


Urodynamic Studies: Philosophy, Science and Interpretation

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Urodynamics

- Philosophy
- Scientific basis
- Good technique
- Quality control
- interpretation




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Aims of UDS

- to reproduce the patient's symptoms
- to define bladder and urethral function
- to provide a precise diagnosis
- to define the most significant abnormality
- to allow selection of most appropriate treatment
- to predict post operative problems
- to assess the results of treatment




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If DO occurs during cystometry Ask the patient:

- "do you feel anything?"
- "is this a feeling you have experienced before?"
- "is the feeling that gives you the problems that led you to seek help?"



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Lower urinary tract dysfunction

- Storage phase
 - Bladder hypersensitivity
 - Detrusor overactivity
 - Urodynamic stress incontinence
 - Inappropriate urethral relaxation
- Voiding phase
 - Detrusor underactivity
 - Bladder outlet obstruction
 - mechanical
 - functional



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Symptoms: Diagnosis

- 11 – 16% of women with the symptoms of Stress Incontinence have Detrusor Overactivity
 - Shepherd et al. J Obstet Gynaecol 1982; 3: 123*
 - Bryne et al. Br J Urol 1987; 59: 228*
 - Lagro-Janssen et al Br J Urol 1991; 67: 569*
- Up to 22% of women with OAB symptoms have Urodynamic Stress Incontinence
 - Jarvis et al Br J Obstet Gynaecol 1980; 87: 893*



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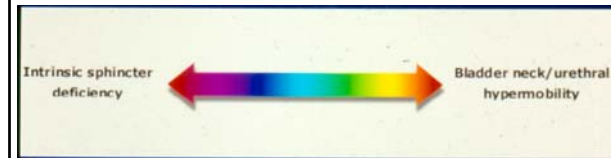
Mixed Stress/Urgency Incontinence

1. Describe the two types of incontinence of patient
2. With the bladder diary decide
 - which is more frequent
 - which is most bothersome
3. After urodynamics, decide which to treat first



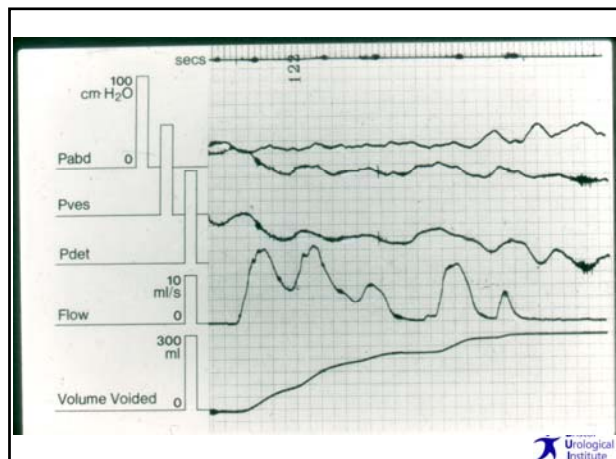
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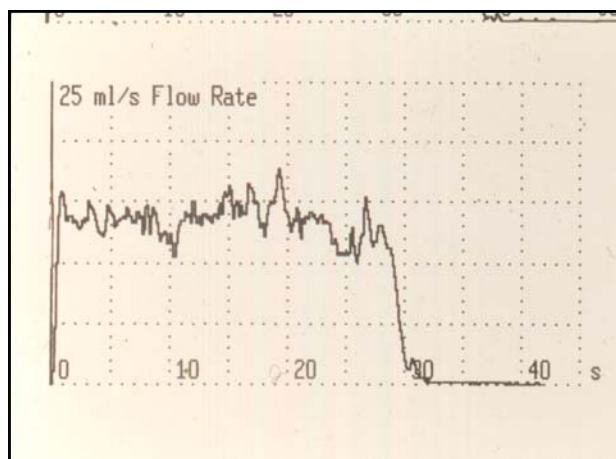
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When should UDS be done?

WHEN THERE IS BENEFIT TO THE PATIENT

- Risk : Benefit
- Cost : Benefit



Urodynamics should only be used after the proper urological assessment of every patient.



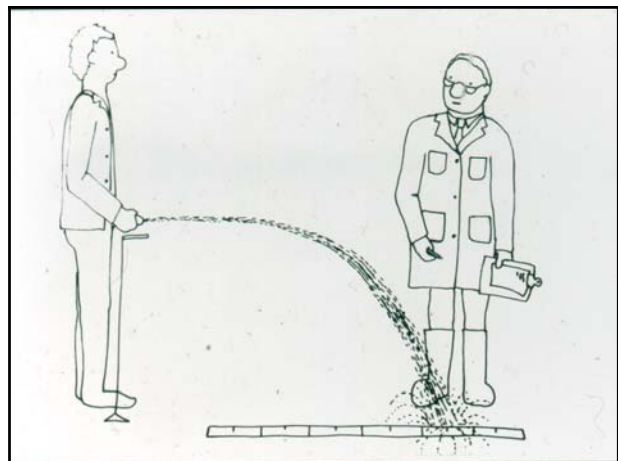
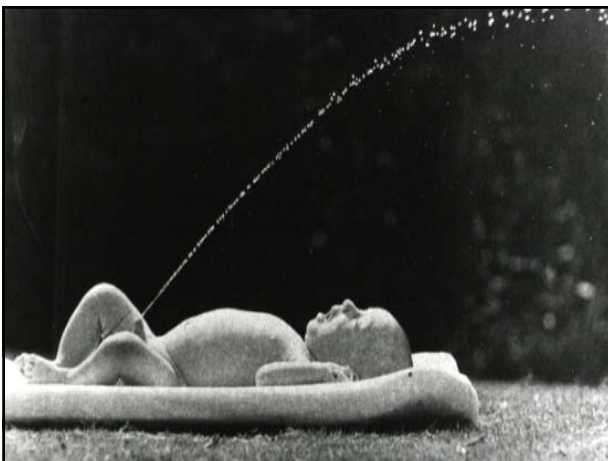
The “Dangers” of UDS

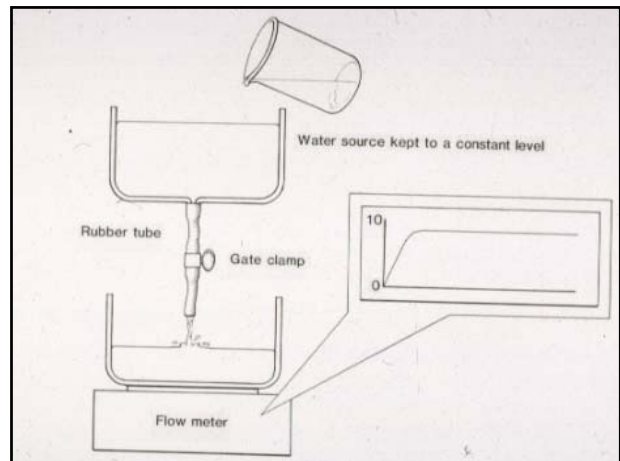
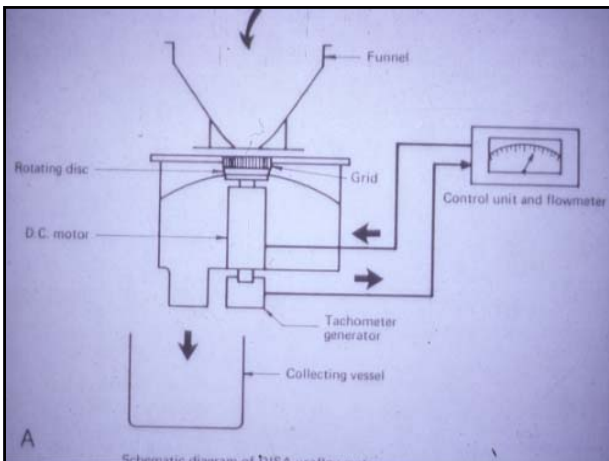
- Discomfort
- Bleeding
- Infection
- “Failure”
 - poor technique
 - inadequate interpretation



Urodynamics

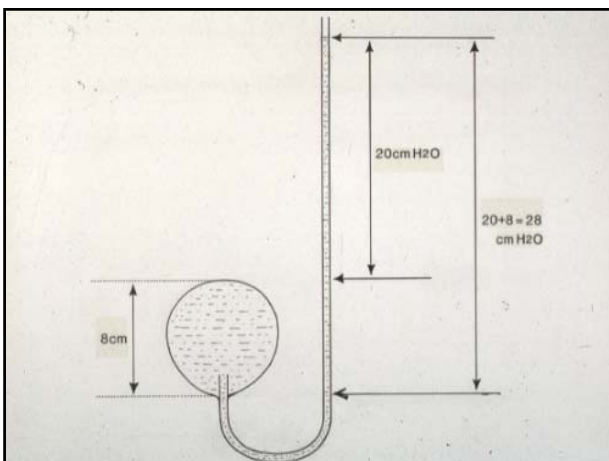
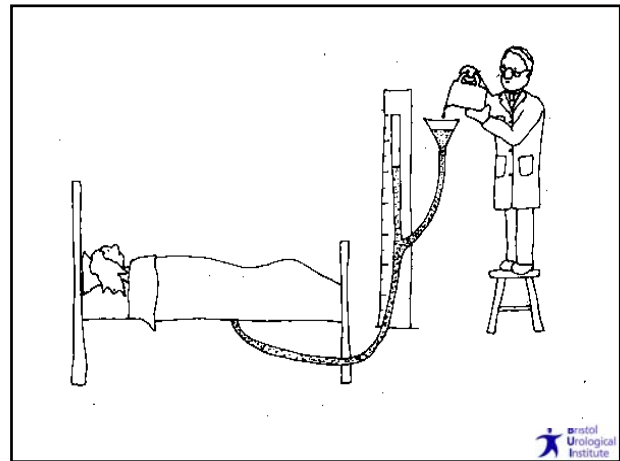
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Scientific Basis of Urodynamics

- measurement of flow
- measurement of pressure



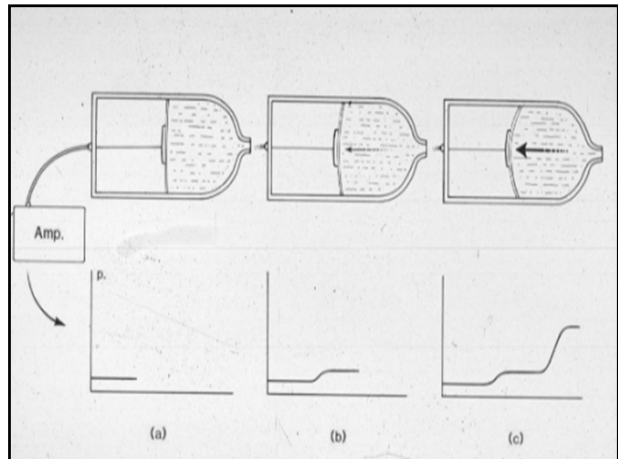
Method of Pressure Measurement

1. External transducers : connected by liquid filled lines to the bladder and rectum.
Can be :
 - mounted on a stand
 - body worn



Principle of pressure measurement

1. Pressure reference level: position transducers at the upper border of the pubis as the zero reference point
2. Reference pressure: both transducers must be zeroed against atmospheric pressure NOT to either bladder or rectal pressure



Urodynamics

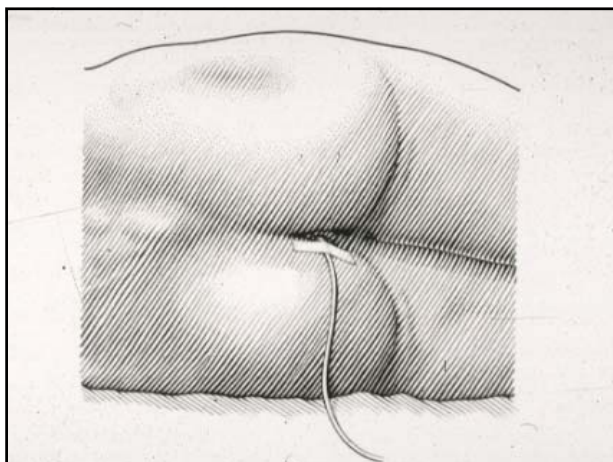
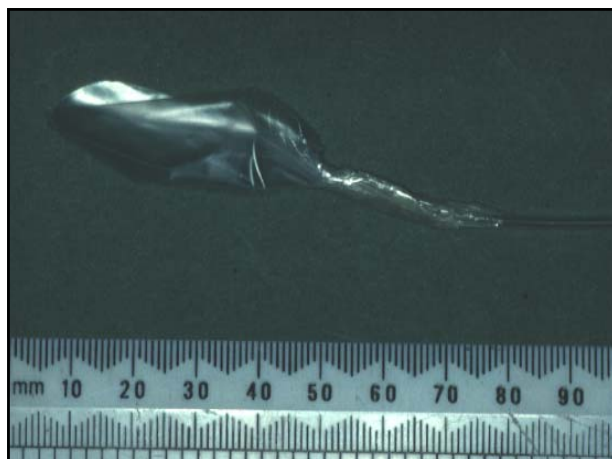
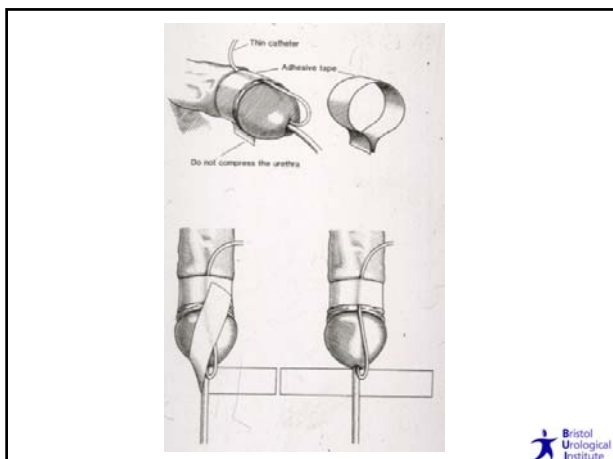
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UDS: Good Technique

- Free of technical failure and therefore technically reproducible
- Safe for the patient
- Allows identification of artefact
- Follows ICS recommendations





Setting up the Equipment

Setting zero

- zero is atmospheric pressure

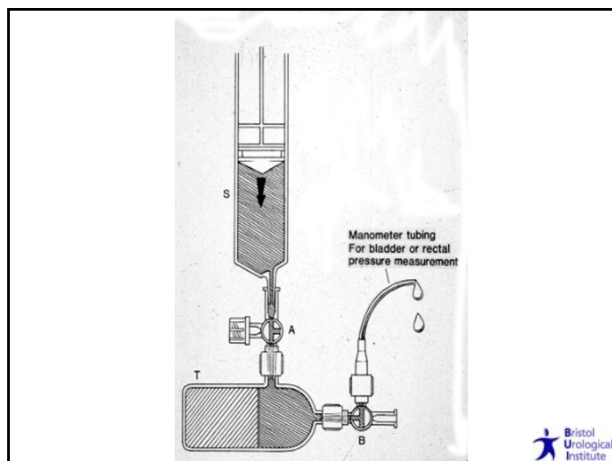
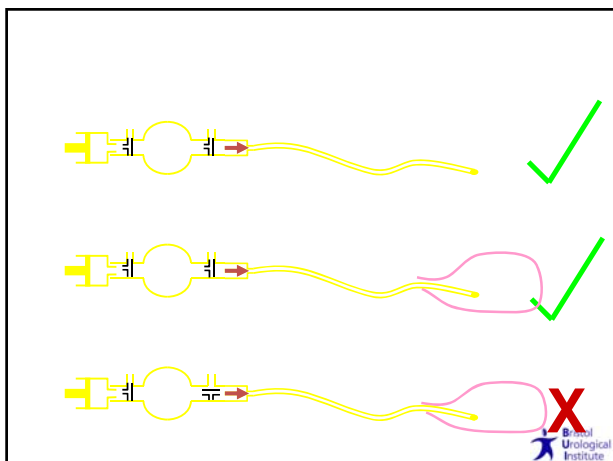
Calibrate transducers

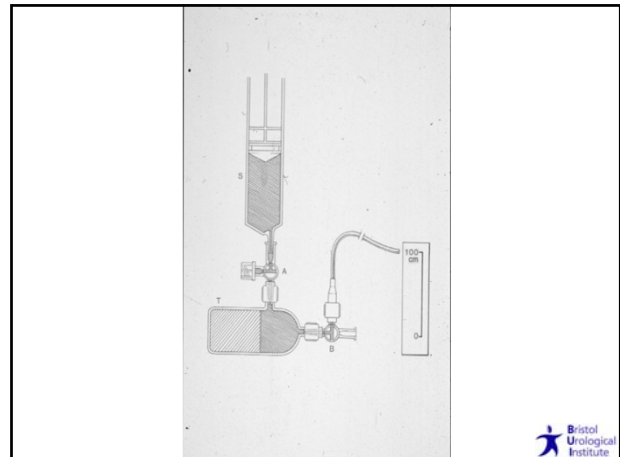
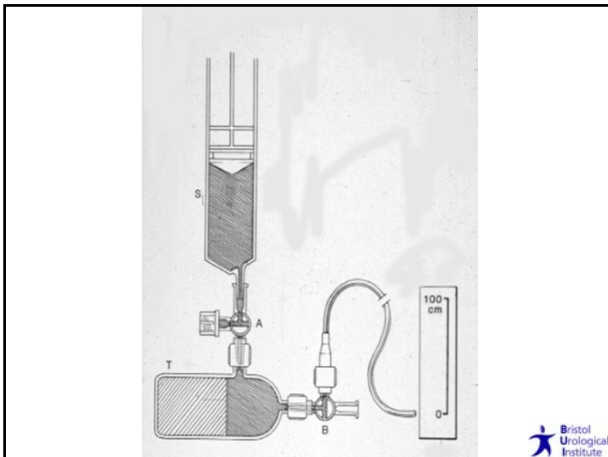
- to 0 and 100 cm H₂O

Pressure reference level

- superior edge of symphysis pubis

As a preliminary to these procedures, all bubbles and leaks must be eliminated





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Urodynamic Studies – Quality Control

Follow accepted procedures (ICS)

- Calibration of equipment
- Positioning of transducers
- Zeroing of transducers
- Ensuring quality of signal during UDS
- Labelling traces for reinterpretation



Correct Preparation of Urodynamic Equipment

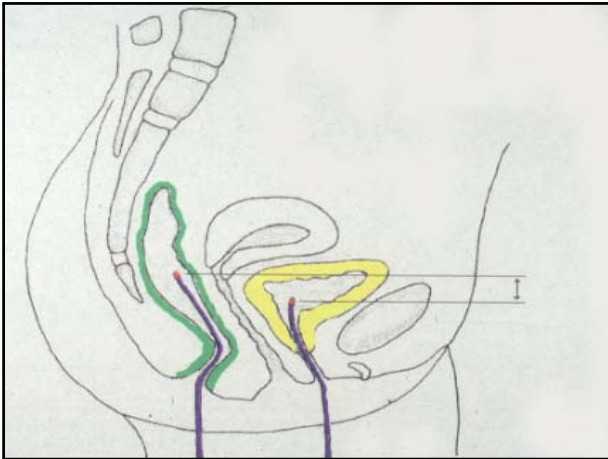
- Calibration of equipment
 - Pressure transducer to read 0 and 100 cm H₂O
 - Urine flow meter to read 0 and 25 (or 50) ml/s
 - Filling pump to fill at 10 and 50 ml/min
- Zero transducers to atmospheric pressure
- Check reference level of transducers
 - Superior edge of symphysis pubis
- Flush tubing to ensure absence of bubbles or leaks



Initial pves and pabd Pressures

- pabd and pves are similar and > 95% lie in the following ranges:
 - lying 0-18 cmH₂O,
 - sitting 15-40 cmH₂O,
 - standing 20-50 cmH₂O
- These data give initial detrusor pressure readings between -5 and +5 cmH₂O (97%, 97% and 96% in the 3 positions).
Sullivan et al 2011 NAU





pdet

- Does it matter if pdet is negative?
- Does pdet exist?

Pressure measurement BEFORE and DURING filling

Before filling:

- Check that the initial pressures are acceptable

During filling:

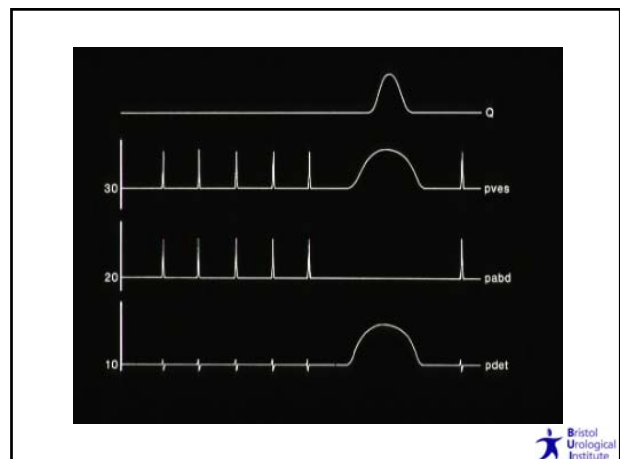
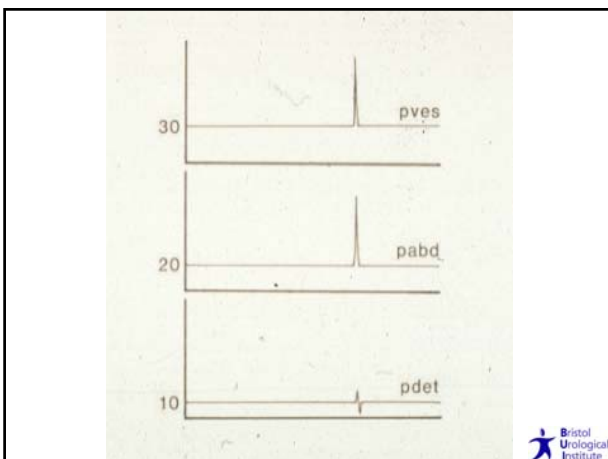
- Neither pves nor pabd should decline

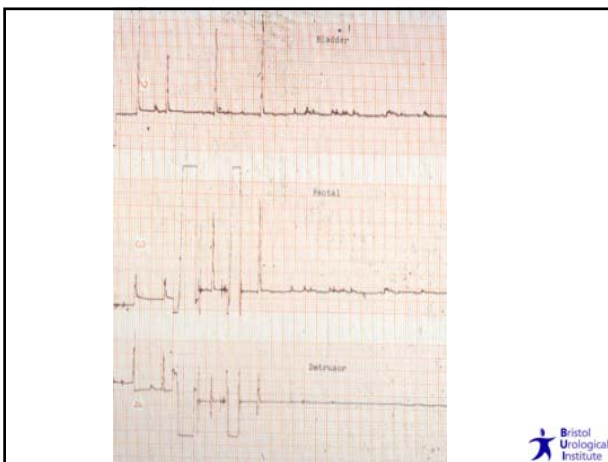
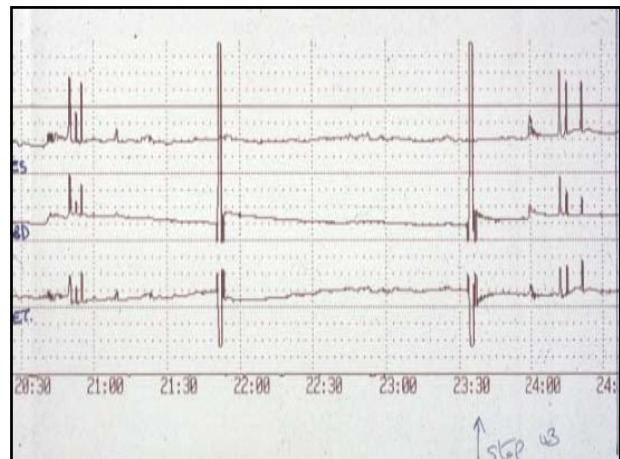
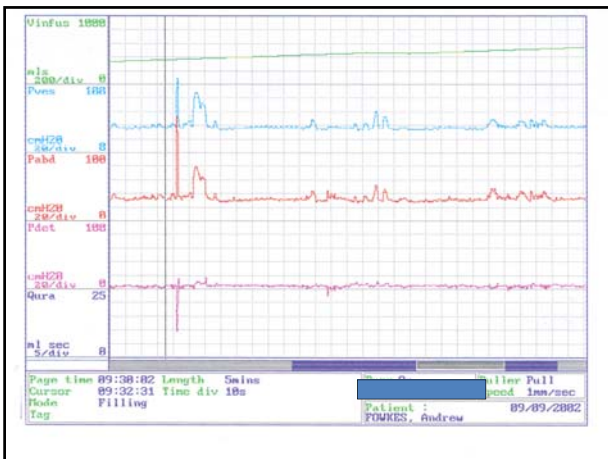
NOTE: if you suspect problems, don't go on
FIX IT!

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Uroflowmetry: interpretation

- Qmax and volume voided
- Shape of the trace
 - continuous/interrupted flow
 - fluctuations in Q

Uroflowmetry: interpretation

Increasing flow may be due to:

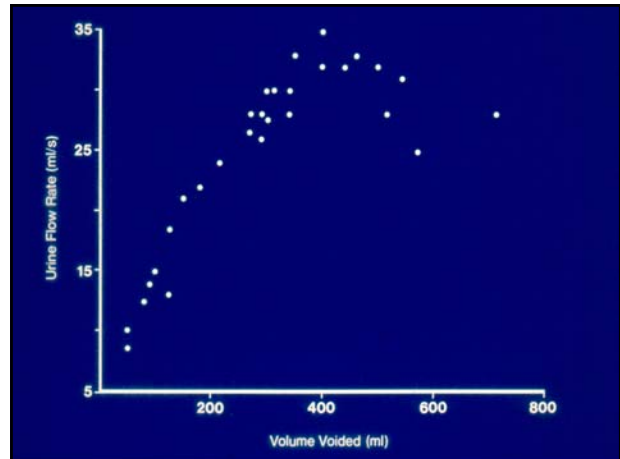
- Strengthening detrusor contraction
- Increased urethral relaxation

Decreasing flow may be due to:

- Bladder becoming empty
- Weakening detrusor contraction
- Increasing urethral resistance

Urine flow is a product of:

1. Propulsive forces
 - Detrusor contraction
 - Straining
2. Urethral resistance
 - Passive component
 - Active component



Urine flow rates in LUTS

Urine flow is a product of:

- Detrusor contraction
- Bladder outlet resistance

THEREFORE low flow can be due to:

- Bladder outlet obstruction – low flow with high pressure
- Detrusor underactivity – low flow with low pressure



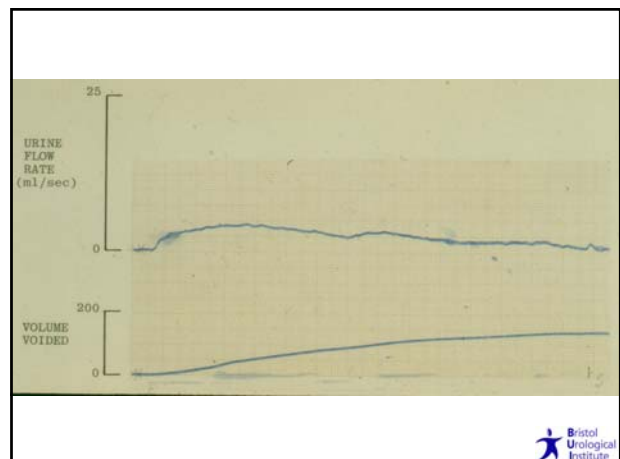
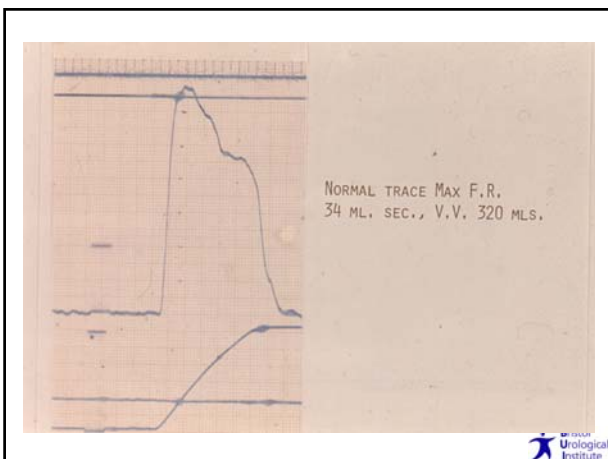
Specificity of Q max

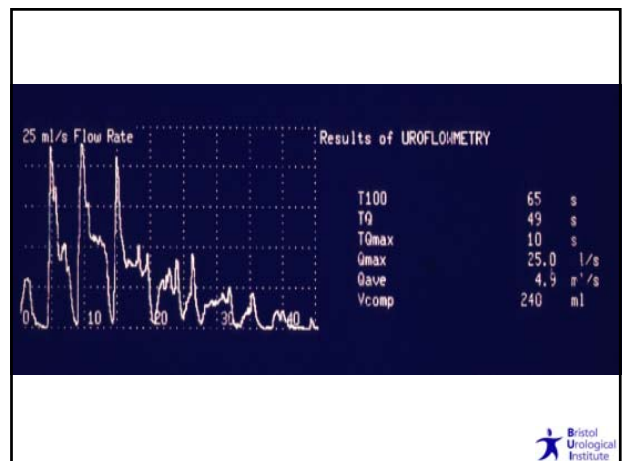
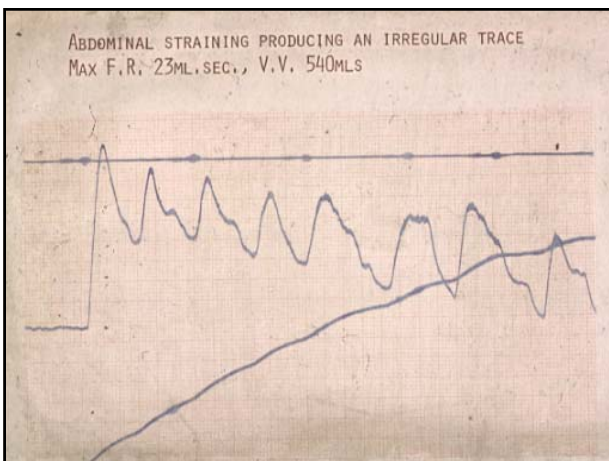
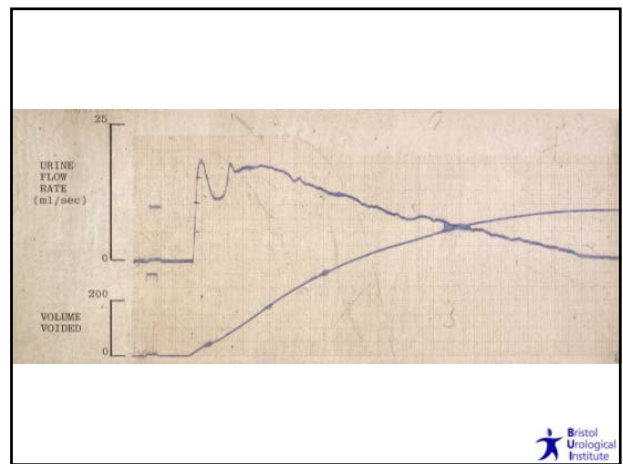
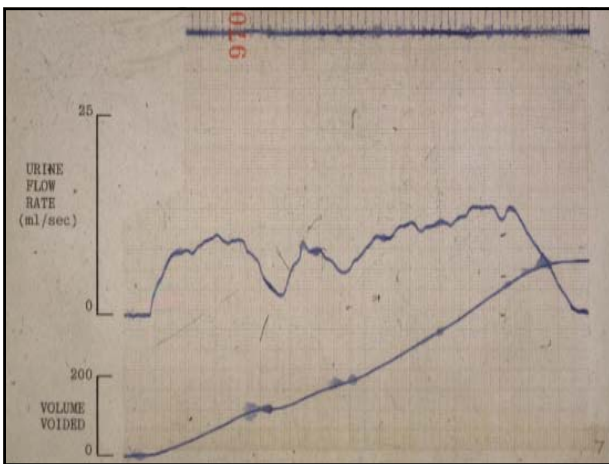
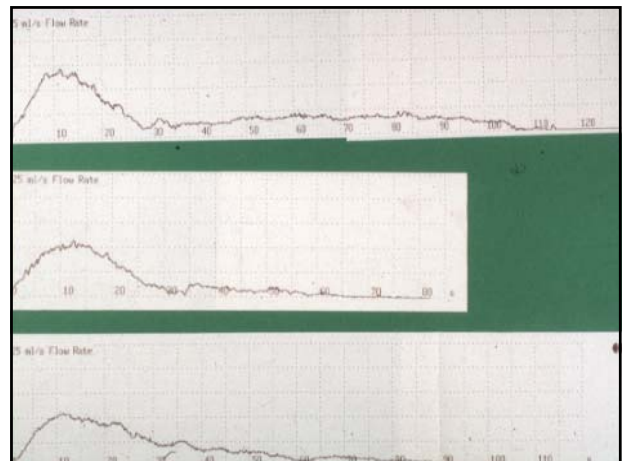
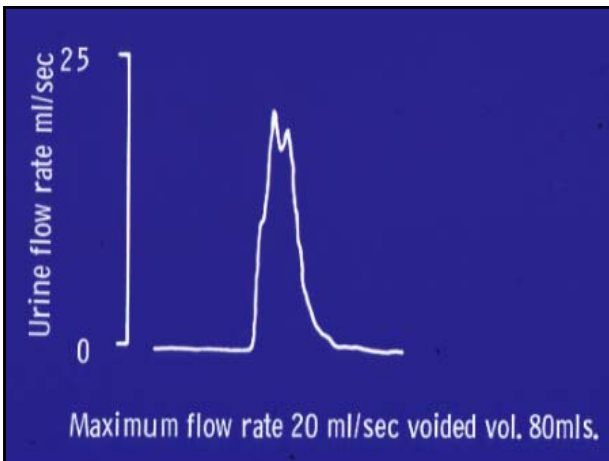
Q max < 10ml/s - 90% patients obstructed

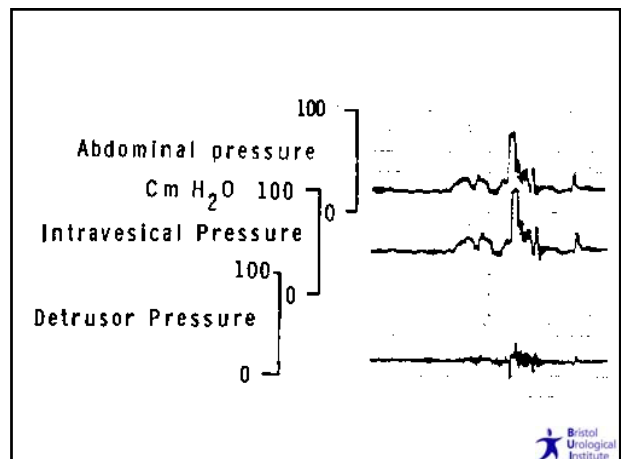
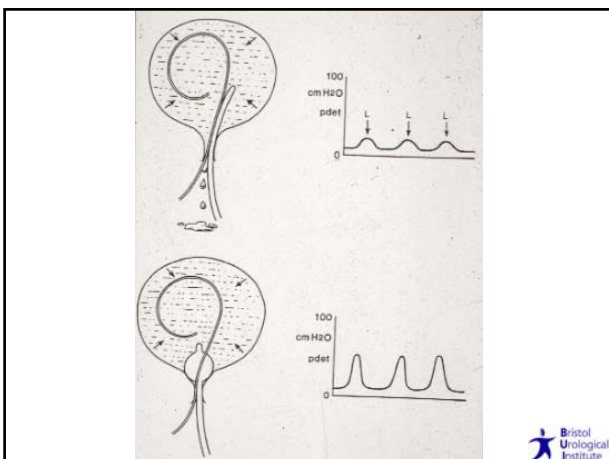
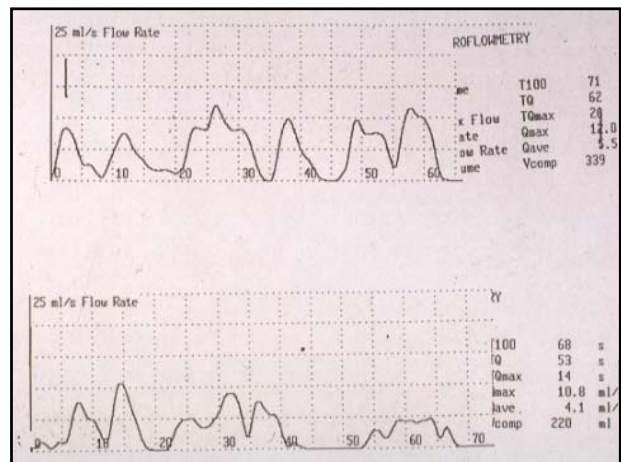
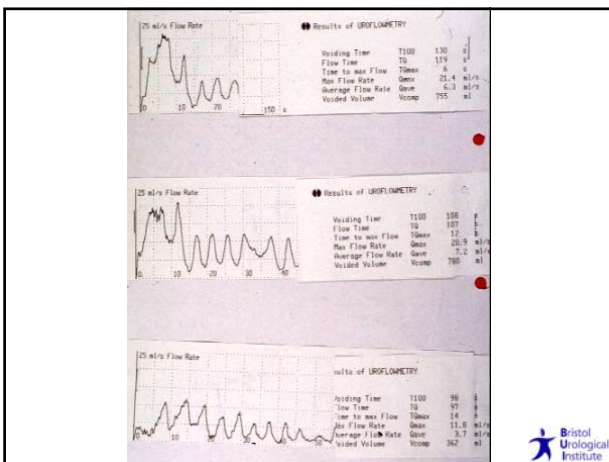
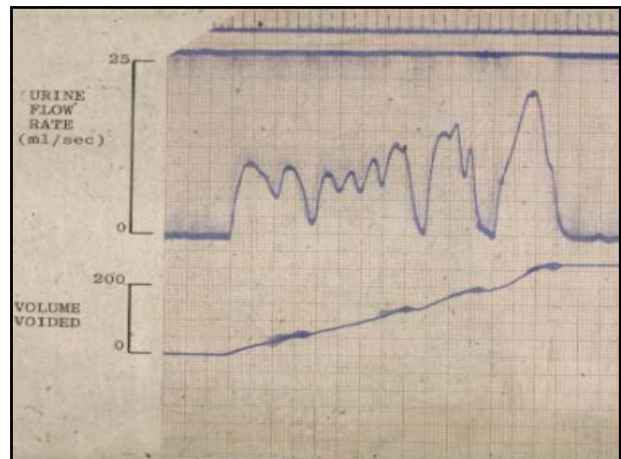
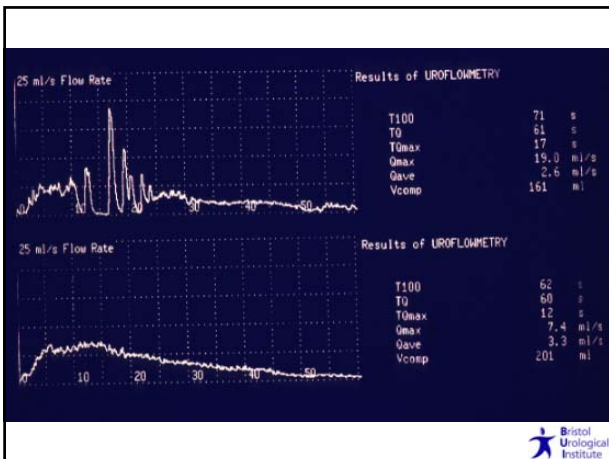
Q max 10 – 15 ml/s - 65% patients obstructed

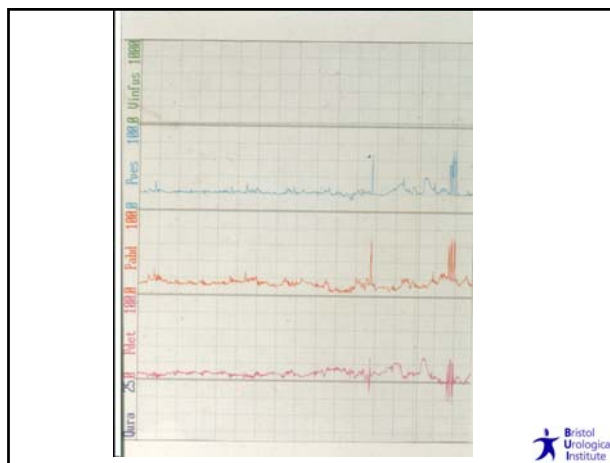
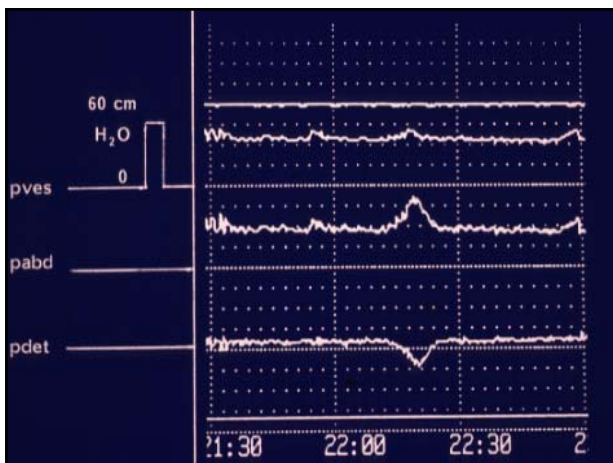
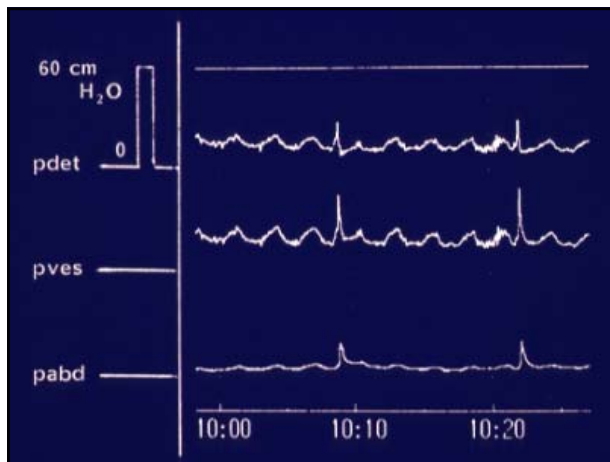
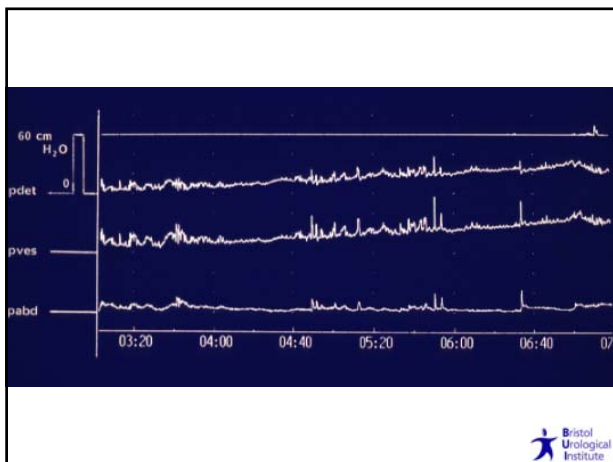
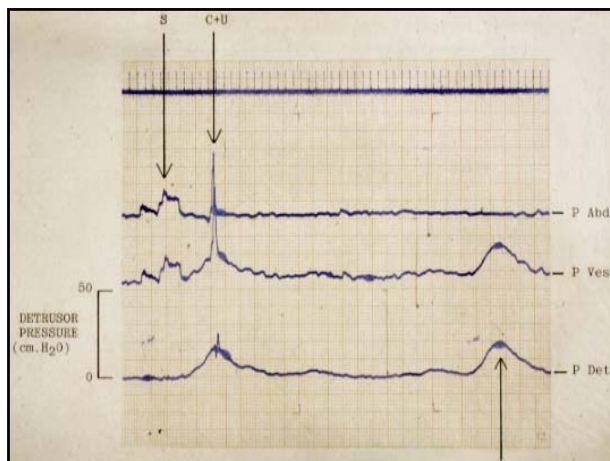
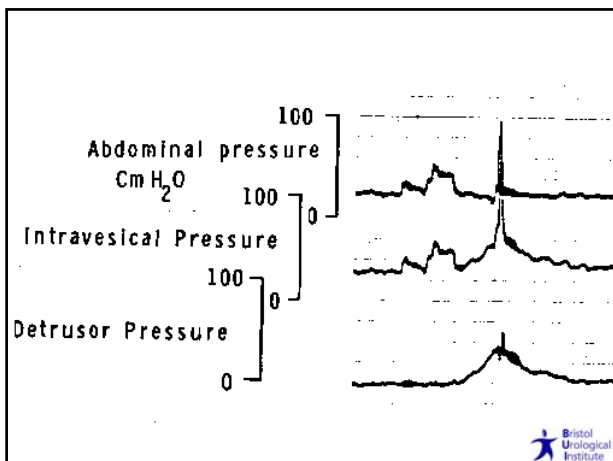
Q max > 15ml/s - 30% patients obstructed

Is a 90% diagnostic accuracy adequate?









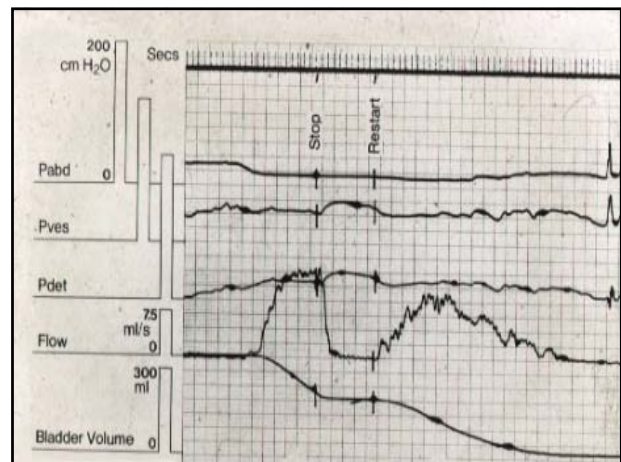
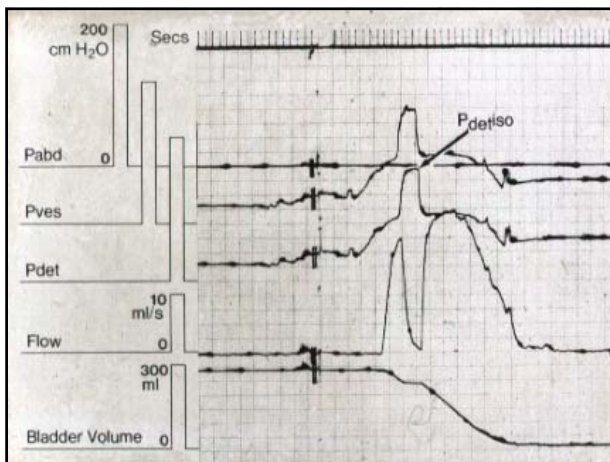
Pressure Flow Studies : Interpretation

- Record Q max and pdet Qmax to define
 - presence and degree of BOO
- Examine changes in Q and pdet to distinguish between
 - detrusor underactivity
 - urethral overactivity



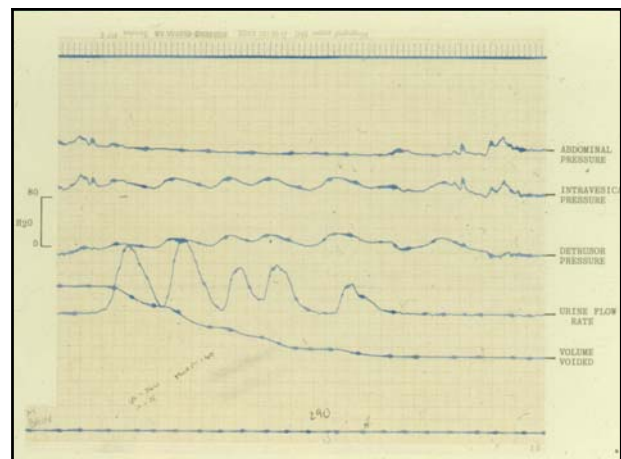
PQS : Influence of technique in findings

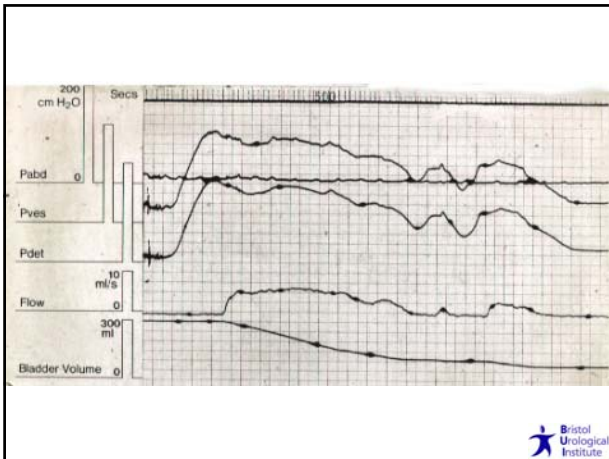
- patient position
 - men stand
 - women sit
 - disabled may have to lie
- test environment
- technical aspects
 - size of catheters
 - speed and degree of bladder filling
 - catheter movement



Detrusor Muscle Function

- isotonic contraction
 - muscle shortens
 - no resistance to shortening
 - no measurement of pressure
- isometric contraction
 - muscle tension increases
 - no shortening occurs
 - no flow occurs as outlet closed
 - high pressure develops





Bladder Voiding Function

Three simple indices

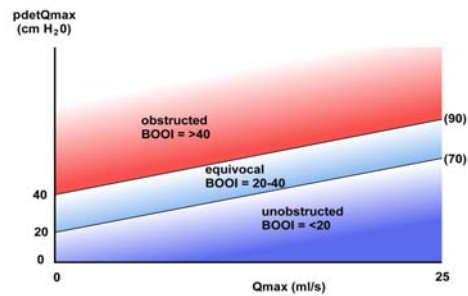
- BOOI (bladder outlet obstruction index)
- BCI (bladder contractility index)
- BVE (bladder voiding efficiency)

Bladder Outlet Obstruction Index (BOOI) (previously Abrams - Griffiths number)

$$BOOI = p_{det}Q_{max} - 2Q_{max}$$

- BOOI >40 Obstructed
- BOOI 20 - 40 Slightly Obstructed (Equivocal)
- BOOI <20 Unobstructed

ICS pressure-flow nomogram using Bladder Outlet Obstruction Index (BOOI = p_{det}Q_{max} - 2Q_{max})



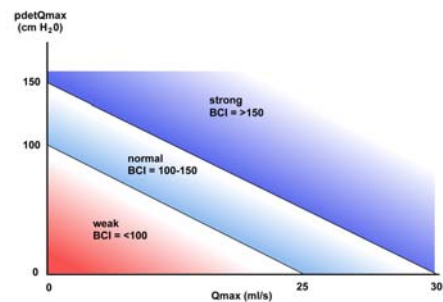
Bladder Contractility Index (BCI)

$$BCI = p_{det}Q_{max} + 5 Q_{max}$$

- BCI >150 Strong Contractility
- BCI 100-150 Normal Contractility
- BCI <100 Weak Contractility

Note: Schäfer (1995) described DECO (unpublished abstract)

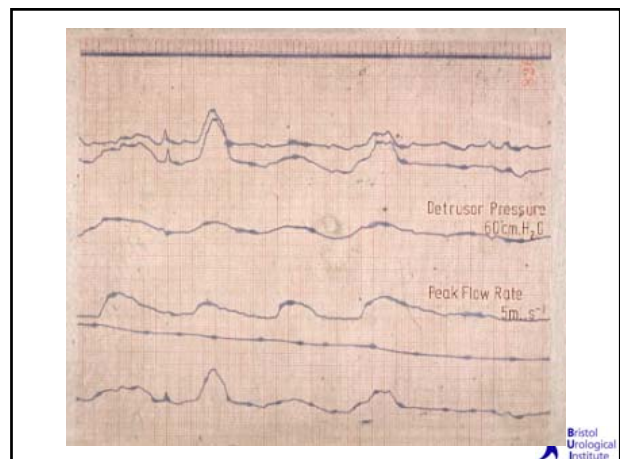
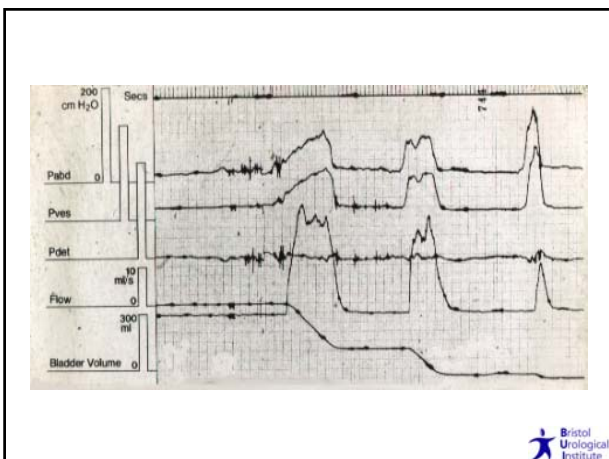
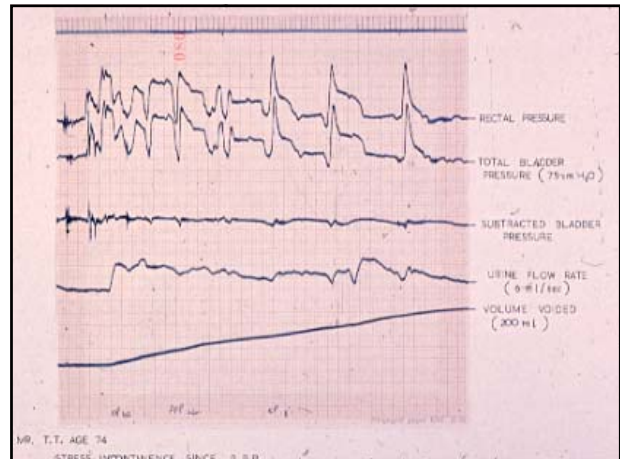
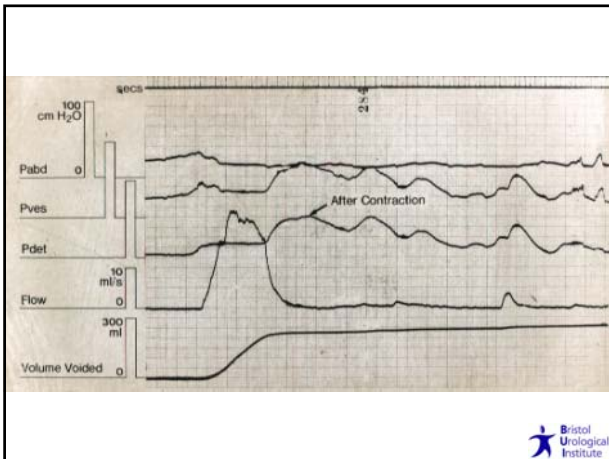
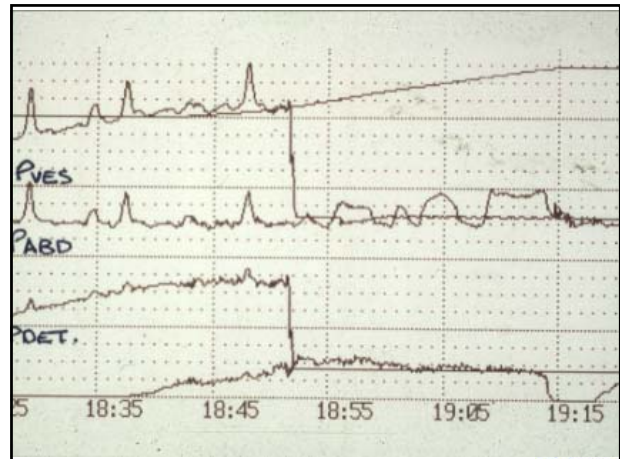
Bladder contractility nomogram (after Schafer) using the bladder contractility index (BCI = p_{det}+5Q_{max})

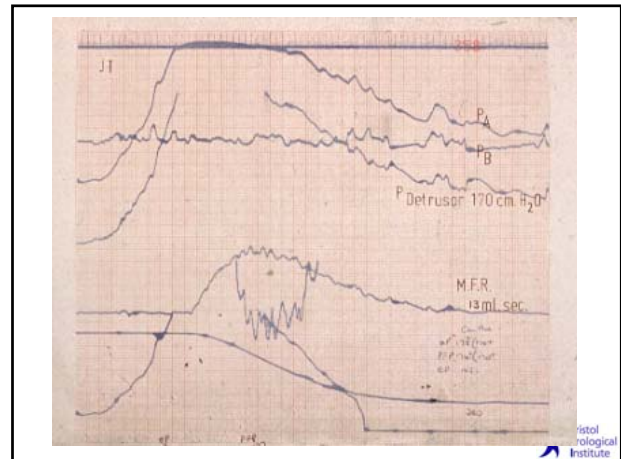
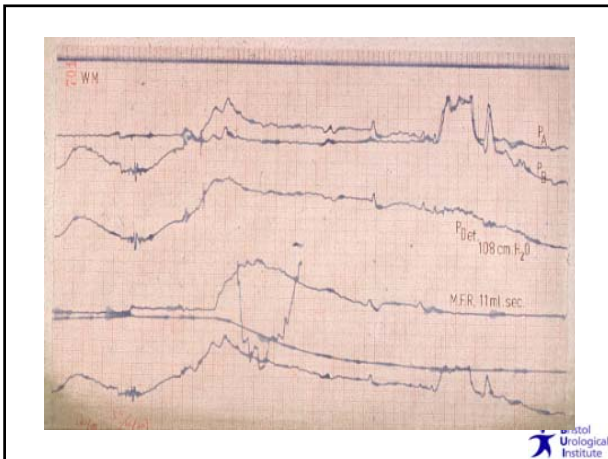
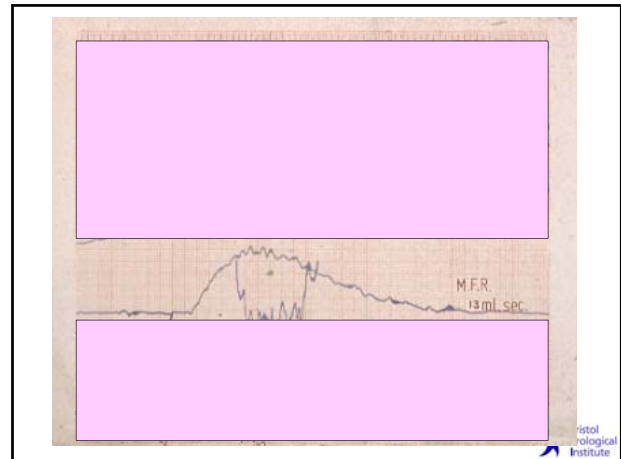
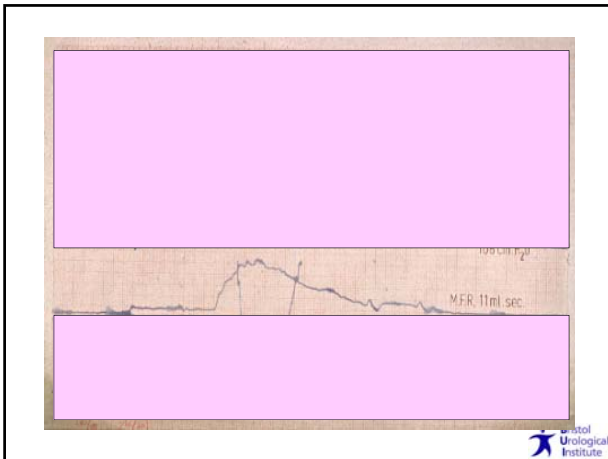


Bladder Voiding Efficiency (BVE)

$$BVE = \frac{\text{voided volume}}{\text{total bladder capacity}} \times 100\%$$

BVE is a measure of bladder emptying





The Four Diagnoses of Urodynamics

1. Bladder during filling
2. Urethra during filling
3. Bladder during voiding
4. Urethra during voiding

The Four Diagnoses of Urodynamics

- Define normal function
 1. Detrusor relaxed during filling
 2. Urethra competent (closed) during filling
 3. Detrusor contracts during voiding
 4. Urethra relaxes during voiding

The Four Diagnoses of Urodynamics

- Define normal function
- Anything else is abnormal
 1. Overactive detrusor during filling
 2. Incompetent urethra during filling
 3. Underactive detrusor during voiding
 4. Obstructed urethra during voiding



The Four Diagnoses of Urodynamics

55 year old women with mixed urgency/stress incontinence who has to strain to void

Findings: urodynamic stress incontinence. Strained to void/low pdet/interrupted flow equates to detrusor underactivity.

| | Filling | Voiding |
|----------|-------------------|------------------------|
| Detrusor | Normal | Detrusor underactivity |
| Urethra | Incompetent (USI) | Normal (relaxed) |

Her symptoms were only partially reproduced , because no urgency or urge incontinence was demonstrated.



The Four Diagnoses of Urodynamics

75 year old man with LUTS including urgency, urgency incontinence, poor stream, hesitancy and an enlarged prostate

Findings: idiopathic detrusor overactivity during filling , increased voiding pressure/reduced flow equates to benign prostatic obstruction.

| | Filling | Voiding |
|----------|-----------------------|-------------------|
| Detrusor | Detrusor overactivity | normal |
| Urethra | Competent | obstructive (BPO) |

His symptoms were fully reproduced and explained by the study.



Conclusions

Getting the best out of UDS depend on:

- appropriate indications
- performing the correct tests
- first-rate technique
- good interpretation



Conclusions

- Patients should have a systematic baseline assessment
- Urodynamic testing should focus on the individual's problems
- Urodynamic testing should be used before invasive treatments
- Urodynamic recording quality must be ensured

