Urodynamics

Surgical Ambulatory Services, LLC
Overview of the Anatomy of the Lower Urinary Tract (LUT)

The Lower Urinary Tract (LUT) is composed of the bladder, the pelvic floor and the urethra.

The Bladder is a hollow muscular organ resting in the pelvic cavity. As it becomes fluid filled it rises above the symphysis pubis. Normal capacity is 350-500 ml. The bladder naturally fills at 1 ml/min. The bladder consists of three layers:

1. An outer layer of connective tissue
2. The detrusor muscle, which is a smooth muscle, affected by both passive and active forces, as well as sympathetic and parasympathetic nerve supply. The pressure created by detrusor contractions is used in Urodynamic testing and is established by subtracting abdominal cavity artifact from intravesical measurement and creating the equation $P_{ves} - P_{abd} = P_{det}$.
3. An inner layer of mucus membrane

The Urethra

1. The male urethra is approximately 6-7 cm in length and comprised of four sections (the prostatic urethra, the membranous urethra, the bulbous urethra, and the pendulous urethra)
2. The female urethra is approximately 4 cm long and 6 mm in diameter

The UroGenital Diaphragm is a muscular structure under voluntary control that with the external urinary sphincter surrounds the urethra. In normal voiding, it is synchronous with bladder contractions and bladder neck relaxation.

An overview of LUT Physiology

During filling the bladder pressure ($P_{ves}$) is lower than the pressure inside the urethra and therefore the bladder neck remains closed. As the bladder continues to fill, $P_{ves}$ rises. When the patient can no longer hold his urine a detrusor contraction is initiated. $P_{det}$ is generated by the contraction of the smooth muscle. The bladder neck or internal urinary sphincter relaxes and opens by a coordinated active force on the external urethral orifice. As the external urinary sphincter relaxes and the voluntary detrusor contraction is generated, urine will begin to flow. At this time bladder and urethral pressure are equal. At the end of voiding, the urethral pressure begins to rise again and the sphincters close in order to maintain continence.
Disorders of the LUT

1. **Incontinence**: The agency for Health Care Policy and Research (AHCPR) defines it as “involuntary loss of urine which is sufficient to be a problem”. The International Continence Society (ICS) defines it as “involuntary loss of urine that can be demonstrated objectively and constitutes a social or hygienic problem”. Over 10 million Americans are plagued with this problem and the costs add up to approximately $15 billion annually.
   - **Stress Urinary Incontinence** (SUI) is leakage with coughing, laughing, sneezing or straining
   - **Urge Urinary Incontinence** (UUI) is leakage with a sudden and strong desire to void, is usually associated with an overactive detrusor. Sudden and strong desire to void associated with an overactive detrusor WITHOUT leakage is referred to as **Overactive Bladder**.
   - **Mixed Incontinence** contains components and symptoms of both SUI and UUI
   - **Sensory Urge Incontinence** is related to urgency. The bladder is generally hypersensitive but there is NO overactive detrusor.
   - **Overflow Incontinence** is generally associated with retention and the full bladder causes the “overflow” to leak
   - **Functional Incontinence** is usually present when the patient has normal sensations to void, but due to environmental or physical factors is unable to get to the bathroom in time

2. **Urinary Tract Infection**
3. **Cystocele**- bladder prolapse, causes “pseudo-obstruction”
4. **Urinary Retention**- can be neurogenic in origin, related to sensory neuropathy (as in Diabetes), related to obstruction, or idiopathic in origin
5. **Benign Prostatic Hypertrophy (BPH)** – enlarged prostate
6. **Neurogenic Bladder**
7. **Interstitial Cystitis**
8. **Bladder Neoplasm**
9. **Bladder Calculi**
10. **Urethral Stricture Disease**
11. **Fistulas** (such as Vesicovaginal Fistula)
12. **Bladder and Urethral Diverticulum**
Urodynamics

Why Urodynamics (UDS)?
For evaluation of symptoms (voiding dysfunction symptoms are not always what they seem) or sequelae (to assess the impact of a disease or disorder that can potentially cause serious damage to the upper or lower urinary tract).

What are UDS?
- The term Urodynamics was first used by Davis in 1954 as the study of the storage and evacuation by the bladder
- UDS evaluate bladder function (capacity, sensation, accommodation, and contractility)
- To confirm a physician’s differential diagnosis

When do you use UDS?
- When the history and physical and simple tests aren’t enough to make an accurate diagnosis

What should be done in addition to UDS?
- Complete history including signs and symptoms, past medical and surgical history, any obstetrical history, medications and any possible neurologic problems
- Physical Exam
- Voiding Diary
- Labs such as a Urinalysis and Culture & Sensitivity
- Other diagnostic studies such as VCUG, IVP, Renal function studies, Cystoscopy
The Components of Urodynamics: The Uroflow

Definition:
Dr. Boone states it is the “measurement of the rate of urine flow over time”. The volume (ml) of fluid expelled from the urethra each second, it is a reflection of bladder emptying, a simple and non-invasive tool used to screen the integrity of the bladder and its outlet during voiding.

Method:
A “comfortably full” bladder is important. A bladder too full can cause decrease flow rates due to overstretching of the detrusor. Adequate volume is considered 200-400 ml. Optimally, the setting for obtaining a Uroflow should be conducive to the patient voiding as he/she normally does making an adequately private environment important.

Terminology: (Taken from Practical Urodynamics by Victor Nitti, MD)
- **Bladder volume** – initial intravesical volume (voided volume + PVR)
- **Voided Volume** – volume of urine actually voided
- **Flow Time** – the time over which measurable flow actually occurs
- **Total Voiding Time** – the total time of flow. The upper limits of normal are about 10 second for 100 ml to 23 seconds for a voided volume of 400 ml
- **Continuous Urinary Flow** – a constant urinary stream without interruption
- **Intermittent Urinary Flow** – flow pattern in which interruptions of varying duration occur between voiding episodes
- **Maximum Flow Rate** – *(Peak Flow Rate)* – in the absence of abdominal straining or intermittent voiding, the maximal flow rate of the Uroflow
- **Time to Maximum Flow** – the elapsed time from the beginning of voiding to the point of maximum flow
- **Mean Flow Rate** – *(Average Flow Rate)* – voided volume divided by flow time

Clinical Indications:
1. Screening tool for dysfunctions of the LUT
2. Assess the results of treatment, such as surgical (TURP for BPH) or pharmacologic (alpha blockers, anticholinergics)
3. Follow the progression of a disease
4. Comparison with the post instrumentation Voiding Pressure Study/Pressure Flow Study
5. Preoperative evaluation
The Normal Uroflow:
Is a smooth bell shaped curve, moderately steep rise to the maximum flow rate

Minimum Acceptable Flow Rates

<table>
<thead>
<tr>
<th>Age</th>
<th>Voided Volume (ml)</th>
<th>Min. Male Flow Rate</th>
<th>Min. Female Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-7</td>
<td>100</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>8-13</td>
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<td>15</td>
</tr>
<tr>
<td>14-45</td>
<td>200</td>
<td>21</td>
<td>18</td>
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<tr>
<td>46-55</td>
<td>200</td>
<td>22</td>
<td>15</td>
</tr>
<tr>
<td>56-80</td>
<td>200</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>

The Abnormal Uroflow:

- **Obstructed Flow**: low peak flow (generally less than 10 cc/sec), low average flow, if repeated is consistently low flow rates with inadequate volumes, indicative of increased outlet resistance and/or decreased contractility, obstruction can be anatomical (BPH), Urethral Stricture Disease, Cystocele) or functional (neurologic, bacterial)
- **Intermittent Flow**: “bursts” of flow, may or may not be at regular intervals, caused by abdominal straining, patient anxiety or **Detrusor Sphincter Dysynergia**
- **Irregular Flow**: changes rapidly, possibly caused by uncontrolled sphincter contraction
- **Super Flow or “Supervisor”**: women with Genuine Stress Incontinence, high flow rate with little time to achieve the peak flow
The Components of Urodynamics
The Cystometrogram (CMG) and Abdominal Pressure (Pabd) Monitoring

Definition:
Dr. Nitti describes it as “a measure of the bladder’s response to being filled.” It allows for determination of the pressure/volume relationship within the bladder. In this component of UDS, as with all the components, every attempt should be made to mimic normal bladder filling and the storage of urine.

The CMG and Pabd Monitoring Evaluates:
- Filling pressure
- Competence
- Stability
- Sensation
- Presence of involuntary or unstable contractions
- Compliance
- Capacity
- Control over micturition
- Detrusor contractility
- Pressure/Flow relationship
- Bladder emptying

Method:
Typically a catheter is inserted into the bladder and the bladder is drained (if a Uroflow was performed prior to this, the amount of urine obtained is the patient’s residual urine or PVR). This catheter measures Pves. A rectal balloon is inserted into the rectum to measure Pabd, therefore providing the subtracted measurement of Pdet. As this is a manometry system, no air should be present within the system. All measurements should be zeroed to atmosphere with the symphysis pubis as the reference point. The bladder is then filled via the catheter with sterile saline or contrast media (if performing video UDS).

The patient will provide subjective information regarding sensation of filling, normal desire to void and their “capacity” (Cystometric capacity). Practical Urodynamics defines normal desire to void as “the patient would void at the next convenient time”. The patient should be instructed to hold his/her urine until he/she is no longer comfortable doing so and then is instructed to void as naturally as possible. The CMG is preformed supine, standing or sitting. Sitting or standing is preferred if there is a need to assess either stress or urge incontinence. Patients sometimes cannot void. This is not necessarily indicative of a physical problem but the patient’s inability to void in a clinical setting.
NOTE: Fluid is the preferred filling medium as it is more physiologic than the CO2 CMG’s of days gone by. It is also less irritating to the bladder. The three filling rates include slow (at up to 10 ml/min), medium (10-100 ml/min) and fast (at greater than 100 ml/min). Patients with known neurological conditions that would indicate detrusor hyperreflexia or autonomic dysreflexia (a syndrome of exaggerated sympathetic activity in response to a stimulus below the level of a spinal cord lesion, generally T7 or above, characterized by a sudden onset of severe HTN, HA, profuse sweating and reflex bradycardia, immediate removal of the stimuli is imperative), patients with suspected decreased compliance and children should be filled at slower rates, usually 25-50 ml/min.

What does it all mean?
The CMG’s graph can generally be divided into four stages:
1. The first stage shows an initial rise in pressure (0-8 cm/H20) in response to filling and is the result of a response to the bladder wall stretching as it fills. Normally, as the bladder fills, a relatively constant and low pressure should be maintained.
2. The second stage shows a very small pressure rise as the bladder accommodates to increasing volumes. This rise is less than 6-10 cm/H20. If more than 10 cm/H20, the reasons may include too rapid a filling rate, bladder wall fibrosis or detrusor hypertrophy.
3. The third stage begins when the bladder wall has reached its limit and an increase in volume shows a substantial increase in pressure. Patients should still be able to voluntarily suppress urination.
4. The fourth stage is the patient’s voluntary contraction to void. Voiding pressures during a contraction are usually 20-40 cm/H20.

NOTE: An uninhibited contraction appears as a sudden or relatively sudden rise in bladder pressure (usually 15 cm/H20 or greater), which is NOT voluntarily initiated. The International Continence Society states that an unstable bladder contraction is one that is uninhibited and exceeds 15 cm/H20 in magnitude or has a steep CMG curve and an end filling pressure greater than 15 cm/H20.
Abnormalities:
1. Contractions that are absent, weak or overactive
   • Absent: can be caused by sensory neuropathy, conscious inhibition of contractions, obstruction, pharmacologic, or lower motor neuron lesions. An areflexic bladder is neurogenic in nature and can present as an extremely large capacity (overflow incontinence)
   • Overactive or unstable detrusor: despite attempts to control it, the detrusor contracts either spontaneously or when provoked. Symptoms include frequency, urgency, nocturia, and Urge Urinary Incontinence. May be caused by irritation or obstruction or may be idiopathic. If it is neurogenic in origin, it is referred to a detrusor hyperreflexia and is generally seen in upper motor neuron lesions, CVA, and congenital or developmental abnormalities.
2. Capacity that is reduced or increased
   • Reduced capacity can have symptoms of enuresis or incontinence and may be caused by UTI’s, overactive bladder, upper motor neuron lesions, fibrosis or post surgical bladder
   • Increased capacity may be caused by sensory neuropathic disorders (DM), lower motor neuron lesions, social inhibitions or outflow obstruction
3. Pressure that is too low or too high
   • Low intravesical pressure (Pves) can be caused by large capacity due to sensory neuropathy (DM), flaccid lower motor neuron lesions, or a large bladder caused by repeated stretching (BPH)
   • High intravesical pressure can be due to reduced capacity, inflammation, overactive bladder, upper motor neuron lesion, or outlet resistance.
4. Sensation can be normal, hypersensitive or hyposensitive
   • Normally patients don’t sense volume in the bladder, only the change in pressure. Patients should perceive the increase in pressure, which signifies that the bladder is filling.
   • It is abnormal for the patient to perceive pain. (Cystitis)
   • A hypersensitive bladder is unstable and the desire to void a maximum Cystometric capacity may be difficult to suppress.
   • DM and herniated discs are common reasons for abnormal sensation.
5. Low Compliance Bladders are characterized by a steady steep pressure curve
6. Unstable Bladder is generally characterized by several small uninhibited contractions
What are Leak Point Pressures?

**Detrusor Leak Point Pressure (Det LPP)** – the pressure in the bladder that is required to push urine across the closed sphincter. It has been shown that upper tract deterioration is likely to occur when bladder storage pressure is greater than 40 cm/H2O in patients with bladder outlet obstruction and/or neuromuscular LUT dysfunction (“Hostile Pressures”).

**Valsalva Leak Point Pressure (Val LPP)** – performed by having the patient Valsalva at a standardized bladder volume. Val LPP is the amount of abdominal force required to cause leakage. Female with urethral hypermobility but normal resting closure of the internal and external sphincter mechanisms require pressure in excess of 80 cm/H2O to cause leakage while patients with non-functioning internal sphincter mechanisms (Intrinsic Sphincter Deficiency) require little pressure to create leakage (0-40 cm/H2O).
The Components of Urodynamics
The Electromyogram (EMG)

Definition:
A record of the electrical activity of individual or generalized skeletal muscle cells, measured through a recording device placed on or in the muscle. Usually measured at the anal or urethral sphincter or on the surface of the skin. It is recorded, usually, simultaneously with the CMG. It detects the presence or absence of external sphincter activity during the bulbocavernous reflex, detrusor contractions and voiding. It measures the voluntary component of the sphincter as well as pelvic floor function.

Method:
1. Needle Electrodes: in theory produce the most accurate EMG reading, are able to detect individual motor unit action potential and can assess the integrity of the motor and nerve supply. However, a local sample of the motor units may not be representative of the entire musculature. Needle electrodes may be difficult to use. A lot depends on the technician’s level of experience with placement, interpretation and tuning. Needle electrodes may produce artifact due to local trauma and muscle tightening caused by pain.
2. Surface Patch Electrodes: are able to detect pelvic floor contraction and relaxation but are not able to detect individual motor unit action potential. They are easy to place, less painful for the patient and the least invasive EMG option. To prepare the site for electrode placement the skin should be wiped with alcohol and dried and any access hair should be removed. The electrodes are placed at a 10 and 2 o’clock position around the anus and the ground electrode is placed on the inner upper portion of the thigh. Adjust amplitude waveform so that is changes with voluntary muscle squeeze or cough.

Indications:
1. To detect pelvic floor muscle contraction and relaxation
2. To assess the integrity of related muscles and their nerve supply when individual motor action potentials are observed
3. To investigate children with voiding dysfunction

The Normal EMG:
The striated muscle of the external urinary sphincter relaxes as the detrusor muscle and vesical neck contract. With increased bladder capacity, and as the urge to void gets stronger, a slight increase in the amplitude of the EMG may be seen. This is also called a “guarding reflex”. This increase will continue until the bladder contracts, at which time a simultaneous reflex relaxation of the EMG activity is noted. Sphincter relaxation, almost as a straight line, is called “silence”. At the end of the contraction, the EMG activity resumes as the sphincter muscles tighten to secure closure of the bladder outlet.

The Abnormal EMG: Shows poor coordination between the detrusor and the sphincter. Multiple sclerosis and Spinal Cord Injury be the cause.
The Components of Urodynamics
The Pressure Flow Study (or Voiding Pressure Study)

Definition:
The simultaneous measurement of Pves and urine flow. It measures the interaction between the bladder and the sphincter and the resulting urine flow rate.

Why?
During normal urination, a pressure from within the bladder (produced by the detrusor or abdominal straining) is necessary. The Pressure Flow Study determines if impaired voiding is due to abnormal detrusor contractions, sphincter relaxation failure or structural outlet obstruction, therefore evaluating the resistance of the outlet. Practical Urodynamics states, “Cystometry assesses the bladder’s response to filling. Cystometry alone tells nothing about the bladder’s ability to empty itself.”

Method:
The Pressure Flow Study is generally obtained after the CMG. It is important that the catheter used for pressure measurement be the smallest size possible since voiding will occur with this catheter in place. A catheter with a retention balloon, such as a foley, should not be used as it will obstruct the flow and can stimulate the bladder neck and distort the study.

The Normal Pressure Flow Study:
1. Opening Time: the elapsed time from initial rise in detrusor pressure to onset of flow. (A prolonged opening time may indicate an obstruction.)
2. Opening Pressure: the pressure recorded at the onset of measured flow (pressures greater than 80 cm/H2O may indicate obstruction.)
3. Maximum Pressure: the maximum value of the measured pressure
4. Pressure at Maximum Flow: the pressure recorded at the maximum urine flow rate (peak flow). (If this pressure is greater than 100 cm/H2O, there may be an obstruction even if the flow is good.)
5. Contraction Pressure at Maximum Flow: the difference between pressure at maximum flow and the pre-micturition pressure.

The Abnormal Pressure Flow Study:
1. A low flow rate and a high detrusor pressure indicate outflow obstruction.
2. A high flow rate and a low detrusor pressure indicate freedom from obstruction.
3. An intermittent flow pattern associated with abdominal straining and low pressure often indicates an underactive detrusor.
4. An intermittent flow pattern and high detrusor pressure occurring during an interruption of low suggests an overactive urethral closure mechanism.
5. Neuropathy and obstruction often coexist, and it is hard to distinguish the effects of one from another.
The Components of Urodynamics
The Urethral Pressure Profile (UPP)

Definition:
Urethral pressure measurements are made while the bladder is at rest (Resting UPP), during stress (Stress UPP) and during voiding (Micturition UPP), used to investigate patients with lower urinary tract dysfunction, evaluates urethral pressure, Practical Urodynamics states, “the UPP as originally proposed is classically measured while the bladder is at rest and provides urethral behavior in that state.”

Clinical Indications:
- Women with incontinence
- Men with BPH

The Normal UPP:
- Normal female urethral pressure decreases with age.
- The male urethra doesn’t decrease with age, but the prostatic urethral length does increase.
- The functional length of the urethra is distinct from the anatomical length. The anatomical length may be long, but only the functional length will be indicative of continence (the “Continence Zone”). In the female, the anatomical and functional length is about the same (about 4 cm), and the maximum closing pressure is found around the center of the urethra. In males, the functional length is longer (6-8 cm) and the maximum closure pressure is located within the membranous urethra.
- Except for voiding, the urethral pressure should always be higher than bladder pressure in order to maintain continence.
- Urethral pressure should increase with standing and bladder filling.
- Closure pressure (urethral minus bladder pressure) is normally adequate even under stress.

The Abnormal UPP:
- An abnormal UPP can be caused by high or low urethral pressure (SUI), a malfunctioning detrusor (UUI), overactive urethral closure pressure or an incompetent urethral closure mechanism (from denervation, trauma, or neurogenic disease).
Indications for Video Urodynamics:  (Jeffrey Woodside, MD)

- Bladder Outlet Obstruction (Dysfunctional bladder neck obstruction, urethral obstruction in women, obstruction and/or poor detrusor contractility)
- Neurological Disorders (Spinal Cord Injury, Multiple Sclerosis, Myelodysplasia, Sacral Agenesis, Parkinson’s Disease)
- Post-Operative Disorders (post-prostatectomy incontinence, radical hysterectomy incontinence and/or obstruction, Abdomino-perineal resection incontinence and/or obstruction, failed previous incontinence procedures in women)
- Miscellaneous (learned voiding disorders, pre-op evaluation for taking down a diversion, reflux and poor detrusor compliance, Hyperreflexic bladder, malfunctioning artificial urinary sphincter)
- Anything not explained in simple Urodynamics
UDS Points to Remember

- The effective diameter of the urethra during voiding is 3-4 mm (10 Fr)
- The practitioner must tailor the testing to fit each patient
- Patients need a thorough explanation of the procedure
- A cooperative patient is very important for a worthwhile study
- Clinical signs and symptoms should be reproduced if at all possible
- The interpretation of UDS is subjective and requires expertise that comes with a good knowledge base and experience
- An active UTI may be exacerbated by UDS and may invalidate results
- A normal flow rate doesn’t rule out inadequate detrusor function or instability
- A CMG measures quality not quantity
- Always consider your institution’s infection control guidelines for the use of tubing and catheters
Performing Urodynamics Studies with Equipment by Laborie Medical Technologies

Preparation of Equipment

1. Turn Equipment On
   - Monitor
   - Printer
   - 64 server if applicable
   - Pump if applicable
   - Computer

2. Preparation of Pump and Transducers
   - Load pump tubing into pump head and lock into place.
   - Insert pump tubing spike into IV solution bag, ensuring that the volume adjustment control on the IV tubing is completely open
   - Place novadomes on P1 (Pves) and P2 (Pabd) and P3 (Pura), if applicable.
   - Attach pressure measurement tubing to novadome.
   - Fill novadomes and tubing with sterile water utilizing sterile syringes, ensuring that no air is present
   - Prime pump tubing as follows:
     1. Select any test that utilizes the pump, i.e. CMG or Micturition
     2. Click pump
     3. Select prime pump
     4. Allow line to fill completely
     5. Click stop.

3. Preparation of EMG
   - Attach EMG gel electrode patches to EMG leads
   - Plug EMG leads into EMG stationhead matching red to red and green to green

4. Preparation of Supplies
   - Gauze squares (2x2 or 4x4) for prep, Cleansing Solution, K-Y Jelly, 14 or 16 French Red Rubber Catheters
   - Alcohol prep pad
   - Tape
   - Urodynamics Catheter
   - Rectal Catheter
   - Tri-cornered beaker
Preparation of the Patient

- Have patient empty bladder by performing a pre-instrumentation Uroflow study.
- Have patient undress and gown.
- Place patient on exam table or chair.
- Insert rectal catheter. Add 5-10 cc (follow manufacturer instructions) water into balloon. (Air should have already been purged from rectal catheter prior to insertion). Tape to leg or buttock.
- Clean perineum with cleansing solution.
- Catheterize patient utilizing the red rubber catheter or equivalent to obtain residual.
- Catheterize patient with Urodynamics catheter. Tape to meatus, labia or leg as appropriate.
- Attach pump tubing to fill port on Urodynamics catheter.
- Attach P1 tubing to other port on Urodynamics catheter and flush catheter from novadome to ensure that the system is a solid column of water and that the catheter is not against the bladder wall.
- Attach P2 tubing to rectal catheter port. If utilizing a stopcock, make sure it is open to the catheter after if has been connected.
- Clean and dry rectal perineum. Shave if necessary. Utilizing the alcohol prep pad will insure better adhesion. Do not use if skin is broken or irritated.
- Attach red EMG leads with gel patches already attached to perineum at the two and ten o’clock positions. Get as close to the anus as possible.
- Attach green EMG lead with gel patch already attached to leg or hip – near a bony prominence.
- Move patient into testing position, sitting or standing is the preferred position.

Preparation of Software

- Click info.
- Click patient info.
- Type in appropriate patient info.
- Click OK – This information will be attached to each test you perform on the patient and will link the test information to the dolphin database. Make sure to put a chart # in the MR# space.

Performing Urodynamics

1. Pre-instrumentation Uroflow
   - Place Uroflow transducer under funnel of commode chair or Uroflow stand
   - Place tri-cornered beaker on Uroflow transducer.
   - Click Uroflow bar on the top panel.
   - Click set zeroes bar.
   - If “auto start” is desired, click auto start bar.
   - Instruct patient to void, providing as much privacy as possible.
   - Click stop bar.
   - Click file.
   - Click save as.
   - Click save.
   - Click info.
   - Click Uroflow summary to add post void residual if desired.
   - Click OK.
   - Click File.
• Click Save As.
• Click Save.
• Replace existing? Click OK.
• Click print bar.
• Click Uroflow report bubble.
• Click OK.
• Select next test – generally CMG or Micturition.

2. Micturition
• Click on Micturition
• Set zeroes by turning stopcocks so that they are “off” to the patient and ensure that EMG is off.
• Click set zeroes bar. Zero “all” and then “exit”.
• Pves values should read between 15-45 depending on the size of the patient. (If the patient is grossly obese, the number may be somewhat higher).
• Have patient cough. Pves value should spike to over 100. **IF NOT:** flush the urethral catheter, being careful not to introduce any air, with 5-10 cc of sterile water.
• If the value still does not respond, check for air in the line and/or reposition the catheter until even spikes are detected on the Pves and Pabd channels with the patient coughing. If Pabd is significantly less than Pves, add 1-3 cc water to the rectal balloon via the stopcock of the measurement tubing, again avoid introducing air into the line. If Pabd is significantly stronger than Pves, remove fluid from the rectal balloon via the stopcock. **Re-cough patient to test pattern.**
• Click equalize bar, if available. The equalize bar will set Pabd=Pves and Pdet to zero.
• Click run and verify the cough patterns.
• Turn on the EMG. Adjust the gain. Generally the EMG value should read between 50 and 100 at rest and should spike to approximately 600 with coughing.
• Click start pump bar.
• Ask the patient to indicate when he/she has the first sensation of filling in his/her bladder.
• Click the first sensation bar when indicated.
• Ask the patient to indicate when he/she first has the urge to void.
• Click the first urge bar when indicated.
• Ask the patient to indicate when he/she can hold no more.
• Click max bar when indicated.
• When 200 cc has been infused into the bladder, click stop pump.
• Perform valsalva and cough stress maneuvers. Mark events as indicated.
• Click pump and rate of fill to restart pump. Continue to fill to capacity.
• Click stop pump when maximum capacity has been reached.
• Conduct valsalva and cough stress maneuvers if desired. Mark appropriate events.
• When finished with stress maneuvers, position the patient to void.
• If significant change in the level of the patient’s symphysis pubis with the level of the transducer occurs, the transducer level should be adjusted accordingly.
• After patient voids, click stop.
• Click file.
• Click save as.
• Click save. The test may be edited later.
References:


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Juliano, Kathy; “Stemming the Flow: A Clinical Update on Urinary Incontinence”, SUNA Chapter Meeting, Fort Worth, TX, July 22, 1999.
