AUA Update Series 2020
Lesson 12 Volume 39

Urinary Tract Infections and Bladder Bowel Dysfunction*

Learning Objective: At the conclusion of this continuing medical education activity, the participant will be able to identify the association between bladder bowel dysfunction and urinary tract infection, as well as describe the evaluation and treatment of these conditions.

Paul F. Austin, MD
Disclosures: Allergan: Consultant/Advisor; Urovant: Consultant/Advisor

and

Angela G. Mittal, MD
Disclosures: Nothing to disclose

Texas Children's Hospital
Baylor College of Medicine
Houston, Texas

***This AUA Update addresses the Core Curriculum topic of Pediatric Urology and the American Board of Urology Module on Neurogenic Bladder, Voiding Dysfunction, Female Urology, BPH and Urethral Stricture.**

This self-study continuing medical education activity is designed to provide urologists, Board candidates and/or residents affordable and convenient access to the most recent developments and techniques in urology.

Accreditation: The American Urological Association (AUA) is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

Credit Designation: The American Urological Association designates this enduring material for a maximum of 1.0 *AMA PRA Category 1 Credits*TM. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Other Learners: The AUA is not accredited to offer credit to participants who are not MDs or DOs. However, the AUA will issue documentation of participation that states that the activity was certified for AMA PRA Category 1 Credit™.

American Urological Association

Education and Research, Inc.
1000 Corporate Boulevard
Linthicum, MD 21090

Evidence-Based Content: It is the policy of the AUA to ensure that the content contained in this CME enduring material activity is valid, fair, balanced, scientifically rigorous, and free of commercial bias.

AUA Disclosure Policy: All persons in a position to control the content of an educational activity (i.e., activity planners, presenters, authors) provided by the AUA are required to disclose to the provider any relevant financial relationships with any commercial interest. The AUA must determine if the individual's relationships may influence the educational content and resolve any conflicts of interest prior to the commencement of the educational activity. The intent of this disclosure is not to prevent individuals with relevant financial relationships from participating, but rather to provide learners information with which they can make their own judgments.

Resolution of Identified Conflict of Interest: All disclosures will be reviewed by the program/course directors or editors for identification of conflicts of interest. Peer reviewers, working with the program directors and/or editors, will document the mechanism(s) for management and resolution of the conflict of interest and final approval of the activity will be documented prior to implementation. Any of the mechanisms below can/will be used to resolve conflict of interest:

- Peer review for valid, evidence-based content of all materials associated with an educational activity by the course/program director, editor and/or Education Conflict of Interest Review Committee or its subgroup.
- Limit content to evidence with no recommendations
- Introduction of a debate format with an unbiased moderator (point-counterpoint)
- Inclusion of moderated panel discussion
- Publication of a parallel or rebuttal article for an article that is felt to be biased
- Limit equipment representatives to providing logistics and operation support only in procedural demonstrations
- Divestiture of the relationship by faculty

Off-label or Unapproved Use of Drugs or Devices: The audience is advised that this continuing medical education activity may contain reference(s) to off-label or unapproved uses of drugs or devices. Please consult the prescribing information for full disclosure of approved uses.

Disclaimer: The opinions and recommendations expressed by faculty, authors and other experts whose input is included in this program are their own and do not necessarily represent the viewpoint of the AUA.

Release date: April 2020

Expiration date: April 2023

Key Words: urinary tract infections, pediatrics, urinary bladder, lower urinary tract symptoms, intestinal diseases

INTRODUCTION AND SIGNIFICANCE

Pediatric urinary tract infections account for 8 million office visits and result in 1.8% of all pediatric hospitalizations.[1] Likewise, lower urinary tract dysfunction is common, resulting in up to 40% of pediatric urology clinic visits.[2] LUTD has been reported in 22% and bowel dysfunction in 30% of school-aged children.[3] **The relationship and frequency of bowel dysfunction and LUTD are well appreciated and together are known as bladder and bowel dysfunction.**[4] BBD is associated with numerous comorbidities including urinary tract infections as well as vesicoureteral reflux. The importance of identification and treatment of BBD is highlighted by several guideline reports and large clinical trials that show poor outcomes with suboptimal management in children with recurrent UTIs and/or vesicoureteral reflux.[5-8] In this AUA Update we focus on UTIs as they relate to BBD and exclude those associated with abnormal genitourinary anatomy or neurogenic bladder.

PATHOPHYSIOLOGY

BBD commonly occurs because the bladder and bowel share the same neural and muscular regulatory controls. Therefore, when children have LUTD they will often have bowel dysfunction. BBD is a broad term but one of the dominant features frequently encountered in children is incomplete or inefficient emptying of the bladder and/or rectum. **The stasis of urine and stool associated with incomplete bladder emptying, functional constipation and infrequent bladder emptying are all factors that increase the risk of UTIs in children.**[9,10]

Bacterial colonization of the urogenital skin originates from the rectum and gastrointestinal tract, which may then ascend into the bladder. Urinary stasis from LUTD allows the bacteria to proliferate within the urine analogous of the laboratory setting of broth media used to culture and propagate bacteria. Finally, bacterial proliferation results in a UTI (fig. 1).

The prevalence of BBD in the pediatric population is believed to be either a maturational delay in the coordination of the physiological storage and emptying mechanisms or represents a learned behavior. Children may ignore the urge to void, which increases the amount of urine stored in the bladder. When the bladder is at or above capacity, episodes of urge incontinence or a sense of urgency occurs which is the hallmark symptom of an overactive bladder. Some children may also void enough to no longer feel the urge to void or void quickly and stop the stream before the bladder is completely empty. These behaviors are heralds of voiding dysfunction and will increase the risk of UTIs.

This tonic pelvic floor muscular contraction leads to incomplete emptying of the bladder as well as constipation. Constipation results in rectal distention, which may decrease bladder storage capacity, promote OAB and possibly cause symptoms of bladder neck obstruction. Constipation increases the presence of pathogenic bacteria in the gastrointestinal tract, which will increase the risk of UTIs.[11] **When treating a child with recurrent UTIs, it is essential to obtain a thorough elimination history to elicit any BBD in order to comprehensively treat the current UTI and prevent further recurrence.**

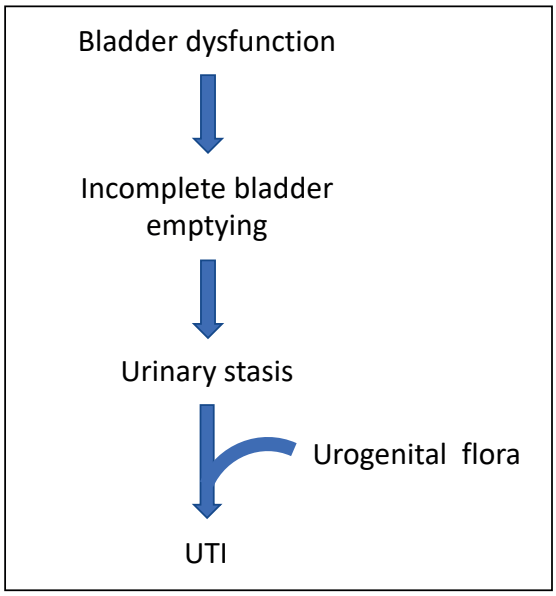

Figure 1. Pathogenesis of UTI with bladder dysfunction.

EVALUATION OF THE CHILD WITH UTI AND BBD

The clinical manifestation of UTIs in infants and toddlers is generally different than in older children who are toilet trained. Infants and toddlers will generally have high fevers compared to older toilet trained children who will often have afebrile UTIs.[12] Additionally, infants and non-toilet trained children will more commonly have a genitourinary anomaly. A standardized protocol or algorithm should be adhered to when evaluating pediatric patients suspected of having BBD (fig. 2).[4]

A detailed elimination history is key to uncovering the presence of BBD in toilet trained children who present with a urinary tract infection. The frequency of voiding and stooling will identify any holding behaviors. It is important to ask about the patterns of emptying not only at home, but also at school. The elimination history can often be quite different in different settings. A variety of symptoms are noted in the history, and common symptoms of BBD are listed in Appendix 1.

Initially, the true presence of a UTI should be established.

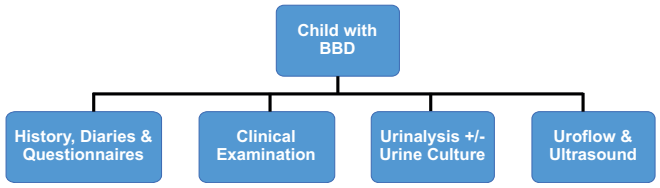

Figure 2. Standardized evaluation of BBD.

ABBREVIATIONS: BBD (bladder and bowel dysfunction), LUTD (lower urinary tract dysfunction), OAB (overactive bladder), PVR (post-void residual), UTI (urinary tract infection)

The method of urine collection, presence of symptoms during the UTI and lab results should be reviewed to establish the presence of an infection. Frequently this information has to be obtained from the pediatrician, emergency room or urgent care facility where the child was seen during the episode(s) of the UTI. Following this documentation, a complete evaluation of the child with a history of UTI should be conducted. A complete prenatal and birth history, including results of prenatal ultrasounds, and any complications during and after pregnancy should be elicited to identify any congenital anomalies that would increase the risk of UTI. The gestational age of the child at birth and if the child required specialized care during the perinatal period, including imaging and intensive care unit requirements, are important to include in the history as premature births are associated with delays in attaining developmental milestones.

If and when the child was toilet trained in relation to the timing of UTIs is important as it may reflect developmental delay with prolonged maturation of the lower urinary tract regulatory mechanisms resulting in inefficient bladder emptying, urinary stasis and increased risk for UTI. BBD may start in young children any time after being toilet trained. Because UTIs in children who are not toilet trained are more likely to have an anatomic cause, BBD is lower on the differential diagnosis scale. **A thorough voiding history should include investigation for any urinary signs and symptoms of frequency, urgency and day or nighttime urinary incontinence.**

Children should be asked the number of voids per day, and the presence of frequency and urgency. It can be difficult to elicit a voiding pattern from the child if they routinely tend to hold the urine and ignore the desire to void. Questions like "Do you sometimes know you have to void but hold it because you are doing something else more fun (ie playing or watching TV)?" or "How often do you know you have to void and you wait a little longer?" can prompt a more accurate response. Inquiry of whether the child displays tactics to delay voiding such as crossing their legs or pinching their genitalia can unmask postural maneuvers used to counteract bladder and/or bowel spasms.[13]

Caregivers should be asked to corroborate based on the child's age as discordance of bladder and bowel emptying patterns between the caregiver and the child often emerges. Children with BBD may void infrequently and, therefore, have urgency when the bladder is at or over capacity. Frequency can result from incomplete bladder emptying and should not be assumed to be a physically small OAB. How much and what kind of liquids the child drinks daily are important as dehydration can contribute to constipation and UTIs. Usually going through a routine day using benchmarks such as bedtimes, mealtimes and after school, and asking when they void or what they drink helps a child go through a routine day and give you an idea of voiding and liquid intake. This is best established with a bladder bowel diary but for an initial visit when this information is not usually available, this part of the history can help decide if bladder dysfunction should be considered in the differential diagnosis. An elimination diary is particularly valuable for refractory or difficult to treat cases or those with a poor history of emptying patterns.

Questions regarding frequency of bowel movements, fecal incontinence and consistency of bowel movements assist in determining the possibility of dysfunctional defecation. Many times parents will not accurately be able to answer questions if they no longer assist the child in the restroom or if the primary caregiver is not available. Occasionally there is a suspicion that the child may be unable to provide a clear history given their age, maturity or developmental delay(s).

The Bristol stool scale is an easy tool for children to use to help them describe stool consistency.[14] The scale pictures are an effective way of engaging the child's input on stool consistency and thus, may help the child and caregiver better report the consistency and provide a more accurate barometer of bowel function in the setting of LUTD. Many children with BBD will not meet the strict Rome IV criteria for constipation, and the Bristol stool scale facilitates the identification of stool consistency that suggests stool holding (eg Bristol stool types 1 and 2) and subsequently bowel dysfunction. Although abdominal x-rays are often reported as tools to examine constipation, these are invariably inaccurate and, therefore, ultrasound showing rectal dilation may be a more sensitive predictor of constipation (fig. 3).[15-17]

Questions one might ask are "How many times a week do you have a bowel movement?" "Is it usually hard or soft in consistency?" "Is it hard sometimes to push out the bowel movement?" "Do you ever know you have to have a bowel

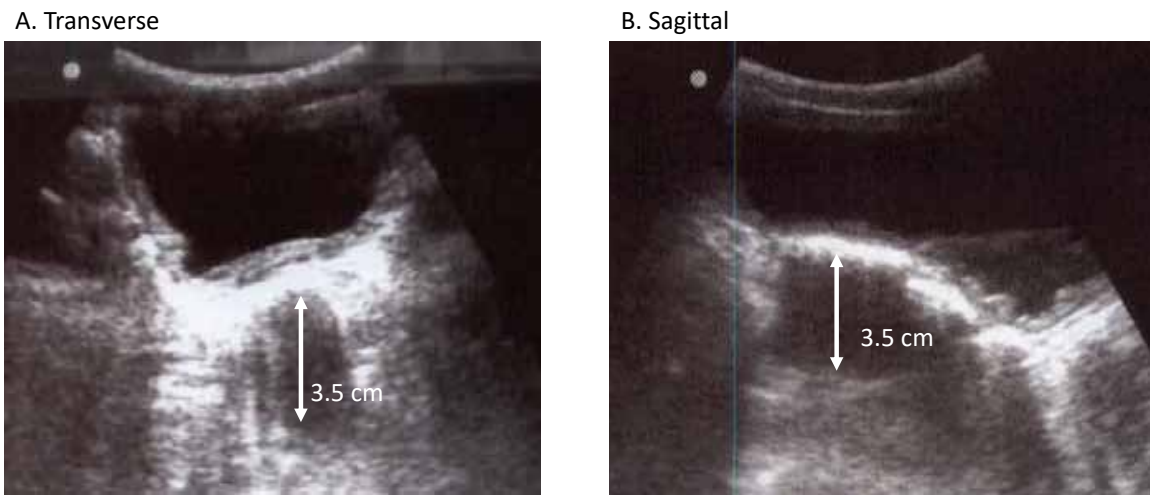

Figure 3. Pelvic ultrasound demonstrates rectal dilation with BBD.

movement but you hold it?" "If so, why?" This last question may reveal if a child is unwilling to use a public restroom, which for many may contribute to BBD.[9] **It is also important to question the patient and the family if there have been any psychological stressors that coincide with the timing of any BBD.** Life stressors, bullying or traumatic events in a child's life can be causative factors that trigger the sudden onset of BBD (Appendix 2).[18-20] Additionally, there is a strong association of neuropsychiatric comorbidities and BBD.[21-23] Approximately 10% to 25% of children with BBD signs and symptoms will have behavioral and psychological disorders.[22, 23] Exploration of concomitant behavioral or psychological issues should be explored as these may impact the outcomes of behavioral mediated treatment plans.

After a thorough history, a physical exam focusing on the genitalia should be performed. Anatomic abnormalities such as meatal anomalies, labial adhesions and vaginal voiding may contribute to dysfunctional voiding and may leave some prone to UTI.[24, 25] The abdominal exam helps to assess the fecal load. On perineal exam the presence of hemorrhoids, fissures or scarring can indicate hard stools or large stools as well as indications of sexual abuse. A digital rectal exam can assess sphincter tone and rectal stool burden. A neurological exam will help determine the presence of a neurological cause of bowel bladder dysfunction. A focused exam on the lower back, examining the sacrum and the lower extremities, can assist in identification of a possible neurological etiology for BBD.[26]

In addition to the Bristol stool scale and bladder bowel diary previously mentioned, kidney and bladder ultrasound can be performed to assess bladder wall thickness, bladder volumes, post-void residual and the upper tracts for pathology. Renal abnormalities may point to a cause of complicated UTI. Ultrasonographic imaging of the bladder and bowel may reveal signs of BBD with increased post-void residual, bladder wall thickness and/or rectal dilation.[15, 27] Uroflow and PVR evaluation are diagnostic studies that can be administered to toilet trained children. Abnormal uroflow with elevated PVR indicates lower urinary tract dysfunction. For children 4 to 6 years old, elevated PVR is >20 ml or 10% of bladder capacity and for children 7 to 12 years old, elevated PVR is 6% of bladder capacity.[28, 29]

More invasive studies such as voiding cystourethrogram or urodynamics are not routinely recommended for the evaluation of BBD. If vesicoureteral reflux is suspected along with BBD or there is an abnormality on renal ultrasound, a voiding cystourethrogram will be diagnostic and may also provide additional information on bladder contour and the "spinning top" urethra often seen in children with bladder dysfunction. Urodynamics give the most accurate information on bladder storage, compliance and detrusor function. Urodynamics are mainly used to diagnose neurological causes of bladder dysfunction and should not be used routinely in children with BBD.[4]

MANAGEMENT OF UTI AND BBD

Conservative treatment for bladder dysfunction is standard urotherapy and is the first line treatment option for all children.[4] Standard urotherapy consists of education of bladder dysfunction and its causes, instructions on behavioral modifications and improvement of voiding habits. Infrequent and incomplete bladder emptying causes stasis of urine, which increases the risk of UTI. Proper hydration dilutes urine, which then decreases the risk of pathogenic bacteria to colonize in the bladder and lead to UTI. Timed and double voiding can help with incomplete and more frequent emptying, which will decrease the risk of UTIs. Voiding with legs apart and in a sitting position with legs supported will help decrease pelvic floor muscle activity, leading to better emptying. Good hygiene for girls, wiping front to back, and pulling redundant foreskin back for boys may decrease the risk of UTIs. Voiding diaries including oral intake can help determine if the child is taking in enough fluid, although this needs to be adjusted for body surface area, climate and activity level.

For children who have recurrent UTIs with BBD, there can be a role to start prophylactic antibiotics to decrease the risk of infection while the conservative management is starting. When daily life and routines are being severely affected because of the frequency of UTIs and the severity of the BBD, daily prophylactic antibiotics may be a short-term treatment option until other treatment strategies are put into effect, including treatment of constipation.[30]

Biofeedback of the pelvic floor helps children better coordinate the pelvic floor and abdominal muscles with electromyography feedback to allow for better bladder emptying.[31] Biofeedback is a time-intensive therapy and is ideal for patients with dysfunctional voiding and simultaneous pelvic floor contraction during voiding. It consists of 6 weekly sessions that last an hour. Given the required time and effort by the family and the providers delivering the biofeedback, it is important to confirm the diagnosis of dysfunctional voiding prior to referring for this mode of therapy. It is also important to determine if the patient and family are motivated to comply with the treatment. In children with non-neurogenic, neurogenic bladder (severe BBD) clean intermittent catheterization is a treatment option once multiple therapies have failed. Clean intermittent catheterization will resolve urinary retention or elevated PVR and ultimately decrease UTIs by ensuring complete bladder emptying.

Medications are selectively chosen in the management of BBD and UTIs in children. Prophylactic antibiotics are selectively prescribed to help decrease the frequency of UTIs in patients with BBD. When a patient is starting to show signs of BBD improvement then the antibiotics can be discontinued to determine if they are still necessary. Alpha blockers are used off-label for primary bladder neck dysfunction and may help lower PVR, diminish urinary stasis and decrease incontinence.[8,32] Anticholinergics are commonly prescribed to children with OAB but are associated with an increased incidence of UTIs as they promote urinary storage. **Anticholinergics can help alleviate many of the symptoms of BBD but may not affect the frequency of UTIs and may even exacerbate the number of UTIs**. Anticholinergics have a well-established side effect of constipation, and so it is important to first treat constipation and continue to monitor bowel habits of children who take anticholinergics.

TREATMENT OF BOWEL DYSFUNCTION

Treatment of constipation will include an aggressive bowel regimen. If there is a significant fecal load and fecal impaction, it might be beneficial to start with laxatives to clean out the bowels and then start on a maintenance therapy with stool softeners or fiber supplements along with behavioral therapy to help with stool elimination.[30] Laxatives, such as bisacodyl or

magnesium citrate weight adjusted, can be given for the initial clean out. Occasionally larger amounts of stool softeners such as polyethylene glycol can also be used for initial clean out. At the end of a successful bowel clean out the stool output should be broth-like without any formed elements.

For maintenance therapy, a well-balanced diet with fiber intake and adequate fluid hydration is necessary. Stool softeners like polyethylene glycol or fiber supplements may be used selectively to promote daily soft bowel movements. Patients and caretakers should know the goal is a daily bowel movement, which is a type 3 on the Bristol stool scale. Until this goal is met, the maintenance regimen should be adjusted. Behavioral modifications include stooling daily, not avoiding stooling, and sitting on the toilet with legs apart and well supported to help with complete elimination of stool.

Children may avoid the bodily cues signaling the need to have a bowel movement, such as stomach discomfort, and may avoid fiber rich foods or not be well hydrated which will cause hard stools that are difficult to pass. Some children will avoid public restrooms, and this fear should be addressed and coping mechanisms offered to promote better toileting habits. Improvement in constipation will help reduce UTI by decreasing bacteriuria and enuresis.[8] If after 6 months of attempted bowel management constipation persists, referral to gastroenterology is warranted.

CONCLUSIONS

UTI is a common presentation of BBD in children. A thorough history, physical exam and voiding diary can lead to a proper diagnosis and treatment. Standard urotherapy and bowel treatment with behavioral modifications, bladder retraining and constipation management improve BBD and UTIs in the majority of patients. At follow-up it is important to assess if the patient is being compliant, and often repeat elimination diaries can be helpful in this assessment. Many patients will stop the behavioral therapy too soon or right after seeing some improvement and then return to old habits, causing symptoms of BBD to recur. Pharmacologic therapy can also be used selectively in patients when deemed appropriate. Following a standardized evaluation protocol and algorithm will maximize patient care success and patient/family satisfaction (fig. 4).

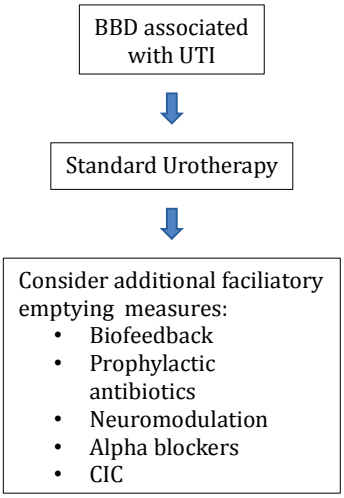

Figure 4. Algorithm of treatment approach for BBD and UTIs. *CIC*, clean intermittent catheterization.

DID YOU KNOW?

- Incomplete bladder emptying, functional constipation and infrequent bladder emptying are all factors that increase the risk of UTIs in children.
- BBD is a known risk factor for UTIs in children.
- Chronic constipation with rectal distention leads to smaller bladder capacity and bladder overactivity manifesting as frequency and urgency symptoms.
- First line therapy for BBD is conservative management with behavioral modifications, including constipation management, timed/double voiding, diary recording, proper hydration and proper positioning while voiding.

Appendix 1. BBD clinical signs and symptoms

LUTD	Bowel Dysfunction
Urgency	Abdominal/suprapubic pain
Frequency	Fecal straining
Dysuria	Stool infrequency
Genital pain	Bristol stool type 1 or 2
Urinary infrequency	Hematochezia
Intermittent incontinence	Encopresis

Appendix 2. Life stressors associated with BBD

Divorce
Birth of new sibling
Loss of family member
Home relocation
Change in school
Bullying
Sexual abuse

REFERENCES

1. Spencer JD, Schwaderer A, McHugh K et al: Pediatric urinary tract infections: an analysis of hospitalizations, charges, and costs in the USA. Pediatr Nephrol 2010; **25:** 2469.
2. Feldman AS and Bauer SB: Diagnosis and management of dysfunctional voiding. Curr Opin Pediatr 2006; **18:** 139.
3. Vaz GT, Vasconcelos MM, Oliveira EA et al: Prevalence of lower urinary tract symptoms in school-age children. Pediatr Nephrol 2012; **27:** 597.
4. Austin PF, Bauer SB, Bower W et al: The standardization of terminology of lower urinary tract function in children and adolescents: update report from the Standardization Committee of the International Children's Continence Society. Neurourol Urodyn 2016; **35:** 471.
5. Hoberman A, Greenfield SP, Mattoo TK et al: Antimicrobial prophylaxis for children with vesicoureteral reflux. N Engl J Med 2014; **370:** 2367.
6. Peters CA, Skoog SJ, Arant BS et al: Summary of the AUA Guideline on Management of Primary Vesicoureteral Reflux in Children. J Urol 2010; **184:** 1134.
7. Tekgül S, Riedmiller H, Hoebeke P et al: EAU Guidelines

on Vesicoureteral Reflux in Children. Eur Urol 2012; **62:** 534.
8. Yang S, Chua ME, Bauer S et al: Diagnosis and management of bladder bowel dysfunction in children with urinary tract infections: a position statement from the International Children's Continence Society. Pediatr Nephrol 2018; **33:** 2207.
9. Kistner M: Dysfunctional elimination behaviors and associated complications in school-age children. J Sch Nurs 2009; **25:** 108.
10. O'Regan S, Yazbeck S and Schick E: Constipation, bladder instability, urinary tract infection syndrome. Clin Nephrol 1985; **23:** 152.
11. Shaikh N, Hoberman A, Keren R et al: Recurrent urinary tract infections in children with bladder and bowel dysfunction. Pediatrics 2016; **137:** e20152982.
12. Arshad M and Seed PC: Urinary tract infections in the infant. Clin Perinatol 2015; **42:** 17.
13. Vincent SA: Postural control of urinary incontinence. The curtsy sign. Lancet 1966; **2:** 631.
14. Riegler G and Esposito I: Bristol scale stool form. A still valid help in medical practice and clinical research. Tech Coloproctol 2001; **5:** 163.
15. Hatori R, Tomomasa T, Ishige T et al: Fecal retention in childhood: evaluation on ultrasonography. Pediatr Int 2017; **59:** 462.
16. Joensson IM, Siggaard C, Rittig S et al: Transabdominal ultrasound of rectum as a diagnostic tool in childhood constipation. J Urol 2008; **179:** 1997.
17. Klijn AJ, Asselman M, Vijverberg MA et al: The diameter of the rectum on ultrasonography as a diagnostic tool for constipation in children with dysfunctional voiding. J Urol 2004; **172:** 1986.
18. Ching CB, Lee H, Mason MD et al: Bullying and lower urinary tract symptoms: why the pediatric urologist should care about school bullying. J Urol 2015; **193:** 650.
19. Martins G, Minuk J, Varghese A et al: Non-biological determinants of paediatric bladder bowel dysfunction: a pilot study. J Pediatr Urol 2016; **12:** 109.
20. Santos JD, Lopes RI and Koyle MA: Bladder and bowel dysfunction in children: an update on the diagnosis and treatment of a common, but underdiagnosed pediatric problem. Can Urol Assoc J, suppl., 2017; **11:** S64.
21. Grzeda MT, Heron J, von Gontard A et al: Effects of urinary incontinence on psychosocial outcomes in adolescence. Eur Child Adolesc Psychiatry 2017; **26:** 649.
22. Joinson C, Heron J and von Gontard A: Psychological problems in children with daytime wetting. Pediatrics 2006; **118:** 1985.
23. Joinson C, Heron J, Butler U et al: Psychological differences between children with and without soiling problems. Pediatrics 2006; **117:** 1575.
24. Dubrovsky AS, Foster BJ, Jednak R et al: Visibility of the urethral meatus and risk of urinary tract infections in uncircumcised boys. CMAJ 2012; **184:** E796.
25. Hoebeke P, Van Laecke E, Raes A et al: Anomalies of the external urethral meatus in girls with non-neurogenic bladder sphincter dysfunction. BJU Int 1999; **83:** 294.
26. Tuite GF, Thompson DNP, Austin PF et al: Evaluation and management of tethered cord syndrome in occult spinal dysraphism: recommendations from the International Children's Continence Society. Neurourol Urodyn 2018; **37:** 890.
27. Tangal S, Gokce MI, Ozayar A et al: Evaluation of a new ultrasound measurement tool for the diagnosis of dysfunctional voiding in pediatric population: full/empty bladder wall thickness ratio. Urology 2014; **83:** 1369.
28. Chang SJ, Chiang IN, Hsieh CH et al: Age- and gender-specific nomograms for single and dual post-void residual urine in healthy children. Neurourol Urodyn 2013; **32:** 1014.
29. Chang SJ, Tsai LP, Hsu CK et al: Elevated postvoid residual urine volume predicting recurrence of urinary tract infections in toilet-trained children. Pediatr Nephrol 2015; **30:** 1131.
30. Burgers RE, Mugie SM, Chase J et al: Management of functional constipation in children with lower urinary tract symptoms: report from the Standardization Committee of the International Children's Continence Society. J Urol 2013; **190:** 29.
31. Koenig JF and McKenna PH: Biofeedback therapy for dysfunctional voiding in children. Curr Urol Rep 2011; **12:** 144.
32. Chase J, Austin P, Hoebeke P et al: The management of dysfunctional voiding in children: a report from the Standardisation Committee of the International Children's Continence Society. J Urol 2010; **183:** 1296.

Study Questions Volume 39 Lesson 12

1. A 4-year-old girl has recurrent UTIs with symptoms of dysuria, suprapubic discomfort and daytime urinary incontinence only during a UTI. She always has urgency during the day and nightly nocturnal enuresis. She voids 3 to 4 times a day, and has 3 bowel movements a week that are Bristol stool scale 2. The next step is
   a. physical exam
   b. bladder diary
   c. uroflow and PVR
   d. renal bladder ultrasound

2. A 6-year-old boy has a 6-month history of urinary incontinence. He was toilet trained at age 3 years and was dry until 6 months ago when day and nighttime incontinence developed. He wets through his clothes 2 to 3 times a day requiring a change of clothes. He denies any symptoms of a UTI, and is otherwise healthy. He is quiet and does not want to answer any of your questions. His mother is not sure how often he is having bowel movement. His physical exam is normal. The next step is
   a. bladder diary
   b. uroflow and PVR
   c. renal bladder ultrasound
   d. obtain further history regarding any stressors or changes in the child's life

3. A 5-year-old girl has dysuria and daytime urinary incontinence. She completed toilet training at age 20 months. Based on history and a completed voiding diary, her elimination pattern is normal. Her mother states that during the last 3 months, however, she has noted that her underpants are damp which often occurs within a few minutes of the child having voided. She denies any urgency or frequency. Two urinalyses in the last 4 weeks demonstrated 5 to 10 white blood cells per high power field. Urine cultures have been negative. Physical examination reveals superficial labial adhesions with erythematous external genitalia. An empty bladder with normal wall thickness is seen on a pelvic ultrasound. A small amount of fluid is noted in the vagina. While the child climbs down off of the examining room table, involuntary leakage of urine occurs. Repeat pelvic ultrasound reveals that the vaginal vault is empty. The most likely diagnosis is
   a. vaginal reflux
   b. dysfunctional voiding
   c. vesicoureteral reflux
   d. urge urinary incontinence

4. A 7-year-old girl has had 4 non-febrile UTIs in the last year. Infections always present with dysuria, frequency and daytime incontinence. All episodes have been confirmed with urinalysis and midstream urine culture positive for Escherichia coli. Renal and bladder ultrasound is normal, except for fecal load in the rectum with rectal dilation. The next step is
   a. reassurance and watchful waiting
   b. voiding cystourethrogram
   c. biofeedback
   d. bladder retraining and constipation treatment with or without short-term antibiotic prophylaxis

5. A 7-year-old boy has recurrent afebrile UTIs for several months. The main symptoms of the infections are frequency and urgency with dysuria. Physical examination reveals physiological phimosis with erythema around the tip of the foreskin. An elimination diary demonstrates 5 voids per day and daily Bristol type1 bowel movements. The next step is
   a. renal ultrasound
   b. voiding cystourethrogram
   c. bladder retraining and management of constipation
   d. continuous antibiotic prophylaxis.

Take this test online and claim CME at http://university.auanet.org.