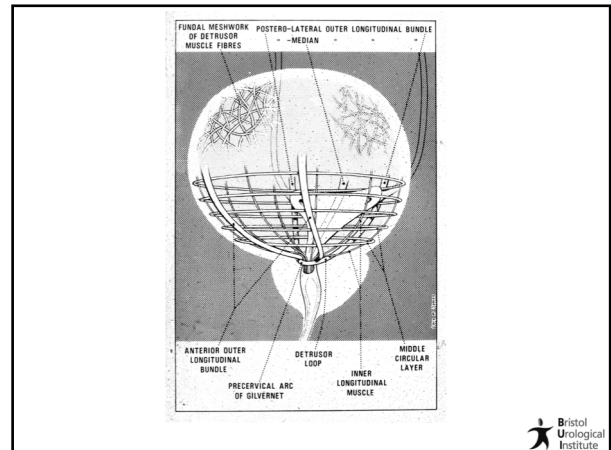


An Overview of Urodynamics

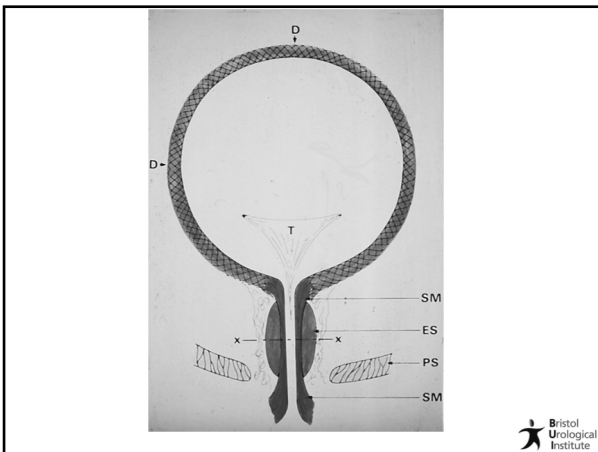
Hashim Hashim
 MBBS, MD, FEBU, FRCS(Urol)
 Consultant Urological Surgeon
 Honorary Professor of Urology
 Director of the Urodynamics Unit

Email: h.hashim@gmail.com
 @Urohash
 @Urohash
 @BristolUrologySurgeon

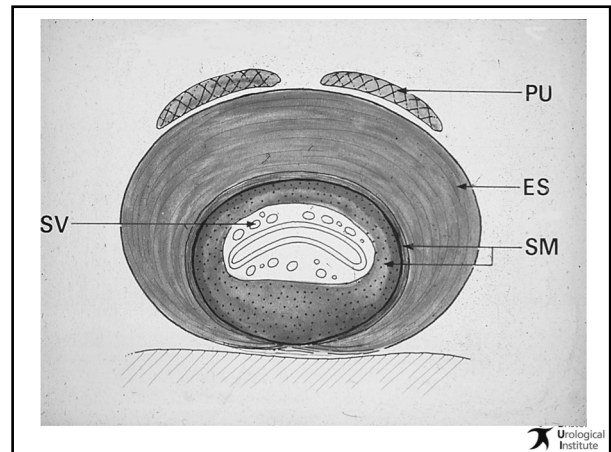
1



2



3



4

Urethral Anatomy

FEMALE	MALE
3-4 cm	15.20cm
Straight	“S” shaped
Wide	Narrow
Sphincter “horseshoe”	Sphincter “circular”
Laminar flow	Turbulent flow
Voiding “low pressure”	Voiding “high pressure”

5


Classification of LUTS

Storage	Voiding	Post-micturition
<ul style="list-style-type: none"> • Urgency • Urinary incontinence • Increased day-time frequency • Nocturia • Pain 	<ul style="list-style-type: none"> • Slow stream • Splitting/spraying • Intermittency • Hesitancy • Straining • Terminal dribbling 	<ul style="list-style-type: none"> • Post-micturition dribbling • Feeling of incomplete emptying

6

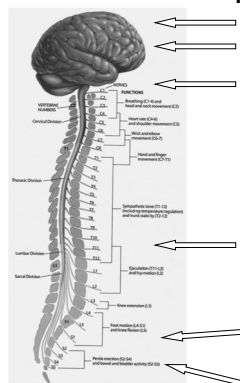
Optimal functioning of lower urinary tract^{1,2}

<h4>Storage</h4> <ul style="list-style-type: none"> • Low pressure • Intermittent signals of filling • Adjustment of sphincter tonus in response to increasing filling • End filling desire to void • Emptying of upper urinary tract • Low pressure in upper urinary tract • Continence 	<h4>Voiding</h4> <ul style="list-style-type: none"> • Voluntary start of micturition • Powerful stream • No post-void residual • Coordination of detrusor contraction & relaxation of pelvic floor • Capable of interruption
---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------


1. Lukacz ES, et al. *Int J Clin Pract*. 2011; 65: 1026
 2. Drake MJ, et al. *Neurourol Urodyn*. 2010;29: 12-17


7

Innervation of the Human Bladder¹

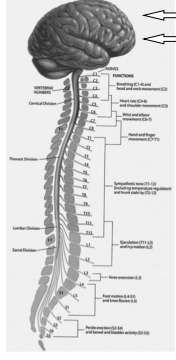


- ← Cortex
- ← Midbrain
- ← Brainstem
- ← Th₁₀-L₂ : Hypogastric nerve
- ← S₂₋₄: Pelvic nerve
- ← S₂₋₄ : Pudendal nerve

1. Beckel JM, et al. *Handb Exp Pharmacol* 2011; 202: 43-76



8

Innervation of the Human Bladder



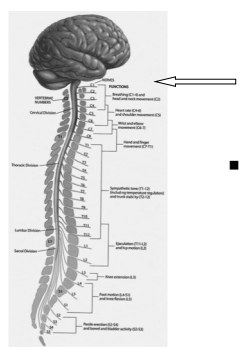
- ← Cortex: permission & attention^{1,2}
- ← Midbrain: safety^{1,2}

- Cerebral cortex^{1,2}
 - Voluntary control
 - Socializing inputs
 - General attention
- Midbrain^{1,2}
 - Safety area

1. Drake MJ, et al. *Neurourol Urodyn*. 2010;29: 12-17
 2. Beckel JM, et al. *Handb Exp Pharmacol* 2011; 202: 43-76



9

Innervation of the Human Bladder¹




- ← Brainstem: relay center

- Brainstem / Pons¹:
 - "on/off" switch
 - M-region: Micturition
 - L-region : Storage

1. Beckel JM, et al. *Handb Exp Pharmacol* 2011; 202: 43-76



10

Innervation of the Human Bladder¹



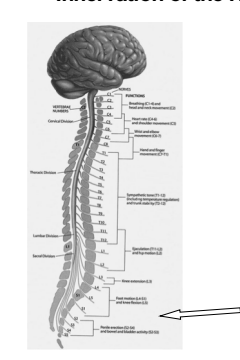
- Thoracic 10 - Lumbar 2
- Storage
- Origin Hypogastric nerve
 - sympathetic
 - bladder dome
 - bladder neck

← Th₁₀-L₂: sympathetic nerve

1. Beckel JM, et al. *Handb Exp Pharmacol* 2011; 202: 43-76



11

Innervation of the Human Bladder¹

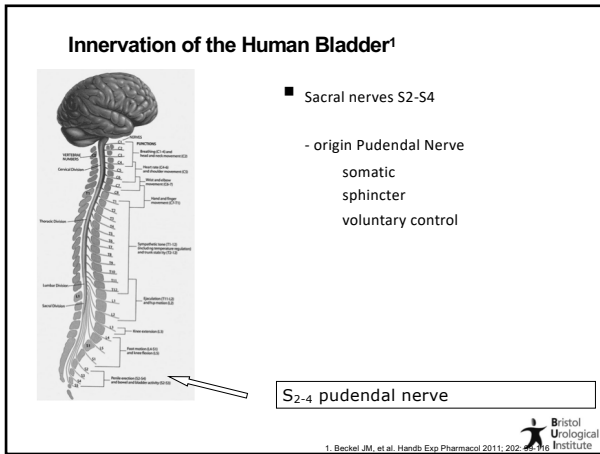


- Sacral nerves S2-S4
- Voiding
- Origin Pelvic nerve
 - parasympathetic
 - bladder

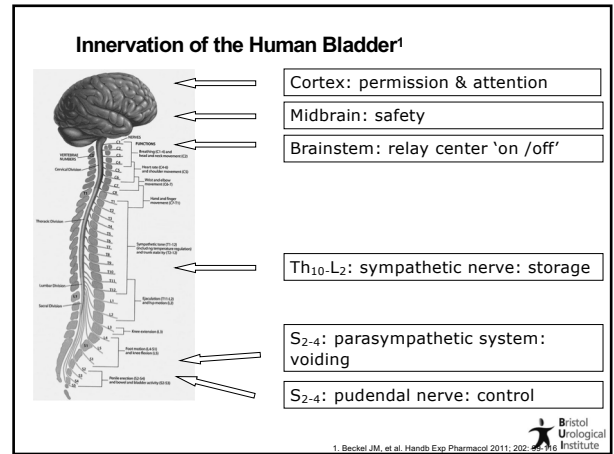
← S₂₋₄: parasympathetic system

1. Beckel JM, et al. *Handb Exp Pharmacol* 2011; 202: 43-76


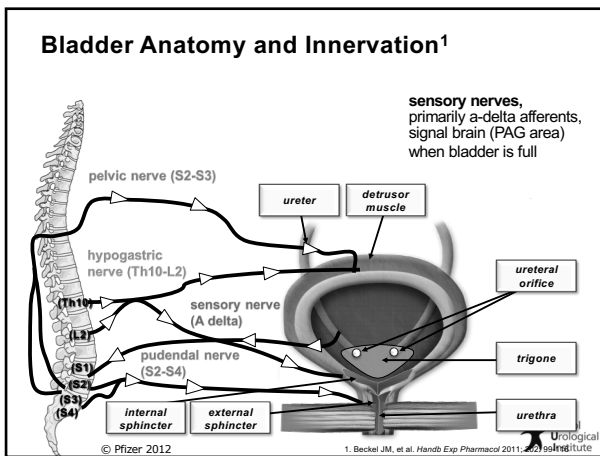
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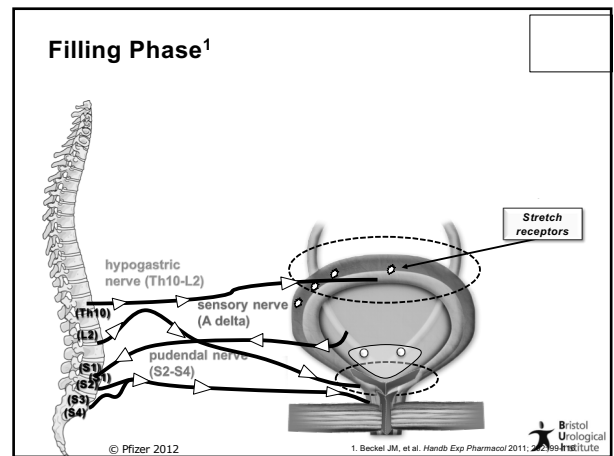
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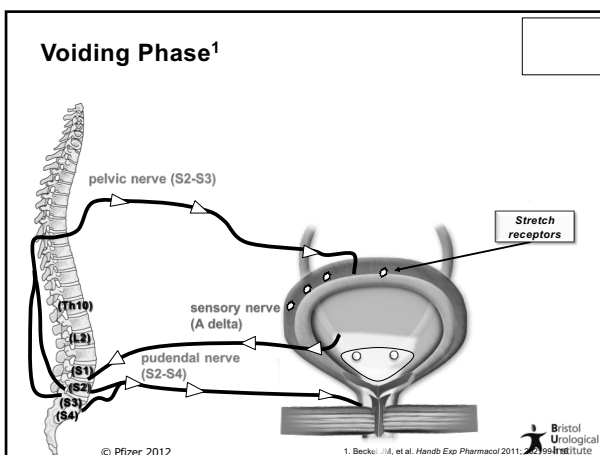
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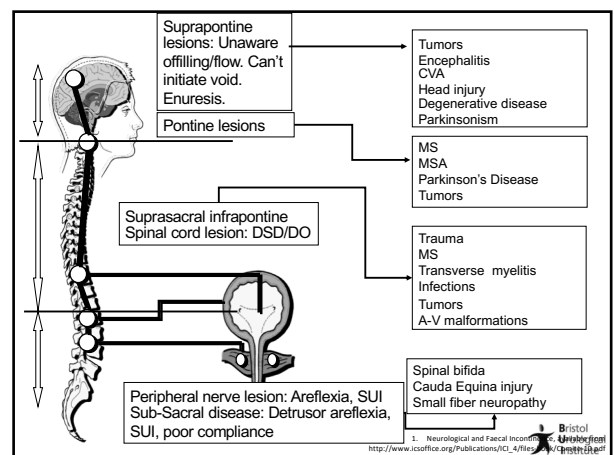
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16



17




18

**Normal neural circuit:
Afferent (sensory) and efferent (motor) pathways**

- **Afferent (sensory) pathways:**
 - Myelinated A Delta fibres
 - Carry signals to the brain that bladder is full
 - C- Fibres
 - Normally inactive and have little role in normal bladder control
- **Efferent (motor) pathways:**
 - Sympathetic (hypogastric nerve)
 - Relaxation of detrusor muscle + contraction of internal urethral sphincter
 - Parasympathetic (pelvic nerve)
 - Contraction of detrusor muscle
 - Somatic (pudendal nerve)
 - Relaxation/contraction of external urethral sphincter
- **Modulated by supraspinal centres**

Andersson KE et al. Pharmacological treatment of urinary incontinence. 3rd International Consultation on Incontinence. Monaco, June 26-29, 2004.




19

**Neurogenic circuit:
Afferent and efferent pathways**

- **Afferent (sensory) pathways:**
 - A δ /C-fibres ratio modification
 - C-fibres activated
 - Form a spinal "exaggerated" reflex circuit in L-S area
 - Voiding escapes outside cerebral control
- **Efferent (motor) pathways:**
 - Suprasacral inhibitory control on the bladder may be affected
- **Both afferent and efferent modifications cause detrusor overactivity**
 - Common targets for pharmacologic management


Andersson KE et al. Pharmacological treatment of urinary incontinence. 3rd International Consultation on Incontinence. Monaco, June 26-29, 2004.



20

CONTINENCE depends on:

1. Detrusor relaxation
2. Continuous urethral closure despite intravesical pressure changes




21

Urethral Closure

Maintained by:


1. Bladder neck (proximal sphincter)
2. Intra-urethral striated muscle sphincter
3. Voluntary pelvic floor contraction



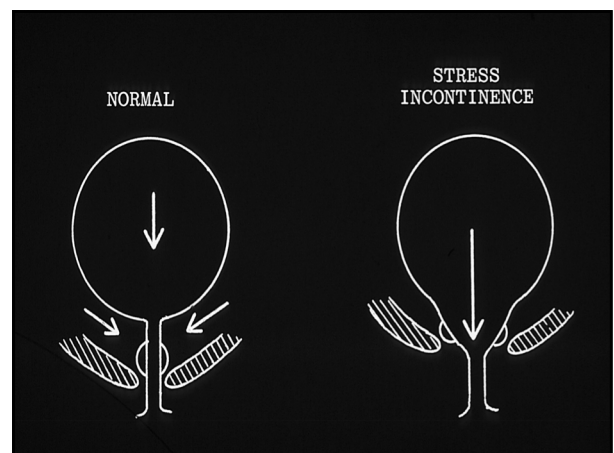
22

Urethral Closure during Filling

1. Bladder neck closure
 - elastic tissue
2. Mucosal surface tension
3. Submucosal vascular plexus
4. Relaxation of inner longitudinal smooth muscle
5. Contraction in the intra-urethral striated muscle
6. Periurethral support
 - Striated muscles of the pelvic floor
 - Collagen of the endo-pelvic fascia
7. Transmission of abdominal pressure




23



24

Factors responsible for efficient voiding


1. Urethral relaxation
2. Adequate expulsive forces
3. Normal urethral geometry



25

Urethral Relaxation During Voiding


1. Pelvic floor relaxation
2. Relaxation of urethral rhabdosphincter (intraurethral striated muscle)
3. Urethral shortening (contraction of inner longitudinal muscle)
4. Funnelling of the bladder neck



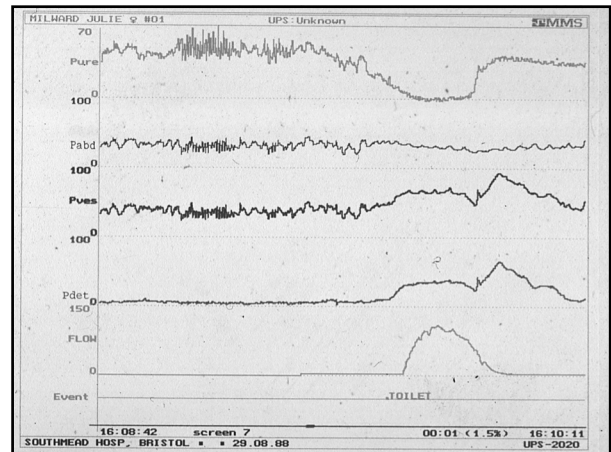
26

Expulsive Forces During Voiding

1. Sustained detrusor contraction
2. Straining during micturition
 - abdominal wall muscles
 - diaphragmatic muscle



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Patient Assessment


1. History
2. Physical examination
3. Urine examination
4. Radiology
5. Endoscopy
6. Urodynamic testing



30

Patient Assessment


1. History
2. Physical examination
3. Urine examination
4. Radiology
5. Endoscopy
6. Urodynamic testing



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History

1. Frequency
2. Nocturia
3. Stream
4. Hesitancy
5. Urgency
6. Incontinence



32

Naam: John Smith Datum afspraak: 14/1/96

Dag	Tijd/Volume (mL/s)	Overdag	's Nachts	Aantal gebruikte push gedurende 24 uur
1	8.00 08.30 09.30 100 50 50	10.00 11.00 12.00 200 100 200	13.00 14.00 15.00 100 100 100	3
2	08.00 08.30 09.00 150 50 100	10.00 11.00 12.00 100 100 100	13.00 14.00 15.00 100 100 100	2
3	08.00 09.00 10.00 100 100 100	11.00 12.00 13.00 100 100 100	14.00 15.00 16.00 100 100 100	4
4	08.00 09.00 10.00 100 100 100	11.00 12.00 13.00 100 100 100	14.00 15.00 16.00 100 100 100	2
5	08.00 09.00 10.00 100 100 100	11.00 12.00 13.00 100 100 100	14.00 15.00 16.00 100 100 100	3
6	08.00 09.00 10.00 100 100 100	11.00 12.00 13.00 100 100 100	14.00 15.00 16.00 100 100 100	4
7	08.00 09.00 10.00 100 100 100	11.00 12.00 13.00 100 100 100	14.00 15.00 16.00 100 100 100	4

Gemiddelde dagelijkse vloeistof inname (in kopjes): 5

33


Name: M. James S. Evans Date of appointment:

DAY	time / volume (ml.)	DAY-TIME	NIGHT
1			
2			
3	8.30 10.30 11.45 2.45 3.10 4.45 6.15 7.45 10.00 11.00		
4	8.45 9.00 10.00		
5			

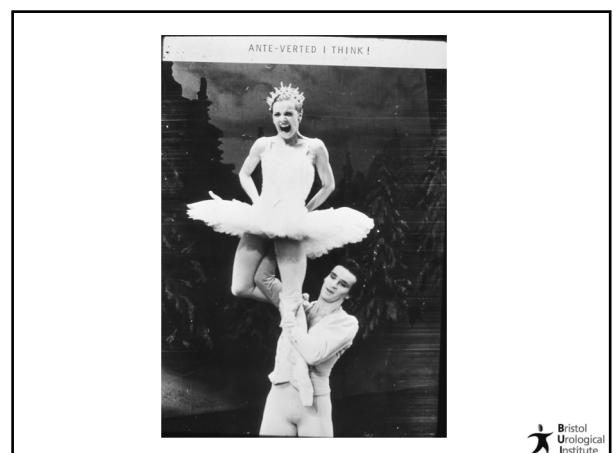
34

Assessing Lower Urinary Tract Dysfunction

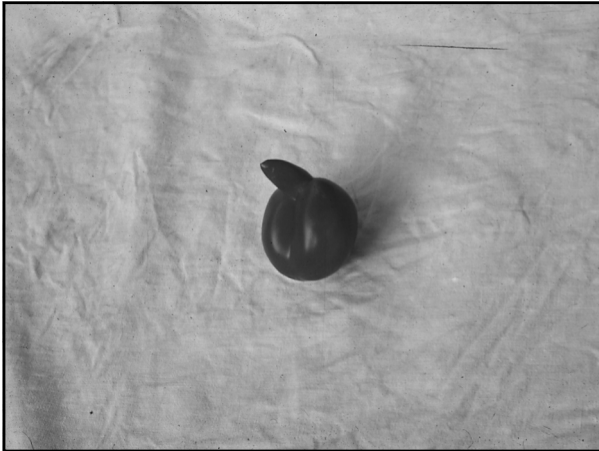
- symptoms
- impact on quality of life
- physical examination
- baseline tests
 - urine analysis
 - imaging?
 - endoscopy?
- urodynamics



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Patient Assessment

1. History
2. Physical examination
3. Urine examination
4. Radiology
5. Endoscopy
6. Urodynamic testing



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Urine Examination

- Look at the urine
- Dipstick
 - Leucocytes
 - Nitrites
 - Blood
- Urine microscopy



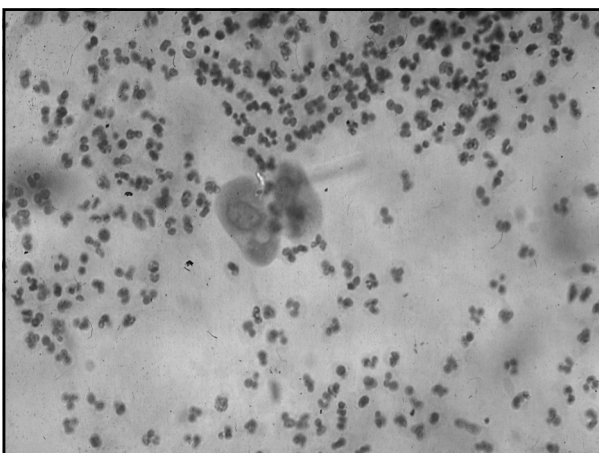
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M.S.U.

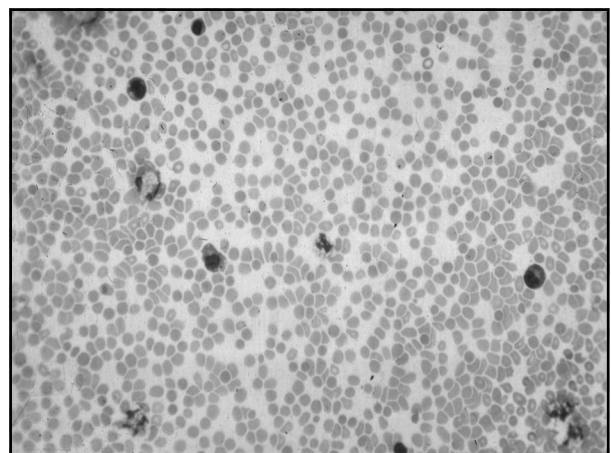
1. White cells
2. Red cells
3. Neoplastic cells



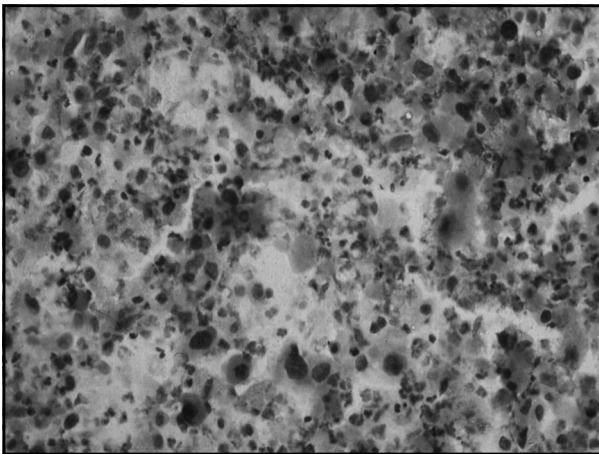
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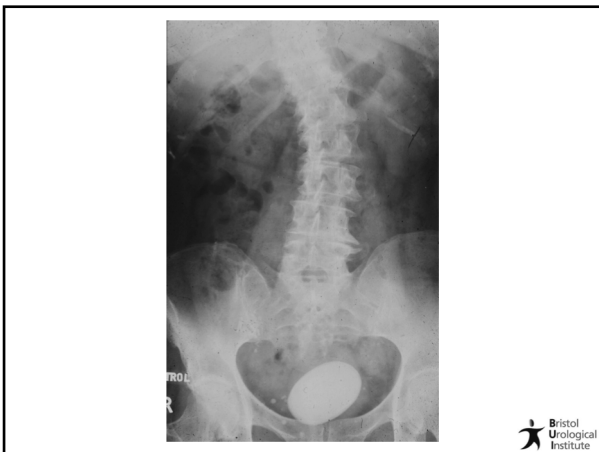
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Patient Assessment

1. History
2. Physical examination
3. Urine examination
4. Radiology
5. Endoscopy
6. Urodynamic testing



44



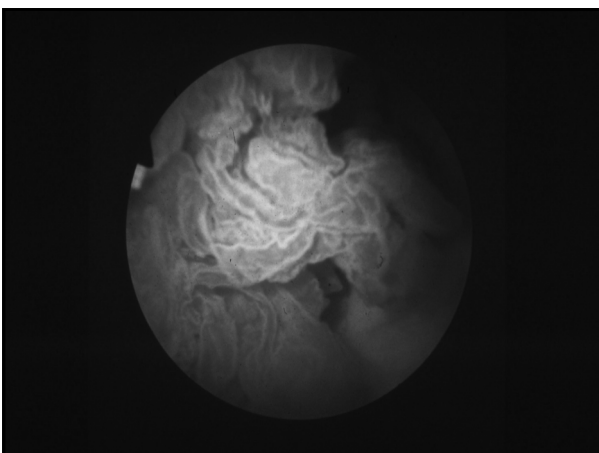
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Patient Assessment

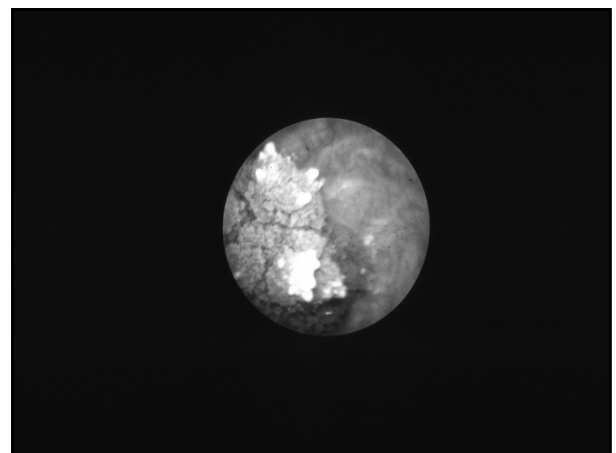
1. History
2. Physical examination
3. Urine examination
4. Radiology
5. Endoscopy
6. Urodynamic testing



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Urodynamic Studies


1. Simple
 - a) uroflowmetry
 - b) ultrasound assessment of residual urine
2. Basic
 - a) filling cystometry
 - b) voiding cystometry
3. Complex
 - a) video urodynamics
 - b) urethral function studies
4. Advanced
 - a) ambulatory urodynamics
 - b) neurophysiological testing



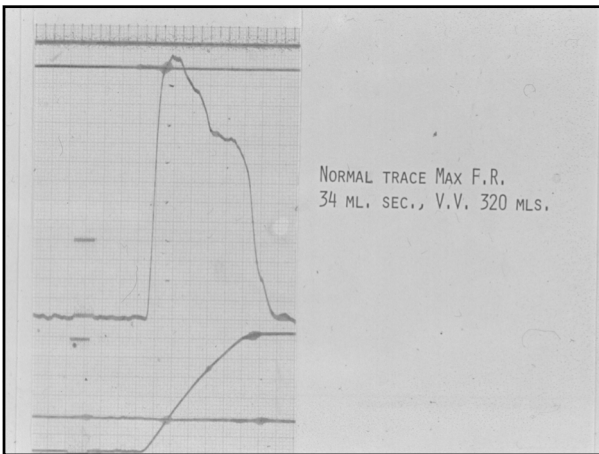
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Urodynamic Studies

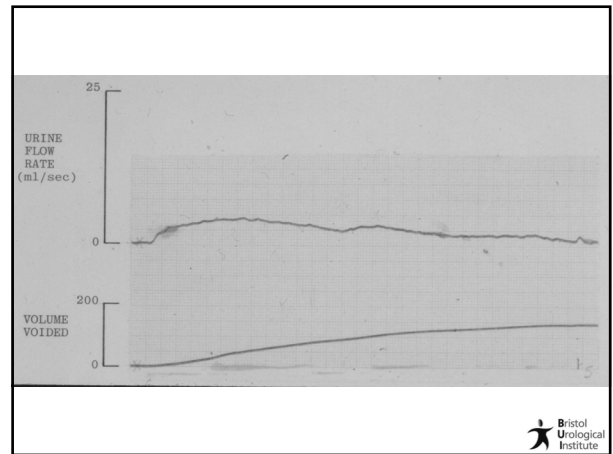
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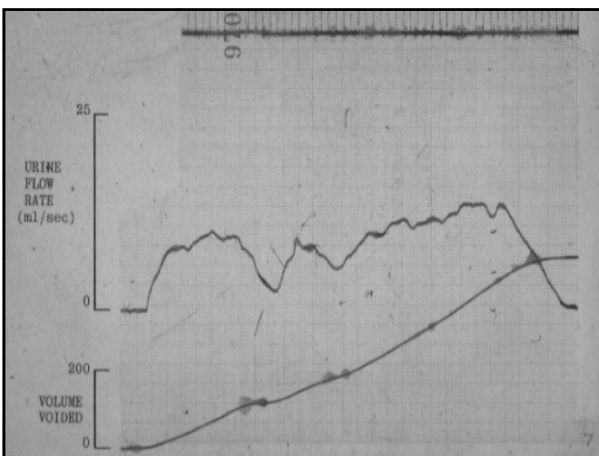
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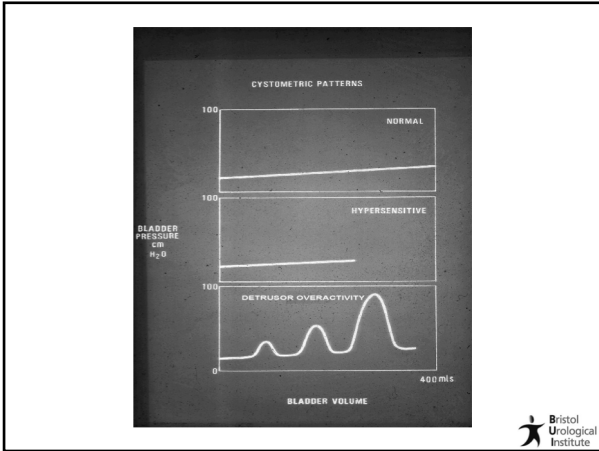
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Urodynamic Studies

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54

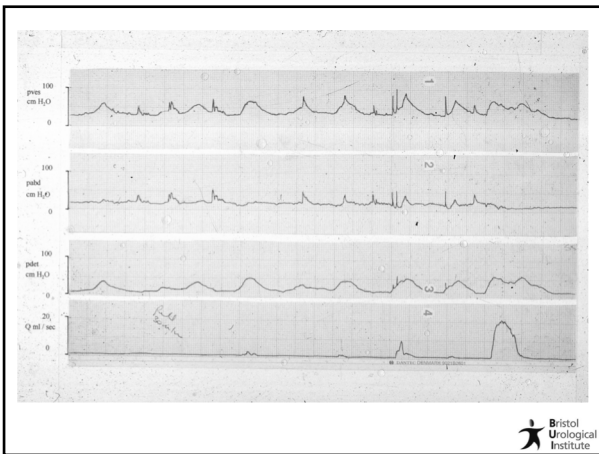


55

Investigation of LUTD: Storage Phase

- Bladder function
 - filling cystometry
- Urethral function
 - urethral pressure profilometry
 - leak point pressures

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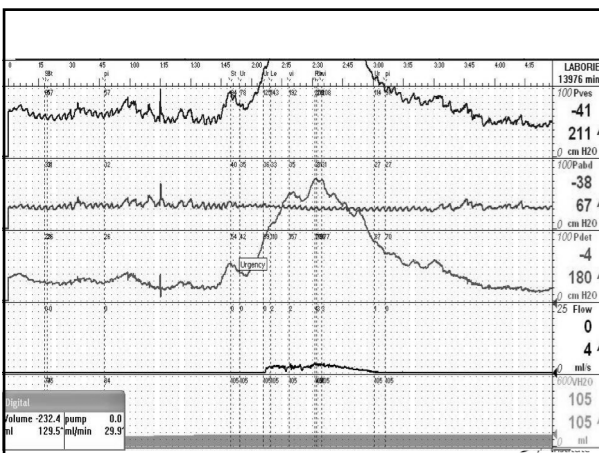


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Investigation of LUTD: Voiding Phase

- Bladder/urethral function
 - urine flow studies
 - pressure-flow studies
- Urethral function
 - sphincter/pelvic floor EMG

58

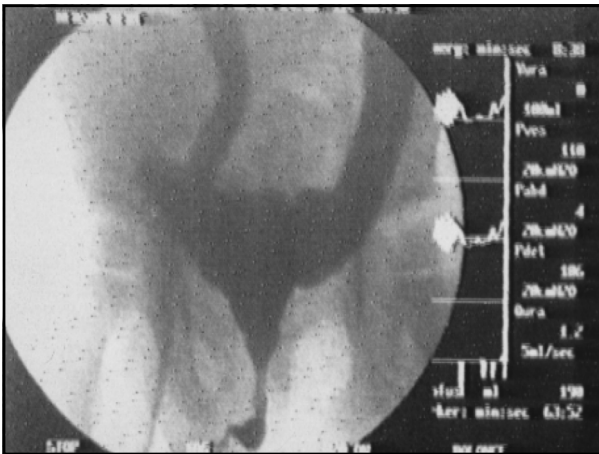


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Urodynamic Studies

1. Simple
 - a) uroflowmetry
 - b) ultrasound assessment of residual urine
2. Basic
 - a) filling cystometry
 - b) voiding cystometry
3. Complex
 - a) video urodynamics
 - b) urethral function studies
4. Advanced
 - a) ambulatory urodynamics
 - b) neurophysiological testing

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Urethral Function Studies


- Urethral pressure profilometry (static)
- Measurement of leak point pressure
- Voiding urethral pressure profilometry



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Urodynamic Studies

1. Simple
 - a) uroflowmetry
 - b) ultrasound assessment of residual urine
2. Basic
 - a) filling cystometry
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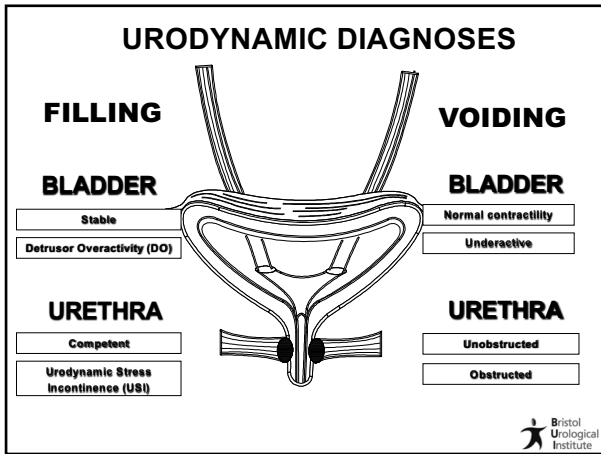
65

Neurophysiological Testing

1. Electromyography
2. Nerve conduction studies
3. Reflex latencies
4. Evoked responses



66



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