W18: Basic Urodynamics - An Interactive Workshop

Workshop Chair: Hashim Hashim, United Kingdom
24 October 2024 17:00 - 19:30

Start	End	Topic	Speakers
17:00	17:05	Welcome and introduction to Urodynamics	Hashim Hashim
17:05	17:25	Physics for the Urodynamicist	Andrew Gammie
17:25	18:25	Practical Session 1	Andrew Gammie Arturo Garcia-Mora Shiby Priju
18:25	19:25	Practical Session 2	Hashim Hashim Laura Thomas Beatrice Bouchard
19:25	19:30	Questions	All

Description

After an initial introduction, explaining the aims of the workshop and content of each part of the workshop, there is a short presentation on the basic physical principles underlying urodynamics. This first half hour sets the scene for those completely new to the topic, and gives the background principles of measurement to allow a good foundation for all levels of experience. Delegates will then be divided into two groups (20 in each group). The workshop will be located in a room large enough to accommodate two stations, as the two sections of the workshop will run simultaneously. Alternatively, as in 2017, two adjacent rooms could be used - this format worked very well. The maximum group size (20 delegates) has been chosen to ensure that all members of the group can have their needs met by the tutors stationed at each. Due to overlap noted in earlier years, where four stations were used, we now present in two stations so more detailed discussion is possible. The stations will address the following: setting up equipment, running a test, troubleshooting, interpreting traces. Delegates will change their station after one hour at each station. At the end of the workshop there will be a chance to address any general questions. The exact format of each station will depend on the needs of the delegates, and teaching aids will be provided as well as the expertise of the speakers. All of the speakers have many years experience in urodynamics and are used to teaching practical urodynamics. The speakers represent both clinical and scientific disciplines. The stations (small group work) in detail: Setting up equipment and running a test: this will provide access to urodynamic equipment, domes and manometer tubing to practice initial setting up and checking calibration. The use of different systems (i.e. water-filled, air charged, microtip) will be discussed. Delegates will be talked through running a test, and test adaptations that could help address 'the urodynamic question' will be discussed. Troubleshooting and interpreting traces: Use of recorded tests with teaching about how to recognise common artefacts. Advice on how to deal with individual artefacts will be given to ensure a quality urodynamic recording. Recorded tests, which show a variety of diagnoses, will be used to discuss pitfalls in interpretation. Delegates will be asked to look at traces of filling and voiding cystometry and interpret them. All the speakers have been involved in similar "hands on" courses, which run successfully in the United Kingdom and at previous ICS meetings. They feel that it is appropriate to offer a similar course to delegates who do not have access to one in their own countries. The small group format has been shown to work well in addressing individual needs. Access to teaching aids and equipment will simulate the clinical scenario as much as possible within the constraints of the conference setting. No particular manufacturer will be advocated, although one machine will be used as a demonstrator. This will be offset by the use of a brand-independent training simulator device as well.

Aims of Workshop

This workshop aims to provide a practical course offering an interactive 'hands on' environment for practitioners to improve their skills in urodynamics. The use of recorded tests, access to equipment and small groups means that individual problems can be addressed. At the end of the workshop delegates should feel more confident in their practice.

Educational Objectives

There is a short presentation on the basic physical principles underlying urodynamics. This first half hour sets the scene for those completely new to the topic, and gives the background principles of measurement to allow a good foundation for all levels of experience. Delegates will then be divided into two groups (20 in each group). The workshop will be located in a room large enough to accommodate two stations, as the two sections of the workshop will run simultaneously. Alternatively, as in 2017, two adjacent rooms could be used - this format worked very well. The maximum group size (20 delegates) has been chosen to ensure that all members of the group can have their needs met by the tutors stationed at each. Due to overlap noted in earlier years, where four stations were used, we now present in two stations so more detailed discussion is possible. The stations will address the following: setting up equipment, running a test, troubleshooting, interpreting traces - all the issues we have identified as being necessary for good clinical practice. Delegates change their station after one hour at each station. At the end of the workshop there will be a chance to address any general questions. All of the speakers have many years experience in urodynamics and are used to teaching practical urodynamics, so can adapt the material to the specific needs of and equipment used by the delegates. The whole session is framed around the application to clinical practice, rather than merely theory.

Learning Objectives

1. Learn how to set up urodynamic equipment
2. Learn how to run a test and troubleshoot according to good practice guidelines
3. Learn basic principles of how to interpret urodynamic traces

Target Audience

Urology, Urogynaecology and Female & Functional Urology

Advanced/Basic

Basic

Suggested Learning before Workshop Attendance

ICS Good Urodynamic Practices; ICS Fundamentals series; ICS urodynamics e-Learning modules

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The curriculum and learning outcomes of a short course in urodynamics

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ABSTRACT

Quality diagnostics require good staff training. In urodynamics, it is helpful to have an introductory training course in both technical and clinical skills before patient clinics commence. It is also beneficial to revise the basic principles and practices after some initial clinical experience. To this end, our Institute has been running short courses in urodynamics for over a decade. These have taken place at the annual scientific meetings of the International Continence Society and of the European Urological Association. In the hope that the structure, curriculum and learning points will be useful for other centres who want to run a similar course, we share these here. We emphasise that a practical, hands-on approach with demonstration equipment and urodynamic traces has been well received.

Introduction

The Bristol Urological Institute has been delivering a short course in urodynamics as a workshop at the International Continence Society's (ICS) Annual Meeting since 2009. Over that time, the curriculum has been developed to offer the most useful points of urodynamic practice that can be communicated effectively in a three hour timespan. This paper aims to share the content and structure of such a course, with a view to giving other centres the opportunity to offer a basic introduction to the subject. The course is not equivalent to the 2–3 day Bristol ICS approved certificate in urodynamics course, given the limitation of the short time involved, but it serves as a foundation level for someone new to the field. There is consistent high demand for practical urodynamics training as new staff come into post and as quality of urodynamics continues to be highlighted in the literature. We have found that a practical approach is well received and caters for the beginner with questions on setting up, good practice and interpretation.

Aims of workshop

This workshop aims to provide a practical course offering an interactive 'hands-on' environment for practitioners to improve their skills in urodynamics. The use of recorded tests, access to equipment and small groups means that individual problems can be addressed. The target audience is anyone interested in urodynamics in Female & Functional Urology and Urogynaecology including doctors, nurses, scientists, physiotherapists etc. At the end of the workshop delegates should feel more confident in their practice.

Learning Objectives

1. Learn how to set up urodynamic equipment (technical)
2. Learn how to run a test and troubleshoot according to good practice guidelines (technical)
3. Learn basic principles of how to interpret urodynamic traces (clinical)

Structure of the course

After an initial introduction, explaining the aims of the workshop and content of each part of the workshop, there is a short presentation on the basic physical principles underlying urodynamics. This first half hour sets the scene for those completely new to the topic and gives the background principles of measurement to allow a good foundation for all levels of experience. Delegates are then divided into two groups, with the maximum group size chosen to ensure that all members of the group can have their needs met by the tutors stationed at each. The stations address the following: setting up equipment, running a test, troubleshooting, interpreting traces. Delegates change their station after one hour at each station. At the end of the workshop there is a chance to address any general questions.

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Table 1
Curriculum and learning points for section 1, introduction to urodynamics.

Introduction to urodynamics	
Curriculum areas	Learning points
Description of urodynamic tests	Uroflowmetry, cystometry and pressure-flow study (standard and video, filling and voiding), urethral pressure profile, ambulatory
Displayed pressures	Abdominal, intravesical, detrusor
Urodynamic traces	Components of a filling and voiding study trace
Context of the test	Indications, physical examination, replication of symptoms, reporting

Table 2
Curriculum and learning points for section 2, physics for the urodynamicist.

Physics for the urodynamicist	
Curriculum areas	Learning points
Measurement units	Pressure: cmH_2O; Volume: mL; Flow: mL/s
Measurement methods	Pressure transducer types; Flowmeter types
Pressures measured and calculated	Abdominal: p_{abd}; Intravesical: p_{ves}; Detrusor: p_{det}
Zero reference pressure	Atmospheric pressure is considered as zero

The use of small groups enhances involvement, giving participants the chance to apply the learning to their own clinical situation. Using two members of the team per session gives the opportunity for detailed explanations to be carried on without stalling the whole group. Real urodynamic equipment, demonstration items and discussion over real urodynamic traces have been found to engage well with participants.

Curriculum and learning points by section

1. Introduction (Table 1)

Urodynamics is the umbrella term that covers investigations of lower urinary tract function. The term encompasses the following investigations: uroflowmetry, cystometry and pressure-flow study (standard and video), urethral pressure profilometry and ambulatory urodynamics. Standard urodynamics is the commonest investigation for storage and voiding symptoms. Urodynamics aims to reproduce a patient's symptoms and, by means of pressure measurements, provide a pathophysiological explanation for them.

Detrusor pressure is measured indirectly from intravesical and abdominal pressures using the formula: $p_{ves} - p_{abd} = p_{det}$. Abdominal pressure is measured to allow for the effect of increases in abdominal pressure, for example straining, on intravesical pressure, and to measure the baseline pressure surrounding the bladder. . Both filling and voiding are normally performed as part of every investigation, with some exceptions, for example in patients unable to void, when filling (cystometry) alone would be carried out.

During a urodynamic test there is a constant dialogue between the investigator and the patient so that any symptoms experienced during the test can be related to urodynamic findings. A full report is produced following a urodynamic investigation, which will normally include history, examination, urodynamic findings and suggestions concerning management. The report should state whether the patient's symptoms were reproduced and whether voiding was felt to be representative.

2. Physics for the urodynamicist – an introduction (Table 2)

Pressure

Pressure can be measured by the height of a column of fluid that it supports. In urodynamics, the unit of pressure has been standardised as cmH_2O. There are usually two pressure transducers associated with urodynamic equipment, measuring intravesical pressure p_{ves} and abdominal pressure p_{abd}. The detrusor pressure, p_{det}, is derived by subtracting p_{abd} from p_{ves}.

In most urodynamics, and in accordance with ICS guidelines, the transducers are external to the patient. Patient pressures are transmitted to the transducers via liquid-filled catheters. There must be no bubbles of air between patient and transducer, no water leaks and a good connection between transducer dome and transducer diaphragm.

Good urodynamics is carried out by making measurements relative to atmospheric pressure. This is achieved by zeroing the equipment with the transducers closed to the patient and open to atmosphere. The transducers in a water-filled system should be level with the symphysis pubis.

Pressure measurements may also be made by using air-charged catheters. With these, there is a practically weightless connection between the patient and the external transducer. This means there is no need to flush air from the system nor is there any need to place anything at a reference level. However, it is still important to set the baseline pressure of these devices to atmospheric pressure, and these catheters are regarded as not yet fully validated.

Urine flow

Urine flow rate in urodynamics is measured using a flowmeter which can either be mounted on a stand or a commode. Urine is directed onto the sensor by a funnel.

One type of flowmeter is the *load cell* flowmeter. A collection vessel is placed onto a weight sensor, which monitors the volume going into the vessel by measuring the increasing weight. The electronics converts the changes of volume with time into urine flow rate Q. This is measured in mL/s. Another type of flowmeter is the rotating disc flowmeter. In this device, there is a rotating disc at the mouth of the collection vessel. Urine hits the disc and slows it down. The amount of energy required to bring the disc back to speed is proportional to the flow rate Q. The electronics then calculates the volume voided in units of mL. Both these flowmeters will measure flow rate accurately but it is important to examine the flow trace in order to correct for any artefacts that have occurred during voiding.

3. Setting up equipment (Table 3)

External, liquid-filled non-disposable transducers

Disposables required: Syringes, Three way taps, Domes, Manometer tubing/catheter to patient, Sterile water and/or physiological saline.

The lines to the patient need to be primed with sterile water to remove air bubbles, and thus create a continuous column of water between patient and transducer. This can be done before the start of the test. The use of two three-way taps either side of the dome makes

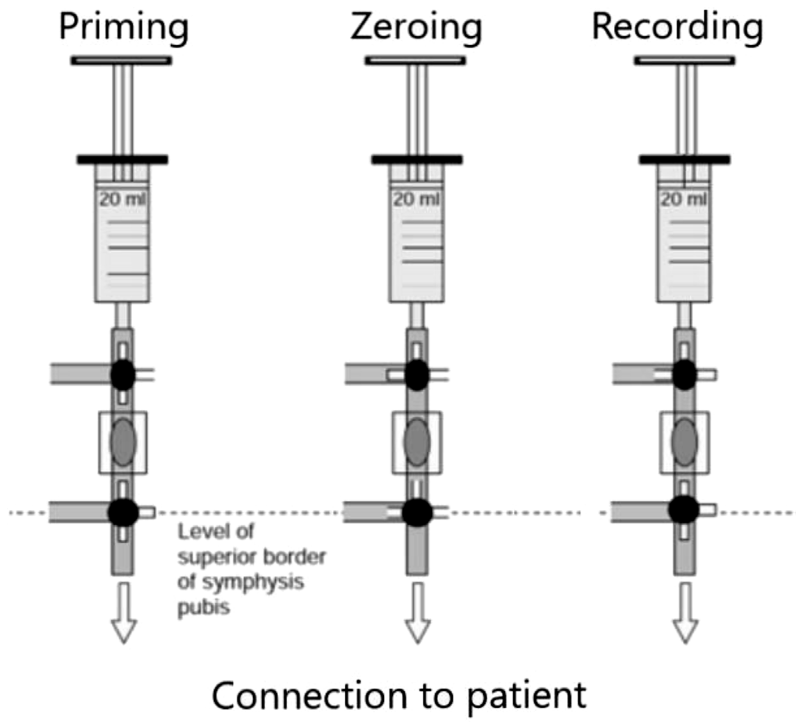

Fig. 1. The position of taps for urodynamic testing with a water-filled system.

Table 3
Curriculum and learning points for section 3, setting up equipment.

Setting up urodynamic equipment	
Curriculum areas	Learning points
Components of the urodynamic system	Transducers, flowmeter and funnel, pump, screen
Priming liquid-filled systems	Filling and mounting liquid-filled domes
Zeroing to atmosphere	Correctly exposing transducer to atmosphere
Checking calibration	Raising water-filled tubes, submerging air-filled
Setting reference height (water-filled systems)	Moving the transducers to level of symphysis pubis
Flowmeter and infusion set	Correctly placing flowmeter, jug and funnel. Mounting giving set within pump.

it easier for troubleshooting (checking zero and flushing) before and during the test, without introducing unnecessary air into the system. See Fig. 1 for illustration of the following stages:

- Prime System: Flush sterile water through the whole system, with both three way taps open before the domes are attached to the external transducers. A small flush after attachment is also advised.
- Zero to Atmosphere: Position the taps so that the transducer is open to the atmosphere and closed to the patient and syringe. The "zero" or "balance" option on the urodynamic equipment is then selected. Pressures will now be read relative to atmospheric pressure.
- For recording: The tap to the syringe remains off. The other tap is open to the transducer and the patient, but off to atmosphere. A calibration check can now be carried out by raising the end of the filled tube to a known height.

Air-charged catheters

To measure pressure the air-charged catheters need to be connected to their individual pressure transducer units. This can be done with the catheters already inside the patient. The switches on the transducer units are turned to the "open" position and the "zero" option on the urodynamic equipment is then selected. The switches on the transducer units are then moved to the "charge" position and the catheters will record pressures inside the patient relative to atmospheric pressure. 'Zero' should not be done when patient pressures are being read, as patient pressures are never truly zero. This type of catheters is currently not approved for use by the ICS as good urodynamics practice due to the lack of validation of pressure values.

Checking calibration

Pressure transducers are not perfect instruments, therefore it is important to check their calibration to ensure that accurate pressure measurements are made. A simple check of calibration for external pressure transducers (before connection to the patient) is to simply move the end of the filled pressure line through a known vertical distance (e.g. 50 cm) above the transducer dome and the pressure reading on the urodynamic equipment should change by the same amount (i.e. 50 cmH_2O). For air-charged or catheter tip transducers, calibration can be checked by submerging the catheter tip in a known depth of sterile water. The pressure reading on the equipment should change by the value of that depth.

Flowmeter and infusion set

The urine collection jug is placed on the flowmeter under the funnel. The giving set is connected to the infusion liquid, filled with liquid to avoid filling the bladder with air and then placed within the pump housing.

Table 4
Checklist for inclusions before the start of the test.

History:	*Frequency volume chart (Bladder Diary):*
• Symptoms	• Fluid intake – caffeine/alcohol
∘ Duration	• Voided volumes
∘ Stress/urge/other incontinence	• Voiding frequency
• Degree of leakage	• Nocturia?
∘ Pad usage	• Post-void residual (if measured)
• Voiding difficulties	*Decide whether they actually need the test*
• Quality of life	
• Past medical history	If so, what special considerations:
• Medication e.g. anticholinergics	Paediatric, Neurological, Stoma etc
• Allergies (latex)	Decide whether you are doing standard
• Parity (where relevant!)	or video urodynamics

4. Running a test (Tables 4–6)

Course of the test

1. Interview
2. Bladder diary analysis
3. Free uroflowmetry
4. Physical examination
5. Catheter placement
6. Urethral pressure profile (UPP, if done)
7. Filling (cystometry)
8. Pressure-flow study
9. Report writing and counselling

Before test

Identify the urodynamic question, i.e. what symptoms are we trying to reproduce?

Use these to inform the urodynamic test, i.e. to make it individual to the patient. Use bladder diary to guide decision on filling volume and filling rate.

Also before the test:

- Check reference level & zero
- Check intravesical and abdominal pressures are in normal range
- Initial cough to test both lines
  - *When the patient has been catheterised and the lines flushed through again, the taps should be set to the recording position and a cough test performed. If the height of one cough peak is less than 70% of the other, the line with the lower value should be flushed with water and the cough test repeated*
- If any problems delay starting the test until quality has been fully addressed

During test

Using annotation marks while running the test is very helpful for later interpretation.

After test

Writing a report:

- Were the symptoms reproduced?
- Was the voiding typical? Was there a residual?
- Leakage – was it on first cough? On an overactive wave? How much leaked?
- History, Examination, summary of bladder diary as above
- Description of test with filling speed and position as well as any problems encountered.
- Urodynamic diagnosis and management suggestions.

Counselling patient on lifestyle issues and prognosis.

5. Troubleshooting (Table 7)

Troubleshooting is a form of problem solving, defined by Wikipedia as "the systematic search for the source of a problem so that it can be solved". Troubleshooting is necessary if there are concerns about the quality of a urodynamic test while it is in progress. There is little that can be done to correct poor traces retrospectively; therefore quality assurance checks should be performed both before and during the investigation. Any problems with quality assurance should be addressed as soon as they are noted; the test can be paused while troubleshooting is performed. The best way to avoid the need for excessive troubleshooting is to ensure all equipment is set up correctly as explained above, with lines fully primed and transducers zeroed to atmosphere.

The following information provides a guide to common problems that are encountered during setting up and running a test, when quality control is not satisfactory. Fig. 2 provides a helpful summary of these steps.

Table 5
Checklist for inclusions during test.

Quality control	Artefacts	Tailoring
Presence of physiological signals	Drift of baseline pressures	Expected cystometric capacity
Regular coughs/deep exhalations	Position changes (both fill and void)	Void volume expected
Can check zero if needed	Rectal contractions	Supine to fill highly overactive bladder
Maintain transducers at the level of the symphysis pubis	Tube artefacts: leaks & knocks	Void position as usual for patient
Cough before and after pressure flow study	Pump artefacts	Filling speed changes
		Running water as provocation
		Stress testing if required, e.g. VLPP or cough while sitting/standing, crouching, exercises.

Table 6
Curriculum and learning points for section 4, running a test.

Running a urodynamic test	
Curriculum areas	Learning points
Before the test	The urodynamic question, taking history, using the bladder diary, checks before starting
Quality control	Resting pressures, cough response, live signal
Artefacts	Recognising drift of baseline pressures, position changes, rectal contractions, tube leaks & knocks, pump artefacts, loss of signal, maximum flow labelled on artefact
Tailoring the test	Expected fill and void volumes, patient position, filling speed, provocations for urgency and stress leaks
Reporting the test	Summary of history and examination, recording any reproduction of symptoms, cause of any leakage, details of test, diagnosis and future management

Table 7
Curriculum and learning points for section 5, troubleshooting urodynamics.

Troubleshooting urodynamics	
Curriculum areas	Learning points
The fundamentals of quality assurance during urodynamics	Consideration of quality assurance factors during the pre-filling, filling and voiding phase of urodynamics
When/what to troubleshoot during a urodynamic procedure	Methods of troubleshooting problems that arise with the transmission of live signal or resting pressures - Flushing lines - Closing leaks in the system - Checking tap orientation - Catheter position - Zeroing and transducer position
Examples of most common urodynamic artefacts	Artefact interpretation: - Flushing - Declining abdominal/intravesical pressure - Movement artefacts - Poor signal transmission - Abdominal artefact - Changes in compliance - Loss of pressure line
How to improve the quality of your urodynamics	Using troubleshooting algorithm chart Using ICS quality scoring system

At the start of the test

Ensuring resting pressures are within an acceptable range:
According to the International Continence Society (ICS) standardisation report on ‘Good urodynamic practices’[1], initial resting intravesical and abdominal pressure measurements in adults should both be within the range of 5–20 cmH_2O if measured with the patient supine, 15–40 cmH_2O, if sitting and 30–50 cmH_2O if standing. These pressures should always be positive. Both intravesical and abdominal pressure are measured from within a common cavity and as such they should be similar in magnitude unless there is a local pressure change (rectal/bladder activity).

***Troubleshooting in liquid-filled systems*:**
If pressures are outside the acceptable range:

- If intravesical and abdominal pressures are similar, but outside the acceptable range: check the height of the transducers. The ICS reference height is the upper edge of the symphysis pubis.
  - If the reference level is not correct, adjust accordingly.
- If only one pressure is outside the acceptable range:
  - Flush catheter
  - Check that zero has been set correctly on the relevant transducer but turning the taps back to atmosphere
  - Consider resiting the catheter (incorrect catheter placement in the ureter or in the urethra will give an elevated intravesical pressure)

Unequal transmission of pressure between intravesical and abdominal lines

- Flush lines
- Check whether there is any air in the dome over the external transducer
- Check taps are in the correct position
- Consider resiting catheter

During the test

Fall in pressure of intravesical or abdominal line during filling:
Neither the intravesical or abdominal pressures should decline during filling. Intravesical and abdominal pressures should be constantly monitored during the test and, if the pressures are noted to drop, then attempts should be made to correct this:

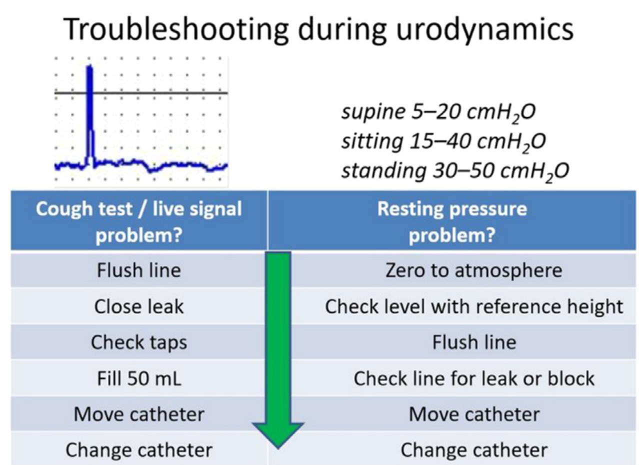

Fig. 2. Summary algorithm of troubleshooting steps.
Source: Taken with permission from Gammie et al. Continence, 2022.

- Flush line – this may be enough to restore pressure transmission
- If pressures continue to fall, check for leaks:
  - Check taps and all connections have been adequately tightened
  - Check lines – occasionally there may be a manufacturing fault

Unequal transmission of pressure between intravesical and abdominal lines
See above

If lines stop recording and the pressures drop dramatically:
This is probably because one of the catheters has fallen out or become compressed

- Reposition or resite catheter
- If intravesical catheter has fallen out before Q_{max}, consider refilling and repeating the pressure/flow

Table 8
Curriculum and learning points for section 6, interpreting urodynamic traces.

Interpreting urodynamic traces	
Curriculum areas	Learning points
Bladder diary	Analysis, interpretation and application of the bladder diary information to urodynamics
Flowmetry	The importance of the flowmetry as part of the urodynamic study
	Use of UPSTREAM as a mnemonic to evaluate aspects of the initial voiding
Quality assurance	Evaluate the quality of signals throughout the urodynamic test and taking artefacts into account
Interpreting filling and voiding phases	Checking, describing and determining the clinical relevance of signals, noting differences between male and female studies

Troubleshooting with air charged catheters:

If any problems arise with quality control:

- Try 'opening' them, and 'recharging' the catheters, ensuring that the patient coughs between charges to remove air from the catheter
- While 'open' the zero level can be checked
- Try moving the catheter position, in case the balloon has become trapped or compressed
- If this fails – catheter will need to be changed.

6. Interpreting urodynamic traces (Table 8)

At the end of the workshop you should be able to:

1. Identify resting baseline pressures (p_{ves}, p_{abd}, p_{det}) and understand their significance
2. Recognise normal artefacts and discuss causes of artefacts.
3. Determine where pressure and flow measurements can be reliably taken from on a trace.
4. Explore a systematic approach to trace interpretation within your own scope of practice

Urodynamic trace interpretation is complex. To become competent in elements of interpretation the urodynamic practitioner will need to be trained, supervised, and assessed in the set-up and use of urodynamic equipment, demonstrate an understanding of how to assure quality, and have the ability to critically analyse the results of the investigation with the urodynamic traces. All interpretation should be undertaken within the context of the patients' presenting urinary symptoms.

Understanding what a normal urodynamic trace should look like during a urodynamic investigation can provide a strong foundation for developing skills in interpretation. This is based on pattern recognition, and on an understanding of how the traces are displayed – axes for scale and time, and the framework of normal values/urodynamic parameters. Developing and using a systematic approach to trace interpretation can be simple. Approaches to developing such a system are outlined below.

Guidelines for reviewing and interpreting urodynamic traces

A urodynamic test aims to identify the information needed, which can be described as 'formulating the urodynamic question'. The clinical significance of it will rely on accurately identifying the patients' needs to resolve bothersome symptoms and reduce possible future problems. Establishing a pattern of recognition skills to identify abnormalities in each part of the test is critical to answering the urodynamic question and developing the treatment plan.

Consider the following characteristics when you are reviewing a trace:

Bladder diary

1. Are the patient complaints demonstrated on the bladder diary?
2. Is the bladder sensation demonstrated in the bladder diary reproducible on urodynamics?
3. Are there any behavioural measurements that can be discussed with the patient?
4. What is the functional bladder capacity of a patient?
5. Will that information be accurate to establish the amount of fluid used during the filling phase?

Flowmetry

The initial void (before catheterisation) is an essential baseline measurement as it provides flow rate, flow pattern, voided volume, residual urine measurements, and the voiding time before instrumentation. It offers physiological information and establishes a baseline for comparing values from their voiding cytometry.

The use of UPSTREAM as a mnemonic to remember essential aspects to assess when scrutinising a flowmetry study is suggested. Usual, Pattern, Shape, Time, Rate, Emptying, Artefact, Meaningful

Quality Assurance

1. Are quality assurance checks performed both before and during the investigation?
2. Are resting pressures in the abdominal, intravesical and detrusor lines in range?
3. Is there a cough test at the beginning of the test, during filling, before, and after voiding to verify that abdominal and intravesical lines are similar with an equal transmission and on normal range?
4. Are there annotations throughout the test indicating when events such as provocation tests, sensations, and instructions happened (e.g., first desire, urgency, detrusor overactivity, leak), regular coughs, or quality checks?

Filling Phase

1. What are the p_{abd}, p_{ves}, and p_{det} resting pressures at the beginning of filling cystometry? The intravesical and abdominal pressures are 'real' and can differ between patients depending on their size and position during filling.
2. Consider using the Cystometrogram '5CS' lifeboat to analyse the filling phase Calibration, Capacity, Contractions, Continence, Compliance, and Sensation.
3. Describe what you see in your analysis of the filling cystometry – consider artefacts (physical or physiological). Fine artefacts can be caused by talking and breathing; it is important to identify them as typical artefacts during an investigation.
4. What are the p_{abd}, p_{ves}, and p_{det} resting pressures at the end of filling cystometry? Consider whether there are normal pressure changes during filling and whether the bladder compliance is normal. Normal detrusor function allows the bladder to fill with little or no change in pressure.

Voiding Phase

1. What are the p_{abd}, p_{ves}, and p_{det} resting pressures at the beginning of the pressure-flow study?
2. What information can you get from the pressure-flow study? Is it normal/abnormal – consider voiding pressures, voiding time, flow pattern, and residual urine?
3. Describe what you see – what is your analysis?
4. Use of index and nomograms to establish the urodynamic diagnosis

5. What are the p_{abd}, p_{ves}, and p_{det} resting pressures at the end of the pressure-flow study?
6. What is the detrusor pressure at maximum flow ($p_{detQmax}$) and is it taken at a point away from artefacts?

Finally, consider what are the overall findings – do they correlate with patient symptoms? If the patient could not void, was this normal for them, or was it 'situational inability to void' (ICS 2016).

Conclusion

We have presented the curriculum and learning points for a short course in urodynamics. This is offered as a resource and template for others doing the same, with the aim of promoting good urodynamic practice.

Background reading material

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Ethics approval

The authors declare that this study did not involve Humans or Animals

Declaration of competing interest

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