

Start	End	Topic	Speakers
13:30	13:45	Introduction to Urodynamics	Hashim Hashim
13:45	14:00	Physics For The Urodynamicist	Andrew Gammie
14:00	15:00	Practical Session 1	All
15:00	15:30	Break	None
15:30	16:25	Practical Session 2	All
16:25	16:30	Questions	All

Speaker Powerpoint Slides

Please note that where authorised by the speaker all PowerPoint slides presented at the workshop will be made available after the meeting via the ICS website www.ics.org/2017/programme Please do not film or photograph the slides during the workshop as this is distracting for the speakers.

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.

Learning Objectives

- Understand the principles of urodynamic measurements
- Understand equipment set up and running a test
- Understand the basics of troubleshooting and interpretation

Learning Outcomes

After the course, the student will be able to:

- set up urodynamic equipment for a standard urodynamic study
- recognise basic features and artefacts of urodynamic traces

Target Audience

All practitioners (nurses, technicians and doctors) who are involved with the practical aspects of urodynamic investigations, but who do not consider themselves to be experts.

Advanced/Basic

Basic

Conditions for Learning

Interactive course with demonstration equipment and urodynamic traces. The numbers are thus limited to 32 delegates.

Suggested Learning and Reading before Workshop Attendance

ICS Good Urodynamic Practices (2002 & 2016)

Urodynamics (P Abrams, Springer)

Urodynamics made easy (C Chapple et al, Churchill Livingstone)

Foreword

Hashim Hashim – Consultant Urologist - UK

This is an interactive workshop. After a brief introduction, you will rotate around four stations during the course of the afternoon. The workshop numbers have been restricted deliberately to enable interaction and to afford individual attention. In addition to the four stations, a short lecture will give an overview of physics relevant to urodynamics.

The four stations are: Setting up equipment, Running a test, Interpreting traces and Troubleshooting.

Setting up equipment

You will have the opportunity to practise setting up equipment in preparation for cystometry. A piece of urodynamic training equipment and a simulation training device will be provided to enable “hands on” practice. The practical methods to ensure a urodynamic test is performed in line with Good Urodynamic Practice (Schäfer) will be discussed. These will include: how to set zero, how to remove air from the system and set the reference level.

Running a test:

This station will take the urodynamicist from taking a history through to the problems and solutions encountered during a urodynamic test. It will also cover elements of writing a urodynamic report.

Troubleshooting:

The general principles of troubleshooting will be discussed with traces that illustrate common artefacts. You will be taught how to recognise different artefacts and how to correct them in order to produce a quality test.

Interpretation of traces:

The principles of trace interpretation will be discussed and there will be the opportunity to look at sample traces and to practice interpretation.

Before the Course

The course is aimed at those with some experience of urodynamics, who do not consider themselves experts. It is suggested that some reading is done around the subject to gain maximum benefit from the workshop.

The course tutors will endeavour to meet individual needs, as much as possible, within the time constraints of the workshop.

Introduction

Hashim Hashim

Urodynamics is the umbrella term that covers investigations of lower urinary tract function. The term encompasses the following investigations: uroflowmetry, cystometry, standard and video, urethral pressure profilometry and ambulatory urodynamics. Standard cystometry is the commonest investigation for storage and voiding symptoms. Cystometry 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 vesical 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 vesical pressure. Cystometry has two parts: filling and voiding. Both 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 cystometry 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.

Setting up equipment

Andrew Gammie – Clinical Scientist - UK

Before urodynamic studies are undertaken it is important to understand how the equipment functions, which disposables are required and how to check calibration. There are a number of different urodynamic machines in use and it is important for the Urodynamicist to develop a good working relationship with the supplier. Before urodynamic equipment is purchased it is advisable to ensure that a service contract can be put in place and that service engineers are readily accessible for any problems, queries or planned preventative maintenance.

Cystometry is performed using pressure transducers which are sited either externally or internally. External transducers are currently more common and require a fluid filled system of catheters and tubing that can transmit pressure from the patient to the transducer. Water is normally used as the fluid, although air-filled systems are also available. Alternatively, transducers are

mounted on the catheters themselves, using catheter tip transducers.

External, Water-filled Non - Disposable Transducers:

Disposables required:

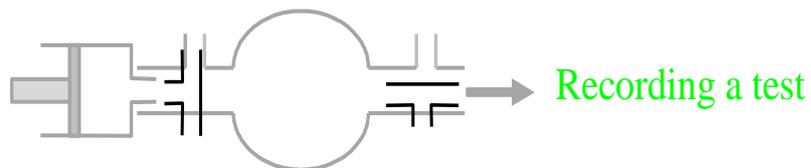
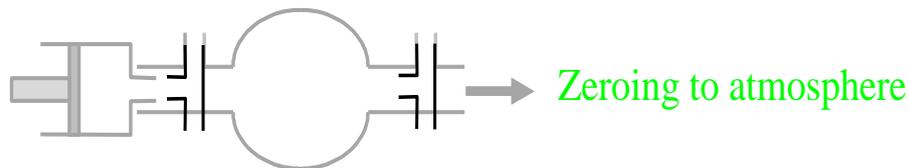
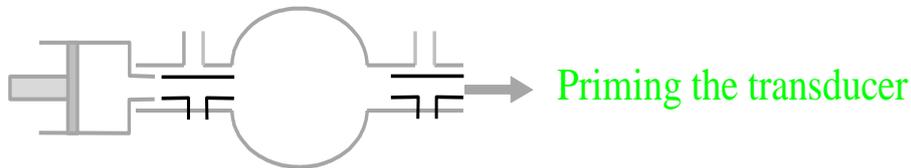
- Syringes
- Three way taps
- Domes
- Manometer tubing/catheter to patient
- Sterile water or physiological saline

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 it easier for troubleshooting (checking zero and flushing) before and during the test, without introducing unnecessary air into the system.

- Prime System: Flush sterile water through the length of the system, with both three way taps open before the domes are attached to the external transducers.
- Zero to Atmosphere: This is done by positioning the taps so that the transducer is open to the atmosphere and closed to the patient. The “zero” or “balance” option on the urodynamic equipment is then selected. Any subsequent pressures will now be read relative to atmospheric pressure.
- Set reference height: The pressure transducers need to be placed at the upper edge of the symphysis pubis to avoid artefactual pressure measurements due to the hydrostatic pressure effect. If the patient changes position during the test, the height of the transducers should be changed to the new level of the symphysis pubis.
- 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 cough test can now be 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.

Three way tap settings for cystometry are illustrated below:

3 way tap settings for cystometry



Catheter tip transducers

To measure pressure relative to atmospheric pressure, the transducers need to be connected to the urodynamic system while outside the patient with nothing touching the sensing element of the catheters. The "zero" or "balance" option on the urodynamic equipment is then selected. The transducers can then be introduced into the patient and will be recording pressures relative to atmospheric pressure.

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" or "balance" 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.

Checking Calibration:

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. 20 cm) above the transducer dome and the pressure reading on the urodynamic equipment should change by the same amount (i.e. 20 cmH₂O). For air-charged or catheter tip transducers, calibration can be checked, if necessary, by submerging the catheter tip in a known depth of sterile water. Again, the pressure reading on the equipment should change by the value of that depth.

Running a Test

Arturo Garcia Mora – Consultant Urologist - Mexico

Before test:

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

<p><i>History:</i></p> <ul style="list-style-type: none"> • Symptoms <ul style="list-style-type: none"> ○ Duration ○ Stress/urge/other incontinence • Degree of leakage <ul style="list-style-type: none"> ○ Pad usage • Voiding difficulties • Quality of life • Past medical history • Medication e.g. anticholinergics • Allergies (latex) • Parity (where relevant!) 	<p><i>Frequency Volume Chart (Bladder Diary):</i></p> <ul style="list-style-type: none"> • Fluid intake – caffeine / alcohol • Voided volumes • Voiding frequency • Nocturia? • Post-void residual (if measured)
	<p><i>Decide whether they actually need the test</i></p> <p>If so, what special considerations: Paediatric, Neurological, Stoma etc</p>

➔ Use these to inform the urodynamic test, i.e. to make it individual to the patient

Also before the test:

- Check reference level & zero
- Check vesical and abdominal pressures are in normal range
- Initial cough to test both lines

If any problems delay starting the test until quality has been fully addressed

During Test- Using annotation marks while running the test is helpful

Quality Control	Artefacts	Tailoring
<p>Presence of physiological signals</p> <p>Regular coughs / deep exhalations</p> <p>Can check zero if needed</p>	<p>Drift of baseline pressures</p> <p>Position changes (both fill and void)</p> <p>Rectal contractions</p> <p>Tube artefacts: leaks & knocks</p> <p>Pump artefacts</p>	<p>Expected cystometric capacity</p> <p>Void volume expected</p> <p>Supine to fill overactive bladder</p> <p>Void position</p> <p>Filling speed changes</p> <p>Running water as provocation</p> <p>Stress testing if required</p> <p>Cough while sitting/standing</p> <p>Crouching</p> <p>Exercises</p> <p>VLPP</p>

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 FVC as above
- Description of test with filling speed and position as well as any problems encountered.
- Urodynamic diagnosis and management suggestions.

Troubleshooting

Laura Thomas – Clinical Physiologist – UK

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 control checks should be performed both before and during the investigation. Any problems with quality control should be addressed as soon as they are noted; the test can be paused while troubleshooting is performed.

The following information provides only a guide to common problems that are encountered during setting up and running a test, when quality control is not satisfactory. The unexpected can always happen, but problems can be solved if troubleshooting is performed in a systematic manner.

At the start of the test:

Pressure readings outside acceptable range:

According to the International Continence Society (ICS) standardisation report on ‘Good urodynamic practices’¹, vesical and abdominal pressure measurements should be within the range of 5-20 cmH₂O if measured with the patient supine, 15-40 cmH₂O, if measured sitting and 30-50 cmH₂O if recorded standing.

Troubleshooting in water filled systems:

If pressures are outside the acceptable range:

- If vesical 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.
- o If the reference level is not correct, adjust accordingly.
- If only one pressure is outside the acceptable range:
 - o Flush catheter
 - o Check that zero has been set correctly on the relevant transducer
 - o Consider resiting catheter

Unequal transmission of pressure between vesical 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 vesical or abdominal line during filling:

Neither the vesical or abdominal pressures should decline during filling. Vesical 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:

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

Unequal transmission of pressure between vesical 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 vesical catheter has fallen out before Q_{max}, consider refilling and repeating the pressure/flow

Troubleshooting with air charged catheters:

If any problems arise with quality control:

- Try 'opening' them, 'recharging' the catheters, ensuring that the patient coughs between charges to remove air from the catheter
- While 'open' the zero level can be checked
- If this fails – catheter will need to be changed

Interpreting Urodynamic Traces

Marcus Drake – Consultant Urologist - UK

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 artefact, and discuss causes of artefact.
3. Determine where pressure 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 control, and have the ability to critically analyze the results of the investigation with the urodynamic traces. All interpretation should be undertaken within the context of the patients' presenting urinary symptoms.

Understanding 'normal', or, in simple terms, 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 normal pattern recognition, and 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 to reviewing and interpreting urodynamic traces

The initial void (prior to catheterisation) is a very important baseline measurement as it provides flow rate, flow pattern, voided volume, residual urine measurements, and the voiding time. It is important to ask the patient whether their void is normal for them, and whether they feel their bladder has emptied completely. This helps to establish a baseline for comparing values from their voiding cystometry.

Consider the following characteristics when you are reviewing a trace:

1. What are the p_{abd} , p_{ves} , and p_{det} resting pressures at the beginning of filling cystometry? The vesical and abdominal pressures are 'real' and can differ between patients depending on their size and position during filling.
2. Describe what you see, what is your analysis of the filling Cystometry – consider artefacts (physical or physiological). Fine artefact can be caused by talking and breathing, and it is important to be able to identify these as normal artefacts during an investigation.
3. 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, is the bladder compliance normal? Normal detrusor function allows the bladder to fill with little or no change in pressure.
4. What information can you get from the voiding cystometry? Is it normal / abnormal – consider voiding pressures, voiding time, flow pattern, residual urine?
5. Quality control – is it good/bad?
Consider the annotation of the trace – are all bladder events recorded (e.g., first desire, urgency, detrusor overactivity, leak), regular coughs/quality checks.
6. What are the overall findings – do they correlate with patients symptoms?

References:

The standardisation of terminology of lower urinary tract function: Report from the standardisation sub-committee of the ICS. Abrams P, Cardozo L, Fall M, Griffiths D et al. *Neurourol Urodyn.* 2002. 21: 167-178.
Good urodynamic practices: Uroflowmetry, filling cystometry, and pressure-flow studies. Schäfer W, Abrams P, Liao L, Mattiasson A et al. *Neurourol Urodyn.* 2002. 21: 261-274.

Physics for the urodynamicist – an introduction

Andrew Gammie

Pressure

- Pressure can be measured as the height of a column of fluid. To describe pressure you simply need to specify what the fluid is and the height to which it goes. In urodynamics, the unit of pressure has been standardised as the cmH₂O.
- Intravesical pressure can be measured by putting a catheter into the bladder, connecting it to a vertical tube filled with water and measuring the height that the fluid reaches relative to the bladder. However, although this is an accurate method of measuring pressure, it does not easily permit a record to be made of how pressure changes with time or bladder volume.
- Continuous recordings of pressure can be made by using a pressure transducer. The diaphragm of the transducer has a series of strain gauges bonded underneath it. Strain gauges are devices whose electrical resistance changes when they are deformed. Pressure on the diaphragm deforms the strain gauges underneath and this provides an electrical signal whose strength depends on how much the diaphragm has been deformed. This signal is displayed as a pressure reading on the computer monitor or on a chart recorder.
- There are usually two pressure transducers associated with urodynamic equipment. One to measure intravesical pressure pves and one to measure abdominal pressure pabd. The pressure exerted by the detrusor smooth muscle, pdet, is derived by the urodynamic equipment electronically subtracting pabd from pves.
- Pressure transducers are not perfect instruments but the urodynamic equipment manufacturer/distributor will have selected transducers that are suitable for measuring pressures accurately during urodynamics. However, as time goes on, the calibration of the transducers can alter and, therefore, it is important to regularly check their calibration to ensure that accurate pressure measurements are always made.
- In most urodynamics, the transducers are attached to the urodynamic equipment and are remote from the patient. Pressures inside the patient are transmitted to the pressure transducers via water-filled pressure catheters. To ensure appropriate pressure measurements there must be:
 - o No bubbles of air in the water connection between the patient and the transducer
 - o No water leaks
 - o A good connection between the transducer dome and the diaphragm of the transducer if using non-disposable transducers.
- Good urodynamics is carried out by making pressure measurements relative to atmospheric pressure. This is achieved in a water-filled system by placing the pressure transducers at the upper level of the symphysis pubis and by zeroing the equipment with the transducers closed off to the patient and open to the atmosphere.
- Pressure measurements may also be made in urodynamics by using catheter-tip pressure transducers or air-charged catheters. With catheter-tip devices, the pressure sensor is actually sited within the body so there is no fluid-filled catheter between the patient and the equipment. With air-charged catheters there is a practically weightless connection between the patient and the external transducer. This means that both these systems are simpler to use compared to the external water-filled devices because 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.

Flow

- Urine flow rate in urodynamics is measured using a flowmeter which can either be mounted on a stand or in a commode. Urine is usually directed into the flow sensor by a funnel.
- One common type of flowmeter is the load cell or gravimetric flowmeter. A collection vessel is placed onto a weight sensor. Urine is directed into the collection vessel, via a funnel, and the weight sensor effectively monitors the increasing volume of fluid going into the vessel by measuring the increasing weight. The electronics of the flowmeter converts the changes of volume with time into urine flow rate Q. This is measured in the units of ml/s.
- Another common type of flowmeter is the rotating disc flowmeter. In this device, the collecting vessel has a motor inside it which rotates a disc at the mouth of the collection vessel at a constant speed. Urine is directed into the collection vessel and when it hits the disc, it slows it down. The electronics of the flowmeter puts more energy into the motor to bring the disc back up to its original speed. The amount of energy required is proportional to the urine flow rate Q provided the stream hits the disc fairly perpendicularly. The electronics of the flowmeter then calculates the volume voided.
- Both these flowmeters (and other less common ones) will measure flow rate accurately but it is important to examine the flow trace after it has been produced in order to correct for any artefacts that have occurred during voiding:
 - o Knocking the flowmeter may produce 'spikes' on the trace which need to be ignored.
 - o Moving the urinary stream relative to the flowmeter will produce artefactual fluctuations in the flow trace – the wag factor.
 - o If making simultaneous measurements of pressure and flow, it may be necessary to correct for the time delay between the stream exiting the urethral meatus and it being recorded by the flow meter – the lag factor.



W17 – Basic Urodynamics
An Interactive Workshop



Prof. Hashim Hashim MD, FEBU, FRCS(Urol)
 Consultant Urological Surgeon & Director of the Urodynamics Unit
 Email: h.hashim@gmail.com



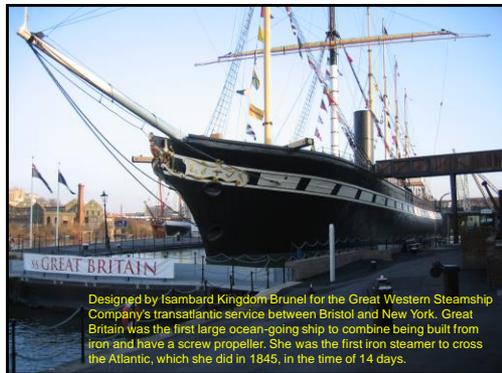
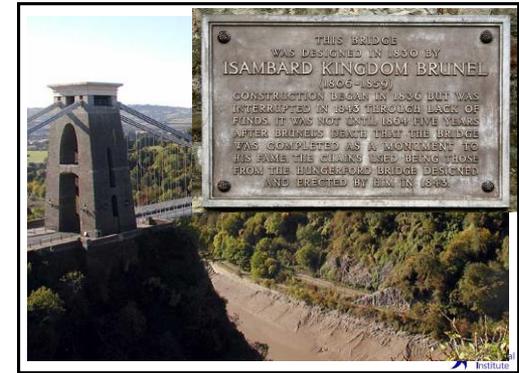
WELCOME TO BRISTOL IN FLORENCE











Aims of course

For those who have some experience, but are not experts

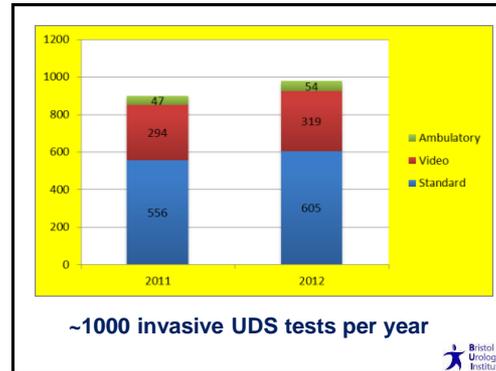
- confidence with equipment
- quality control
- troubleshooting
- interpretation

Emphasis on practical aspects rather than management



Urodynamic Services @ Bristol

- Clinical service
- Education
- Research



Education

- Certificate in UDS course – ICS recognised
 - 12 National in the UK per year
 - 2-3 International per year
 - Middle East & Far East
- Basic UDS course
- Advanced UDS course
- Consolidation UDS course
- Interactive UDS workshop at the ICS & EAU



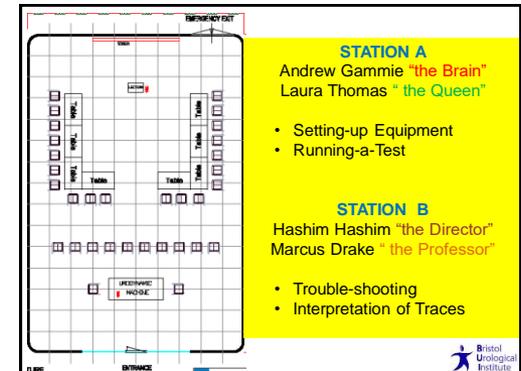
Plan for today

- 2 stations
- 60 minutes/station
- Rotate between stations at ring of bell
- Equipment provided by Laborie



Program for session

- Introduction + Physics (30 min)
- Setting-up + Running a test (60 min)
- Break (15 min)
- Trouble-shooting + Interpretation of traces (60 min)
- Questions, answers and feedback (15 min)



A bit of house-keeping!!

- Switch mobiles off or put on vibrating mode
- Emergency exits
- Use SoMe –  @urohash @lauraellenthomas
 @urohash @MarcusDrake @L_E_Thomas
- Fill out feedback forms

Bristol Urological Institute
 North Bristol NHS
 University of BRISTOL

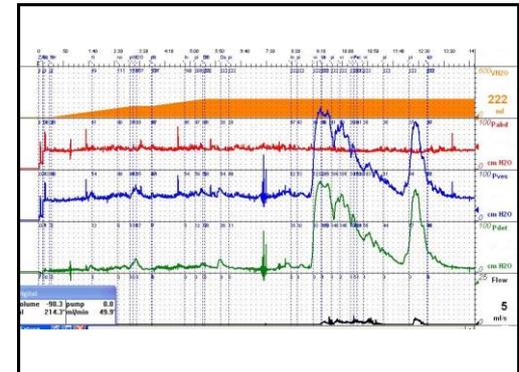
Interpretation



Marcus Drake
 University of Bristol, UK

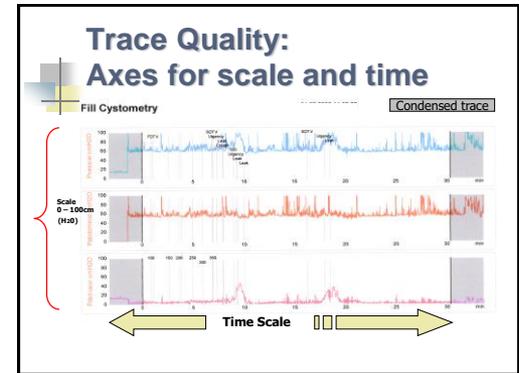
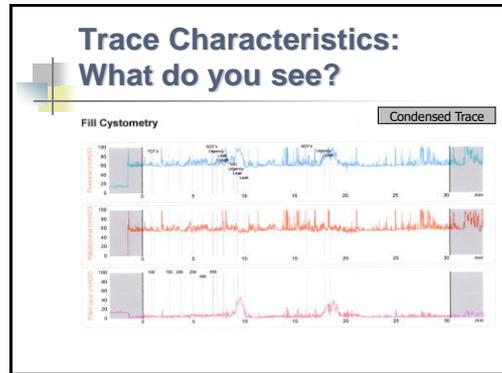
Interpretation- objectives

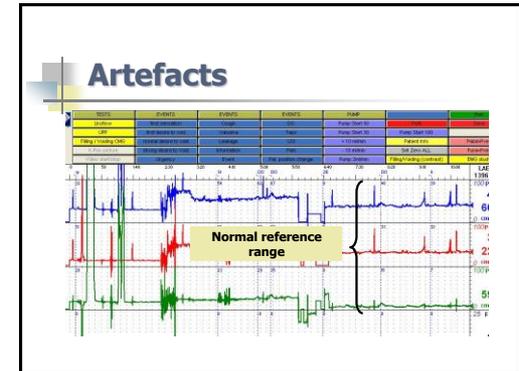
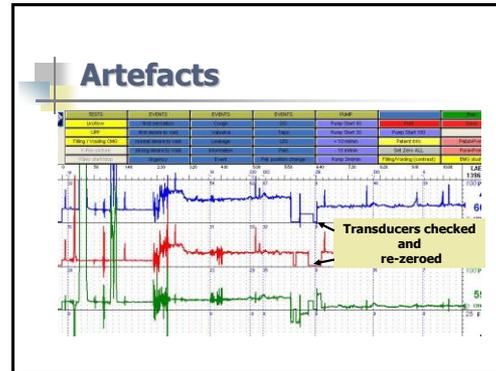
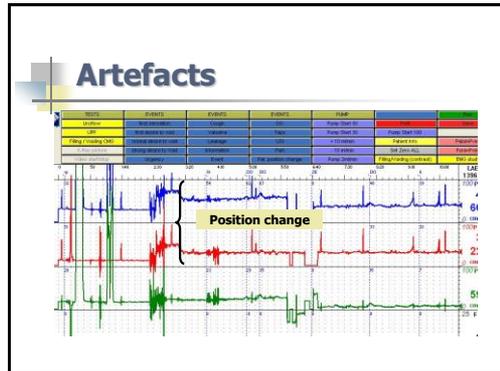
- Identify resting baseline pressures (P_{ves} , P_{abd} , P_{det}) and understand their significance
- Recognise artefact
- Determine where pressure measurements can be reliably taken from on a trace
- Explore a systematic approach to trace interpretation within your scope of practice



What is a normal trace?

- Resting pressures in the bladder (P_{ves}) = abdominal (P_{abd}) (+/- 10cm H₂O)
- Pressures should be within the following ranges, according to patient position:
 - Supine 5 – 20 cm H₂O
 - Sitting 15 – 40 cm H₂O
 - Standing 30 – 50 cm H₂O





Quality Control

- Eyeball the trace – initial impressions count!
- Is the trace annotated – are urinary 'events' captured?
 - e.g.,
 - First desire
 - Urgency – detrusor overactivity
 - Leakage – urodynamic stress incontinence/detrusor overactivity incontinence
 - Position change
- Regular coughs?
 - Consider alternatives to coughing, e.g., staining/valsava
 - Quality of fine movement on trace/artefact

Quality control - Annotation

- Investigator may not be the trace interpreter/ treating doctor
- Good practice – an accurate record of events during the investigation

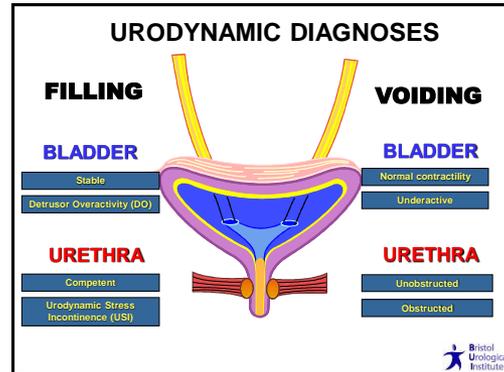
Describing what you see – the analysis

- What are the Pabd, Pves, Pdet at the beginning of the filling cystometry?
- What are the Pabd, Pves, Pdet at the end of the filling cystometry?
- What are the Pabd, Pves, Pdet during voiding cystometry?



W17 – Basic Urodynamics Troubleshooting

Prof. Hashim Hashim MD, FEBU, FRCS(Urol)
 Consultant Urological Surgeon & Director of the Urodynamics Unit
 Email: h.hashim@gmail.com



Systematic approach

- Define the problem
- Gather the information
- Define the cause
- Create options
- Make a decision

Think Logically = Critical Thinking!

Isolate the source of the problem

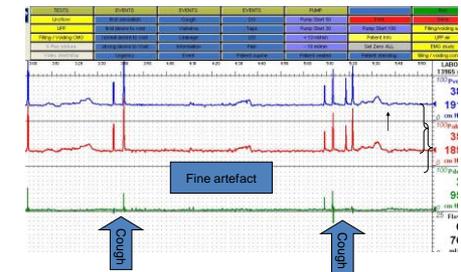
Remember it is usually one of five options:

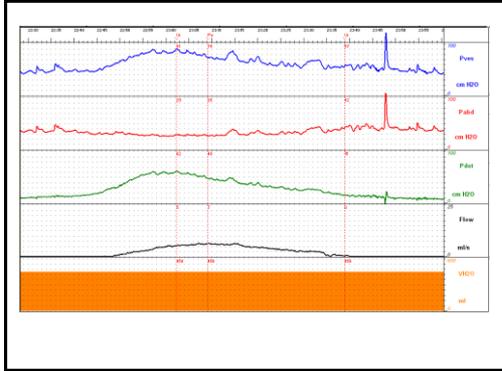
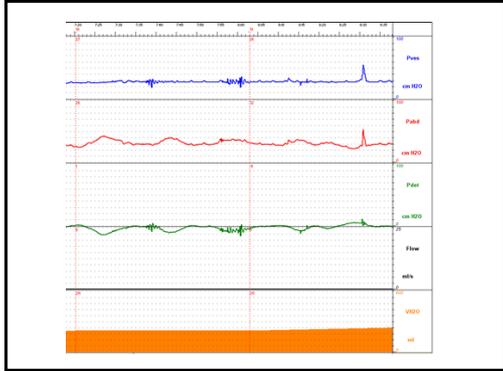
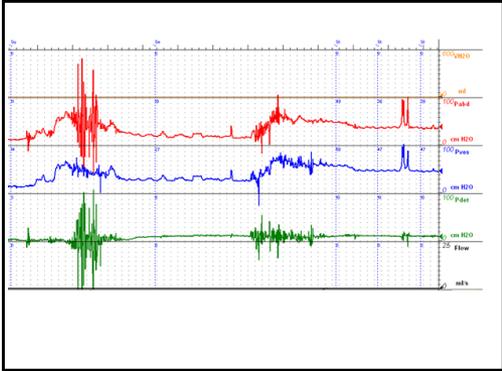
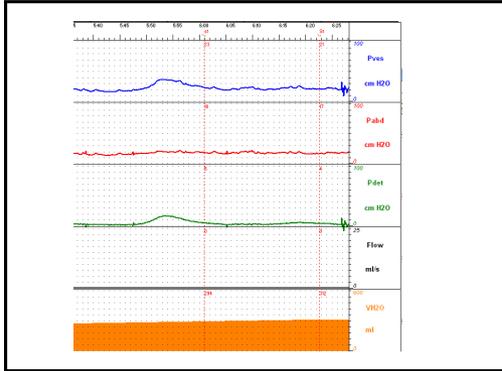
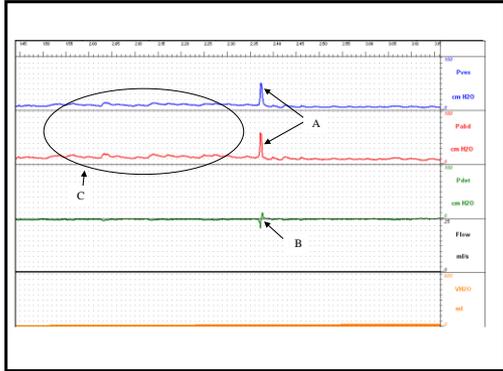
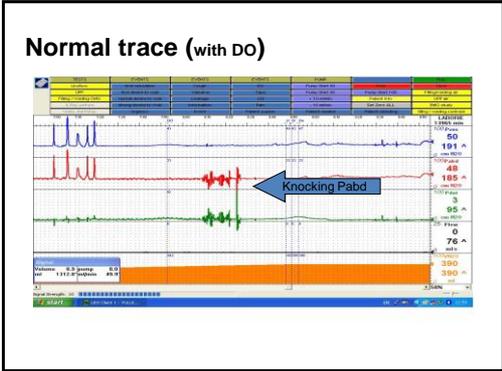
- Software
- Hardware
- Disposables
- Patient
- Operator!

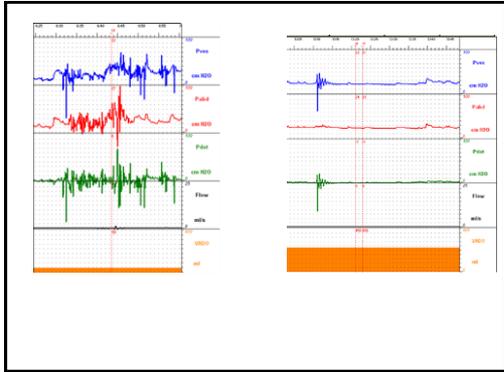
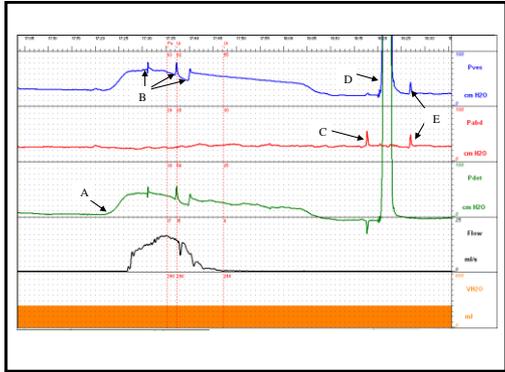
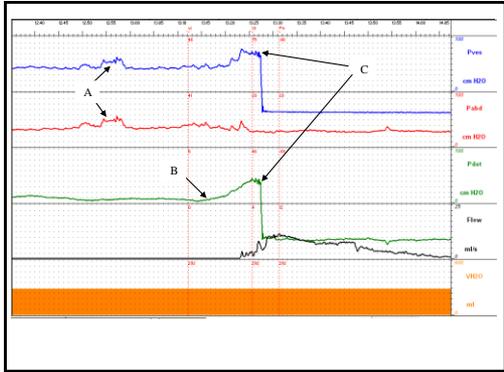
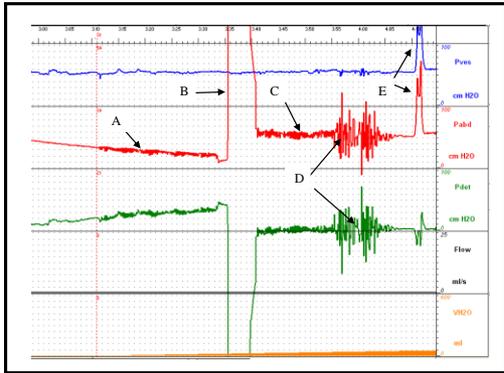
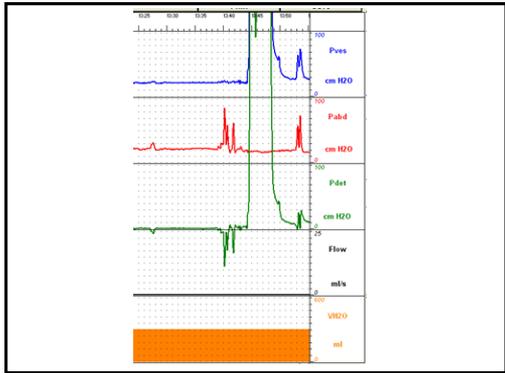
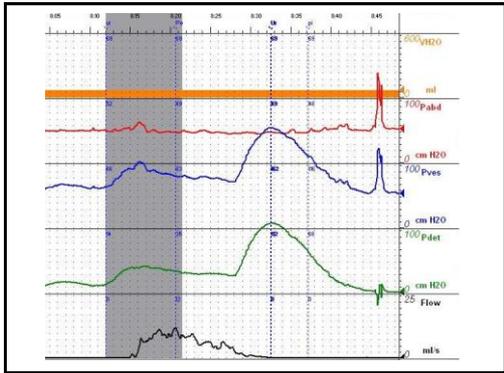
Quality control

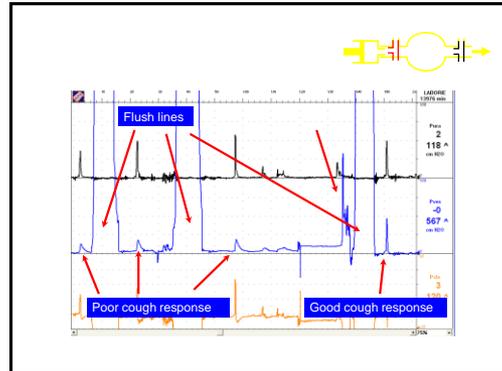
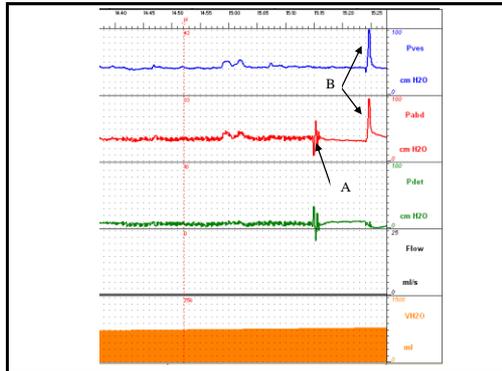
- Vital during the test
- Difficult to correct for poor traces retrospectively
- May need to reject poor quality traces
(Lewis 2000)

Normal Trace

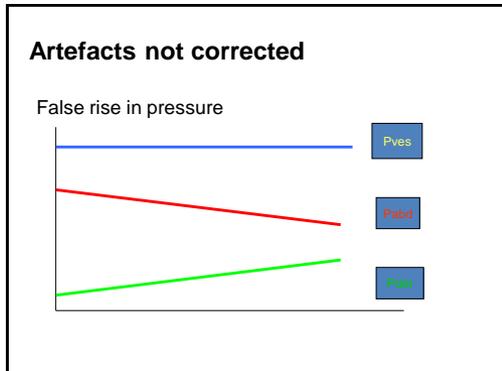




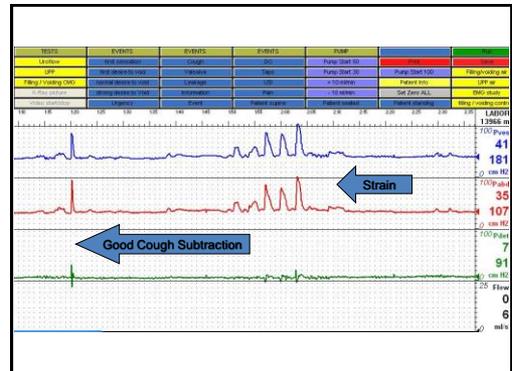




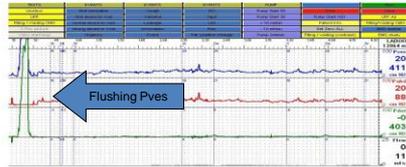
- ### Troubleshooting – pressures outside acceptable range
- Check equipment zeroed correctly
 - Check siting of catheters
 - Flush catheters
 - Reference level



- ### Troubleshooting - Fact
- Pves and Pabd should not drop below zero during filling

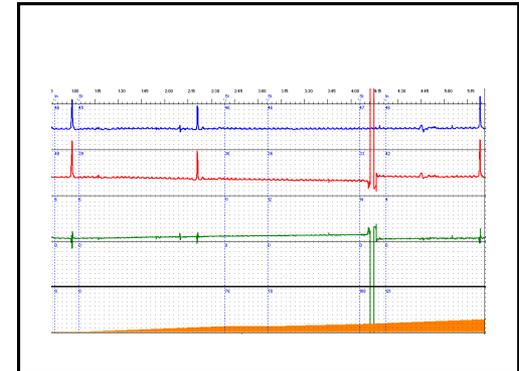


Flushing Pressure line



Flushing the pressure lines

- Often the pressure lines have not been flushed (primed) enough! If in doubt flush again...
 - As a general guide – use 2 – 5ml to flush the line
 - After flushing, ask the patient to cough, check lines
 - If OK continue, if not repeat flush – sometimes several attempts are needed



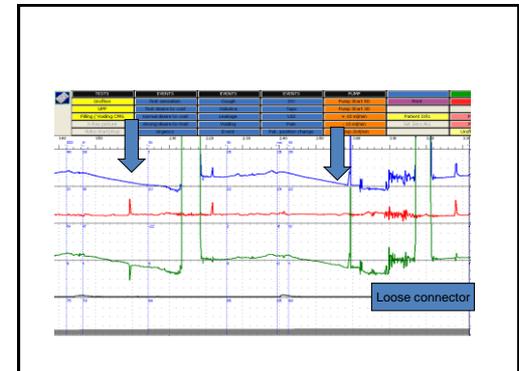
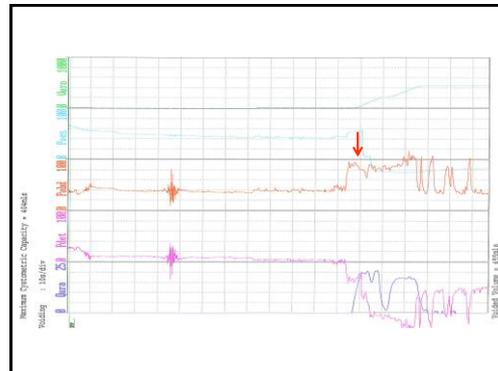
Drop in rectal (Pabd) pressure

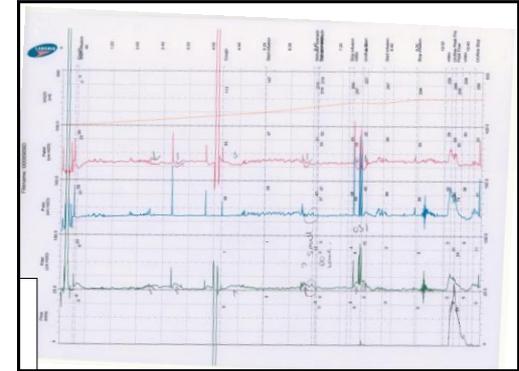
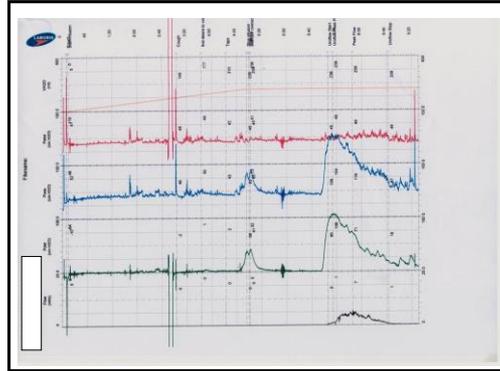
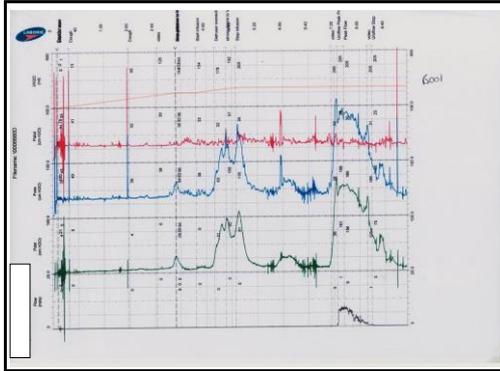
Usually...

- Rectal line has lost position/fallen out
- Loose connection

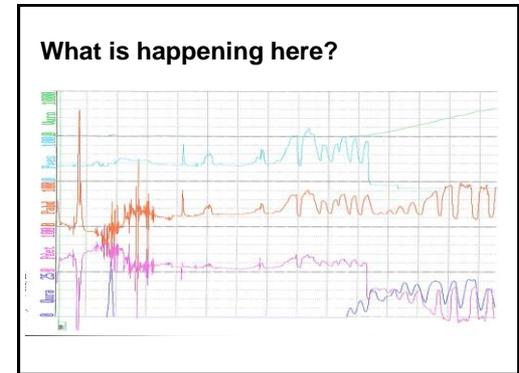
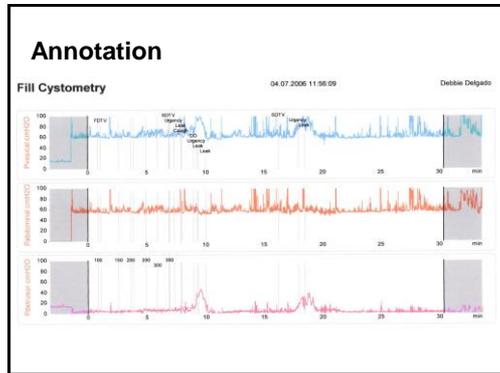
Rarely...

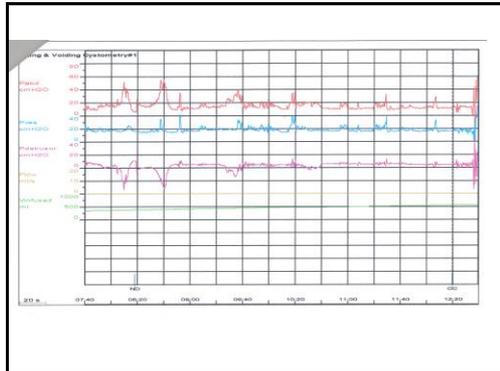
- Equipment/transducer failure





- ### Poor subtraction – Checklist
- Air in the system → Dampened signal
 - Check for loose connections - taps, luer-locks, transducers, catheter → Loss of pressure
 - Damaged/broken equipment → Check transducer (not just the dome cover)
 - Set-up - is it fluid filled? → Is the tubing primed?
 - Double-lumen catheters - caution! → Often double lumens need more flushing & respond better as bladder fills





Trouble shooting

- Flush catheter — *air doesn't transmit well*
- Check domes — reference level
- Re-zero to atmospheric pressure
- Start filling up to 50ml — *catheter against bladder wall*
- Resite catheter
- Change catheter (double lumen/solid state)

Troubleshooting tips

Check Zero

Stop, check, be sure!

Contact details of manufacturer

Equipment handbook

Wishing you
Good Urodynamic Practice!

Basic Principles of Urodynamics
- in a nutshell

Andrew Gammie
 Bristol Urological Institute, Southmead Hospital, Bristol, UK

With grateful acknowledgement of
Gordon Hosker
 The Warrell Unit, St Mary's Hospital, Manchester, UK.

Andrew Gammie ICS 2017 FLORENCE

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† All financial fees (over the last year) that you may have with any business organisation with respect to the subjects mentioned during your presentation

Funding for speaker to attend:

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

What is pressure?

Force per unit area



Unit of pressure

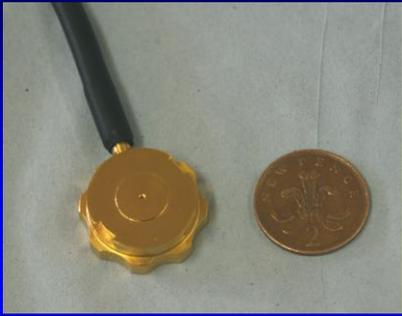
cm H₂O

1 cm H₂O = 0.74 mm Hg
 100 cm H₂O = 74 mm Hg

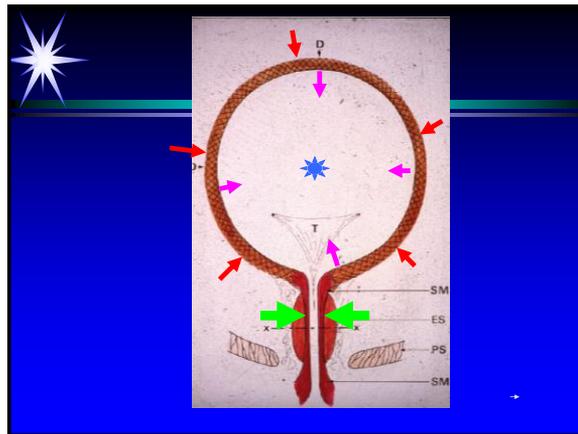
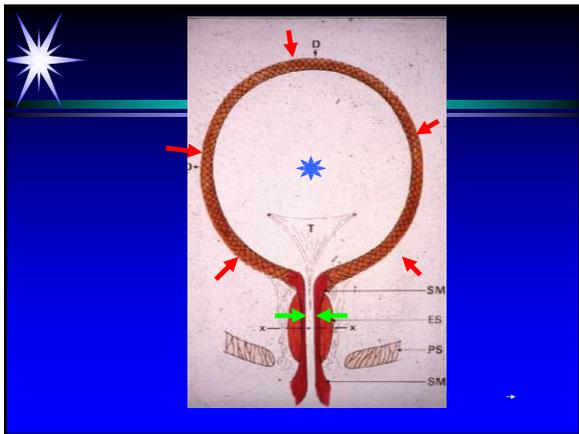
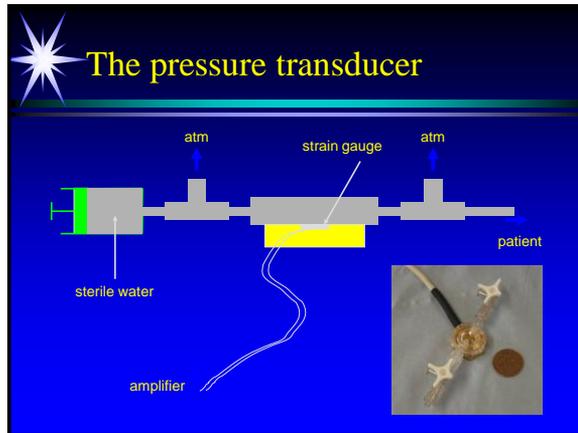
1 mm Hg = 1.36 cm H₂O

External pressure transducer with dome and taps

External pressure transducer without dome



"No fluid" pressure measurement



Definition of detrusor pressure

$$P_{det} = P_{ves} - P_{abd}$$

The effect of air in the system

Effect of air in the system

Transducer  Bladder 

Effect of air in the system

Transducer  Bladder 

_____ ←

Effect of air in the system

Transducer  Bladder 

_____ ←

Effect of air in the system

Transducer  Bladder 

_____ ←

_____ ←

_____ ●

Effect of air in the system

Transducer



Bladder



Two horizontal lines represent the tubing. The top line has a yellow circle (air bubble) on the left side. The bottom line has a yellow circle (air bubble) in the middle. Pink arrows point from the bladder towards the transducer on both lines.

Effect of air in the system

Transducer



Bladder



Two horizontal lines represent the tubing. The top line has a yellow circle (air bubble) on the right side. The bottom line has a yellow circle (air bubble) in the middle. Pink arrows point from the bladder towards the transducer on both lines.

Effect of air in the system

Transducer

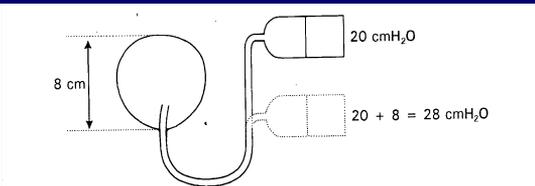


Bladder



Two horizontal lines represent the tubing. The top line has a yellow circle (air bubble) on the left side. The bottom line has a yellow circle (air bubble) in the middle. Pink arrows point from the bladder towards the transducer on both lines.

External pressure transducer



8 cm

20 cmH₂O

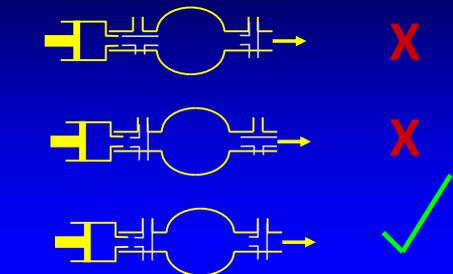
20 + 8 = 28 cmH₂O

Fig. 3.31 External pressure transducers measure pressure according to their position (outside the body) in relation to the bladder: the lower position (dotted lines) also records the 8 cm pressure head of the bladder itself. The position of the catheter in the bladder does not change the pressure measurement.

Where do you start from?

- We need to know the reference height of the transducers
 - Compare readings on the same patient
 - Check for realistic pressures
 - Equal reference for p_{abd} , p_{ves} relative to bladder
- The standard reference height is the upper edge of the symphysis pubis

Zeroing to atmosphere

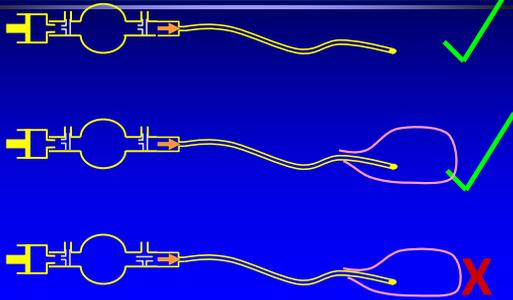


The first diagram shows a transducer connected to a bladder with a yellow bar (atmosphere) on the left side. It is marked with a red X.

The second diagram shows a transducer connected to a bladder with a yellow bar (atmosphere) on the right side. It is marked with a red X.

The third diagram shows a transducer connected to a bladder with a yellow bar (atmosphere) on the left side. It is marked with a green checkmark.

Zeroing while connected



Summary

- Pressure
- Transducers
- P_{ves} , P_{abd} , P_{det}
- Air bubbles
- Reference height
- Zero