Aims of Workshop

This workshop, organized by the ICS Urodynamics Committee, is intended to discuss when and how to perform different urodynamic investigations in clinical practice. The workshop will provide information about aims and methods of commonly used urodynamic tests. The workshop will discuss limits and potentials of the urodynamic investigations in different indications, providing to the audience the best available information, to understand the present role of these tests. The workshop is intended for professionals (urologists, gynecologists, rehabilitation physicians, nurses or other) who are treating functional pathologies of the lower urinary tract and want to improve their knowledge on urodynamic investigations.

Learning Objectives

Improve knowledge on indications of the urodynamic tests

Target Audience

Urology, Urogynaecology, Conservative Management

Advanced/Basic

Intermediate

Suggested Learning before Workshop Attendance


A full diagnostic evaluation of urinary incontinence requires a medical history, physical examination, urinalysis, voiding diaries, assessment of quality of life, cough stress test, pad test, uroflowmetry, pelvic floor imaging and, when initial conservative treatments fail, invasive routine and ambulatory urodynamics, urethral pressure profilometry.

The cough stress test is usually performed in the standing position at a bladder volume of 300 mL or at maximum cystometric capacity if it was less than 300 mL. The results of the cough stress test are recorded as positive if urine loss occurred with a cough or as negative if no urine loss was seen and the bladder volume was recorded. The cough stress test appears to be a reliable test. The reliability is more consistent in women with a diagnosis of urodynamic stress incontinence.

Pad testing is a non-invasive method of detecting and quantifying severity of urine leakage. The 4th International Consultation on Incontinence defined pad testing as “an optional test for evaluation of urinary incontinence.” Diverse testing durations have been reported in the literature and only for the 1-hr pad test a specific test protocol has been standardized. Although it is generally believed that longer tests are more reproducible, evidence on the accuracy of different methods of pad testing is inconsistent. A 24-hr test is more reproducible than a 1-hr test, but longer testing requires more preparation and a greater commitment on the part of the patient. A 24-hr testing is reported to be adequate in routine clinical settings while 48- to 72-hr testing is deemed necessary for clinical research. Performing this test in conjunction with a voiding diary, or simply recording fluid intake and frequency of incontinence episodes, will significantly increase its utility. A standard protocol for 24- to 72-hr pad testing does not exist at the present time. Despite the above limitations, the pad test provides objective assessment of involuntary urine loss.

Cystometry is the method by which the storage function of the lower urinary tract (LUT) is measured during the filling of the bladder. The aim of urodynamics is to find an objective, pathophysiological, explanation for the patient's LUT symptoms. Urodynamics is a replication of the LUT physiology in a laboratory situation and it is still considered the golden standard for LUT storage function assessment.

An analysis of and information on procedures available for the ambulatory setup in women with stress urinary incontinence will be presented.

The role of urodynamic investigation (UDI) before surgery for stress urinary incontinence (SUI) in female patients has been widely discussed in the last years. Although UDI used to be considered mandatory before surgery in all female patients affected by SUI according to several guidelines or recommendations, there was a lack of clear demonstrations on its role in improving clinical outcomes and clinical decision making.

Two systematic reviews on this subject have been published. In the first one, Clement et al. concluded that while urodynamics may change clinical decision-making, there is “some high quality evidence that this did not result in lower urinary incontinence rates after treatment”. In the second one, Rachaneni et al. stated that UDI do not improve outcomes “in women undergoing primary surgery for SUI or stress-predominant MUI without voiding difficulties”. These two systematic reviews included few papers and most of the patients analyzed came from the ValUE study.

This sort of conclusions should be properly analyzed focusing on the type of stress incontinence (uncomplicated and complicated). Agur et al. retrospectively analyzed 6276 women with UI, from an electronic database at a tertiary referral center; only 324 (5.2%) women had pure SUI. This was largely confirmed by an Italian multicenter database that showed that only 36% of more 2053 patients could have been diagnosed as having an “uncomplicated” SUI and 64% were “complicated”, according to ValUE trial criteria. Furthermore, preoperative UDI led to the diagnosis of different type of urinary incontinence in 74.6% of
complicated vs 40% of uncomplicated SUI cases (P = 0.0001). Moreover, a voiding dysfunction on UDI was observed in 13.4% of the uncomplicated cases and in 22.5% of the complicated cases (P = 0.0001).

These considerations lead one to think about two main points. On one hand, the so-called “uncomplicated” SUI patients are a minority. On the other hand, in the majority of “complicated” patients, the urodynamic observation varies from the pre-urodynamic diagnosis much more frequently than in the “uncomplicated” patients. Thus, in “complicated” patients, the role of urodynamic seems not to be challenged yet and UDI seems to be highly suggested.

Furthermore, for uncomplicated patients we can say that UDI might not change the outcome but there are other parameters we need to evaluate such as an overlapping voiding dysfunction or an underlying detrusor overactivity. A tailored treatment is an essential target to obtain. UDI may prevent surgical intervention in women without SUI or with prevalent detrusor overactivity incontinence. An accurate assessment of the risks and benefits of surgery is fundamental to facilitate a correct preoperative counseling directed towards appropriate patient expectations, as well as guide the proactive management of postoperative symptoms. In particular, the presence of a pre-existing voiding dysfunction could affect the outcomes.

In conclusion, in the majority of patients (the “complicated” ones) the role of UDI has not been fully evaluated. Maybe UDI itself can expand our knowledge in those conditions where pathology is variable, uncertain and multifactorial and where the “evidence-based” methods are difficult to satisfy.

09:50 - 10:00  LUTS in males <40 years old
Eskinder Solomon

Although “young” men with lower urinary tract symptoms (LUTS) are not uncommon, they are often misdiagnosed as having chronic prostatitis or psychogenic voiding dysfunction due to negative physical or laboratory investigation findings. These men are typically empirically treated with antibiotics, antimuscarinic, β3-AR agonist and/or α-blockers with unpredictable response rates.

Unlike in older men, LUTS in “young” men have a variety of underlying causes. These include bladder neck dyssynergia, dysfunctional voiding (non-relaxing external sphincter/idiopathic DSD), late-presentation posterior urethral valves, early-onset begin prostatic hyperplasia and urethral strictures. Detrusor overactivity and underactivity may also result secondary to chronic bladder outlet obstruction (BOO) or idiopathically.

In this section of the workshop, we will discuss how to evaluate potential BOO using video urodynamics with examples of characteristic presentations of various aetiologies. The pressure/flow study and the potential applicability of BOO nomogram in young men will also be addressed.

Young men are often bashful and anxious during urodynamic investigations limiting the validity and information that can be acquired during the test. Practical tips on how to obtain a representative study, including when to consider ambulatory urodynamics as well as how to make the UDS study as tolerable as possible will also be addressed.

10:00 - 10:10  LUTS in males >40 years old
Marcus Drake

Past the age of 40, there is an increased prevalence of benign prostate enlargement and detrusor underactivity (DUA). Consequently, the emergence of slow stream can reflect two potential contributory factors. Medical history can indicate likely factors for DUA, such as chronic diabetes mellitus. However, the main way to decide the exact mechanism of slow stream in an individual patient is to measure bladder pressure when passing urine, i.e. a pressure flow study. A high pressure with slow flow is diagnostic of bladder outlet obstruction (BOO), and is quantified by assessing the BOO Index (BOOI). This is calculated very simply by looking at the detrusor pressure at the time of maximum flow rate (PdetQmax) and the maximum flow rate (Qmax), being careful to exclude any artefacts which might mislead the numbers being used. The equation giving BOOI is PdetQmax – 2Qmax, and if this gives a number above 40 then the BOOI indicates obstruction is present. In general it is assumed that the prostate is responsible, particularly if the rectal examination finds enlargement. For the BCI, the same parameters are used, but in this case the equation is PdetQmax + 5Qmax. A value above 100 indicates normal contractility. If a man has BOOI > 40 and BCI > 100, then he has an excellent chance of improved urinary stream by doing an operation to reduce the blockage. In order to be confident about the conclusions of the urodynamic pressure flow study, it is essential to optimise the conditions of testing. The man must not be over-hydrated, they must be dealt with considerately so they are fairly relaxed, catheterisation should be gentle, and filling should not be too fast. If detrusor overactivity is seen during filling, it should be allowed to settle, and perhaps even stabilised by laying the patient flat, before the pressure flow study is started. Quality checks are essential, since the pressure-measuring catheter might become unreliable during the study; this means that cough subtraction checks should be done during filling, and also before and after voiding.
Urinary incontinence may occur to some degree after prostate surgery (benign and malignant): in approximately 70% of men after radical prostatectomy (RP) for prostate cancer (with 1-5% of men seeking surgery for this) and 2% of men after surgery for benign prostatic hyperplasia (BPH). The most common cause is urethral sphincter deficiency due to damage/trauma/scarring of the urinary sphincter mechanism resulting in stress urinary incontinence (SUI). However, a bladder dysfunction (eg. detrusor overactivity, low bladder compliance, detrusor weakness/underactivity) may also be present in 50-70% of these men and, in a minority of post RP patients (<10%) a bladder dysfunction is the sole cause for the incontinence. The evaluation of the patient with post-prostatectomy incontinence is performed to identify the type(s) of incontinence present as well as any other lower urinary tract symptoms/pathology. A history and physical exam are essential in this regard, as is urine testing to rule out infection and hematuria. Voiding diaries and pad testing provide a quantitative assessment of the patient’s urinary habits and help assess the magnitude of the incontinence. Endoscopy may be performed to rule out urethral and intravesical pathology (stricture, tumor). Formal urodynamic testing (UDS) to assess the functioning of the lower urinary tract (bladder, sphincter) may be of value in helping to identify the type(s) of incontinence (when the diagnosis uncertain based on the history and physical exam) and associated lower urinary tract pathology. The filling phase of UDS (cystometrogram, CMG) provides information on bladder capacity and compliance/storage pressures, the presence of detrusor overactivity and the presence of stress urinary incontinence (via stress testing/leak point pressure testing) while the voiding phase (pressure-flow study, PFS) assesses for the presence of bladder outlet obstruction and provides information on detrusor contractility (i.e. presence/absence of detrusor weakness/underactivity) and bladder emptying. While not essential in the initial conservative management of the patient with post-prostatectomy incontinence, UDS identification of the specific type(s) of incontinence and associated bladder dysfunction may be helpful to guide patients to appropriate surgical therapies for the incontinence. Furthermore, the UDS identification of serious bladder dysfunction (e.g. very low bladder compliance), may warrant more aggressive management of that dysfunction prior to surgical treatment of the more common sphincter deficiency; at a minimum, it may prompt closer monitoring of the issue over time. While the UDS techniques in the post-prostatectomy patient are essentially the same as for any UDS, some modifications may be required in order to optimize the chances of identifying the various dysfunctions of concern.

Multiple sclerosis (MS), Parkinson’s disease (PD), Dementia, and Multiple System Atrophy (MSA) have been classified in the last ICI as acquired, progressive conditions of brain and brainstem leading to neurogenic lower urinary tract dysfunction (N-LUTD). MS and MSA are conditions that can arise in more than one region of the CNS. Urodynamic studies are considered gold standard evaluation methods for N-LUTD. However, there is no single algorithm that works best for all patients with N-LUTD, even in the same subgroup, since the underlying neurogenic deficit may be quite heterogenous in terms of severity, natural progress, clinical symptoms and signs and consequently, of the risk for upper urinary tract deterioration. Unfortunately, most of the evidence on LUTD comes from studies in patients with SCI and myelodysplasia.

MS is an immune-mediated neuroinflammatory and neurodegenerative disease of the central nervous system with a heterogeneous clinical presentation and course and is the leading non-traumatic neurological cause of disability in young and middle-aged people. The prevalence of LUTD in patients with MS is about 50–90%. Furthermore, the incidence of LUTD was reported to be related to the disability status of patients; if a patient has walking difficulty, the possibility of that patient having LUTD is nearly 100%. There is much debate regarding the use of invasive urodynamics in the initial evaluation of LUTD in patients with MS. According to some authors, the initial treatment of patients with MS-related LUTD appears to be possible by a reasonable non-invasive evaluation and invasive urodynamic tests should be spared for cases of initial conservative treatment failure and/or UUT deterioration. This suggestion may be true in a very selected group of patients, but cannot be generalized to the whole MS population. The most common urodynamic abnormality in MS is detrusor overactivity (DO) which is commonly complicated by striated sphincter dyssynergia.

PD is a neurodegenerative disorder of unknown etiology that affects the dopaminergic neurons of the substantia nigra. The differential diagnosis should include MSA, progressive supranuclear palsy, cortical-basal ganglionic degeneration, vascular parkinsonism, and Lewy body dementia. LUTD occurs in 35% to 70% of patients with PD where the most common urodynamic finding is DO. The smooth sphincter is always synergic. True detrusor sphincter dyssynergia (DSD) does not occur, however, sporadic involuntary activity in the striated sphincter during involuntary bladder contractions or a delay in striated sphincter relaxation (bradykinesia) at the onset of voluntary micturition can be urodynamically misinterpreted as DSD. Detrusor areflexia is a rare finding in PD.

It is important to remember that many cases of “PD” in the older literature may essentially have been MSA, and citations regarding urodynamic findings may therefore not be correct. MSA is a progressive neurodegenerative disease of unknown etiology. DO is the most frequent finding. Decreased compliance may accompany. As the disease progresses, difficulty in initiating and maintaining voiding may occur. In MSA, video-urodynamic studies may reveal an open bladder neck, associated with findings of striated sphincter denervation on motor unit electromyography leading to sphincteric urinary incontinence.
Spinal cord lesions present an array of different urodynamic patterns depending mostly on the degree and the level of the lesion.

The aim of urinary rehabilitation of these patients involves a thorough knowledge and assessment of the neural urinary control. Dysfunction range from urinary incontinence and infection to voiding obstruction. The first are responsible for an impact on quality of life while the second, even silent can lead to upper tract deterioration. Bladder sensations, volumes and bladder wall behavior are the most important features to appraise the storage phase, while pressure flow curves describe the voiding phase.

The urodynamic evaluation of these patients involves three important exams:
- Filling and voiding cystometries,
- Perineal or sphincter EMG
- Video urodynamics

These urodynamic examinations test different features of the neurogenic uropathy and are to be chosen by the clinician upon the anatomy of the lesions.

Different dysfunctions are to be expected in different groups of patients. Classically are divided in:
- Sacral lesions
- High supra-sacral lesions
- Low supra sacral lesions
- 2nd neuron lesions

The resulting dysfunctions can affect bladder sensation, and bladder volume, both measured in a filling cystometry. Bladder compliance and, bladder contractions and its magnitude are the goal of manometric cystometry. These are the result of complete or partial loss of brain control.

In supra-sacral lesions, the sacral reflexes of bladder are accompanied by a loss of sphincter synergy with detrusor leading to even higher pressures of bladder lumen and risk of upper tract dilation. This dyssynergia may affect the distal sphincter or the proximal or bladder neck, depending on the affection of sympathetic pathways to the bladder.

External or distal dyssynergia is characterized by an evidence of obstruction during detrusor contraction and a raise in perineal EMG activity. Proximal dyssynergias need imaging methods synchronous to pressure measurements as in video-urodynamics. Adding imaging, vesico-urethral reflux can be seen and at which pressure occurs.

Filling cystometry may also detect the bladder pressure at the beginning of leakage. This leakage or incontinence pressure (detrusor leak point pressure) is known to be important determining the prognosis of upper tract deterioration.

Wrap-up:

Use of simple urodynamics (filing and voiding cystometry) to evaluate:
- Bladder sensation
- Bladder compliance
- Bladder volume
- Detrusor filling behaviour
- Leak point pressure
- Detrusor emptying power
- Outlet obstruction

And video-urodynamics
To set pressure of VU reflux
To identify level of dyssinergia
Please complete the in-app evaluation in the workshop before leaving.

- Handout for all workshops is available via the ICS app, USB stick and website.
- Please silence all mobile phones.
- PDF versions of the slides (where approved) will be made available after the meeting via the ICS website so please keep taking photos and video to a minimum.
Diagnostics in an ambulatory setting

ICS Core Curriculum: How Can Urodynamics Help me in my Clinical Practice?

How to evaluate a female patients with SUI before surgery in a urodynamic lab

ALEX DIGESU
Imperial College London - UK

Affiliations to disclose:

Funding for speaker to attend:

- Self-funded
- Institution (non-industry) funded
- Sponsored by: International Continence Society

Introduction

The typical diagnostic work-up involves:

- Medical history
- Physical examination
- Q-tip test
- Urinalysis
- Frequency volume chart
- Stress test
- Pad test
- Uroflow and assessment of post-void residual volume
- Urodynamics
- UPP
- Imaging
- QOL questionnaire

HISTORY

- The onset, duration, severity and timing of UI
- Associated LUTS and voiding symptoms
- Risk factors or conditions that can exacerbate UI:
  - Age
  - Obstetric history (parity and mode of delivery)
  - Gynaecological status (pelvic organ prolapse or fibroids)
  - Medical status (UTI, dementia, delirium, diabetes mellitus, diabetes insipidus, cardiorespiratory disorders, chronic cough, obesity and obstructive sleep apnoea)
  - Pharmacological status (ie diuretics, lithium, opioids).
  - Lifestyle factors ie. smoking, mobility and heavy lifting

The bladder is an unreliable witness....it has a limited means of expressing its own pathology
Record / Diary of:
Fluid intake
Voided volumes
No of voids
Incontinence/urgency
Pad

What is normal?
- 151 asymptomatic women
- 19 - 81 yrs
- 48 hour FVC

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.8</td>
<td>3 - 11</td>
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</table>

<table>
<thead>
<tr>
<th>Total voided vol (ml/24hrs)</th>
<th>Mean</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>1430</td>
<td>600 - 3100</td>
<td></td>
</tr>
</tbody>
</table>

| Mean void (ml) | 250 | 90 - 610 |
| Largest void (ml) | 460 | 200 - 1250 |

Larsson & Victor (1988)

Frequency / Volume Charts
- Compare 1st week results with subsequent week in 14 day chart - good correlation
  Wyman et al 1988
- Compare 1st day results with subsequent 5 days - good correlation but total voided volume varied
  Barnick et al 1993
- Most units use 3 - 7 days

Patterns
- Normal volumes / normal frequency
  Normal/USI
- Normal volumes / increased frequency
  Excess intake
- Reduced volumes – fixed frequency
  BPS
- Reduced volumes – variable frequency
  DO

Klevmark 1989

Urinalysis & MCS
Urinalysis using a colorimetric reagent test strip evaluates urine for a range of chemical parameters including pH, protein, glucose, ketones, blood, bilirubin, urobilinogen, nitrite, leukocytes and specific gravity.

Urinalysis is recommended as a screening tool for UTIs.

Urinalysis has a low sensitivity and high specificity for the exclusion/identification of UTIs hence a formal microscopy, culture and antibiotic sensitivity (MCS) analyses are recommended in women who have symptoms of UTI or have a positive dipstick.

The microbiological criteria for UTI are defined as bacteriuria of:
- >100,000 colony-forming units (CFU) per ml on voided specimen or
- >1000 CFU per ml on catheterized specimen with pyuria (defined as >10 white blood cells per ml).
Physical examination

Mental status, mobility as well as BMI.

Abdominal examination should assess for pelvic masses and/or a palpable bladder.

The urogenital examination might reveal vaginal atrophy and incontinence-associated dermatitis, urethral diverticulum, fistula

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The urogenital examination might reveal vaginal atrophy and incontinence-associated dermatitis, urethral diverticulum, fistula

Performed during a Valsalva manoeuvre in different positions (supine, left lateral or standing).

Only a weak-to-moderate correlation between anatomical descent and urinary symptoms has been shown.

POP-Q

For women with stage 2-4 pelvic organ prolapse, the anatomical distortion may kink the urethra, sometimes resulting in a false-negative cough stress test.

Reducing the prolapse digitally without distorting the bladder neck while performing a cough stress test might be of value.

However, limited evidence has been reported on how to optimally reduce urethral kinking for the test.

Pelvic floor muscle examination

A digital examination palpating the pelvic floor for muscle tone, contraction technique and strength is advised.

Cough stress test

It is performed in supine or standing position at a bladder volume of 300 mL or at maximum cystometric capacity if it was <300 mL.

It is recorded as positive if urine loss occurs with a cough or as negative if no urine loss occurs.

A positive cough stress test has a high sensitivity and specificity for diagnosing SUI but invasive urodynamic studies are required to confirm the diagnosis.

Urethral mobility

The relationship between urethral mobility and SUI has been assessed using a range of techniques, including:

- POP-Q point Aa descent
- urethral Q-tip
- ultrasonography
- urethrocystography

However, none of these is recommended and there is no consensus definition for clinically relevant urethral hypermobility. The advantage of hypermobility assessment lies in finding the absence of urethral descent, which is associated with a twofold higher rate of surgical failure.
**Pad testing**

It is a non-invasive method of detecting and quantifying severity of UI.

The 4th ICI defined pad testing as “an optional test for evaluation of UI.”

An absorbent perineal pad is worn by the patient while conducting a range of normal activities designed to replicate the usual provocations of UI, such as walking and exercising to detect the presence of UI and to measure the volume lost.

A positive pad test is defined as a weight increase of:

- >1 g over a 1-hour test or
- >4 g for a 24-hour test.

These thresholds are also recommended as an objective measure of treatment outcome.

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**ICS pad weight test**

Only 1 hour pad weight test is standardized\(^1\)

- 0 - 15 min: drinking of 500 ml sodium-free liquid, resting
- 15 - 45 min: walking, including stars climbing to one flight up & down
- 45 - 60 min: standing up from sitting (10 times)
  - coughing vigorously (10 times)
  - running on the spot (1 min)
  - bending to pick up small object from the floor (5 times)
  - washing hands in running water (1 min)


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**Pad weight testing**

- Qualitative assessment (continent vs incontinent)
- Quantitative assessment (how much)
- Weight of the pads before and after test
- Weight gain in g = urine loss in mls

<table>
<thead>
<tr>
<th>Short term tests</th>
<th>Long term tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 min – 2 hrs</td>
<td>12 hrs – 72 hrs</td>
</tr>
<tr>
<td>qualitative assessment</td>
<td>quantitative assessment</td>
</tr>
</tbody>
</table>

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**PVR measurement**

“The amount of residual urine in the bladder after a voluntary void”


It is recommended when evaluating those with voiding symptoms, symptomatic POP or palpable bladder overdistension.

It is important to determine because it can alter the choice of UI treatment options as some treatments can further impair voiding.

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**PVR measurement**

Threshold values delineating what constitutes an abnormal PVR are poorly defined.

Most urologists agree that volumes of 50-100 ml constitute the lower threshold to define an abnormal PVR.


Urethral catheterization has been accepted as the gold standard for PVR measurements, but this may cause discomfort for patients and carries a risk of urinary tract infection and trauma.


Non-invasive ultrasound bladder volume measurement has been used as an alternative to urethral catheterization, as a good compromise between accuracy and patients safety/comfort.

Ultrasound bladder volume estimation can be performed in two ways:

1. By a real-time ultrasound to directly visualize the bladder.

2. By using a portable bladder scanner to calculate the volume automatically without directly visualizing the bladder.

Bladder scanner advantages:

1. easy to use;
2. requires only basic training;
3. can be carried out on the ward.

Reliability? (Better with additional real-time pre-scan imaging?)

The interval between voiding and PVR measurement should be as short as possible (eo). It is advisable to ask the patients if the voiding was similar to a typical micturition in his/her daily life (eo).

Use preferably noninvasive ultrasound bladder volume measurement instead of urethral catheterization (LE 3).

Measurement of PVR is recommended at the management of female SUI (LE 3).

Assessment of PVR is considered mandatory in a variety of pediatric patients (LE 3).

Three-dimensional ultrasound of the urethral sphincter predicts continence surgery outcome.

Objective: To assess the predictive value of three-dimensional (3D) ultrasound volumes of the urethral sphincter in women undergoing continence surgery.

Materials and Methods: Women with idiopathic stress incontinence undergoing to Burch colposuspension were prospectively studied using videourodynamics (VUDS), urethral pressure profilometry (UPP), and a 3D transperineal ultrasound scan of the urethra. The total vesical sphincter volume, vesical volume, maximum cross-sectional area, and restitution-sphincter volume were calculated, respectively. Surgical outcome was assessed at 6 months using VUDS. Uretal function parameters were correlated to surgical outcomes using the Mann Whitney U test.

Results: Ninety-one women were studied. Women who failed continence surgery had significantly smaller preservative urethral sphincter volume than those who had an objective cure (P < 0.001). UPP parameters were not found to be predictive of surgical outcome (P > 0.05).

Conclusions: The assessment of the anorectal sphincter using a 3D ultrasound scan predicts the outcome of continence surgery.
Pelvic floor imaging

Ultrasonography and other radiological modalities have been used to investigate UI by visualizing the morphology and movement of structures such as levator ani, pelvic organs, bladder, bladder neck, urethral sphincter and urethra (diverticulum).

Ultrasonography might have a role in confirming the findings of the clinical examination, assessing postoperative complications or as a means of providing biofeedback to help women to identify effective pelvic floor contraction during pelvic floor muscle training (PFMT).

Urodynamic studies

Urodynamic studies constitute a series of investigations assessing lower urinary tract function that include:
- Uroflowmetry
- Filling cystometry
- Voiding cystometry
- Urethral pressure profilometry (UPP)

Auxiliary tests using fluoroscopy or ambulatory equipment might also be of value.

Normal flow rates (VV > 150ml)

<table>
<thead>
<tr>
<th>Age</th>
<th>Qmax</th>
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<tbody>
<tr>
<td>Men</td>
<td></td>
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<tr>
<td>&lt;40 yrs</td>
<td>&gt;22</td>
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<tr>
<td>40-60</td>
<td>&gt;18</td>
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<tr>
<td>&gt;60</td>
<td>&gt;13</td>
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<tr>
<td>Women</td>
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<td>&lt;50</td>
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<td>&gt;50</td>
<td>&gt;18</td>
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<tr>
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<td>&lt;10</td>
<td>&gt;15</td>
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<tr>
<td>10-20</td>
<td>&gt;20</td>
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</table>

2SD from the mean is 10ml/s at 150ml, 15 at 500ml
URETHRAL STRicture

Uroflometry - Straining

Normal pressure flow study

Voiding cystometry

Continent vs Incontinent (SUI)

Preoperative pressure-flow studies: useful variables to predict the outcome of continent surgery
Urethral pressure profile (UPP)

- Intravesical pressure measured to exclude simultaneous detrusor contraction
- Subtraction of intravesical pressure from urethral pressure produces urethral closure pressure

\[ \text{FUL} = \text{length over which urethral pressure exceeds intravesical pressure} \]

<table>
<thead>
<tr>
<th>Urethral closure pressure (cmH2O)</th>
<th>Male Mean</th>
<th>Male Range</th>
<th>Female Mean</th>
<th>Female Range</th>
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<td>37-126</td>
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<td>35-113</td>
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<td>45-64</td>
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<td>40-100</td>
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<tr>
<td>&gt;64</td>
<td>71</td>
<td>35-105</td>
<td>65</td>
<td>35-75</td>
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Urodynamic studies

Associated risks include:
- post-procedure transient dysuria/discomfort (47%)
- haematuria (14%)
- bacteriuria (12%)
- symptomatic UTI (28%), with no significant reduction in UTI when prophylactic antibiotics are given.

Urodynamic studies are not recommended:
- before non-surgical management of uncomplicated SUI, urgency or MUI
- in patients with symptomatically predominant, demonstrable SUI, no POP and a PVR volume of <150 ml

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Questionnaires and leaflets

All subtypes of UI are highly bothersome and assessment should include:
- assessing the patient’s willingness to engage in treatment
- determining patient’s expectations
- determining the effect of UI on the individual QOL
- discussing current evidence and recommendations for specific treatment, including benefits, alternatives, risks and complications.
Although not life-threatening, UI can certainly prove to be life-changing.

The severity of UI has been reported as a risk factor for poor QOL and has a negative effect on many dimensions of QOL, mental health, sexual life, personal/marital relationship, physical, daily and social activities.

Women with UUI are generally more bothered than those with SUI, because the leakage is unexpected, sudden and often of large volume. These women show worse scores on QOL and depression scales, poorer quality of sleep, worse sexual function and lower productivity than matched controls.
"Urodynamics does not have any add-on value as long as detailed office evaluation is carried out prior to primary SUI surgery in women with isolated SUI or stress predominant MUI who have a normal bladder capacity and FVE."

HOW MANY UNCOMPLICATED PATIENTS DO WE SEE?

Inclusion criteria:

• history of symptoms of SUI for at least 3 months
• stress or mixed incontinence (if SUI prevalent)
• a post-voiding residual urine volume of less than 150 ml
• a negative urinalysis or urine culture
• a clinical assessment of urethral mobility
• a desire for surgery for SUI
• a positive provocative stress test

Exclusion criteria:

• previous surgery for incontinence
• history of pelvic irradiation
• pelvic surgery within the previous 3 months
• anterior or apical pelvic-organ prolapse of 1 cm or more distal to the hymen

2708/4083 (66.3%) complicated patients
1375/4083 (33.7%) uncomplicated patients

740/2053 (36%) patients considered "uncomplicated" according to the definitions used in the VALUE trial.
We emphasize that the ValUE data should be considered as applicable only to adult women with uncomplicated stress predominant UI planning to undergo surgery, and do not affect recommendations for UDS in the setting of complicated incontinence and voiding dysfunction.

Why does invasive urodynamic investigation seem particularly relevant in complicated patients?

- Voiding dysfunction
  - In 13.4% of uncomplicated patients (similar to the 11.9% reported in the ValUE trial)
  - In 22.5% of complicated patients
Management strategy modified in 11% of uncomplicated patients (not far from the 6.8% reported in the VaLUE trial)

In 23.8% of complicated patients

More information by the urodynamic investigations

Voiding dysfunction

Therapeutical strategy more often modified

Management strategy modified in 19% of pts after UDS

ARE INVASIVE URODYNAMIC INVESTIGATIONS REALLY USELESS IN UNCOMPPLICATED PATIENTS?
NAGER CW
RE TO:
Voiding Dysfunction

29 vs 230 pts
62.1 vs. 78.3% success rate
p=0.06...

---

Serati M, Finazzi Agrò E: ICS 2018

- 60/192 consecutive uncomplicated patients (31.2%) using abdominal straining during voiding phase
- Preop. Qmax not different from the other patients (20.5 vs. 19.5 ml/s, p=0.76)
- At minimum follow up of 5 years
- Higher risk of episodes of urinary retention or voiding dysfunction (19% vs. 6%, p=0.056) and of OAB (38.3% vs 19.7%, p=0.007)

All international guidelines (IC: ALA/SUFU; EAU; NICE) recommend the use of UDS in complicated stress urinary incontinence forms.

---

CONCLUSIONS

- Use extensively non invasive urodynamics
  - Bladder diaries, UF, PVR
  - Urodynamics may be omitted in selected uncomplicated patients
  - Data from studies on uncomplicated patients should be used only for decision making in these patients' group
  - Relevant informations from invasive urodynamic studies to modify the choice of treatment in complicated patients
  - Some important infos (at least for counseling) from invasive urodynamic studies also in uncomplicated patients
Case 1

- Fem, 74, obese. Two vaginal deliveries.
- SUI since 40yo. Became worse in the last 6 months. Nowadays, 3 pads/day.
- Urgency sometimes without incontinence (around 3 times/week)
- Nocturia 1x. No prolapse.
- Medications for depression, hypertension and memory (She doesn’t remember the names)
- Normal bowel function, no sexual life.
- Stress test in the office – positive
- Urodynamics??

Case 2

- AAT, 67 yo. Fem. 3 vaginal deliveries.
- Urgency, urge-incontinence, increased daytime frequency (12 times/day) and nocturia 2 or 3 times.
- SUI sometimes with big efforts.
- Hysterectomy 18 years ago.
- No diseases, no medications.
- Anterior prolapse Stage II.
Case 2

• Treated with PFMT and darifenacin 15 mg/day.
• Improved the urgency, but remains with episodes of urge-
incontinence.
• Urodynamics?

Caso 2

• Treated with MUS and prolapse correction with complete resolution
  of the symptoms.
• Without medications and without incontinence.
UDS in Men <40 years
Eskinder Solomon
Consultant clinical scientist
Guy’s and St Thomas’ NHS Trust, UK

1

BPH prevalence vs age

2

ICS nomogram

3

Bladder neck obstruction

4

VIDEO UDS

5

6
The causes of BOO is diverse in young men (often with similar symptoms and urodynamic presentation)

The ICS BOO nomogram does not apply in young men (especially for dysfunctional voiding)

Video urodynamics is recommended accurate diagnosis of the cause of the BOO.
Urodynamics; Male over 40

Marcus Drake
University of Bristol, UK

Urodynamics is one step in a long pathway

Presentation
History and examination
Symptom score
Urinalysis
Ultrasound
Conservative therapy
Free flow rate
Filling cystometry and pressure flow study
Therapy decision

Older men; Urgency, nocturia, PMD, slow stream

Detrusor overactivity (DO), benign prostate obstruction (BPO), detrusor underactivity (DUA)
Huge importance of symptom score and bladder diary
Medical history must identify risk factors for DUA, such as chronic diabetes mellitus.

UDS;
1. Filling cystometry: DO
2. Pressure flow study: The main way to decide the exact mechanism of slow stream in an individual patient is to measure bladder pressure when passing urine. BPO or DUA.

In order to be confident about the conclusions of the urodynamic pressure flow study, it is essential to optimise the conditions of testing.

- The man must not be over-hydrated
- They must be dealt with considerably so they are fairly relaxed
- Catheterisation should be gentle
- Filling should not be too fast; slow it if DO

Quality checks are essential; cough subtraction checks should be done during filling, and also before and after voiding.
Bladder outlet obstruction index

The equation for BOOI is $P_{\text{det}}Q_{\text{max}} - 2Q_{\text{max}}$. BOOI > 40 must allow for any artefact.

Bladder contractility index

For the BCI, the same parameters are used, but in this case the equation is $P_{\text{det}}Q_{\text{max}} + 5Q_{\text{max}}$. BCI > 100 indicates normal contractility.

If DO is seen during filling, it should be allowed to settle, and perhaps even stabilised by laying the patient flat, before the pressure flow study is started.
THE UTILITY OF UDS IN THE EVALUATION OF POST-PROSTATECTOMY INCONTINENCE

Michael L. Guralnick, MD, FRCSC
Professor of Urologic Surgery
Medical College of Wisconsin
Milwaukee, WI

Post-RP Incontinence
- 70% of patients have some degree at 2 yr
5% seek surgery

Diagnosis/Characterization

Management/Counseling

Severity/Butter

Sphincteric (SUI)
85-90% of patients

Behavioral/Pelvic floor PT
Defensive
Urethral bulking
Sling

Mixed (MUI)
25-40% of patients

OAB (UI)
10-40% of patients

OAB Meds
Neuromodulation
Botox/A - A
Augment/Diversion

Evaluation Prior to Surgical Therapy
(can be applied to nonsurgical therapy as well)

• History
• Physical examination – visible SUI (cough Valsalva stress test)
• Urimetry
• Urim culture
• Post-vodastress trial (by ultrasound)
• Voding diary (2-7 days)
• Polyuria without diuretics: BUN, Creatinine, Glucose
• Pain test
• Cystourethroscopy
• Urodynamics (UDS)
• Multichannel urodynamics

Low Compliance
Underactive Detrusor
BOO
Prior XRT

Mixed (MUI)
Unawares
Overflow/retention

OAB (UI)
Mixed (MUI)

What Does UDS Help With?

Does Everyone Need UDS?

“Clinicians may perform urodynamic testing in a patient prior to surgical intervention for stress urinary incontinence in cases where it may facilitate diagnosis or counseling. (Conditional Recommendation; Evidence Level: Grade C)”

Funding for speaker to attend:

- Self-funded
- Institution (non-industry) funded
- Sponsored by:

Affiliations to disclose:

None

*Conflict of Interest Disclosures and Acknowledgements*
UDS Prior to Management?
How essential is accurate diagnosis/characterization of incontinence?

**SUI/ISD**

**Role for UDS?**

1st Line
- Behavioral
  - Pelvic floor therapy

2nd Line
- Duloxetine
  - +/- OAB meds

3rd Line
- Urethral bulking
  - Sling
  - AUS
  - Neurmodulation
    - BTX-A
    - Augment (4th line)

UDS for SUI: CMG + LPP Testing

Stress testing (cough/Valsalva)
- Typically at 150mL and repeat at intervals (50-100mL) and capacity
- VLPP-CLPP vs ALPP

Fluoro can capture moment of sphincteric incont (videoUDS)
- BN-urethral hypermobility during Valsalva
- Surrogate for the repositioning test prior to TO sling?

Does Actual LPP Matter?

ALPP doesn’t correlate with incont severity (24hr pad wt)
- \( r = -0.191, P = 0.38 \)

**Purpose of LPP testing is to identify SUI**

VLPP/ALPP doesn’t impact results of AUS

Technical Issues With LPP Testing

Urethral catheter more likely to invalidate LPP measurements in males relative to females

18-35% of patients with SUI have -ve LPP testing with catheter but +ve without catheter

So... If neg stress testing but still suspicious of SUI
- Repeat stress testing without urethral catheter (ie ALPP)

Technical Issues: Severe Outlet Incompetence

Unable to fill bladder (fluid immediately leaks out)
- Doesn’t allow of assessment of bladder dysfunction

Remedy: Occlude bladder outlet/urethra
- Foley balloon inflated to occlude BN
- Penile clamp

VLPP >100 has higher success rate for TO slings
- Failed in 3/11 (27%) with VLPP ≤ 100
- Failed in 3/35 (9%) with VLPP >100
- HR=4 for failure with a VLPP ≤100

VLPP <60 predicts higher failure rate for urethral bulking
- VLPP <60 → 19% “Favorable response”
- VLPP >60 → 70% “Favorable response”
50-75% of Patients with ISD/SUI Have Concomitant Bladder Dysfunction

50-46% have DO
De novo in ~5%
DO as sole cause of PPI in ~12%

30-40% have detrusor underactivity (DU)

5-28% have low compliance Depends on definition: <30?, <20?, <10?

50-75% of Patients with ISD/SUI Have Concomitant Bladder Dysfunction

XRT Effects?

XRT patients:
- Preop DO (70% vs 38%, p=0.001)
- Capacity (253ml vs 307ml, p=0.01)
- Preop OAB meds (45% vs 30%, p=0.03)
- Postop OAB meds (44% vs 25%, p=0.01)

50+ patients stopped OAB meds postop

>50% patients stopped OAB meds postop

Are the Storage Pressures Real Reliable?

DO and reduced compliance post RP represents de novo bladder dysfunction probably due to bladder denervation during RP

UDS at unphysiologic fill rates to an unaccustomed volume may trigger overactivity and elevated pressure

UDS tip: if Pdet starts to rise, stop fill to see if plateau (DO vs compliance) and wait for baseline, then fill at slower rate

On the Other Hand...

Patients with preop DO less likely to have “perfect continence” after AUS

Pre-op DO had greater postop pad usage and worse PGI-I after Advance sling (avg f/u 36 mo)

More likely to need OAB meds postop after bone anchored sling

50-60% vs ~10%

What About Low Compliance?

Data mainly from NGB (spina bifida)

Poor compliance + DLPP >40 cmH2O:
- Risk for VUR, hydronephrosis and renal dysfunction
- DLPP <40 - 0 VUR, 10% ureteral dilation (n=20)
- DLPP >60 - 68% VUR, 81% ureteral dilation (n=22)

AUS PRB typically 61-70 cm H2O

Retrograde LPP of 60 for slings
Compliance May Improve After AUS

Al Afraa et al, Can J Urol Jun 2011 (16 patients, mean fu 42 mo):
- Compliance improved after AUS (7.8 → 13 mL/cmH2O)
- Capacity also improved (271mL → 296mL)

Perez & Webster J Urol 1992 (27 patients, mean fu 4 yr):
- Low compliance (even end fill Pdet 60) didn’t adversely affect results of AUS (pad use, revision rates)
  - Provided it was managed appropriately
- No patient developed upper tract changes
- No fu UDS to assess post-op compliance

Not Everyone Improves

Decayed compliance persists beyond 36 mo in 28%

XRT? – Low compliance (<30 mL/cmH2O) noted in 63% of patients at median of ~8yr post RP and XRT (n=16, none had SUI)

Rochha et al at Urology 2008:
- 2 patients with the worst preop bladder compliance (12–14 mL/cmH2O) had unsuccessful AUS (ie failure)
  - Postop compliance didn’t change despite ↑ VLPP
  - Persistent OAB issues (F/U/UUI) after AUS

Abdulla et al Prog Urol 2019 (abstract):
- Low compliance had “negative impact” on results of Virtue sling

Giannantoni et al J Eur Urol 2008:
- Decreased compliance persists beyond 36 mo in 28%

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  - Persistent OAB issues (F/U/UUI) after AUS

Significantly more AUS failures than successes had XRT (72% vs 15%)
Post-op UDS in failures showed persistent DO and/or low compliance to be main cause

Bottom Line

“...For patients with poor compliance and SUI, the observation that untreated poor bladder compliance did not worsen the AUS continence outcomes must be viewed with caution...the Panel believes that when such patients are identified, they should be carefully followed to avoid upper tract decompensation”

So is UDS Necessary to Identify Do/Low Compliance Prior to Treatment?

- Not necessary to have DO for OAB meds to help
- SUI surgery could improve DO, compliance (perhaps via bladder cycling)
- Preop DO/low compliance not contraindication to SUI surgery

- Magnitude of DO/bladder compliance might predict surgical failure
- XRT patients more likely to have DO/low compliance and persistent OAB issues

At a minimum, UDS could assist with patient counseling and prompt closer follow-up

So What is the Value of UDS?

- Characterize incontinence when uncertain
- Identify patient with adverse bladder features (eg bladder compliance)
  - Might warrant closer follow-up
- Patient counseling re expectations (eg OAB issues)
  - Serve as baseline for future comparison
  - With subsequent UDS if problems postop
  - Clinical research
Tack så mycket

VideoUDS Protocol for PPI

Hackabay et al Neurosurg Urodynam 2005

- Filling rate 50mL/min - to 30 if sign of UUI or known small bladder capacity (diary)
  - Penda clamp if severe ISD
- At 150mL (or half FBC if small FBC), VLPP
  - Repeat every 50mL if no SUI seen
- Fill to capacity
  - Identify any DO and determine compliance
  - Do PFS (with urethral catheter)
- 2nd fill to 50-75% of 1st fill capacity
  - Remove catheter and do LLP (ALPP)
- Then do non-intubated uroflow (free flow)
  - Use fluoro for both studies to identify SUI, urethral narrowings

UDS for Bladder Contractility

Detrusor Underactivity (DU)

- detrusor contraction of reduced strength/duration resulting in prolonged emptying and/or failure to empty bladder within normal period of time

- ? Normal values for voiding Pdet in PPI patients

Surrogates:

- Valsalva voiding
- Low Qmax, Pdetmax
- Bladder contractility nomograms
- Plus (isovolumetric detrusor pressure)
  - Mechanical stop test (urethral compression)
  > Pdet<50 = DU

DU May Not Be a Concern With AUS. But Slings...?

Voiding with AUS in open state → no outflow resistance

Urethral compression/obstruction by sling → ? Retention risk

Preop DU did not portend worse outcome with AUS

Qmax<10
Pdetmax<10
BCI<100

DU (BCI) and/or Valsalva voiding
  + complete emptying (n=50):
  - No difference in the postop incidence of retention/elevated PVR, Q, outcome success (PGI-I)
  - >50% had Advance DO and SUI
Juma & Comiter Urol Clin NA 2014

- ISD in 90% of men with PPI
  - Only 25-50% have ISD alone
  - 30-40% also have DO
  - 10-25% also have BOD
  - 5% also have decreased compliance
- DO in 30-40% of men with PPI
  - Isolated DO in 10%
  - De novo DO in 5%
  - Decrease from 58% at 8 mo to 18% at 36 mo
- DU occurs in 30-60% of patients after RRP (de novo in ~45-50%)
  - Decreased compliance in 8-40% after RRP (de novo in 50%)
  - DU and decreased compliance thought to improve within 8 mo
  - But persistent decreased compliance in 28% after 36 mo

Ballert and Nitti

- Preop DO not associated with worse outcome after bone anchored sling
- Excluded patients with signif impaired compliance
- Mean f/u 17 mo (short term)
- Using PGI scores, 30% without DO and 41% with DO were failures after sling
- But signif more patients with preop DO had to use OAB meds postop (59% vs 12%)
- But preop DO didn’t affect number of patients using pads postop
- Preop DO should not be contraindication to sling
- But preop DO may be more likely to need postop OAB med (counselling issue)

Some UDS parameters improve after AUS

- Urodynamic parameters evolution after artificial urinary sphincter implantation for post-radical prostatectomy incontinence with concomitant bladder dysfunction
  - Afraa Al Tala, Campeau Lysanne, Mahfouz Wally, Corcos Jacques, ;
  - Can J Urol Jun 2011 (Vol. 18, Issue 3, Pages( 5695 - 5698)
    - DO disappeared on 50% of patients post-AUS
    - Bladder capacity improved significantly (271mL ± 298mL)
    - Compliance improved significantly (7.6 mL/cmH2O ± 13 mL/cmH2O)
    - But it’s still relative low compliance
    - Avg f/u was 42 mo – so hardly long term f/u
    - Concluded that the presence of multiple adverse UDS parameters in the same patient is not contraindication to AUS implant
    - Not told if there were any patients who were excluded from AUS based on UDS parameters (not included in this study) ie selection bias

To UDS or Not? – in general, UDS should only be done if results will affect management

Need to look up uds in eval of Incont AFTER prior Incont surgery
Thiel DD, Young PR, Broderick GA, et al. Do Patients with poor compliance used more pads postop than normal compliance but not stat.

Low ALPP (<30)

No patient had DO pressure >40

AUS will help all magnitudes of Low Reduced Trigo

BCI=

Small bladder capacity = <300mL

Even with the preop presence of DO (even high pressure DO), low compliance (even transobturator DO) was still associated with worse outcome.

Preop DO was not associated with worse continence results or OAB issues postop

Reflux (in those with preop reflux) post RP is a strong predictor of failure

Preoperative pad usage is independently associated with failure of non-AUS treatment for incontinence—univariate Cox regression analysis, increasing age (p=0.02), CCI (p=0.02), and preoperative pad use (p=0.007).

Increasing preoperative pad use is independently associated with an increased risk of failure after non-AUS treatment for incontinence (35.5% vs. 13.4%; p=0.008). Patients wearing >3 pads per day were more likely to experience failure (35.5% vs. 13.4%; p=0.008). Patients with severe incontinence (>5 pad use) had no association with patient self-report history of postoperative urinary leakage documented or not.

Preoperative RBC levels were not associated with continence results after AUS. Adverse urodynamics, sling fixation, and postoperative complications did not affect continence results after AUS.

AdVance adjustable male transobturator sling for post-RP incontinence. Patient selection bias because they excluded patients with non-refractory poor compliance.

Academic/clinician scientist

We should all be evaluating our clinical practice (assessment, management) indefinitely

Academic/clinician scientist

We should all be evaluating our clinical practice (assessment, management) indefinitely

Generally the magnitude of SUI is best determinant for selecting AUS vs Sling

AUS will help all magnitudes of Incent

Slings less effective if severe incontinence (>400mL/24hr)

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Generally the magnitude of SUI is best determinant for selecting AUS vs Sling

AUS will help all magnitudes of Incent

Slings less effective if severe incontinence (>400mL/24hr)
And the detrusor dysfunction should ideally be addressed preop

“In our study, we were reluctant to implant the AUS into patients with poor bladder compliance unless their storage pressure could be safely managed preoperatively.”

Lai et al J Urol 2009

“Appropriate management of impaired compliance...should be advocated prior to undertaking SUI surgery...with repeat urodynamics to assess for treatment success”

Hennessy et al Trans Androl Unit 2017

Conclusions

- UDS in the context of PPI is optional
- Some potential value in confirmation of type of incontinence, identification of poor bladder compliance and DO (especially if prior XRT)
- But may or may not alter management
  - If an AUS is already planned for SUI/ISD that’s obvious, odds are UDS won’t affect what you do unless concerned about (poor bladder compliance such as an XRT patient) and AUS can still be implanted, but prep UDS findings might prompt more comprehensive f/u
  - If a sling being contemplated, depending on type of sling (compressive vs repositional) prep UDS might be of value in determining bladder contractility which could influence sling selection

Is it Real/Reliable?

- DO on UDS after RP might be “artifact”:
  - Chronically underdistended bladder (due to ISD/SUI) filled at unphysiologic rates
  - 30 - 40% have DU

- UDS can also miss DO in men
  - 44% of patients with U/F had DO on UDS
  - 25% of patients with UUI had no DO on UDS

UDS for Bladder Dysfunction

- 50-75% of patients with ISD/SUI have concomitant bladder dysfunction

- 30-40% have DO
  - De novo in ~5%
  - DO as sole cause of PPI in ~10%
  - 5-25% have decreased compliance
    - Depends on definition: <30? <20? <<10?
  - 30-40% have DU
What About Low Compliance?

Reduced compliance reported in 5% - 28%

Depends on definition: <30?, <20?, <10?

Basic UDS Principles

Will results impact management?
- Counseling/decision making
- Identify confounding issues needing fu (eg low compliance)
- Baseline for comparison

Have specific questions you want the study to answer
- SUI?
- DO?
- Compliance?
- BOO?
- Urethral anatomy, VUR (videoUDS)?

Study should reproduce the symptoms

Magnitude of Incontinence May be Best Determinant

Slings less effective if “severe” incontinence

UDS Can Help Guide Management of Patient With PPI

Management based on UDS findings (preop avg 5ppd):
- DO → OAB med
- SUI → AUS
- MUI → OAB med + AUS (OAB controlled first)
- 87% achieved “social continence” (<2ppd)
- No improvement in untreated patients

UDS tip: if Pdet starts to rise, stop fill to see if plateau (DO vs compliance) and wait for baseline, then fill at slower rate

Reduced compliance post RP represents de novo bladder dysfunction probably due to bladder denervation during RP

UDS at unphysiologic fill rates to an unaccustomed volume may trigger overactivity and elevated pressure

UDS Can Help Guide Management of Patient With PPI

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Reduced compliance post RP represents de novo bladder dysfunction probably due to bladder denervation during RP

UDS at unphysiologic fill rates to an unaccustomed volume may trigger overactivity and elevated pressure
The Concern With PPI…

- ISD/SUI may be protective in presence of low bladder compliance
- Treatment of sphincter may unmask elevated storage pressures
  - AUS PRB typically 61-70 cm H2O
  - Retrograde LPP of 60 for slings
  - > McGuire’s DLPP of 40
- Extrapolating from the NGB population
  - Hydro after AUS has been reported (NGB)
- Minimal data in post-prostatectomy population

UDS May Not Be Essential in Straightforward Patients

- History consistent with SUI
- No voiding difficulties/complete emptying
- Demonstrable SUI on exam
- No poor compliance risk factors
- XRT
- NGB

UDS may not alter management re SUI surgery
- If plan is for AUS
  - UDS not predictive of AUS outcome
  - Some preop UDS parameters may improve after AUS
  - Less data on slings

What About Slings?

Urethral compression/obstruction by sling → ? Retention risk

Quadratic (Virtue) sling vs Repositioning (Advance) sling
- Compressive with fixed resistance
- in some degree of urethral obstr
- Compresse sphincter
- Some degree of urethral obstr
- Repositioning bulb to improve coaptation/force of ext sphincter
- Does not cause urethral obstr

Need for detrusor contractility?

DU (BCI) and/or Valsalva voiding + complete emptying (n=50):
- No difference in the postop incidence of retention/elevated PVR, Q,
  outcome success (PGI-I)
  - >50% had Advance
Case discussions: male >40 yrs

Filling phase

Case discussion: male <40 yrs

- 24 years old medical student
- Nocturnal enuresis
- Occasional daytime UUI
- Ultrasound: Hydronephrosis (R)
- Cystoscopy: “slightly high bladder neck”

Voiding phase

Repeated fill and void
67 yr male with incontinence

- Hx of open radical prostatectomy in 2011 (G 3+4)
  - "Mild" activity related incontinence (1-2ppd)
- EBRT in 2014 for rising PSA – now undetectable
  - "Moderate" incontinence now - bothersome
  - Worse with activity but also incontinence at rest (unawares)
  - +/- urgency
  - Nocturnal enuresis
  - No significant voiding difficulty but does strain at times
  - Has tried pelvic floor PT/PFMEs and oxybutynin without benefit
  - 4 pads/d, 1-2 pads/h
  - No visible SUI on exam
  - Only voided 40mL in clinic (uroflow uninterpretable), PVR 0mL

67 yr male with incontinence

- Diary: avg void 150mL (max void 200mL), 24 hr volume 1400mL
- 24 hr pad test: 250g (typical for him)
Multiple sclerosis (MS), Parkinson’s disease (PD), and Multiple System Atrophy (MSA)

- Acquired, progressive conditions of brain and brainstem leading to neurogenic lower urinary tract dysfunction (N-LUTD).
  - ICI 2017

- MS and MSA are conditions that can arise in more than one region of the CNS.

Urodynamic studies are considered gold standard evaluation methods for N-LUTD.

- There is no single algorithm that works best for all patients with N-LUTD, even in the same subgroup,

- The underlying neurogenic deficit may be quite heterogeneous in terms of:
  - severity,
  - natural progress,
  - clinical symptoms and signs
  - the risk for upper urinary tract deterioration.

- Unfortunately, most of the evidence on LUTD comes from studies in patients with SCI and myelodysplasia.

Urodynamics in PD

- Many cases of “PD” in the older literature may essentially have been MSA, and citations regarding urodynamic findings may therefore not be correct.

Urodynamics in MS

- According to some authors, the initial treatment of patients with MS-related LUTD appears to be possible by a reasonable non-invasive evaluation and invasive urodynamic tests should be spared for cases of initial conservative treatment failure and/or UUT deterioration.
  - This may be true in a very selected group of patients, but cannot be generalized to the whole MS population.
Parameters predisposing patients with Mb to significant urologic complications

(1) striated sphincter dyssynergia in men;
(2) high detrusor filling pressure; and
(3) an indwelling catheter.

- Progressive neurologic disease in patients with MS rarely causes UI/UT damage, even when severe spasticity and disability exist.
- The reason for this is unknown
  - Wyndaele, 2005; Drake et al, 2013

Clinical & UDS

<table>
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<tr>
<th>CDS</th>
<th>PD</th>
<th>MSA</th>
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<tr>
<td>Detection of LUTS</td>
<td>UDS at diagnosis 80% if patient has walking difficulty, sign of UUT damage.</td>
<td>30% to 50%</td>
</tr>
<tr>
<td>Common urodynamics features</td>
<td>UDS at ≥30%</td>
<td>Detrusor-related symptoms are common</td>
</tr>
<tr>
<td>Compliance</td>
<td>Normal</td>
<td>Detrusor–sphincter dyssynergia in &lt;50%</td>
</tr>
<tr>
<td>Risk of LUTS damage</td>
<td>Low</td>
<td>Low</td>
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<tr>
<td>Initial management</td>
<td>Anticholinergics or B3 agonists</td>
<td>Anticholinergics or B3 agonists or anticholinergic drugs</td>
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The urogenital criteria favoring a diagnosis of MSA

- Urinary symptoms that precede or occur with parkinsonism;
- Male erectile dysfunction that precedes or occurs with Parkinsonism;
- Urinary incontinence;
- Significant PVR;
- Worsening LUT dysfunction after urologic surgery;
- Progressive nature of LUTS associated with MSA.
  - With time, incontinence and significant postvoid residual volume become more problematic, with steady progression of the condition in all patients
  - Paparrhos et al, 2008

Specific patient groups

- Patients with BPH should be warned that symptoms of neurogenic DO, especially in men with existing BPO or coexisting LUTS, are more likely to persist than in non-neurological disorders.
- Edsarra et al, 2013

Summary

- UDS are needed in patients with MS, PD and MSA
  - at the initial diagnosis
  - to follow the progress of the neurogenic disease
  - to manage complications such as UI and UTI
  - prior to any surgical intervention such as anti-incontinence procedures or prostate surgery
Urodynamics of spinal cord lesions

What to expect from the anatomy of the SCI
- Sacral and supra-sacral lesions
- 2nd neuron lesions
- Motor and sensory
Lack of clinical-UD correlation
Most are Supra-Sacral, InfraPontine
Most are traumatic

Value of Urodynamics
Use of simple urodynamics to evaluate:
- Bladder sensation
- Bladder compliance
- Bladder volume
- Detrusor filling behaviour
- Detrusor leak point pressure
- Detrusor emptying power
- Outlet obstruction
- Perineal/sphincter EMG activity
And video-urodynamics
- Pressure of Vesico-Ureteral reflux
- Level of dysynergia

Value of Urodynamics
Risk of Upper Tract Dysfunction in Spinal Cord Injury
- Low bladder compliance
- Bladder cystometric capacity < 200ml
- Maximum detrusor pressure > 75 cmH2O
- Long contraction duration < 1/3 of CMG
- High detrusor leak pressure (DLPP)
- High contraction pressure leak (NDL-LPP)
- Detrusor-sphincter dyssynergia
- Vesico-ureteral reflux

Luis Abranches Monteiro

Affiliations to disclose:
MMS

Funding for speaker to attend:
- Self-funded
- Institution (non-industry) funded
- Sponsored by:

Luis Abranches Monteiro

ICS urodynamic committee

Supra-sacral - Infra-pontine lesions
- Complete lesions
  - Loss of cortical sensation
  - Loss of inhibitory control over Bladder Saccral reflex
  - Loss of sphincter synergy
- Incomplete lesions
  - Array of multiple deficits
- Supra lumbar/thoracic lesions
  - May include loss of sympathetic control
  - Proximal dysynergia
  - Autonomic dysreflexia

1

2

3

4

5

6
Detrusor-sphincter dyssynergia (DSD)

Proof of sphincter and detrusor synchronous contraction –
EMG and/or Video-cystomanometry

Continuous
Intermittent

External (distal)
Internal (proximal)

Pseudo dyssynergias

DSD

- Proof of obstruction
- High pressure – low flow
- Open bladder neck
- Dilated proximal urethra
- Closed external sphincter with detrusor contraction
- When proximal DSD, closed bladder neck

Vesico-ureteral reflux

Low pressure reflux more ominous
"Ureteric leak point pressure"

Bilateral VUR at 6 cmH2O
Right VUR at 12 cmH2O

Frequency of UDS

- 1st exam ASAP after the end of spinal shock
- 2nd 6-12 mo after the injury
- Yearly for 5 yr in cervical/thoracic lesions
- Less if low pressure and complete emptying is achieved
- Yearly for 2 yr in lumbar lesions and every other yr thereafter

Attention to:
- Incomplete suppression of detrusor
- VUR
- Reflex voiders with
  - Poor bladder compliance
  - DSD

Wrap-up

1. VUDS is gold standard in SCI
2. Evaluating the Upper Tract risk
   1. IPP
   2. Contraction duration
   3. DSD
   4. VUR
3. Assessing evolving lesions
4. Managing long term therapy
Clinical Case

♂
48
10 yr diagnosis of MS
Relapse-remission
Occasional diplopia
Undefined gait disorder
No leg sensory disturbance
Recently urgency and weak stream, but continuous flow
Hesitancy, nocturia 3x
>200 ml PMR
Prostate 55 cc
Small improvement on alfa-blocker

Discussion:
MS neurogenic voiding dysfunction?
DSD
overactive detrusor
BPH?
prostatic obstruction
overactive detrusor

Clinical Case

Cystometry shows:
Q max: 5 ml/sec continuous bell shaped curve
PF curve of obstruction
Normal contraction

Urodynamic diagnosis
Bladder outlet obstruction

Clinical Case

Clinical doubts
Urodynamics compatible with prostatic obstruction
Lack of alfa-blocker effect
What MS contribution?

Impact on therapy:
no point on alpha blockers or bph therapies
possible effect of baclofen on distal sphincter
Eventually:
threats for overactive detrusor
CIC
Case: F.G.

67 year old lady presented in 2009
Complaint: Mixed UI, 3 years
Past medical history:
  2 vaginal deliveries
  TAH for benign indication
  Hypothyroidism
Normal Urinary system on ultrasound

F.G.: UDS in 2009

- Cystometry: Normal capacity (350 ml) and compliance with normoactive detrusor
  - Urodynamic SUI
  - ALPP: 49 cmH2O
  - Couldn’t void for PFS (catheter irritation?)
- UF: Normal
- PVR: 0 ml
- Mobile urethra

F.G.: 2011 Repeat UDS: The scenario has changed!

- Cystometry:
  - Decreased bladder sensitivity (FS: 215 ml)
  - Increased bladder capacity
  - ALPP 9 cmH2O
  - PFS
  - Unable to start micturition
- Urethrogram: Interrupted voiding
- PVR: 157 ml.

What would you propose?

F.G.: 2011 The scenario has changed!

- Neurology consultation
- Dx: Parkinsonian syndrome (IPD or MSA)
- Urethra still mobile
- What would you propose?
F.G.: 2011

- All (?) options were discussed
- She underwent TOT and started CIC in 2011
  - + Anticholinergics
- She was completely dry until 2013, doing CIC by herself.

F.G.: 2013, recurrent UI between CIC episodes

- Progression in Parkinsonism, but still successfully performing CIC (150-200 ml)
- Cystometry: Continuous leakage at 258 ml capacity with 7 cmH2O DLPP
- Proposals:
  - Adding antimuscarinics (didn’t help)
  - BOTOX
  - Surgery?
- She is still on CIC and using padded underwear
OBJECTIVES

• To describe the importance of physical examination of the urogenital region in patients with neurological diseases, focusing on spinal dysraphism and spinal cord injuries

• To explain the relevance of the clinical physical examination in relation to the management and prognosis of neurogenic lower urinary tract dysfunction

  • Physical examination may facilitate the interpretation of urodynamic observations
  • Physical examination may provide information on prognosis of neuro-urological patients

METHODS

• Systematic review of the literature (Pubmed and Embase databases)

• MESH terms:
  • 'physical examination'
  • 'bulbocavernosus reflex'
  • 'neurogenic'
  • 'urodynamics'

INITIAL EVALUATION

• LUT problems in neurologic patients are not necessarily related to the neurological pathology

• Other diseases such as prostate pathology and pelvic organ prolapse might also have an influence

• CLINICAL EXAMINATION

• General urological examination

• General neurological examination

Neuro-uro-gynecological examination

General neurologic examination

• Standard ASIA:
  • Chart

  • Clinical Axle of Nerve:
    • LMND: Hyperreflexia:
      • below the lesion
  • UMND:
    • Anesthesia:
      • in the lesion

Guidelines on Neuro-Urology
Value of clinical testing in spinal cord injured patients

- Significant correlation between presence or absence of perineal sensation and presence or absence of sensation in the LUT

- DERMATOMES
  - Sensitivity in S2-S5 for touch and pain

**How Should Sensations Be Tested?**

- The sensory exam includes testing for pain sensation:
  - (pin prick) and light touch sensation (brush)
- Initial evaluation is completed with the patient lying supine or in lithotomy position
  - at physician’s office or just prior to urodynamics
- Instruct the patient to say ‘sharp’ or ‘dull’ when they feel the respective object
  - Show the patient each object and allow them to touch them
- With the patient’s eyes closed, alternate touching the patient with the needle and the brush at intervals of roughly 5 seconds.

**Reflex Testing**

- Cremaster reflex
- Knee reflex
- Ankle reflex
- Anal reflex

Voluntary control of anal sphincter and perineal muscles.
**How Should BCR Be Tested?**

- The test involves monitoring internal/external anal sphincter contraction in response to squeezing the glans penis or clitoris, or pulling on an indwelling Foley catheter.
- This reflex should be tested just before or after sensory examination (dermatomes) – in the same position.
- BCR can also be tested electrophysiologically, by (electrically) stimulating the penis or the clitoris and (EMG) recording from the anal sphincter.

**Why Should We Test BCR?**

- Presence/Absence of bulbocavernous and anal reflexes correlates significantly with detrusor and striated sphincter reflexes/areflexia.
- In the Elderly a BCR may be negative without obvious neuropathologic finding!!!
  - Related to the aging process.

**Interpretation of BCR in Spinal Cord Injured Patients**

- The absence of the reflex without sacral spinal cord trauma indicates spinal shock.
- Typically BCR is one of the first reflexes to return after spinal shock (24–72h)
  - Lack of motor and sensory function after the reflex has returned indicates complete SCI.

**Special situation: peripheral neuropathy**

- Peripheral neuropathy can also cause loss of BCR and loss of sensation in perineal dermatomes and penis or vagina.
- Thus, it has clinical implications, since the reflex may be absent without direct association with lower urinary tract dysfunction.
  - PN may however also be associated with loss of bladder filling sensations and or underactive or acontractile detrusor.
  - Possible causes: nerve palsy during orthopedic surgery, entrapment neuropathy following cycling, Peyronie disease, and diabetes mellitus.

**Special situation: circumcision**

**Physiological reduced BCR in circumcised men and those with retracted foreskin.**

**Erectile (Dys)function: why should we assess ed in spinal cord injured patients**

- Absence of reflex erections (or erectile dysfunction) is associated with absence of BCR and also with detrusor areflexia (P > 0.001).
Prognosis

Can perianal (S4-5) pin sensation (PPS) and BCR help us to predict bladder recovery after spinal cord injury?

• Testing PPS and BCR within 72 hours of SCI could help predicting bladder recovery up to 1 year afterwards

• One year after SCI:
  • No patient with absent PPS voided unassisted
  • Only 15% with an absent BCR voided spontaneously
  • 65% with preserved PPS were voiding spontaneously
  • 60% with an intact BCR were able to void

CONCLUSIONS

• Clinical neuro-uro-gynecological examination helps to personalize management of patients with neurological abnormalities.
  • Combine with Urological and neurological exam
  • Existence or recurrence of reflexes
  • PPS and BCR are moderately sensitive in predicting the return of (spontaneous /reflex) voiding in patients with spinal cord lesions

The best patient care begins with the best physical examination

Thank you,
Enjoy the ICS Meeting !!!
ICS Teaching Module: Urodynamics in Patients with Myelomeningocele

Tufan Tarcan, Giovanni Mosello, Jian Guo Wen, Enrico Finazzi Agrò, Stuart B. Bauer

Structure
- Introduction
- Urodynamics in the newborn with MMC
  - Discuss prenatal closure
  - Timing and Technique (newborn or at time of diagnosis for occult dysraphisms)
  - Urodynamics parameters of significance
  - Interpretation of the results and stratification
- Effect of UDS on initial management
- Effect of proactive management on prognosis
- Urodynamic follow up of the newborn after initial evaluation
  - Why to follow up?
  - When to perform UDS during follow up
- Post pubertal evaluation
  - Interpretation of the results
  - Effect of UDS on postpubertal management
- Urodynamics in transition to adult care

N-LUTD in children
- Neurologic causes
  - Myelomeningocele 85%
  - Tethered cord syndromes 10%
    - Occult dysraphisms
    - Severe agenesis
    - Imperforate anus
    - Curarino triad
    - Neurocognitive teratoma
    - Spectrum of spastic diplegia 4%
    - Spinal cord / CNS tumors
    - Transverse myelitis 1%

When Should Urodynamic Testing be Done in Children with Myelodysplasia & Other Spinal Dysraphisms?

Newborn period (1 – 3 months of age)
Time of diagnosis (occult lesions)
Development of hydronephrosis / VUR
Achievement of continence
Occurrence of incontinence after a period of dryness
Change in lower extremity function
Evaluate for tethering or re-tethering

Primary spinal repair: Sooner is better

- In children operated within 24 hours of life
  - Cystometric capacity is significantly higher
  - DLPP significantly lower, at 3 years of age

Tarcan et al. (2018), September 2006
Urodynamic Evaluation Prior to Spinal Canal Closure

30 newborns - urodynamic studies pre (day 1) & post closure (before day 8) = 3.2% changed
• 18 normal detrusor + coordinated sphincter activity: 18 no △ post-closure
• 11 areflexic detrusor + absent sphincter activity: 10 no △ post-closure
• 1 overactive detrusor + sphincter dyssynergy
  • Areflexic detrusor + absent sphincter activity
1 overactive detrusor + sphincter dyssynergy: 1 no △ post-closure

Thus, no need to perform UDS prior to spinal canal closure


Incidence of Urinary Tract Deterioration in Neonates with Myelodysplasia

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>(%) Deteriorated</td>
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* excludes 8 with deterioration at birth


Prophylactic versus Expectant Treatment in Myelodysplasia

• LPP of 40 cm H2O was predictive of urinary tract deterioration
  • 68% (15/22) had hydronephrosis s/r reflux if LPP >40 vs 20% (2/10) if LPP <40
• Infants with bladder sphincter dysynergy had a 53% chance of developing upper urinary tract deterioration within 3–5 years of life
  • Bauer SB, et al: JAMA, 1984; 252: 650
• Augmentation cystoplasty is significantly reduced from 27% to 11% when children are started on prophylactic LUT treatment prior to age 1 versus >4 years

Prophylactic versus Expectant Treatment in Myelodysplasia

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Long-term Continence Management in Myelodysplasia

• 60% on CIC + antimuscarinics achieve continence with no further treatment
• Augmentation cystoplasty now ‘required’ in 15%
  • Incontinence,
    • Marginally compliant, marginal capacity bladder
  • Upper urinary tract deterioration
• Urodynamics plays a major role in helping to characterize & efficiently manage the lower urinary tract in spina bifida

Long-term Continence Management in Myelodysplasia

Can not precisely discriminate high-risk patients for UUTD (Grade B/C)

Should not be used as the sole decider for invasive therapies
Normal UDS in Myelodysplastic Newborns

• 25 / 204 newborn closures (12%) - 14 ♀ + 11 ♂ had normal UDS
• 8 (32%) demonstrated UDS changes (most before age 3)
  - Dyssynergy - upper motor neuron
  - 5 developed lower motor neuron disease + dysynergy
• 25% regained normal function after untethering
• 15 lumbar myelo - All had normal lower extremity function
• Capacity (vs EBC): normal = 47%
• Compliance (<10 ml/cm): 27%
• Max Detrusor Pr (> 40 cm H₂O): 20%
• Overactivity = 7%

Tarcan T, et al: J Urol 2001; 165; 564

• Cannot predict lower urinary tract function by normal lower extremity function

Changing UDS Patterns in Newborns with Myelodysplasia

• 34 w myelo - UDS at 1, 4, 10 mo.
  - Fill rate 1.6 – 8 ml/min; subtracted detrusor pr.; perineal patch EMG

UDS Findings Following Prenatal Closure of MMC

• 5 children closed prenatally & who lived in the Boston area
  - Postnatal UDS age (mean): 12 mo. (1.5 – 36)
  - 100% had DO on CMG
  - 100% had complete denervation on EMG


Effects of Prenatal Closure on LUT Function

• 115 children from MOMS trial
  - 56 pre- vs. 59 post-natally closed babies
  - Evaluated at 12 & 30 months
  - Prenatal UDS age (mean): 12 mo. (1.5 – 36)
  - Abn bladder wall, % trabeculation, open BN was similar in both groups


UDS Findings Following Prenatal Closure of MMC

• 5 children closed prenatally & who lived in the Boston area
  - Postnatal UDS age (mean): 12 mo. (1.5 – 36)
  - 100% had DO on CMG


Summary: Why Perform UDS in Neonates with Myelodysplasia & other Dysraphisms?

• Provides a baseline assessment of LUT function, including EUS innervation to identify children ‘at risk’
• Promotes specific medical and/or surgical therapy, and assesses their effectiveness
• Allows subsequent studies to denote progressive changes in function or innervation
• Enhances parental counseling regarding future lower urinary tract & sexual function
Thank you!