Pediatric Urodynamics

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TREATING CHILDREN: minimally invasive approaches preferred; limit invasive urodynamic studies (UDS) to patients with neuropegenic bladder; noninvasive UDS includes uroflowmetry with or without patch electromyography (EMG); invasive UDS includes cystometrography with catheter, pressure studies, and EMG; less common invasive tests video UDS and needle EMG.

Initial Evaluation: obtain history, physical examination, and 3-day voiding and bowel diaries; use renal sonography to assess volume of bladder, postvoid residual (PVR), and thickness of bladder wall; on bladder scan, normal PVR <20 mL; PVR useful in patients on anticholinergics or α-blockers; assess hydrenephrosis and diameter of rectal ampulla.

Nonneurogenic Incontinence: look for labial adhesions and female epispidias; ectopic ureter characterized by incontinence and excreted, constantly moist perineum and visible on retrograde study; most children with nonneurogenic bladder dysfunction toilet trained, but subsequently present with lower urinary tract symptoms (LUTS); urgency, frequency, and incontinence manageable with behavioral or physical therapy; limit anticholinergic medication to children refractory to other treatments; drugs can cause constipation, begetting more incontinence; do UDS if patient unimproved; nonneurogenic wetting and overactive bladder (OAB) peak at 6 to 7 yr of age; self-limited, but distressing for families.

Radiologic Findings: signs of dysfunctional voiding thickened bladder wall, volume >70% of estimated capacity, and rectal diameter >3 cm.

Constipation: although abdominal films may show fecal retention, retention difficult to quantify, and films expose child to radiation; constipated children have wetting due to displacement of bladder by rectum; diameter of ampulla >3 cm indicates fecal impaction, Rome III diagnostic criteria for constipation important but not sufficient; children can classify their stools using pictures on Bristol Stool Form Scale; types 1 through 3 denote constipation.

Uroflowmetry: noninvasive and useful in patients who void spontaneously; flow pattern accurate if bladder contains >50% of estimated capacity; shape of curve reveals detrusor function, outlet resistance, or external sphincter dysfunction in patients with dysfunctional voiding; indications — daytime and nighttime LUTS unresponsive to timed voiding, recurrent nonfēbile urinary tract infection (UTI), thick-walled bladder, history of straining, and recurrent terminal hematuria; voiding patterns — bell-shaped curve normal; tower suggests OAB; staccato pattern means sphincter activity during voiding; interrupted curve implies underactive bladder; plateau means outlet obstruction; conclusions — uroflowmetry ideal for noninvasively assessing capacity and ability to empty; provides clues about bladder function and causes of incontinence.

Electromyography: use to assess activity of urethral sphincter during micturition or determine etiology of abnormal pattern of flow; distinguishes dysfunctional voiding from straining to empty; helps determine whether child can benefit from biofeedback (BFB); indications — staccato or interrupted pattern on initial flowmetry or incomplete emptying on initial flowmetry; interpretation — irregular, sawtooth flow curve with increased EMG activity indicates dysfunctional voiding; flat EMG curve means child straining to void; when child straining, use extra electrodes on lower abdominal wall to determine whether straining comes from abdominal wall or pelvic floor.

Diagnosis: voiding dysfunction refers to all wetting; dysfunctional voiding means dysfunction during voiding due to inadequate relaxation of external sphincter, which may indicate neurogenic bladder.

Invasive Urodynamics: use to assess cystometric capacity and compliance during storage; use rectal and bladder catheters; can distinguish detrusor pressure from bladder pressure; natural filling ideal but impractical; UDS positive in 63% of children with refractory incontinence.

Indications for Baseline and Periodic Urodynamics: anatomic — posterior urethral valves, anorectal malformations, bladder extrophy, and epispiadas; neurologic — myelodysplasia, occult spinal dysraphism, tethered cord, sacral agenesis, spastic diplegia and other CNS disorders such as cerebral palsy; functional — day and nighttime incontinence with or without recurrent UTI.

Meningomyelocele: children may have synergic voiding pattern, dysynergia, or complete denervation; with pressures >40 cm H₂O, detrusor sphincter dyssynergia (DSD) leads to reflux, hydronephrosis, and renal insufficiency; repeat UDS if change in pharmacotherapy, new onset of incontinence or hydronephrosis, recurrent symptomatic UTI, or change in orthopedic or neurologic examination.

Posterior Urethral Valves: often accompanied by detrusor overactivity and diminished bladder compliance; myogenic failure occurs as child grows, manifested by increased output of dilute urine and renal insufficiency.

Educational Objectives

The goals of this program are to improve diagnosis and treatment of incontinence. After hearing and assimilating this program, the clinician will be better able to:

1. Interpret urodynamic studies (UDS) in children.
2. Identify infants and children who are candidates for invasive or periodic UDS.
3. Manage a patient who is undergoing physical therapy for incontinence.
4. Develop a comprehensive physical therapy center for women with incontinence.
5. Select the best surgical procedure for a patient with stress urinary incontinence, based on historical and anatomic factors and comorbidities.

Faculty Disclosure

In adherence to ACCME Standards for Commercial Support, Audio-Digest requires all faculty and members of the planning committee to disclose relevant financial relationships within the past 12 months that might create any personal conflicts of interest. Any identified conflicts were resolved to ensure that this educational activity promotes quality in health care and not a proprietary business or commercial interest. For this program, the following has been disclosed: Dr. Rovner is an advisor or consultant for Amphora Discovery (subsidiary of Nanosyn) and Medtronic; is an advisor or consultant for and/or has received grant/research support from Johnson & Johnson and TARIS Biomedical; is an advisor, consultant, meeting participant, or lecturer for and/or has received grant/research support from Allergan, American Medical Systems (AMS), Astellas Pharma US, and Ferring Pharmaceuticals; has received grant/research support from Contura International A/S; and has an investment interest in NextMed. Dr. Homsy, Ms. Sasso, and the planning committee reported nothing to disclose.
Other malformations: anorectal — associated with spinal abnormalities, tethered cord, and neurogenic bladder; children have OAB with or without DSD; occult spinal dysraphism — one-third of infants have abnormal UDS, but as child ages and tethering of cord increases, abnormal UDS more likely; detrusor overactivity found in all age groups with occult tethered cord; on examination, look for sacral dimple, tuft of hair, bump, asymmetry of buttocks, or underdeveloped gluteal cleft; myelodysplasia — produces “Christmas tree” bladder; sacral agenesis — associated with OAB or underactive bladder and flattened buttocks; may have detrusor acontractility or OAB with or without DSD

Invasive urodynamics: performance — use sitting or supine position; difference between rectal and urethral catheters gives detrusor pressure; obtain PVR; place patch electrodes; assesses pelvic floor muscles (PFM) during filling and emptying; use warm infusion fluid and fill at rate of 5% to 10% of expected bladder capacity/min (=10 mL/min); child with neurogenic bladder has capacity 25% below normal; for catheterized children, use largest daytime volume; use 2 cycles of filling unless child has no sensation; fill until strong urge to urinate, child uncomfortable, voiding starts, pressure >40 cm H2O, or volume >150% of expected capacity; add video UDS if concerned about reflux or external sphincter; interpretation — increase in detrusor pressure of >15 cm H2O defines overactivity; volume >150% of expected capacity with low pressure means underactivity; normal compliance 10 to 20 cm H2O or 5% of child’s normal capacity; most patients with neurogenic bladder have low compliance

Behavioral Management of Urinary Incontinence

Karen Sasso, RN, Program Manager and Urogynecology Clinical Nurse Specialist, NorthShore University Health System, Evanston, IL

Treatments: pelvic floor therapy (PFT) — used to treat stress urinary incontinence (SUI), anal incontinence (AI), and urgency incontinence (UI); therapy increases muscle tone, strength, and urethral and rectal resistance, and helps inhibit inhibition; diet and fluids — over- and underhydration both problematic; decrease foods that irritate bladder; bladder retraining — restores normal voiding frequency and urine suppression

Evaluation: ask patient which symptom most bothersome; may begin with pharmacologic therapy and wean within 3 to 4 mo; slow twitch fibers support levators and maintain urethra; fast twitch fibers enable squeezing with sneeze or cough and urethral suppression; assess strength, duration, and tone of PFM; to grade strength, have patient contract for 10 sec, then relax for 10 sec, 3 to 4 times

Pelvic floor therapy: do 2 10-min sessions/day of 5-sec contractions and relaxations; “knack” maneuver (quick contraction of PFM) can decrease episodes of SUI; PFT can improve pelvic organ support in patients with mild prolapse

Other therapies: in addition to PFT, may add BFB, pelvic floor electrical stimulation (PFES), or vaginal cone therapy; BFB — trains patient to perform correct contraction of PFM; PFES — trains patient who cannot perform contraction; vaginal cones — use as first-line therapy or to maintain improvements achieved by PFT

Biofeedback: uses surface electrodes for accessory muscles, plus internal probe; patient tries to reach goal line on graph while contracting and relaxing

Electrical stimulation: stimulates levators, producing contraction; use frequency of 50 Hz to treat SUI and AI; use 5 to 12.5 Hz for OAB; treat twice daily for 3 mo

Vaginal cones: produce desire to contract; use during light activity while patient standing up; treat for 3 mo

Efficacy: PFT alone often successful; additional benefit of other therapies small; among patients with SUI who perform PFT, rate of continence 60% in patients seeing physical therapist weekly vs 17% in home exercisers; compliance low among patients not attending physical therapy

Bladder retraining: used for OAB, dysfunctional voiding, painful bladder syndrome, and frequency-urgency syndrome; patient learns urge inhibition; bladder inhibition techniques include distraction, Kegel exercise, and change of position; many patients achieve continence

Hydration: overhydration can cause urgency and frequency; dehydration can result in lower urine pH with more irritation and urgency; use color of urine to assess hydration

Diet: avoid irritants such as caffeine, alcohol, carbonation, citrus fruits, and arylalkylamines (chocolate, cheese, and older artificial sweeteners)

Nocturnal polyuria: increased proportion of 24-hr urine output occurs at night, in absence of OAB or diabetes insipidus; to diagnose, use diary and measure voids; limit intake of fluid and caffeine in evening; elevate lower extremities above heart in evening; patients on diuretics should take dose between 3 PM and 5 PM

Absorbent products: menstrual pads, panty liners, and toilet paper not recommended (irritate vulva); incontinence pads designed to wick urine away from vulva; supportive devices include tampons, pessaries, and compression devices; ensure patient able to empty bladder when using device; urethral patch and intraurethral plug not highly efficacious

Lifestyle changes: moderately obese patients who lose >5% of body weight may decrease SUI by 50%; nicotine irritates lining of bladder and smoking causes cough; preventing constipation decreases urgency

Behavioral therapy: inexpensive, noninvasive, and has no side effects, but requires time and motivated patient

Surgery for Stress Incontinence: An Overview

Eric S. Rovner, MD, Professor of Urology, Medical University of South Carolina, Charleston

Overview: presentation today refers to SUI due to sphincter dysfunction, not prolapse or other disorders; midurethral sling (MUS) now most common procedure for SUI; preferred procedures today MUS, retropubic (RP) suspension, fascial sling, and sometimes bulking agents

Guidelines: in 1997, American Urological Association stated slings and RP suspensions preferred over needle suspensions and anterior repairs; updated guideline states MUS, fascial sling, bladder neck sling, and injectables for SUI reasonably efficacious at 48 mo; cystoscopy recommended in all patients undergoing procedures for incontinence; if treating both incontinence and prolapse, place sling or adjust tension on it after repair of prolapse

Choosing procedure: depends on experience of surgeon and patient factors; operations not equivalent; patients have different comorbidities; one operation not appropriate for all patients because those with previous failed procedures or complications may require new approach; important patient factors include mobility of anterior vaginal wall and urethra, prolapse, body mass, urethral function, diverticula or fistula, radiotherapy, steroids, compromised immune function, diabetes, and other comorbidities

Procedures: synthetic MUS good choice for many patients, but for patients with urethral disease, fistula, diverticula, previous erosion or exposure, or wound-healing issues such as irreversible vaginal atrophy, use autologous fascial sling; if patient cannot assume lithotomy position or concomitant abdominal procedure performed, consider Burch procedure; for patients unfit for surgery or unwilling to have surgery, use Coaptite or other bulking agent; avoid mesh in patients reluctant to receive it

Choice of sling: procedures — choices transobturator (TOT), RP, or minisling; approaches — include inside-out, outside-in, up-down, or down-up; comparison — most trials suggest TOT and RP procedures equivalent when type I mesh used; in randomized trial of >600 patients, efficacy same in both groups; RP group had more retention and voiding dysfunction and TOT group had more thigh pain

Retropubic sling: advantages include familiar anatomy and rapid convalescence; good procedure for learning autologous fascial
Suggested Reading


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Take posttest 10 minutes

Sling: can use symphysis to guide trocar; risk for perforation of urethra and bladder higher than with TOT; risk for perforation of bowel and vascular structures with RP tape but not TOT

Transobturator tape: wide margin of safety and low risk for injury to bowel or bladder; good for patients with failure of Burch or Marshall-Marchetti-Krantz, in whom reentry into RP space increases risk for perforation of bladder; less obstruction and voiding dysfunction after TOT than after RP sling; however, anatomy unfamiliar, and TOT introduces risk for thigh pain

Minisling: minimally invasive with no risk for intestinal or vascular injury; recovery quick; long-term data lacking and data on efficacy mixed

Treatment algorithm: not supported by robust evidence; assumes that surgeon equally skilled at all approaches and that patient has no severe prolapse, normal bladder function, and no history of irradiation or fistula; 3 important factors in choice of surgery: urethral function as measured by maximal urethral closure pressure, mobility of urethra, and history of previous surgical failure or complication; urethral function — RP preferred in patients with intrinsic sphincter deficiency (ISD); TOT associated with higher failure rate than RP sling in studies measuring urethral function; some, but not all studies found RP superior; urethral mobility — RP preferred in patients with immobile urethra; TOT associated with higher failure rate in these patients; some, but not all studies found RP superior; recurrence — determine whether SUI recurrent; if mixed incontinence, determine whether stress component most bothersome; assess obstruction in patients with previous sling; obstruction and SUI can coexist; in patient with previous RP surgery and good urethral mobility and function, consider TOT; use autologous sling in patient with previous mesh complication
TOPICS IN INCONTINENCE

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1. Which of the following is a noninvasive urodynamic study?
   (A) Cystometrography with catheter  (C) Patch electromyography
   (B) Urethral closure pressure  (D) Video urodynamics

2. Children with nonneurogenic bladder dysfunction usually present with a complaint of:
   (A) Unsuccessful toilet training  (C) Urinary tract infection
   (B) Lower urinary tract symptoms  (D) Perineal excoriation

3. Preferred methods for diagnosing constipation in children with bladder dysfunction include:
   1. Abdominal film
   2. Bristol Stool Form Scale
   3. Uroflowmetry
   4. Ultrasonographic diameter of ampulla
   5. Electromyography
   6. Invasive urodynamic studies
      (A) 2,4  (B) 1,3,4  (C) 1,2,3  (D) 2,3,5,6

4. A tower-shaped pattern on uroflowmetry suggests:
   (A) Sphincter activity during voiding  (C) Outlet obstruction
   (B) Normal function  (D) Overactive bladder

5. Most children with refractory incontinence have abnormal urodynamic findings.
   (A) True  (B) False

6. Indications for baseline and periodic urodynamic testing include all the following, except:
   (A) Anorectal malformation  (B) Sacral agenesis
   (C) Labial adhesions  (D) Epispadias

7. The most successful mode of physical therapy for incontinence is:
   (A) Biofeedback  (B) Pelvic floor exercise therapy
   (C) Vaginal cones  (D) Pelvic floor electrical stimulation

8. A high proportion of 24-hr urine output occurring at night suggests a diagnosis of:
   (A) Overactive bladder  (C) Anal incontinence
   (B) Frequency-urgency syndrome  (D) Nocturnal polyuria

9. A single operation for stress urinary incontinence (SUI) is not appropriate for all patients primarily because:
   (A) Patients have different anatomic characteristics
   (B) Some patients have diabetes or other comorbidities
   (C) Some operations carry higher risks for visceral perforation
   (D) Some patients have previously failed a procedure for SUI

10. The most critical factors for the surgeon to consider when choosing a procedure for SUI include all the following, except:
    (A) Presence of diabetes and other comorbidities
    (B) Urethral function
    (C) Urethral mobility
    (D) Presence of recurrent SUI

Answers to Audio-Digest Urology Volume 36, Issue 23: 1-B, 2-B, 3-C, 4-D, 5-B, 6-A, 7-D, 8-A, 9-C, 10-A

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