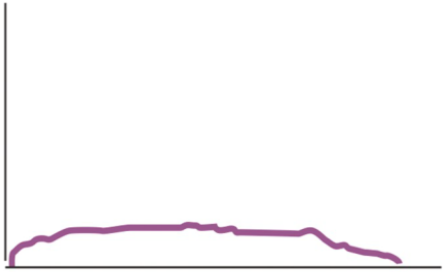
Tower shape/Supervoider

- After surgery for BOO
- Decreased urethral resistance (SUI with ISD)
- Detrusor overactivity



Compressive flow curve

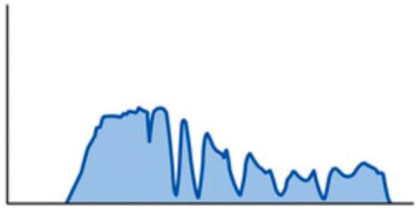
- elongated into a tail
- BPH



Constrictive flow curve

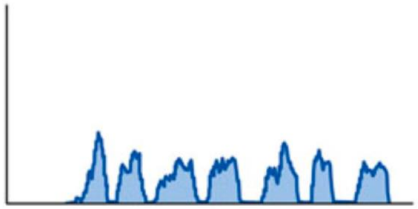
- Plateau-shaped
- Little change between Qmax and Qave
- Anastomotic stricture

Interrupted flow curves



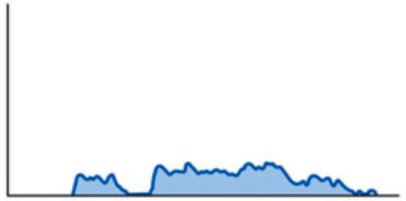
Staccato/Undulating

- Sawtooth curve
- Burst of involuntary ES contractions
- Dysfunctional voiding
- DSD
- Anxiety



Intermittent

- A flow stops (reaching zero) and starts several times
- Abdominal straining
- Poor sustained or fluctuating detrusor contractions
- DSD



Compressive flow curve

- A symmetrical trace with a low maximum flow rate
- Qmax may occur in the 2nd half of the trace
- Continuous or interrupted

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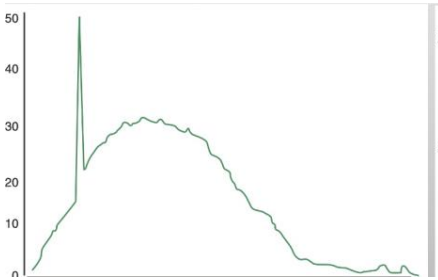
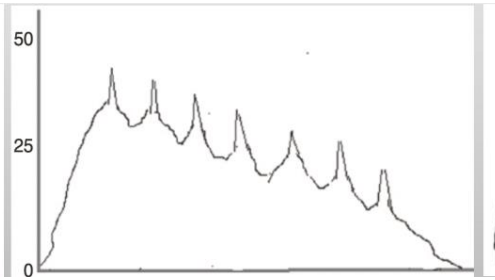
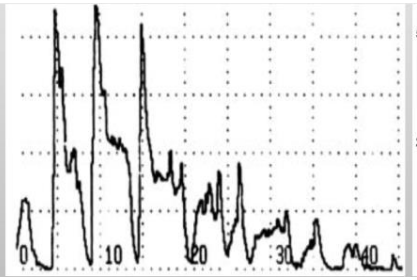
Artifacts



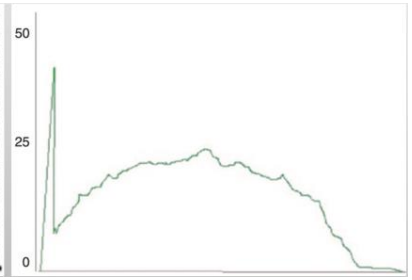
Accidental kick to the instrument



Cruising



Squeezing



Compression of the glans

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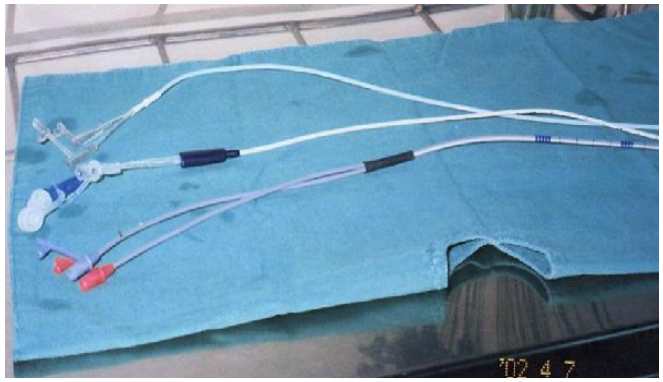
Cystometrography (CMG)

- Demonstrate the entire filling (cystometry) and voiding (pressure-flow study)process
- Measuring intravesical pressure (Pves) during bladder filling
- Physiological rate: body weight/4 (ml/min)
- Non-physiological filling
- Combined with abdominal pressure (Pabd) and external sphincter electromyography (EMG)
- Detrusor pressure (Pdet) = Pves- Pabd

Setup

- Step 1: EMG electrode placement
- Step 2: Sterilizing the urethra
- Step 3: Post-void residual urine measurement
- Step 4: Catheter insertion into the bladder and rectum
- In female, advance the catheter into UB 8-10 cm
- In males, do not advance it more than 24 cm
- Place the rectal catheter to a depth of approximately 10-15 cm

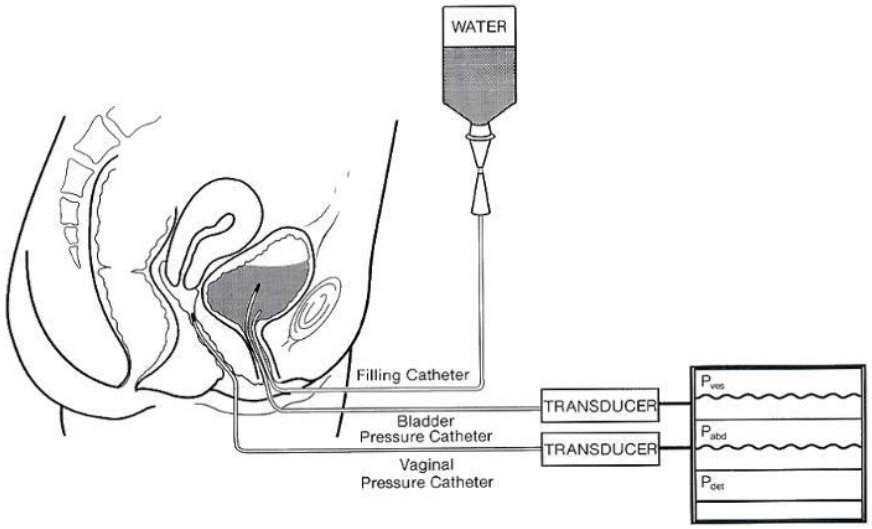


Urethral catheter – 6 or 8 Fr

Rectal balloon catheter–8 or 10Fr

Setup

- Step 5: Flushing
- Step 6: Zeroing UDS machine
- Step 7: Checking the quality of signals
- By asking the patient to gently cough
- Periodically checked during filling (every 50ml), at the end of filling, after voiding



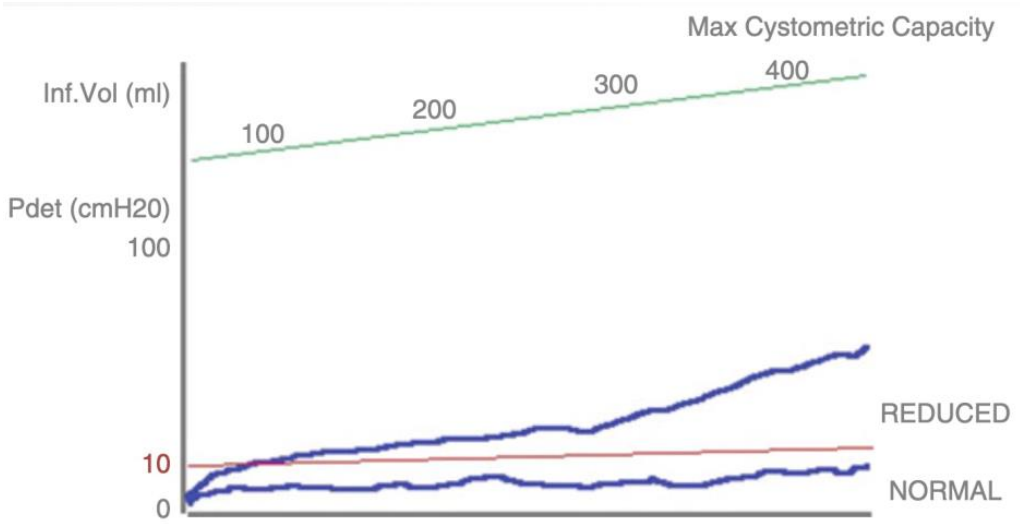
Filling phase

- Bladder sensation:

1. First sensation of filling (FSF): patient realizes that the bladder is filling
2. First stimulus of voiding (FS): experiences for the first time the need to urinate
3. Strong desire (US): becomes difficult to postpone micturition
4. Maximum cystometric capacity: volume beyond which you cannot put off micturition

Filling phase

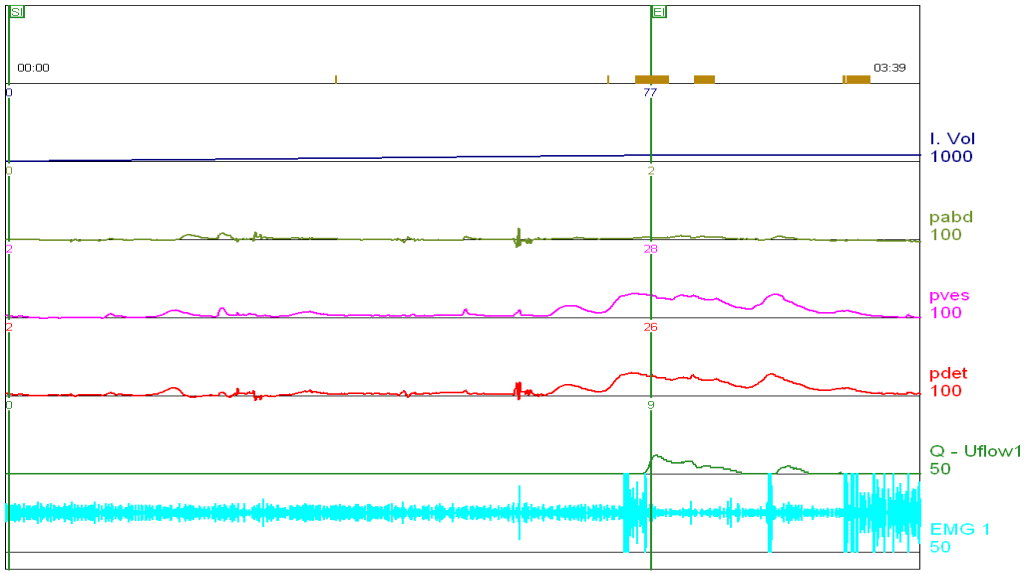
- Bladder compliance (Δ volume/ Δ pressure): <30-40ml/cmH2O.



- DLPP (lowest detrusor pressure at urinary leakage in the absence of DO or abdominal straining):40 cmH2O to determine the safe bladder capacity.

Filling phase

- Detrusor function (DO, spontaneous or provoked)



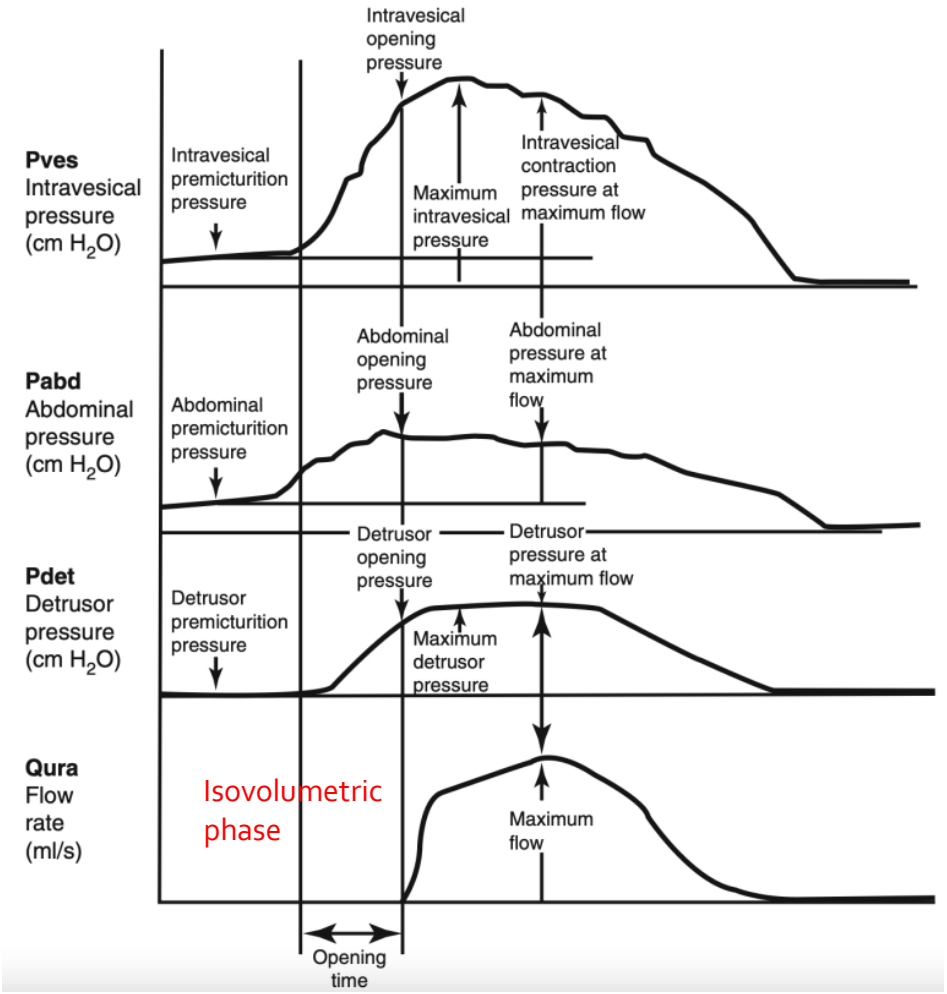
- Involuntary contractions (spontaneous or provoked) during filling is defined as detrusor overactivity

Filling phase

- Urethral function

1. Urodynamic stress incontinence (USI)
   - Leakage seen at the urethral meatus during coughing while the trace shows no detrusor contraction
   - Coughing to demonstrate USI is best performed with a patient sitting on the electronic urodynamic chair with a bladder filling of 150 ml
2. Abdominal leak point pressure (ALPP)
   - Vesical pressure at leakage during a voluntary increase of abdominal pressure in the absence of DO
   - Valsalva maneuver (VLPP), coughing (CLPP)

Voiding phase



Opening pressure	pressure recorded at the onset of urine flow
Opening time	time elapsed from the initial rise in detrusor pressure and the onset of flow
Maximum pressure	the maximum value of measured pressure
Pressure at maximum flow	lowest pressure recorded at maximum measured flow rate

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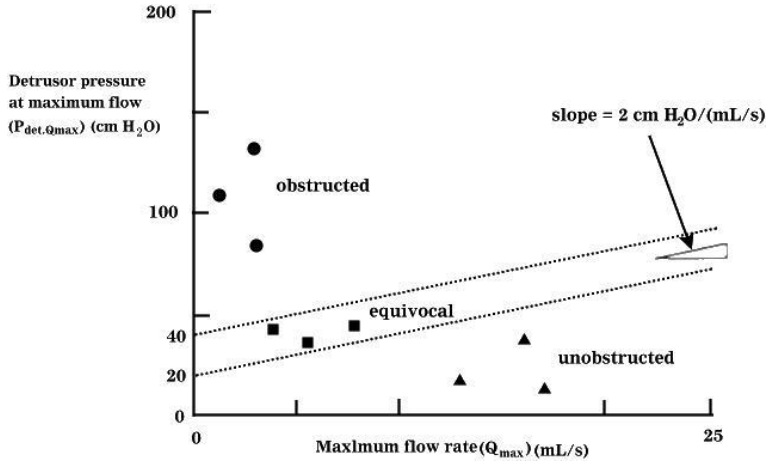
Voiding phase



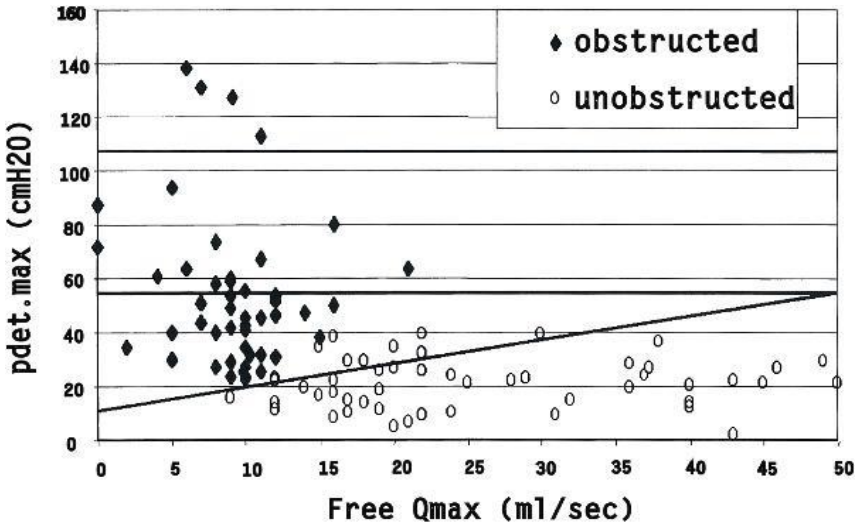
BOO in men

1. Bladder outlet obstruction index(BOOI)
   - Pdet@Qmax – 2Qmax
   - > 40: Obstructed
   - 20–40: Equivocal
   - < 20: Unobstructed
2. Bladder contraction index(BCI)
   - Pdet@Qmax + 5 Qmax
   - > 150: Strong contractility
   - 100–150: Normal contractility
   - < 100: Weak contractility

Voiding phase

BOO in women

- No consensus about standard urodynamic criteria for the diagnosis of DU and BOO in women.
  - BOOI female, Groutz and Blaivas nomogram …



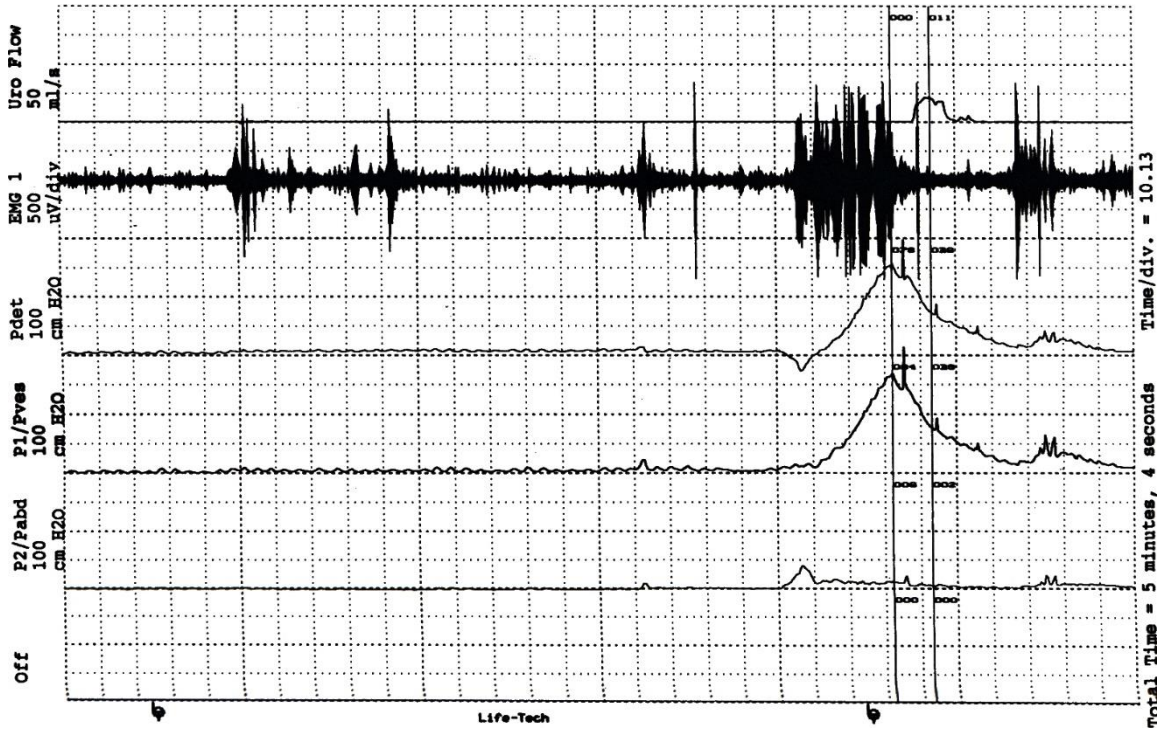
Voiding phase

BOO in women

- Etiology:
  - Anatomical: pelvic prolapse, urethral stricture, iatrogenic obstruction after stress incontinence surgery
  - Functional: dysfunctional voiding, poor relaxing of pelvic floor muscle
- Clinical practicing threshold:
  - Qmax < 12 ml/s combined with a Pdet Max of >20 cmH2O
  - Evident radiographic obstruction in the presence of a sustained detrusor contraction of >20 cmH2O

Voiding phase

- Electromyography (EMG)



Urethral sphincter dyssynergia

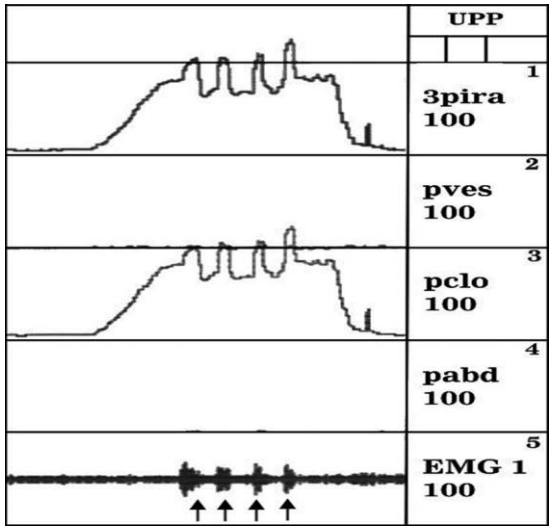
Urethral Pressure Profilometry (UPP)

Urethral Pressure Profilometry (UPP)

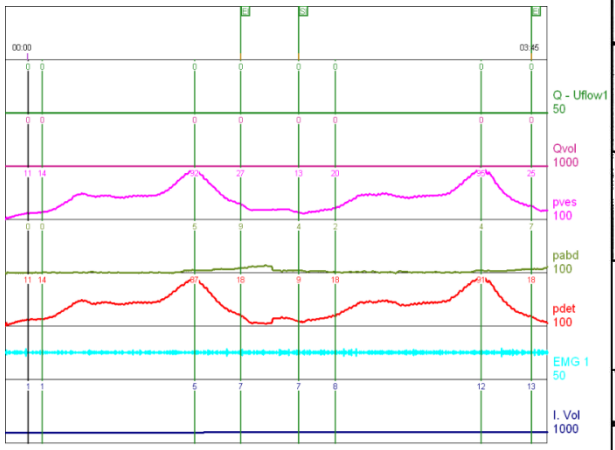
- UPP is a graph indicating the intraluminal pressure along the length of the urethra from the bladder neck to the external meatus in females/ bulbous urethra in males.
- The maximum pressure is assumed as the urethral closure function.
- Despite abundant literature on UPP, its clinical relevance is controversial, so not routinely perform in clinical practice.
- Academic purpose and assessment of therapeutic results (e.g. urethral injection)

Urethral Pressure Profilometry (UPP)

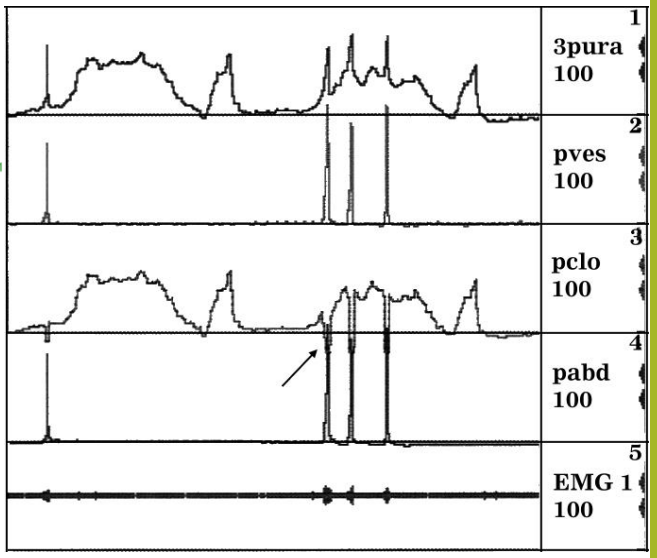
- Measuring Intra-urethral resistance by perfusion technique or microtip transducer
- A static pressure measurement, but cannot predicting voiding efficiency



Voluntary Pelvic floor contraction



UPP after RaRP



Stress UPP in Incontinent woman

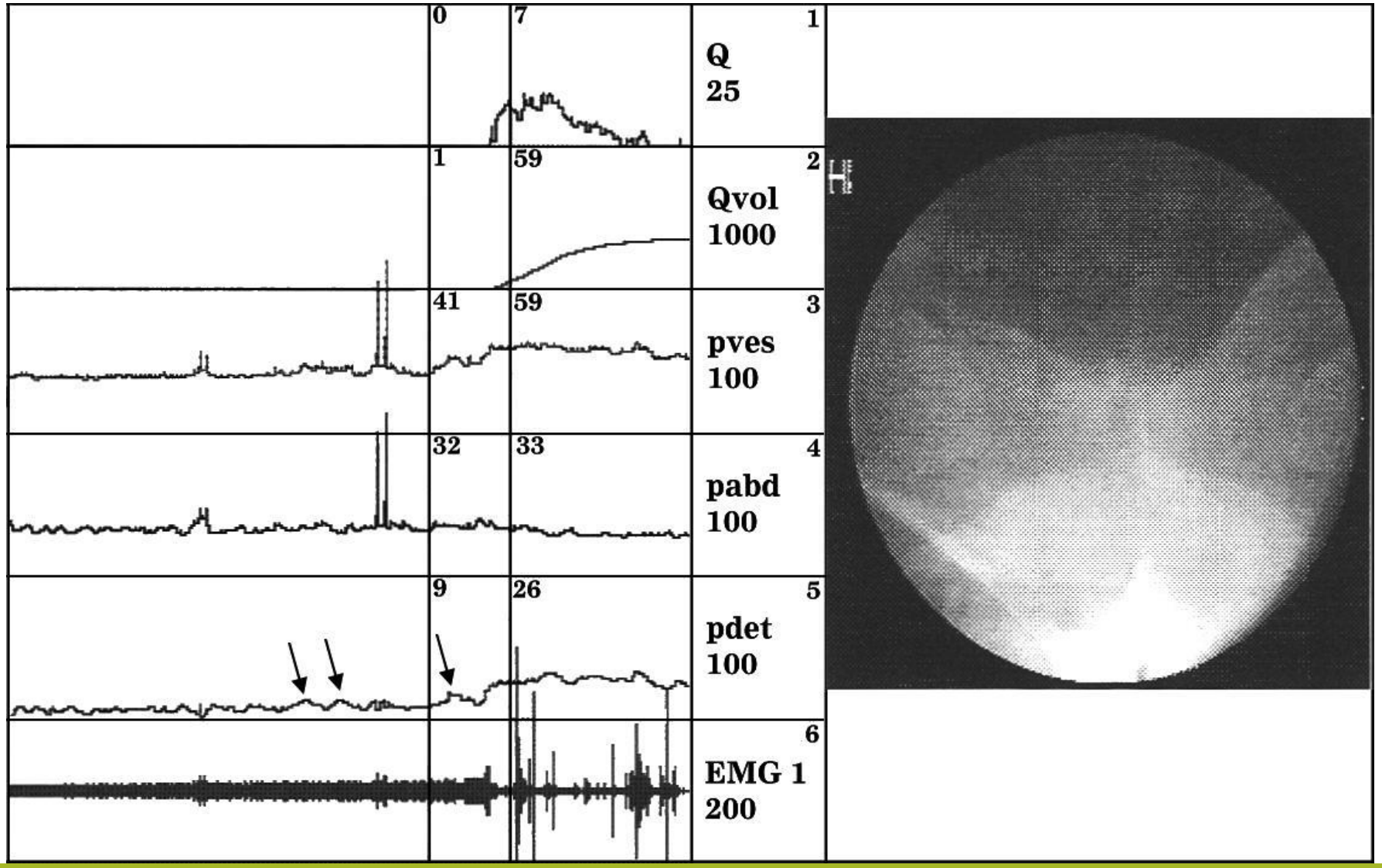
Videourodynamics (VUDS)

- UDS manner+ C-arm fluoroscopic unit
- X-ray intends on the bladder perpendicularly in AP direction
- Filling phase:
  - bladder position, bladder shape and outline, bladder neck/cystocele (rest, valsalva, cough), reflux, diverticula, cystocele
- Voiding phase: bladder neck and external sphincter relaxation, whole urethral outline, a post-void image

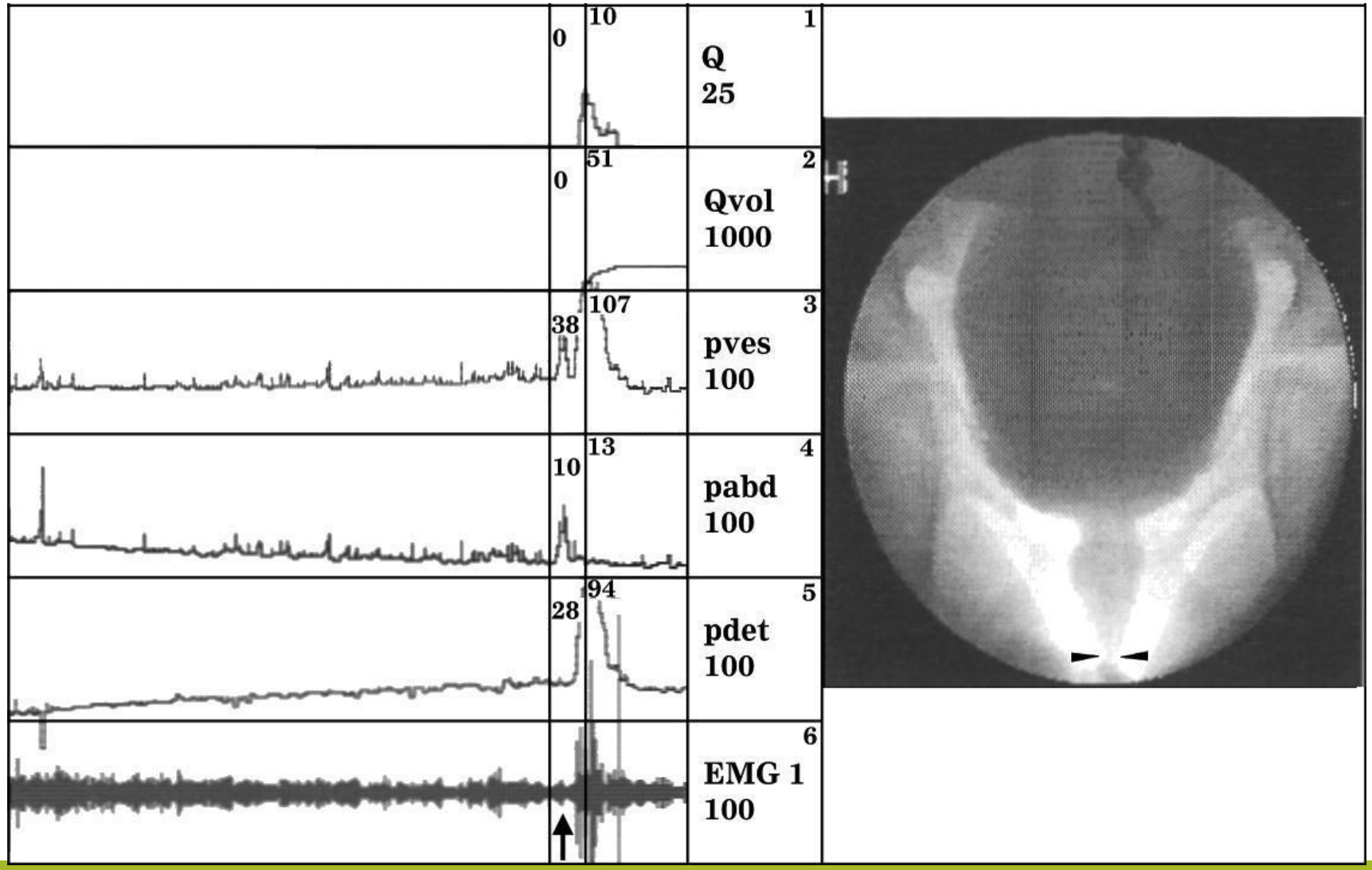
Clinical Application of Videourodynamics in LUTS

- Differential diagnosis of BOO
- Identify types of stress incontinence
- Confirm bladder neck dysfunction and DSD in neuropathic voiding dysfunction
- Upper tract dynamics and determine site of obstruction
- Analysis of pathophysiology of LUTS

Videourodynamic study in DO

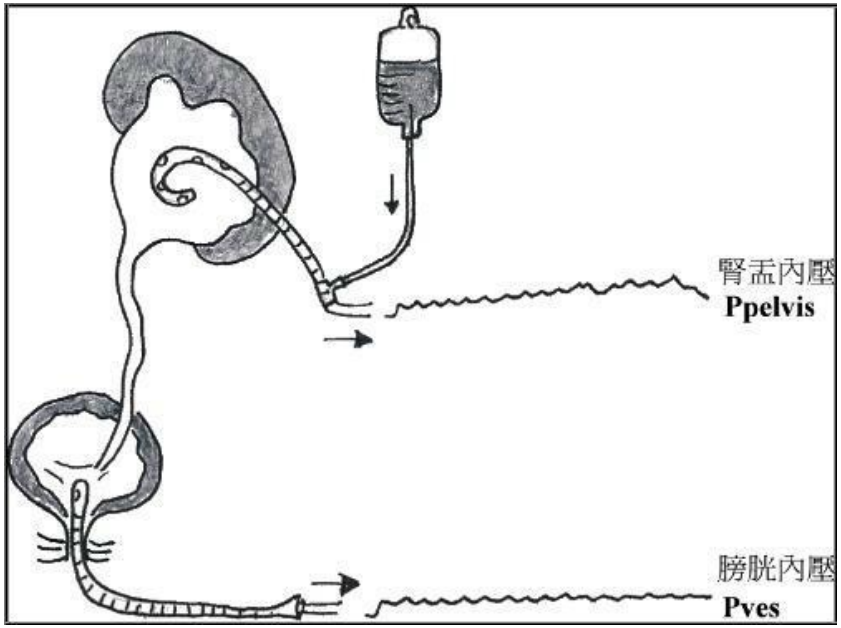


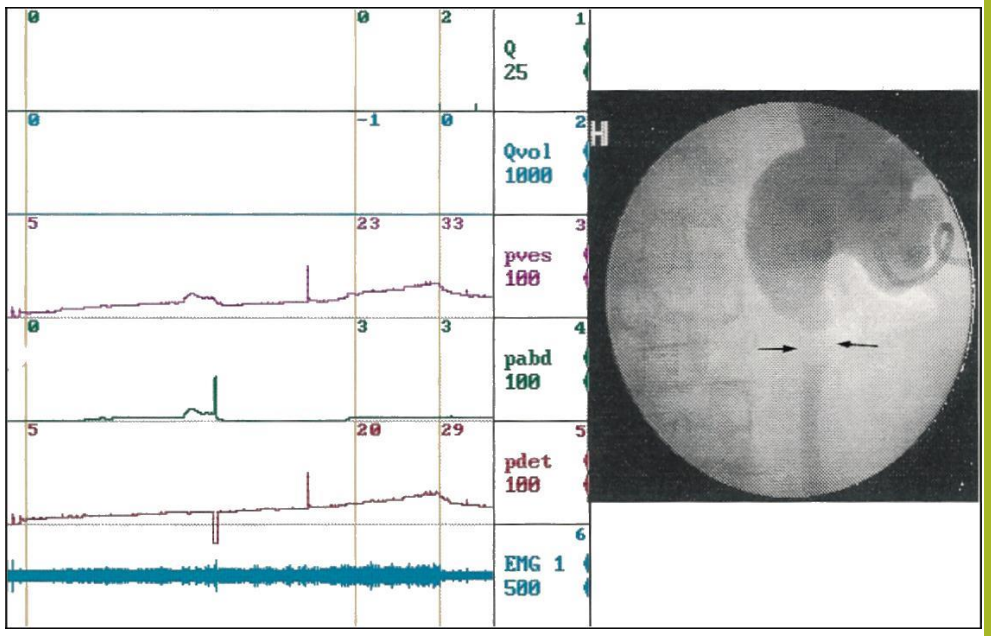
Dysfunctional voiding in woman with urge incontinence



Upper urinary tract videourodynamics (Whitaker test)

- To diagnose ureteral obstruction and hydronephrosis
- To determine the obstructed site
- To investigate megaloureter and hydronephrosis





Upper urinary tract videourodynamics (Whitaker test)

- Non-obstruction: differential pressure
  < 15cm water
- Equivocal: 15-22 cm water
- Obstruction: >22 cm water
- Increased perfusion rate if pressure at equivocal zone
- Stopped the examination if patient felt pain