BUI – HKUA Certificate Course on URODYNAMICS

20th – 21st December 2019
Hong Kong SAR, China

Video Urodynamics in Neuropathic Bladders

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- Urology
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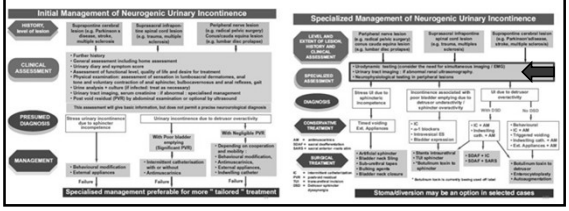
Table 1: Guidelines for urodynamics and uro-neurophysiology tests in NLUTD	GR
Urodynamic investigation is necessary to document the (dys-)function of the LUT.	A
The recording of a bladder diary is advisable.	B
Non-invasive testing is mandatory before invasive urodynamics is planned.	A
Video-urodynamics is currently the preferred method for invasive urodynamics in patients with NLUTD. If this is not available, then a filling cystometry continuing into a pressure flow study should be performed.	A
For standard urodynamic testing, a physiological filling rate (see Table 1, e.g. not faster than 20 mL/min) and body-warm fluid must be used.	A
Specific uro-neurophysiological tests and provocative manoeuvres (e.g. fast filling cystometry with cooled saline [the 'ice water test'], coughing, tapping, anal stretch) are selective procedures.	C

Clinical guidelines present the best evidence available to the experts / clinicians but following guideline recommendations may **not necessarily** result in the **best** outcome.

Guidelines can **never replace clinical expertise** when making treatment decisions for individual patients, but **rather help to focus decisions** – also taking **personal values and preferences** / individual circumstances of patients into account.

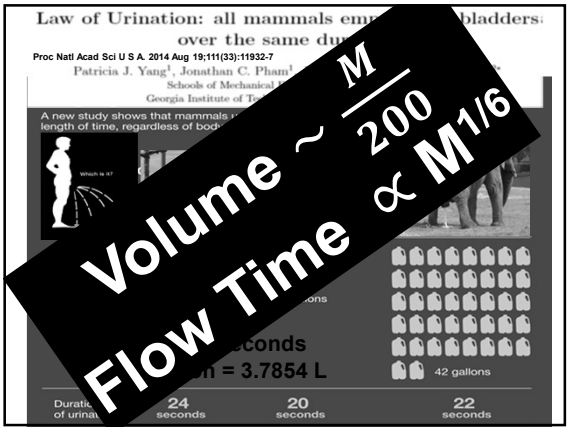
Guidelines are **not mandates** and do **not purport** to be a **legal** standard of care.

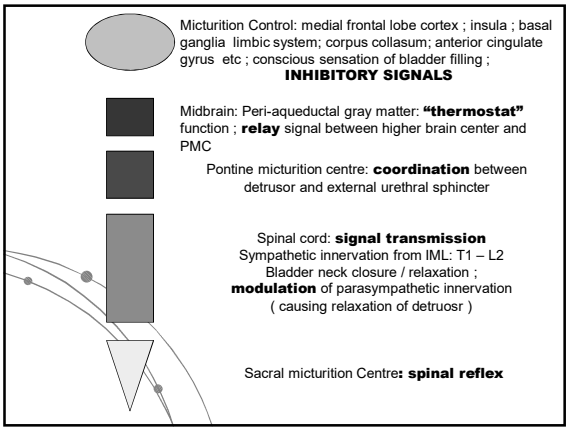


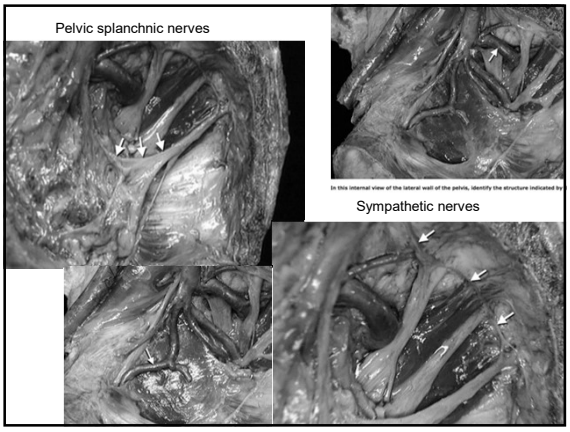
Bascics

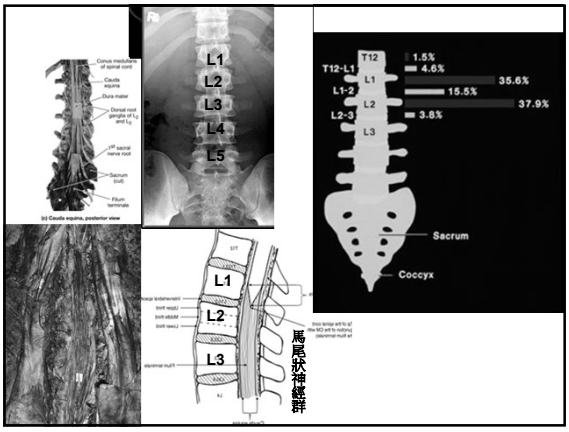
Normal Lower Urinary Tract Function

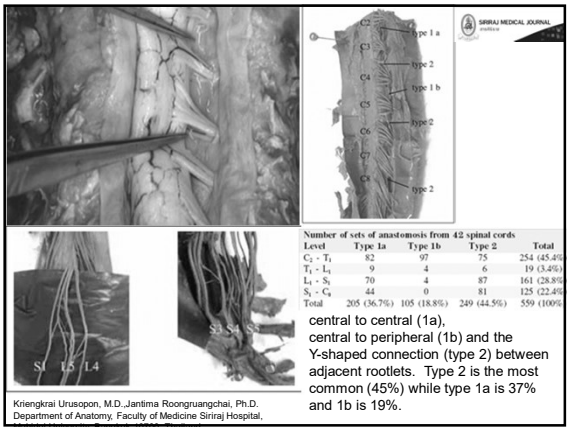
Storage: 低壓量高穩定無痛無洩漏
Emptying: 可控迅速暢順徹底不費力

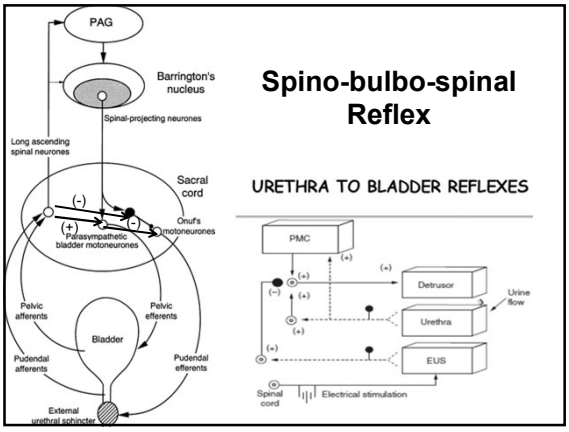


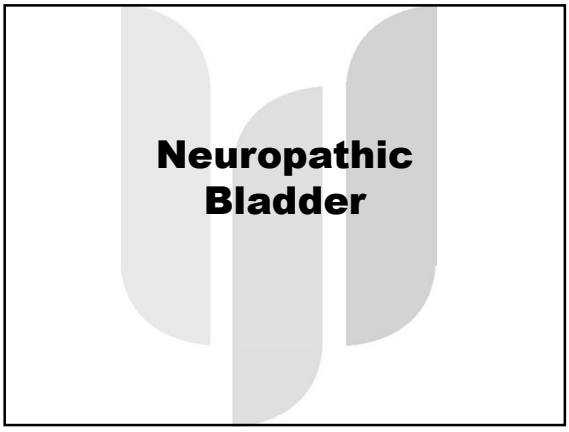

Micturition Control: medial frontal lobe cortex ; insula ; basal ganglia limbic system; corpus collasum; anterior cingulate gyrus etc ; conscious sensation of bladder filling ;
INHIBITORY SIGNALS
Midbrain: Peri-aqueductal gray matter: "thermostat" function ; relay signal between higher brain center and PMC
Pontine micturition centre: coordination between detrusor and external urethral sphincter
Spinal cord: signal transmission
Sympathetic innervation from IML: T1 – L2
Bladder neck closure / relaxation ;
modulation of parasympathetic innervation
(causing relaxation of detruosr)
Sacral micturition Centre: spinal reflex

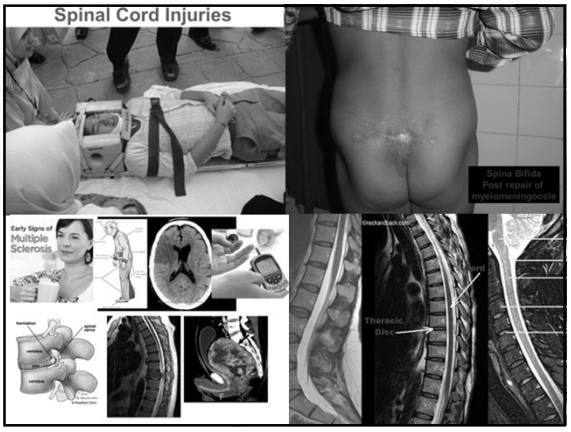

Pelvic splanchnic nerves
Sympathetic nerves


L1
L2
L3
L4
L5
T12
T12-L1
L1-2
L2-3
1.5%
4.6%
35.6%
15.5%
37.9%
3.8%
Sacrum
Coccyx


Number of sets of anastomosis from 42 spinal cords
Level Type 1a Type 1b Type 2 Total
C_2 - T_1 82 97 75 254 (45.4%)
T_1 - L_1 9 4 6 19 (3.4%)
L_1 - S_1 70 4 87 161 (28.8%)
S_1 - C_0 44 0 81 125 (22.4%)
Total 205 (36.7%) 105 (18.8%) 249 (44.5%) 559 (100%)
central to central (1a),
central to peripheral (1b) and the Y-shaped connection (type 2) between adjacent rootlets. Type 2 is the most common (45%) while type 1a is 37% and 1b is 19%.
Kriengkrai Urusopon, M.D.,Jantima Roongruangchai, Ph.D.
Department of Anatomy, Faculty of Medicine Siriraj Hospital,


PAG
Barrington's nucleus
Spinal-projecting neurones
Long ascending spinal neurones
Sacral cord
Onuf's motoneurones
Parasympathetic bladder motoneurones
Pelvic afferents
Pelvic efferents
Bladder
Pudendal afferents
Pudendal efferents
External urethral sphincter
Spino-bulbo-spinal Reflex
URETHRA TO BLADDER REFLEXES
PMC
Detrusor
Urethra
EUS
Urine flow
Spinal cord
Electrical stimulation


Neuropathic Bladder

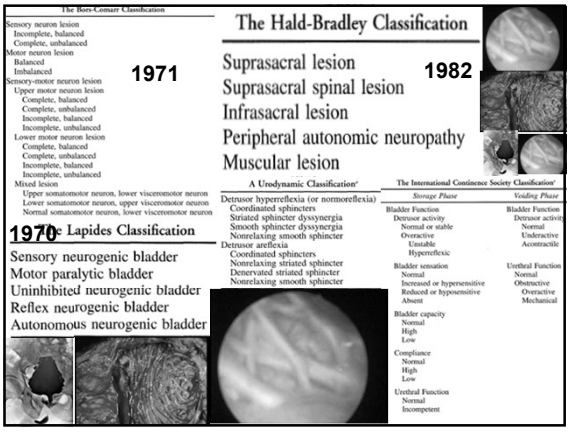


1960 Ed.

Automatic Bladder
(自動膀胱)
{suprapontine / infant
(before 3y.o)}

Autonomic Bladder
(失神經支配自主性膀胱)
(suprasacral + infrapontine)

Autonomous Bladder
(自主性膀胱)
(sacral / infra-sacral :
NO sacral arc reflexes)

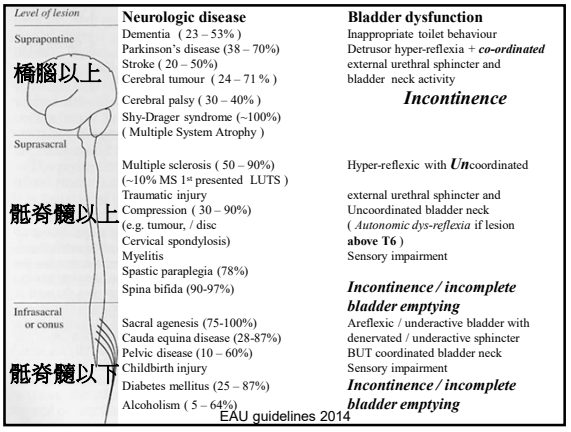


Neuropathic Bladder

- **Malfunctioning urinary bladder due to neurologic dysfunction or insult emanating from internal or external trauma, disease, or injury.**
- **The subsequent bladder dysfunction depends grossly on the location and the extent of the neurologic lesion**

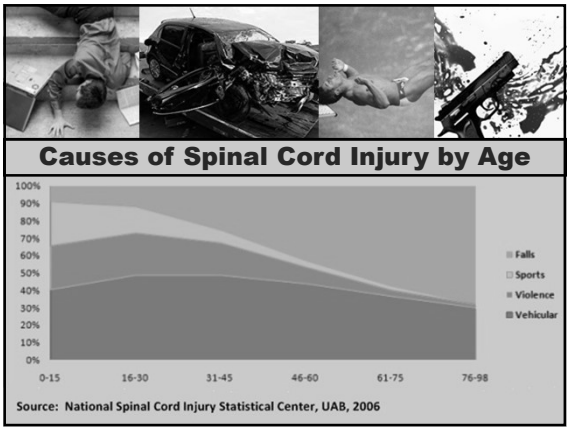
- **Failure to Store 儲存失效**
- **Failure to Empty 排尿失效**
- **Both of Them 以上兩者**

International Continence Society 2002



Neurologic disease	Bladder dysfunction
Dementia (23 – 53%)	Inappropriate toilet behaviour
Parkinson's disease (38 – 70%)	Detrusor hyper-reflexia + ***co-ordinated***
Stroke (20 – 50%)	external urethral sphincter and
Cerebral tumour (24 – 71 %)	bladder neck activity
Cerebral palsy (30 – 40%)	***Incontinence***
Shy-Drager syndrome (~100%)	
(Multiple System Atrophy)	
Multiple sclerosis (50 – 90%)	Hyper-reflexic with ***Un***coordinated
(~10% MS 1st presented LUTS)	
Traumatic injury	external urethral sphincter and
Compression (30 – 90%)	Uncoordinated bladder neck
(e.g. tumour, / disc	(*Autonomic dys-reflexia* if lesion
Cervical spondylosis)	**above T6**)
Myelitis	Sensory impairment
Spastic paraplegia (78%)	
Spina bifida (90-97%)	***Incontinence / incomplete bladder emptying***
Sacral agenesis (75-100%)	Areflexic / underactive bladder with
Cauda equina disease (28-87%)	denervated / underactive sphincter
Pelvic disease (10 – 60%)	BUT coordinated bladder neck
Childbirth injury	Sensory impairment
Diabetes mellitus (25 – 87%)	***Incontinence / incomplete bladder emptying***
Alcoholism (5 – 64%)	

EAU guidelines 2014



Code of Hammuraby & The Edwin Smith Papyrus
2686 - 2613 B.C.



….one having a dislocation in a vertebra of his neck, while he is unconscious of his two legs and two arms and his urine dribbles. An ailment not to be treated.


Rufus from Ephesus (1st century AD) "a paralytic bladder, as from spinal cord injury, should be treated by catheterization"

Hamada G. et al Clin Orthop 1972, 89: 253 – 268 ; Bloom D, et al., J Urol 1994; 151: 317 – 325
Tribe CR., et al., Paraplegia 1963; 4: 391 - 409

Mortality of spinal cord injury due to *renal problems*
Balkan War (1912 – 1913) **in the past 100 years** (Donnelly J et al 1972; Borges PM et al 1982)

World War I (1914 –1918) **80%**

World War II (1939-1945) **40%**

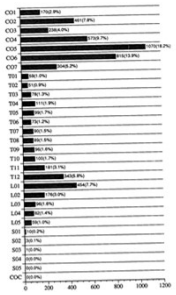
B. FOLEY
June 1935.

Korean War (1950 – 1953) **25%**

Vietnam War (1964-1975) **5-10%**

Spinal Injuries to Soldiers Much More Common in Iraq, Afghanistan Wars
About 11 percent of U.S. combat wounds now involve spine, study finds


Spinal Cord Injury
Incidence of spine injury by highest level
(Northwestern University Acute Spine Injury Centre 1972-1990) *Meyer 1994*



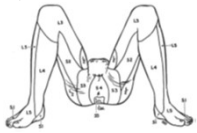
Outcome of Spinal Cord Injuries

Tetraplegia 四肢癱瘓 C5/6	53%
Paraplegia 下身癱瘓 T4-6; T11/L1	46%
Complete recovery完全康 復	1%
Complete injuries 徹底創傷	48%
Incomplete injuries不徹底創傷	52%
Associated Head injuries	11%

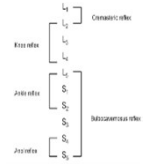
The Journal of Spinal Cord Medicine 2006; 29(5): 527 - 573

Evaluation of Neuropathic Bladder
History Taking : Bladder Dysfunction ; Bothersomeness ; Hand Function ; Dependency
Physical Examination :

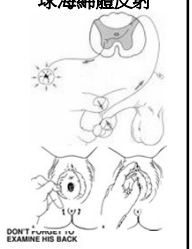
Bulbocavernosus reflex
球海綿體反射

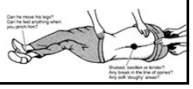


Dermatomes 皮節of spinal cord levels L2 – S4

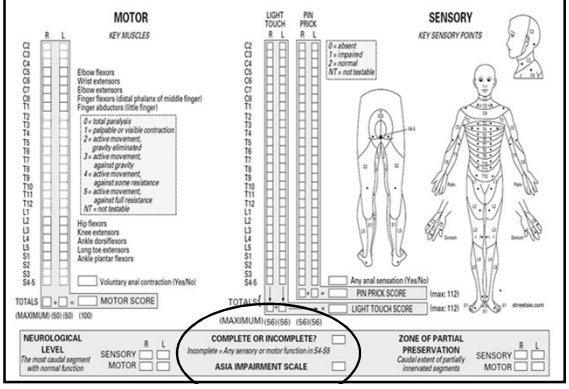


Reflexes of lower spinal cord segments肌節

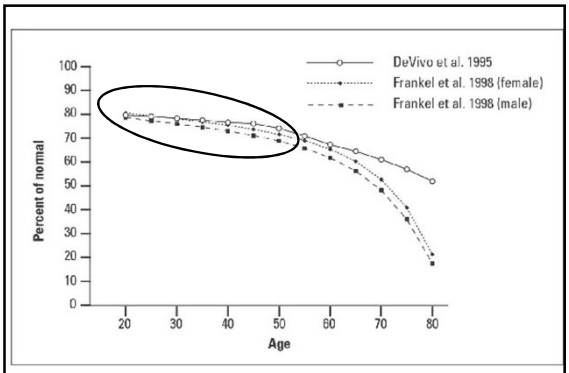




STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY



How long can these people live ?



Paraplegia: Age-specific standardized mortality ratios

Anderson TW et al., BCMJ, Vol. 45, No. 4, May 2003, page(s) 178-182

How long can these people live nowadays ?

Life expectancy for persons who survive the 1st year post spinal cord injury (years)

(National spinal cord injury database USA)

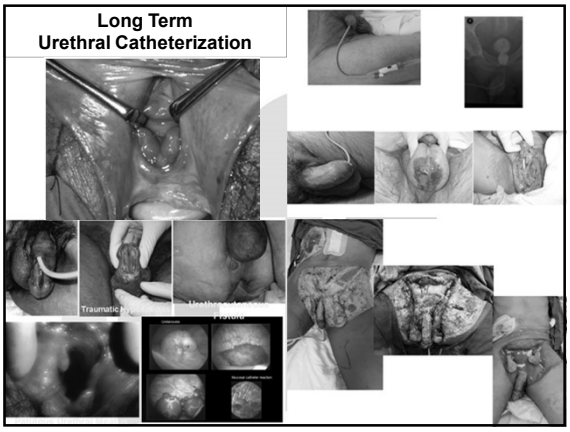
21% SCI patients died of respiratory cause

1952 - 2004

Age at injury	NO spinal cord injury	Functional at any level	Paraplegia	Tetraplegia (C 5-8)	Tetraplegia (C 1-4)	Ventilator Dependent at any level
20	57.2	52.5	46.2	41.2	37.1	26.8
40	38.4	34.3	28.7	24.5	21.2	13.7
60	21.2	18.1	13.7	10.6	8.4	4.0

Lidall IB et al., J Rehabil Med 2007 Mar; 39(2): 145 - 51

Long Term Urethral Catheterization



Natural Course of Neuropathic Bladder due to SCI

Neurological Disease & Bladder Dysfunction

- Bladder (sphincter) dysfunction

$$\bullet f\ (t, l, c, p, a)$$

t = time from disease / injury onset ,
l = level of disease / injury,
c = completeness of disease / injury
p = progression of disease / injury
a = Age at onset of dysfunction

Drake MJ et al., Neurourol and Urodyn 2016; 35: 657 - 665

Spinal Cord Injury

- Bladder dysfunction (time factor)
- Spinal shock phase
- Recovery phase
- Stable phase

- Spinal shock phase
- 脊椎性休克
  - Flaccid paralysis (弛緩性麻痺) and absence of reflex activity below the lesion
  - Areflexic bladder(逼尿肌無反射)→ urinary retention
  - 2 – 12 wks
  - 6 – 12 months

Spinal Cord Injury

- Neurogenic shock
- 神經源性休克
- Loss of vascular tone in part of the body deprived of supraspinal control, supine systolic BP < 90 mmHg in absence of low intravascular volume

- Spinal shock phase
- 脊椎性休克
  - Flaccid paralysis (弛緩性麻痺) and absence of spinal reflex activity below the lesion
  - Areflexic bladder(逼尿肌無反射)→ urinary retention
  - 2 – 12 wks
  - 6 – 12 months

Spinal cord injury

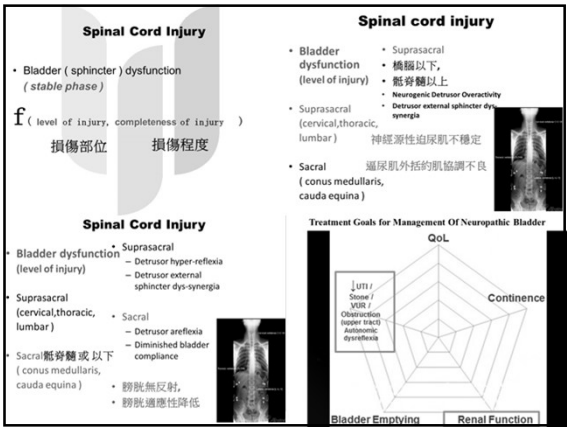
- Bladder dysfunction (time factor)
- Spinal shock phase
- Recovery phase
- Stable phase

- Recovery phase
- 康復階段
  - Reflexic activity (反射活動) returns
  - Level of injury may give a hint BUT NOT always
  - 2 – 12 wks

Spinal Cord Injury

- Bladder dysfunction (time factor)
- Spinal shock phase
- Recovery phase
- Stable phase

- Stable phase
- 穩定階段
  - NO further neurologic recovery
  - Urodynamic pattern stable
  - 6 – 12 months
  - Bladder function can still change with time e.g. the compliance of bladder膀胱適應性



	Upper tract dilatation	Risk for renal failure (compared to the general population)
Multiple Sclerosis	**8%**	**Same risk**
Traumatic paraplegia	**23%**	**5x**
Neural tube defects	**68%**	**8x**

de Seze et al 2007
Lawrenson et al., 2001

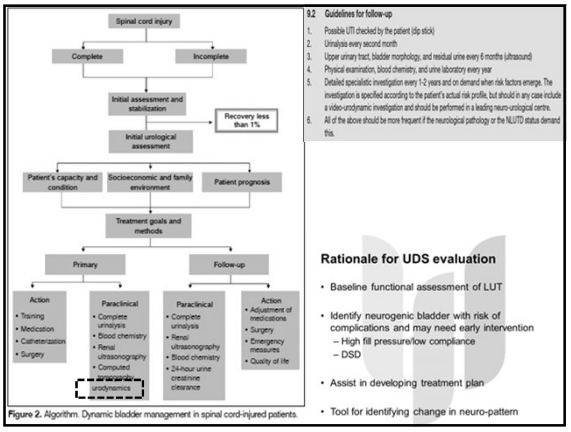
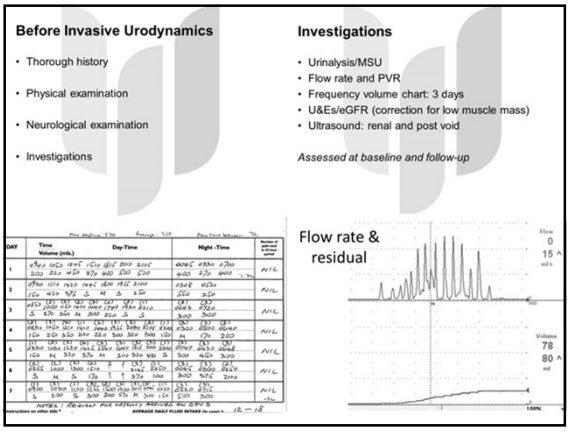


Figure 2. Algorithm. Dynamic bladder management in spinal cord-injured patients.



AUA/SUFU 2012

Clinicians should perform:

- **PVR assessment**, either as part of complete urodynamic study or separately, during the initial urological evaluation of patients with relevant neurological conditions (e.g., spinal cord injury, myelomeningocele) and as part of ongoing follow-up when appropriate. (*Standard; Evidence Strength: Grade B)*
- a **complex CMG** during initial urological evaluation of patients with relevant neurological conditions with or without symptoms and as part of ongoing follow-up when appropriate. In patients with other neurologic diseases, physicians may consider CMG as an option in the urological evaluation of patients with LUTS. (*Recommendation;* Evidence Strength: *Grade C)*

AUA/SUFU 2012

- Clinicians should perform **pressure flow analysis** in patients with relevant neurologic disease with or without symptoms or in patients with other neurologic disease and elevated PVR or urinary symptoms. (*Recommendation;* Evidence Strength: *Grade C)*
- When available, clinicians may perform **fluoroscopy at the time of urodynamics (VUDS)** in patients with relevant neurologic disease at risk for NGB or in patients with other neurologic disease and elevated PVR or urinary symptoms. (*Recommendation; Evidence Strength: Grade C)*

Urodynamics

- Bladder Diary (膀胱日记)
- Uroflowmetry + post-void residual urine(PVR)
- (尿流速 + 残留尿量)
- Urethral pressure profile (UPP) (尿道压力测定)
  - Static
  - Micturitional urethral pressure profile
- Cystometry (膀胱测压)
  - Filling (充盈性膀胱测压)
  - Voiding (排尿期膀胱测压)
- Detrusor / Valsalva leak point pressure (漏尿点压力测定)
- Electromyography (EMG) (同步盆底肌电图测定)
- (surface electrode vs needle electrode 外括約肌肌電圖)
- Video-cystometrography (VCMG) (尿流动力暨影像检查)
- Ambulatory cystometry (动态 尿动力学监测)
- Non-invasive cystometry (experimental)
- Penile pressure cuff

Urodynamics in Neuropaths

- What information should it give us?
  1. Is the patient's renal function safe?
     - Dysynergia, poor bladder compliance, reflux
  2. How to manage symptoms
     - Storage, voiding, bladder/outlet
- Technical points *(Good Urodynamic Practice; Schafer et al., Neurourol Urodyn 2002)*
  - Slow filling
  - Video preferred
  - Dangers: autonomic dysreflexia, latex allergy

International Urodynamic Basic Spinal Cord Injury (SCI) Data Set

- Bladder sensation during filling cystometry
- Detrusor function and compliance during filling
- Detrusor function during voiding
- Detrusor leak point pressure
- Maximum detrusor pressure
- Cystometric bladder capacity
- Post-void residual

Why video UDS?

Intraprostatic reflux-
indicating sphincter obstruction

Anatomy !

Modifications

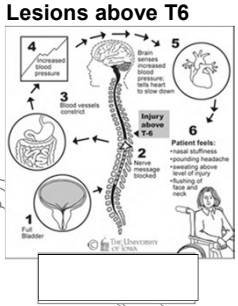
- **Preparation**
  - allow time
  - assistance
- **Equipment**
  - space
  - hoist
  - flow pipe
  - room
- **Technique**
  - position
  - slow filling speed
  - ?drain residual urine
  - VCMG
  - pregnancy test

BEWARE autonomic dysreflexia! (spinal cord damage above level of T6)

Autonomic Dys-reflexia

Lesions above T6

自主神經異常反射



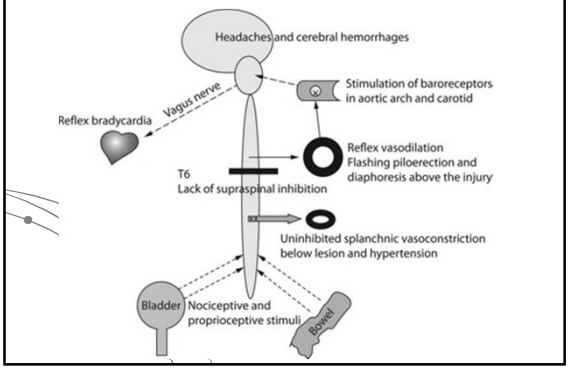
Conditions triggering autonomic dysreflexia:

Full Bladder
Constipation or a full bowel
Pain
Infection
Skin breakdown
Ingrown toenail嵌趾甲
Sudden temperature changes in the surrounding environment

Signs and Symptoms :
Goose Bumps (pilo-erection)
High blood pressure (SBP ↑ 20 mmHg above baseline)
Low heart rate
Anxiety
Severe pounding headache
Sweating above the level of the injury
Nasal stuffiness

Consequences: Stroke, heart attack, or seizures

Autonomic dysreflexia



ICS Standard Nomenclature

- **Acontractile Detrusor**
  - Old nomenclature: Areflexia - Atonic, Flaccid
- **Detrusor Overactivity (old: Detrusor Instability)**
  - Neurogenic DO
  - DO Incontinence
- **Dyssynergia - Bladder/Sphincter discoordination**
  - Internal urethral sphincter: smooth bladder neck
  - External urethral sphincter: striated rhabdosphincter

Leak Point Pressures

- **Abdominal Leak Point Pressure**
  - intravesical pressure at which urine leakage occurs due to increased abdominal pressure in the absence of a detrusor contraction
- **Detrusor Leak Point Pressure**
  - lowest detrusor pressure at which urine leakage occurs in the **absence** of either a **detrusor contraction** or **increased abdominal pressure**

ALPP vs DLPP

ALPP

- Measures urethral resistance
- Measure of SUI
  - ISD (<60cmH_20),
  - Gray (60-90cmH_20)
  - Hypermobile (>90cmH_20)

McGuire 1993

DLPP

- Measures compliance
- Measure of bladder ability to safely store urine
  - >40cmH_20: Risk of damage to upper urinary tract (>20 in NLUTD)

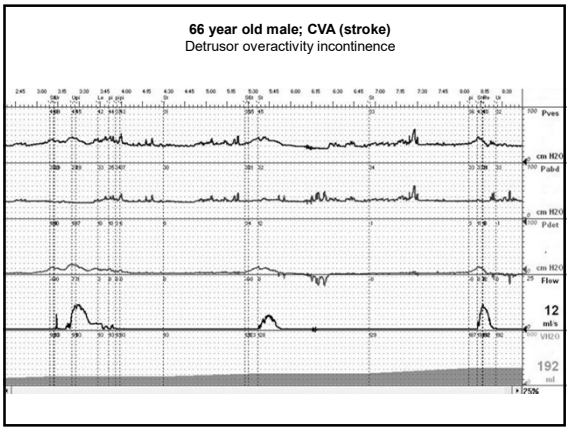
McGuire 1983

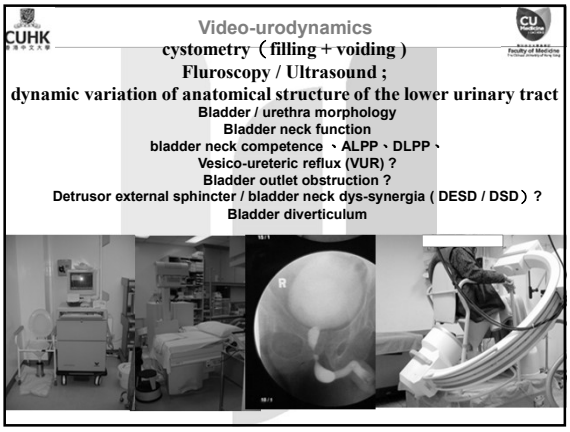
Outlet during filling

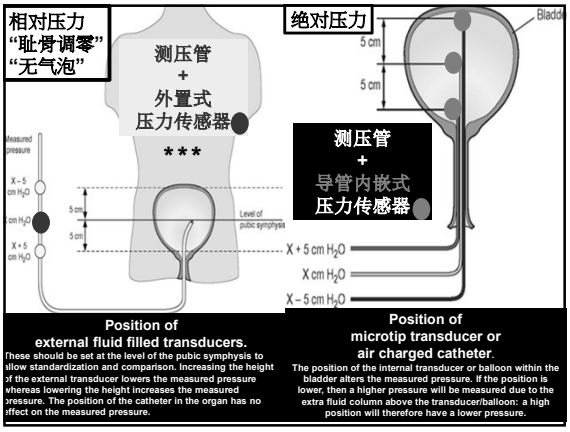
VLPP;
Test for ISD

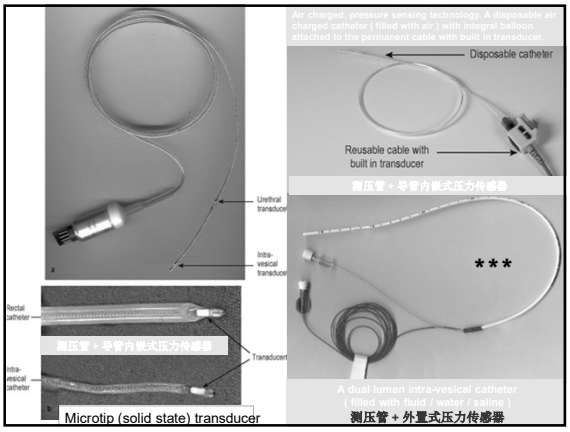
Urodynamics

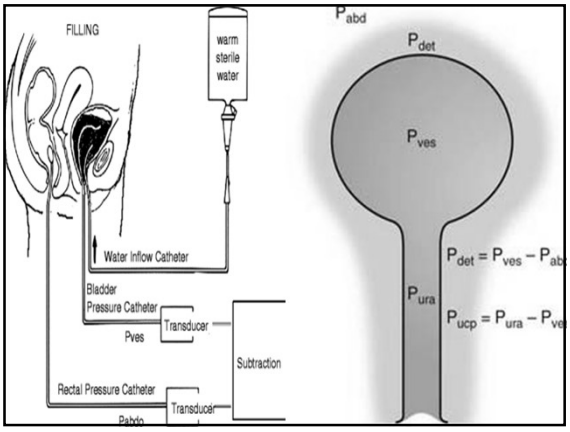
Non-neuropathic; DO at 08.15 and 09.15, cough-provoked DO 10.30, voids on overactive contraction, small cystometric capacity

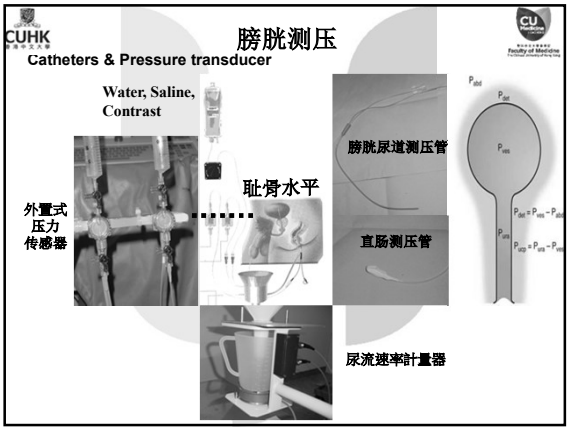

66 year old male; CVA (stroke)
Detrusor overactivity incontinence
Pves
Pabd
Pdet
Flow
12
192

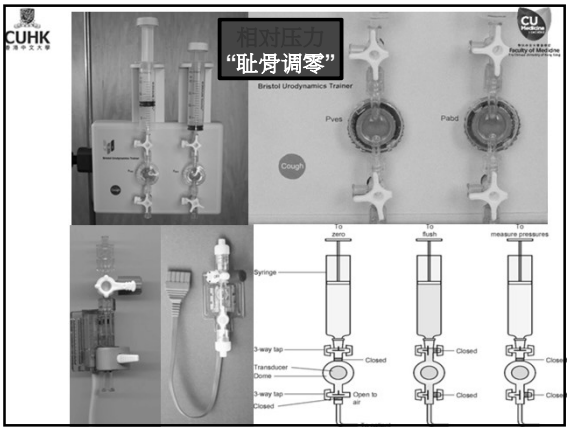

CUHK
Video-urodynamics
cystometry（filling＋voiding）
Fluroscopy / Ultrasound ;
dynamic variation of anatomical structure of the lower urinary tract
Bladder / urethra morphology
Bladder neck function
bladder neck competence 、ALPP、DLPP、
Vesico-ureteric reflux (VUR) ?
Bladder outlet obstruction ?
Detrusor external sphincter / bladder neck dys-synergia（DESD / DSD）?
Bladder diverticulum

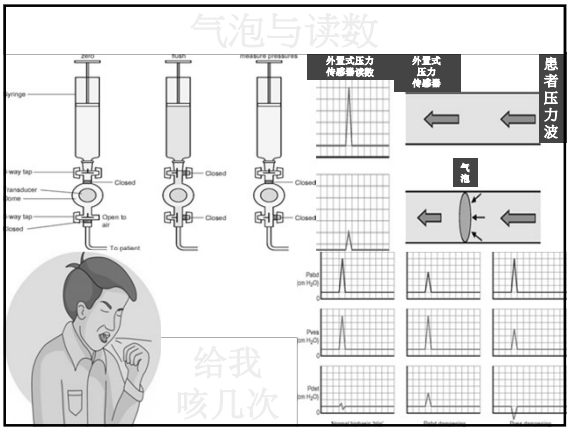

相对压力
“耻骨调零”
“无气泡”
测压管
+
外置式
压力传感器
***
绝对压力
测压管
+
导管内嵌式
压力传感器
5 cm
5 cm
X + 5 cm H2O
X cm H2O
X – 5 cm H2O
Position of
external fluid filled transducers.
These should be set at the level of the pubic symphysis to allow standardization and comparison. Increasing the height of the external transducer lowers the measured pressure whereas lowering the height increases the measured pressure. The position of the catheter in the organ has no effect on the measured pressure.
Position of
microtip transducer or
air charged catheter.
The position of the internal transducer or balloon within the bladder alters the measured pressure. If the position is lower, then a higher pressure will be measured due to the extra fluid column above the transducer/balloon: a high position will therefore have a lower pressure.


Air charged pressure sensing technology: A disposable air charged catheter (filled with air) with integral balloon attached to the permanent cable with built in transducer.
Disposable catheter
Reusable cable with built in transducer
测压管 + 导管内嵌式压力传感器
Urethral transducer
Intra-vesical transducer
***
Rectal catheter
测压管 + 导管内嵌式压力传感器
Transducer
Intra-vesical catheter
Microtip (solid state) transducer
A dual lumen intra-vesical catheter
(filled with fluid / water / saline)
测压管 + 外置式压力传感器


FILLING
warm sterile water
Water Inflow Catheter
Bladder Pressure Catheter
Transducer
Pves
Subtraction
Rectal Pressure Catheter
Transducer
Pabdo
Pabd
Pdet
Pves
Pura
Pdet = Pves – Pabd
Pucp = Pura – Pves

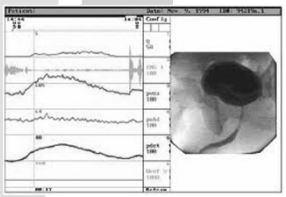

CUHK
膀胱测压
Catheters & Pressure transducer
Water, Saline, Contrast
外置式
压力
传感器
耻骨水平
膀胱尿道测压管
直肠测压管
尿流速率計量器
Pabd
Pdet
Pves
Pdet = Pves – Pabd
Pura
Pucp = Pura – Pves





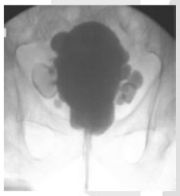
Video-Urodynamics (VUDS)

- Cystometry with simultaneous imaging of the lower urinary tract
- In other words, simultaneous structural and functional information
  - VUR
  - USI
  - Bladder shape
  - Pelvic support
  - Diverticula etc.



Male Bladder Outlet Obstruction

Cystography



- Performed during VCMG and overall shape of bladder noted
- Can give indication of post free flow RV
- Also highlights other pathologies……..

A patient with BPE highlighting the value of cystography

Neuropathic Bladder

Note the small capacity “fir tree” configuration of the bladder with trabeculation

Cystography - Technique

- Bladder half full (200-250ml)
- AP Lateral and Oblique projections
- At rest and during valsalva / coughing
- Also important to do post void image
  - Indicates PVR
  - Shows VUR and allows grading

Points to Note

- Filling – residual volume, sensation, overactivity, pressure change, incontinence, reflux
- Provocation – descent, induced DO, ALPP and sphincteric incompetence
- Voiding – co-ordination, obstruction and level, reflux, sphincter overactivity
- Post-void film and cough essential

Electromyography (EMG)

- Simultaneous measurement of muscle activity
- **Needle** or **surface** electrodes are placed on the perineum to detect general striated muscle activity
- **Failure** of the urethra / pelvic floor to **relax** and **detrusor sphincter dyssynergia** can be theoretically detected during voiding using this technique

ElectromyographyE M G

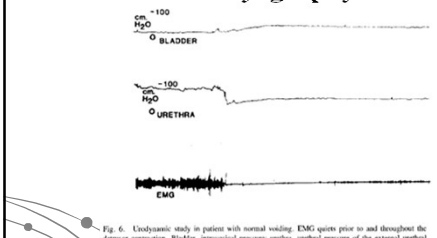
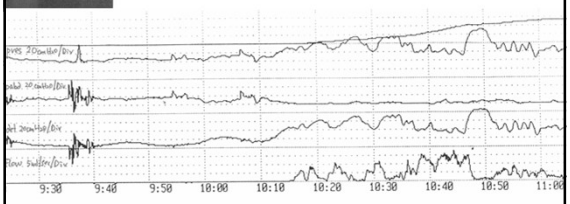


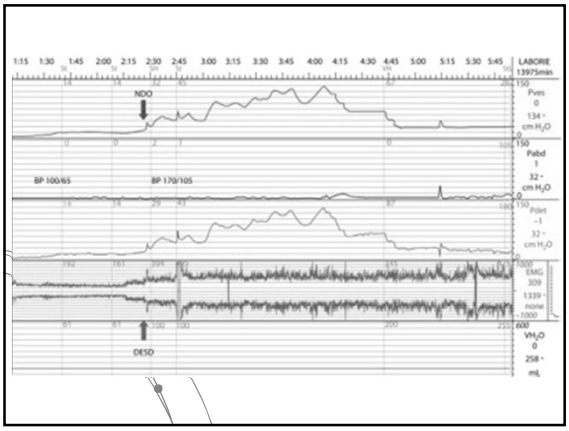
Fig. 6. Urodynamic study in patient with normal voiding. EMG quiets prior to and throughout the detrusor contraction. Bladder, intravesical pressure; urethra, urethral pressure of the external urethral sphincter; EMG, external anal sphincter activity.

Indicates the patient's coordination (control) of pelvic floor in relation of detrusor contraction

Rudy et al Neurourology and Urodynamics 1991; 10: 169 - 176

Detrusor External Sphincter Dys-synergia DESD





Electromyography E M G

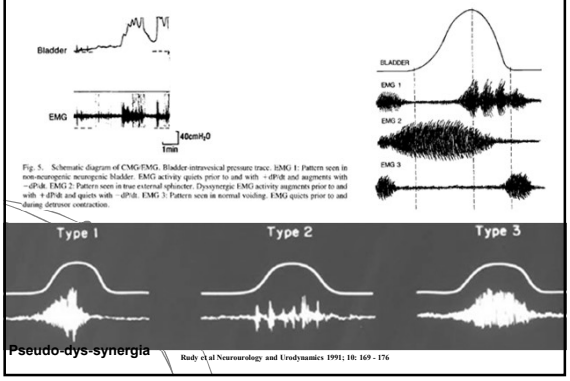
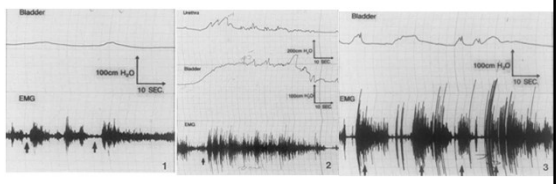


Fig. 5. Schematic diagram of CMG/EMG. Bladder-intravesical pressure trace. EMG 1: Pattern seen in non-neurogenic neurogenic bladder. EMG activity quiets prior to and with +dPves and augments with −dPves. EMG 2: Pattern seen in true external sphincter. Dyssynergic EMG activity augments prior to and with +dPves and quiets with −dPves. EMG 3: Pattern seen in normal voiding. EMG quiets prior to and during detrusor contraction.

Pseudo-dys-synergia

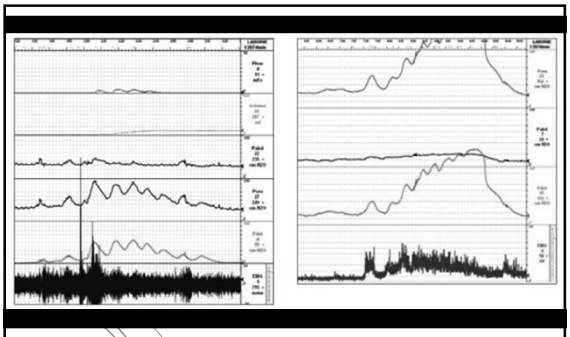
Rudy et al Neurourology and Urodynamics 1991; 10: 169 - 176

Electromyography E M G



The electromyographic findings have been described in detail. Blaivas et al. defined type 1 DSD as "a crescendo increase in electromyographic activity that reached a maximum at the peak of detrusor contraction" type 2 DSD as "clonic sphincter contractions interspersed throughout the detrusor contraction" and type 3 DSD as "a sustained sphincter contraction that coincided with detrusor contraction" [23]. Yalla et al. coincided with detrusor contraction" [23]. Yalla et al. described grade 1 DSD as high voiding pressures with a normal urinary flow rate and inconsistent external sphincter contractions during void, their grade 2 DSD corresponds to Blaivas types 1 and 2, and their grade 3 DSD corresponds to Blaivas type 3 [24]. More re-

Rudy et al Neurourology and Urodynamics 1991; 10: 169 - 176

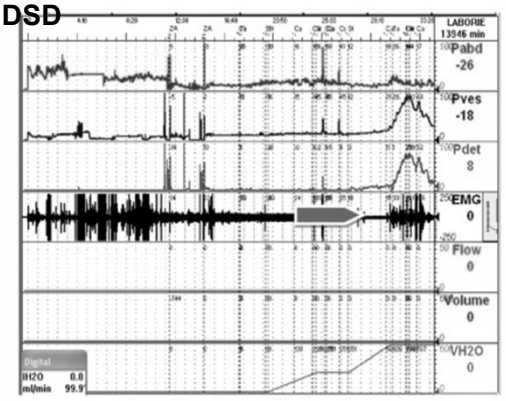


Mirrored EMG Tracing of Detrusor Sphincter Dyssynergia (DSD) in
a. Patient with Multiple Sclerosis
b. Baseline EMG Tracing in a Patient with T9 Spinal Cord Injury

Electromyography

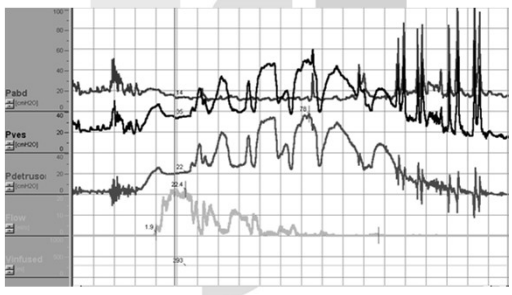
- Technically difficult to ensure a good quality EMG signal from the **appropriate** muscle
- There have been little or no published clinical evidence in at least the last 20 years indicating the benefits of combining EMG with cystometry (ICI, 2012).

DSD

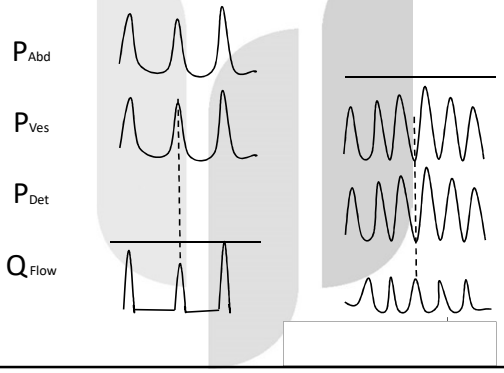


Detrusor Sphincter Dyssynergia

- When there is flow, detrusor pressure drops



Straining vs DSD



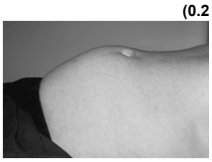
Fowler's Syndrome (1985)

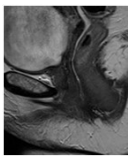
? Most common cause of idiopathic urinary retention in young female (<40y.o.)

Prof. Clare FOWLER

Fowler's Syndrome

(0.2 / 100,000 per year)

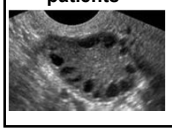




Painless Urinary Retention

Residual urine > 1000 ml
But
Painful Insertion of Urethral Catheter / Upon its removal

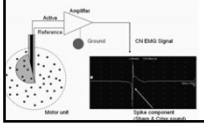
Polycystic ovaries in 50% patients



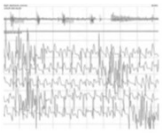
Fowler's syndrome

Clinical history	Female
	Aged between onset of menarche and menopause
	No evidence of urological, gynecological or neurological disease
	Retention with a volume in excess of 1000 ml
	No sense of urinary urgency despite high bladder volumes
	Straining does not help emptying
	Sense of "something gripping" or difficulty on removing catheter
	No history of urological abnormalities in childhood or associated abnormalities of the urinary tract
	Association with polycystic ovarian syndrome and endometriosis
Laboratory findings	Raised urethral pressure (>50% expected value for age)
	Increased sphincter volume (>1.8 ml on US5 assessment)
	Characteristic urethral sphincter EMG

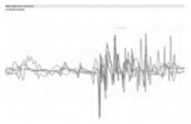
Concentric Needle Electrode

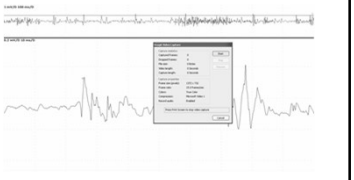


Decelerating bursts



Complex repetitive discharges





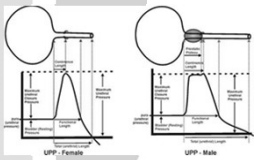
AUA/SUFU 2012

- Clinicians should perform **EMG** in combination with **CMG** with or without **PFS** in patients with relevant neurologic disease at risk for NGB or in patients with other neurologic disease and elevated **PVR or urinary symptoms.**

  (*Recommendation; Evidence Strength: Grade C)*

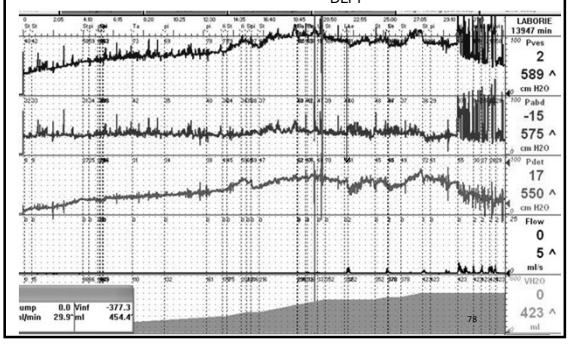
Urethral Pressure Profilometry (UPP)

- Maximal urethral closure pressure (MUCP) is the maximum urethral pressure minus intravesical pressure
- Functional urethral length is the distance along the urethra in which urethral pressure exceeds bladder pressure
- In most continent women
  - FPL – 3cm
  - MUCP – 40 - 60cmH2O



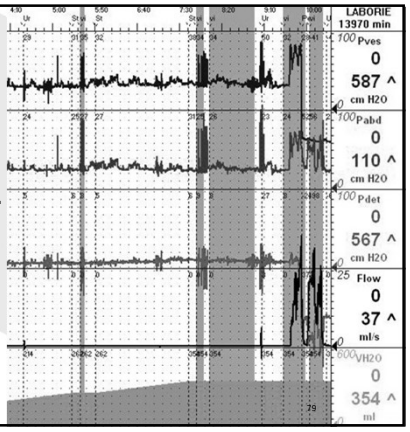
Sacral SCI; unsafe LMNL

DLPP



Peripheral nerve injury;

"safe" LMNL
(i.e. renal function should not be at risk)



Progressive Neurological Conditions

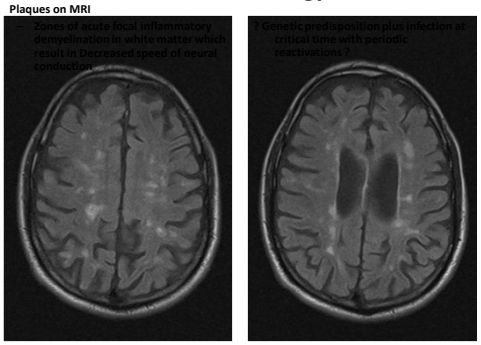
- Multiple Sclerosis
- Parkinson's disease
- MSA
- Dementias
- Neuropathies
- Ataxias
- Odds and Ends
  - (Adrenomyeloneuropathy ???)

MS - Epidemiology

- Incidence 7/100,000
- Prevalence 120/100,000
- Life-Time risk 1 in 400
- 2 females : 1 male , peaks age at diagnosis 20-50
- Caucasians > Orientals
- Commoner in extreme latitudes
- Monozygotic twins 30%
- Dizygotic twins 3-5%
- Siblings 0.1% -0.4%

MS - Pathology

- **Plaques on MRI**
  - Zones of acute focal inflammatory demyelination in white matter which result in Decreased speed of neural conduction
  - ? Genetic predisposition plus infection at critical time with periodic reactivations ?



- **Autoimmune attack on CNS myelin**
  - **Oligodendrocytes phagocytosed T-lymphocytes, Antibodies to oligodendrocytes, genetic loci,**
  - **EBV, HHV6, Chlamydia Pneumoniae**

MS - Syndromes

- Relapsing Remitting (80%)
  - Discrete clinical attacks with full recovery
  - 30-40 % develop Secondary Progressive
- Primary Progressive (20%)
  - 20% develop Progressive relapsing

MS - Diagnosis

Clinical evidence
- 2 + distinct attacks
- 1 + anatomical sites

"Para Clinical Data"
- MRI – T2 weighted – plaques in 95%
- CSF - Oligoclonal IgG in > 90%
- Visual Evoked Potentials

MS – Urinary symptoms

- Urinary symptoms in 52-92%
  - Frequency and urgency – 31-86%
  - Incontinence – 34-74%
  - Retention 2-49%
- 10% voiding symptoms only initial presentation
- Urinary symptoms have major influence on QOL and disability scores
- Patients > 50 more bothered by urinary symptoms

MS - Patho-Neuro-Urology

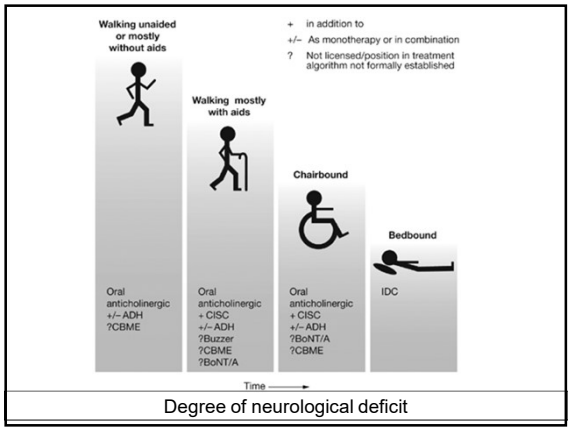
- Intracranial
  - 60-80% patients – periventricular zone
    - Normal coordinated voids but loss of inhibition and initiation and bladder perception
- Suprasacral spinal cord
  - 90+% patients Cervical cord – reticulospinal tracts
  - 40% patients Lumbar cord
    - Loss of coordination – DESD, loss of inhibition - DO
- Sacral spinal cord
  - 18% patients
    - Hypocontractile, areflexic

MS – Urodynamic Findings

- Litwiller meta analysis of 1904 patients
  - DO 63%
  - DSD 25%
  - Hyporeflexia 20%
  - **Normal 10%**
- Bemelmens
  - MS but **no LUTS 52% abnormal** VUD
- Koldewjn
  - 100% symptomatic pts have abnormal VUD
  - 50% asymptomatic pts have abnormal VUD
- Nb 15-55% VUD change over time

MS - Role of VUDS

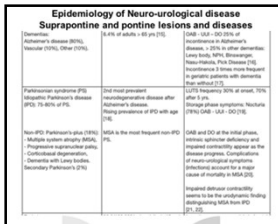
- "Routine VUDS" not indicated
  - Simple assessment usually gives clear picture of underlying problem
  - Upper tract deterioration rare (7%)
  - Simple management often effective
- VUDS definitely indicated if
  - Upper tract concerns
  - Failure to respond to simple management
  - Major intervention planned
  - Complete lack of clue !



Degree of neurological deficit

Factors of good and poor prognosis in multiple sclerosis Adapted from Keegan BM, Noseworthy JH. Annu Rev Med 2002; 53: 285–302

Good prognosis	Poor prognosis
Female gender	Male gender
Younger age of onset	Predominant cerebellar and motor involvement
Optic neuritis	Incomplete resolution of attacks
Sensory attacks	
Complete recovery from attacks	Progressive course from onset
Few attacks	Frequent early attacks
Long inter-attack interval	Short inter-attack interval



Parkinsons Disease

- Decreased spontaneous movements, gait difficulty, postural instability, rigidity and tremor
- De pigmentation and neuronal loss with Gliosis in Substantia Nigra

Parkinsons Disease

- Urinary symptoms in 35-70%
  - Usually years after PD diagnosis
  - Storage and voiding symptoms
- VUD
  - DO in 36-93%
  - Sensation preserved
  - Hypo or Acontractile 0-48% (?late)
  - DSD – some studies only
  - "Sphincter Bradykinesia"

Parkinsons Disease

- "Sphincter Bradykinesia"
  - Normal guarding reflex but failure of rapid relaxation for void.
  - ? skeletal muscle hypertonicity
  - Improves with s/c apomorphine injection
- PD and TURP
  - 28% patients incontinent post op Staskin et al 1988
  - ? Due to poor voluntary sphincter control
  - ? Actually due to failure to recognise MSA

Multi System Atrophy

- Term introduced in 1969
- Disorders of unknown cause affecting extrapyramidal, cerebellar and autonomic pathways
- Includes previously described syndromes
  - SND (Striatotrigonal degeneration)
  - OPCA (Sporadic Olivopontine Degeneration)
  - Shy-Drager Syndrome (1960)
- In 1989 Glial Cytoplasmic inclusions (? Cytoskeletal alteration of glial cells) common to all
- Classified as
  - MSA-P (Parkinsonian dominant)
  - MSA-C (Cerebellar dominant)

MSA – Urinary symptoms

Sakakibara et al 2000
- 121 Patients
- 96% LUTS
  - Difficulty voiding 79%
  - Nocturia 74%
  - Urgency 63%
  - Urge incontinence 63%
  - Frequency 43%
  - Nocturnal Enuresis 19%
  - Retention 8%
- 43% postural Hypotension
- LUTS first 48%
- Hypotension first 29%
- Together 23%
- ED usually precedes both

Wenning et al 1994
- 100 patients
  - Incontinence 71%
  - Retention 27%
  - Postural faintness 53%

MSA

- MSA-P Commonest
- Differentiation from Parkinson's disease can be difficult
- MSA-P more likely if
  - Lack of one sided dominance
  - Lack of resting tremor
  - Poor response to L-Dopa
  - Rapid Progression
  - LUTS and/or ED at presentation
- MSA-C
  - Differential diagnosis from spinocerebellar ataxias
  - Autonomic failure prominent

MSA

- VUDS findings
  - DO 33-100%
  - Poor compliance 31-45%
  - Late sensations 12%
  - Weak detrusor 60-70%
  - Involuntary sphincter relaxation 33%
  - 47% DSD / failure of sphincteric relaxation (nb L-Dopa, Epinepherine for low BP)
  - Open bladder neck at start of filling 53% (SNS)
  - Sphincter EMG – Chronic Reinnervation (Onufs anterior horn cells)
- Progression from DO to poor compliance to detrusor failure

Dementias

- Urinary incontinence 11-90%
- 53% of demented Vs 13% non demented elderly
- "Functional Incontinence"
  - Motivation, cognitive disability, immobility etc
- Co Morbidities
  - BPH, SUI, Nocturnal polyuria, Drugs, Depression etc
- VUD findings
  - DO in 38-60%
  - impaired detrusor contractility
  - Uninhibited Sphincter Relaxation
    - Frontal lobe SPECT changes

Diabetes

- 1% population
- Neuropathy
  - 10% at diagnosis
  - 50% after 25 years
- Peripheral
  - Symmetrical upper and lower limb poly neuropathy
- Autonomic (usually later)
  - Pelvic nerves PS – detrusor afferents and efferents
  - Pudendal nerves somatic – sphincter
  - Hypogastric nerves – urethra and BN

Autonomic Neuropathies

With Somatic Neuropathy
- Metabolic
  - DM
  - CRF
  - Hepatic failure
  - Vit B12 def
- Amyloid
- Porphyria
- Alcoholic
- Sarcoidosis
- Connective Tissue diseases
- Paraneoplastic
- Toxins

Without somatic neuropathy
- Acute / subacute autonomic neuropathy
- Pure autonomic failure

Diabetes

- Progressive detrusor failure with decreased sensation
  - Hesitancy, CRU, overflow
- O/e peripheral neuropathy
- < knee and ankle reflexes, < Bulbocavernosal reflex
- < anal tone
- FVC
- VUD
  - Delayed sensations and desire
  - Decreased detrusor activity
  - Poor flow and high residuals

Sarcoid, Alcohol and Porphyrias

- Sarcoid
  - Accumulations of lymphocytes, mononuclear phagocytes forming noncaseating epithelioid granulomas
  - 5% get neuro sarcoid which can mimic MS, SC ataxia etc
- Alcohol
  - Polyneuropathy including autonomic in 5-15% chronic alcoholics
  - Thiamine deficiency / direct toxicity on axons
  - Similar to diabetic bladder
- Porphyrias
  - Inherited disorders of haem synthesis
  - Rarely causes patchy demyelination with resultant peripheral and autonomic neuropathy

Peripheral Neuropathies

- Lumbosacral Herpes Zoster
  - Retention in 3-5% pts due to sacral sensory neuropathy
  - Areflexic on VUD, recovers within 4-8/52
- Genitourinary Herpes Simplex
  - Retention usually due to genital pain
  - 1% localized lumbosacral meningomyelitis / pelvic neuritis
  - Areflexic on VUD usually recovers
- CMV
- Infectious mononucleosis
- Syphilis
- Guillain-Barré

Guillaine Barré Syndrome

- Autoimmune attack on small and large myelinated nerves
  - Anti-ganglioside antibodies
- Ascending paralysis
  - 30% ventilated
- 25% urinary symptoms
  - Mostly hesitant, poor flow , retention etc
  - Some urge and incontinence
- VUD – most underactive / atonic a few DO plus DSD
- Usually improve within 6/52 – 2 years

Ataxias

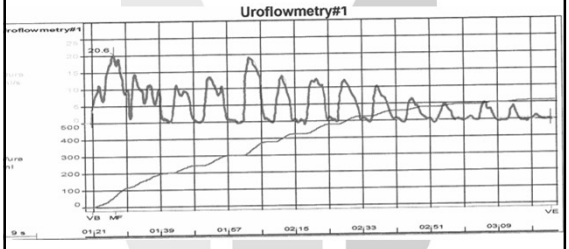
- Progressive premature neuronal death and atrophy
- Broad based gait, incoordination, tremor, dysarthria, motor and autonomic dysfunction
- Genetic – Friedrichs >50%
- Non Hereditary - Acute or Chronic (Toxins)
- Cerebellar only – no LUTS
- Spino-Cerebellar – multisystem => LUTS
- Chami et al 1984
  - 195 pts with Hereditary S-C ataxia
  - 23% Urgency 6% incontinence
  - DO 25-53%, DSD 6-37%, Hypocontractile 16-27%

Urodynamics – 5Ws

- Who? Neurogenic patients
- Which? Video Urodynamics
- Why? Anatomical and functional information
- Where? Special latex free, lead lined room
- When? Baseline and every 5-10 years

VUDS in neuropaths - tips

- Video essential
- Be prepared to improvise
- **? Don't drain residual at start**
- Multiple fills if needed
- Thomas Drain Pipe
- Foley test
- SP pressure to test for SUI
- SP tapping for DO
- Drain residual at end
- ? Prophylactic antibiotics



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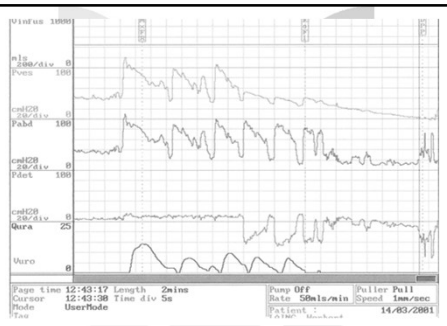

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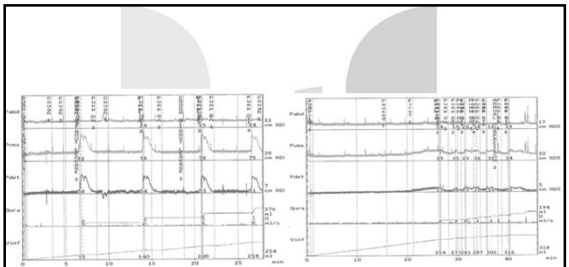
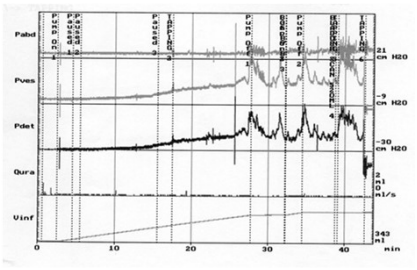
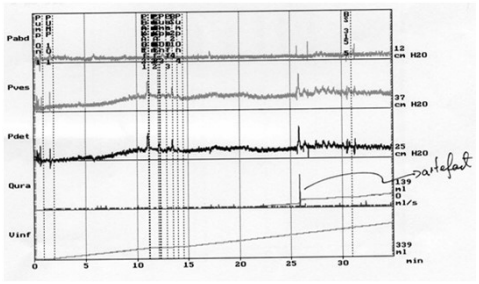


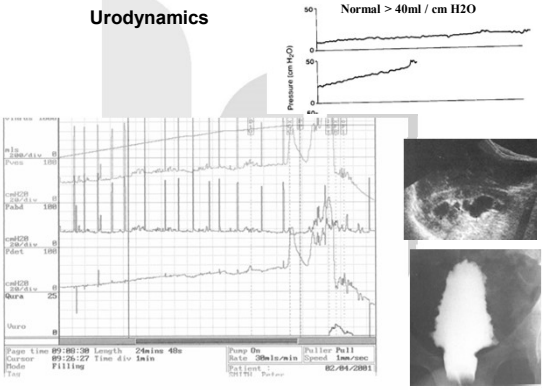
Pre-treatment **Post-treatment**

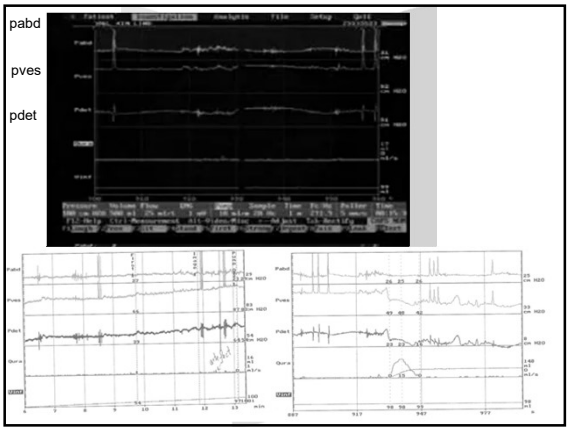


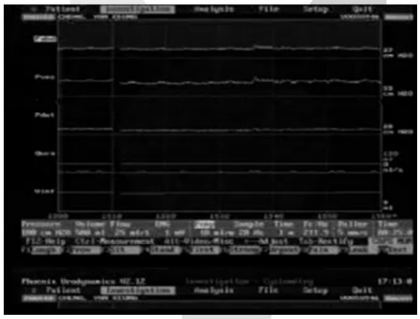
C5#, ASIA Class A, PVR 426 ml

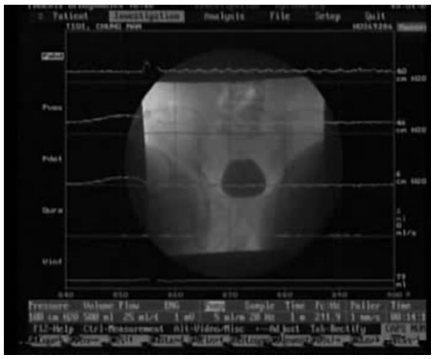


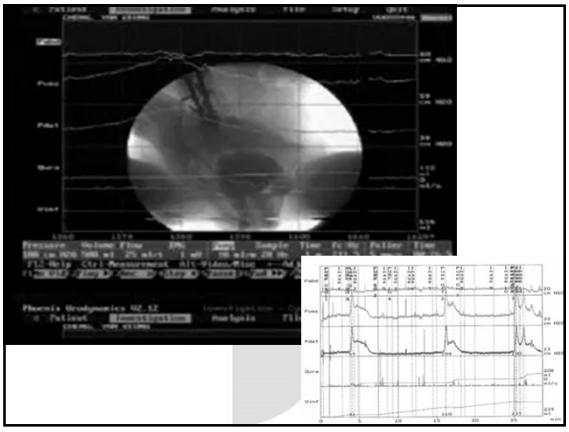
C5#, ASIA Class A, 3 months post tx

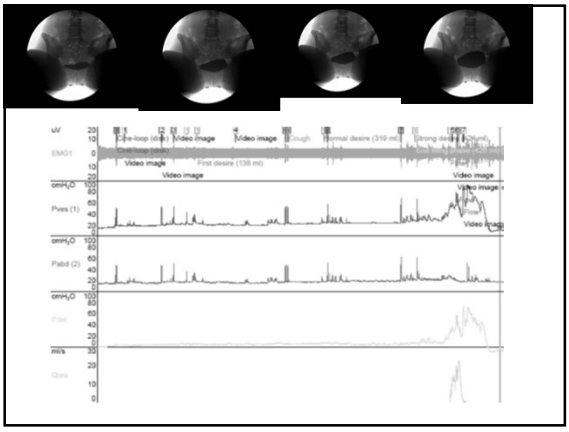


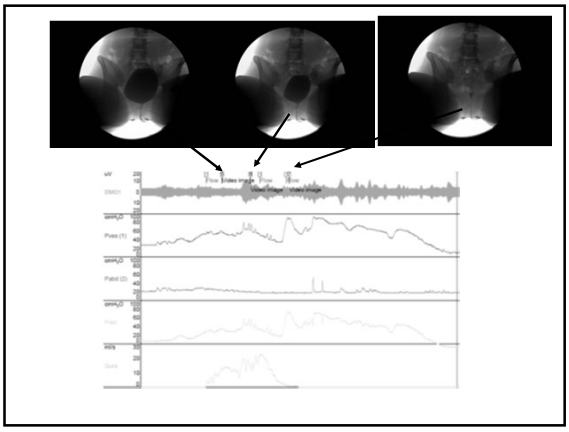


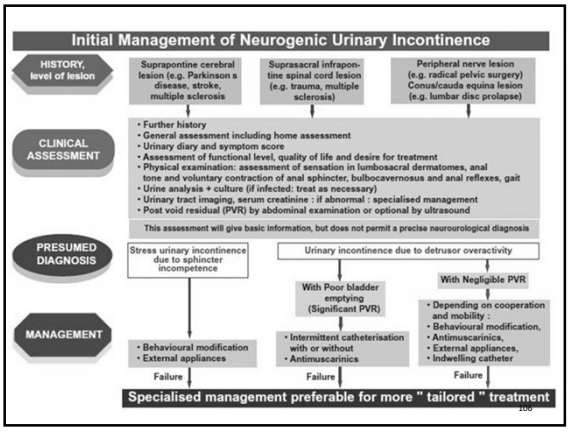


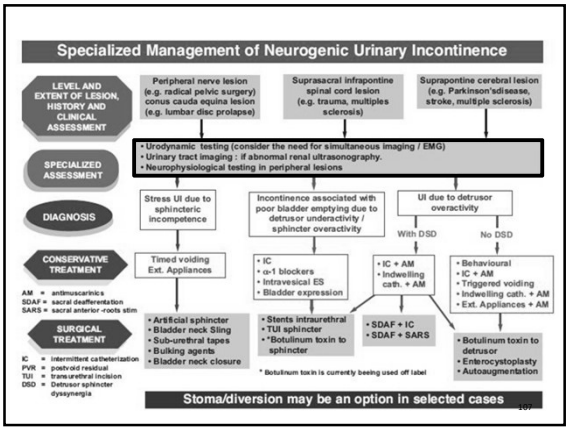












Conclusions – 1

- Findings of UDS can be difficult to anticipate from clinical assessment alone in NLUTD (LE 2).
- Most patients with NLUTD require specialised assessment
  - VUDS should be used, if available, when surgical interventions are planned or when the “bladder may be unsafe”
  - Upper tract imaging is needed in some patients and more detailed renal function studies will be desirable if the upper tract is considered in danger

Conclusions – 2

- *Filling cystometry* is the only procedure that quantifies the filling function of the bladder. However it must be combined with *Pressure / Flow studies* to record the function of the LUT during the voiding phase.
- *DLPP has* limited diagnostic value a stand alone test.
- *UPPs* can be used as an adjunct to assess urethral function

Conclusions – 3

- Filling rate can influence the outcome of several urodynamic parameters (LE 2).
- Pressure development in the bladder is one of the important parameters to be studied and high LPP is a risk factor for renal deterioration (LE 2).
- Complications of urodynamic testing are rare, but antibiotic prophylaxis can be advocated (LE 2).

Conclusions – 4

- VUDS combines the above with radiological imaging to provide the most comprehensive information of evaluating NLUTD
- EMG is a semi-quantitative measure of pelvic floor activity, which can be used to detect detrusor/ sphincter dyssynergia (DSD) and pelvic floor relaxation disorders, but has limitations

General principles

- Listen to the patient
- Consider the kidneys
- Consider the whole patient and surroundings
- Start simply and progress step wise with Ix and Rx
- Urodynamics to answer specific questions **not as "routine"**
- Promote independence where possible
- Suprapubic rather than urethral catheters please !

THANK YOU