Voiding Disorders in Pediatrician's Practice

Magda Rakowska-Silska, Katarzyna Jobs, Aleksandra Paturej and Bolesław Kalicki

Department of Paediatrics, Paediatric Nephrology and Allergology, Military Institute of Medicine, Warsaw, Poland.

Clinical Medicine Insights: Pediatrics
Volume 14: 1–7

DOI: 10.1177/1179556520975035

SAGE

ABSTRACT: Voiding disorders result usually from functional disturbance. However, relevant organic diseases must be excluded prior to diagnosis of functional disorders. Additional tests, such as urinalysis or abdominal ultrasound are required. Further diagnostics is necessary in the presence of alarm symptoms, such as secondary nocturnal enuresis, weak or intermittent urine flow, systemic symptoms, glucosuria, proteinuria, leukocyturia, erythrocyturia, skin lesions in the lumbar region, altered sensations in the perineum. Functional micturition disorders were thoroughly described in 2006, and revised in 2015 by ICCS (International Children's Continence Society) and are divided into storage symptoms (increased and decreased voiding frequency, incontinence, urgency, nocturia), voiding symptoms hesitancy, straining, weak stream, intermittency, dysuria), and symptoms that cannot be assigned to any of the above groups (voiding postponement, holding maneuvers, feeling of incomplete emptying, urinary retention, post micturition dribble, spraying of the urinary stream). Functional voiding disorders are frequently associated with constipation. Bladder and bowel dysfunction (BBD) is diagnosed when lower urinary tract symptoms are accompanied by problems with defecation. Monosymptomatic enuresis is the most common voiding disorder encountered by pediatricians. It is diagnosed in children older than 5 years without any other lower urinary tract symptoms. Other types of voiding disorders such as: non-monosymptomatic enuresis, overactive and underactive bladder, voiding postponement, bladder outlet obstruction, stress or giggle incontinence, urethrovaginal reflux usually require specialized diagnostics and therapy. Treatment of all types of functional voiding disorders is based on non-pharmacological recommendations (urotherapy), and such education should be implemented by primary care pediatricians.

KEYWORDS: Lower urinary tract symptoms, overactive bladder, physicians, primary care, monosymptomatic enuresis

RECEIVED: July 1, 2020. **ACCEPTED:** October 22, 2020.

TYPE: Review

FUNDING: The author(s) disclosed receipt of the following financial support for the research, authorship, and/or publication of this article: This article is financed from the funds allocated to the implementation of the Military Institute of Medicine research project No. 487.

DECLARATION OF CONFLICTING INTERESTS: The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

CORRESPONDING AUTHOR: Magda Rakowska-Silska, Department of Paediatrics, Paediatric Nephrology and Allergology, Military Institute of Medicine, 128 Szaserów St., 04-141 Warsaw, Poland. Email: mrakowska@wim.mil.pl

Introduction

Voiding disorders are commonly encountered in pediatrician's practice. They most often result from functional disturbances caused by malfunctioning of the lower urinary tract or delayed maturation of the central nervous system.[1] Patient's examination should focus on excluding relevant organic diseases such as urinary tract malformations, recurrent urinary tract infections, neurological diseases and diabetes. ICCS (International Children's Continence Society) has published numerous guidelines for pediatricians, urologists and pediatric nephrologists in order to systemize the terminology and to direct the diagnosis and treatment of functional micturition disorders in children.

Aim

This study aimed to summarize the current state of knowledge about the most common voiding disorders in children, considering the anatomical background and recommended terminology. Particular attention was paid to the role of primary care physician or pediatrician in diagnosing and treating functional voiding disorders. Furthermore, specific situations that require further diagnostics, were emphasized.

Structure and Function of Lower Urinary Tract

Bladder is anatomically divided into fundus, body and neck. Fundus of the bladder is composed of smooth muscle fibers, which form the detrusor muscle. Its contraction results in a rapid reduction of bladder capacity and urine outflow, when sphincteric mechanism is relaxed. Beneath the detrusor muscle, within the bladder neck and urethra, located are smooth muscle fibers that form the internal sphincter of the urethra. The urethra is surrounded by striated fibers of the external urethral sphincter muscle. External urethral sphincter, together with pelvic floor muscles play a major role in storage of urine in the bladder.

Function of the lower urinary tract is regulated by the central nervous system (CNS). Regions that control voiding are found in the brain (frontal lobes, limbic system, thalamus, cerebellum, brainstem) and the spinal cord (sacral spinal nerves 2-4). CNS is responsible for both the conscious control of the urinary tract (somatic nervous system: cortico-spinal tract and pudendal reflex) and will-independent function of bladder and urethra (autonomic system: sympathetic and parasympathetic fibers). Both parts of the autonomic system are antagonistic to each other. Detrusor consists of mainly parasympathetic receptors, whereas the internal sphincter is comprised of sympathetic receptors. Stimulation of the parasympathetic cholinergic receptors results in contraction of detrusor muscle, whereas stimulation of the less abundant beta-adrenergic receptors causes its relaxation. Stimulation of numerous alpha-adrenergic receptors in bladder neck and urethra results in constriction of the internal sphincter and urine retention (Figure 1).

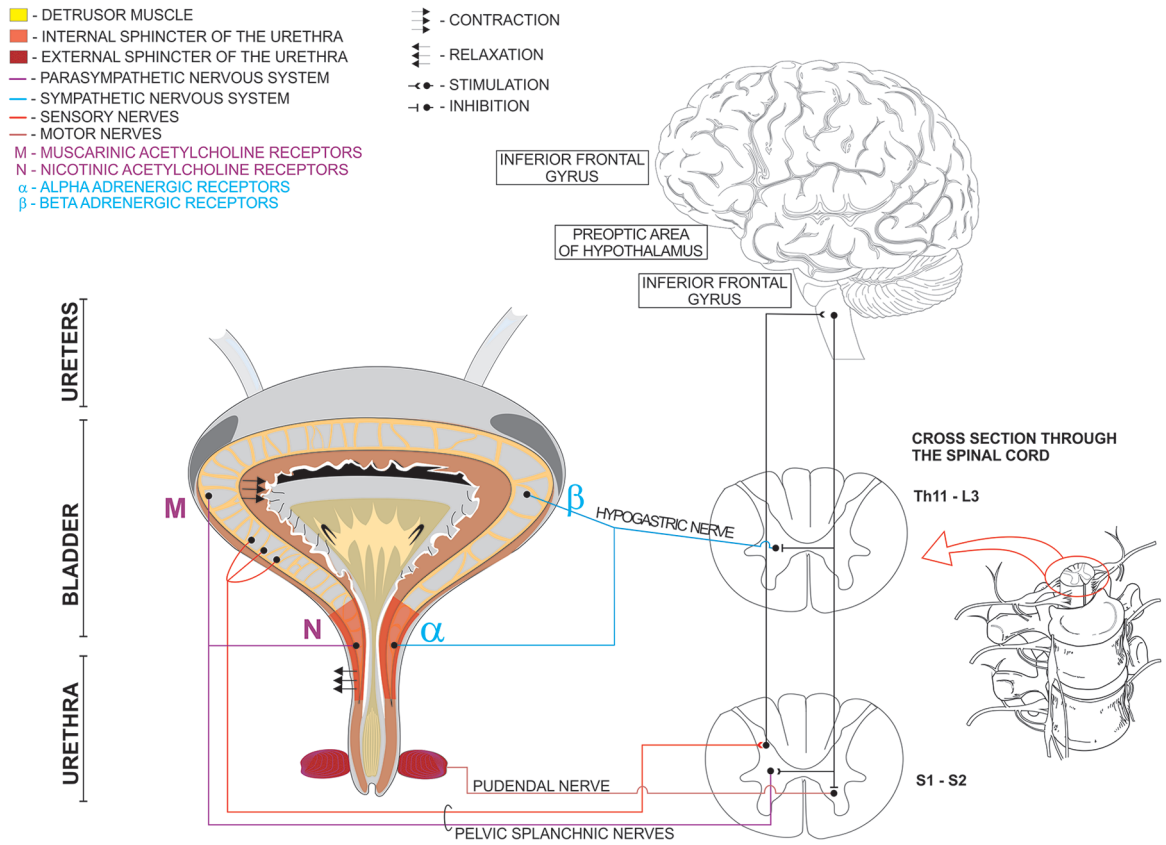

Figure 1. Stimulation of the parasympathetic cholinergic receptors results in urine accumulation in the bladder, and stimulation of alpha and beta adrenergic receptors of the sympathetic nervous system is responsible for emptying of urinary bladder.

Afferent fibers that innervate bladder and urethra, travel mainly through the hypogastric and pelvic nerves and provide information about the bladder filling to the CNS regions that control micturition. Accumulation phase is characterized by sympathetic system activity allowing urine collection in the bladder. Furthermore, any unplanned bladder emptying is hindered by the will-dependent somatic innervation of the external urethral sphincter and pelvic floor muscles. The conscious voiding act is controlled by the frontal lobe. When willing to urinate, a signal is transmitted from the frontal lobe to the micturition reflex arc in sacral spinal cord, causing stimulation of the parasympathetic system and contraction of detrusor.[2-4] Such complex innervation of the lower urinary tract allows for urine accumulation and conscious control of the voiding act.

Development of the Lower Urinary Tract

Maturation of the nervous and urinary system occurs gradually as the child develops. Micturition occurs involuntarily in infants, as a spinal autonomic reflex, as the cerebral cortex is not yet involved.[3] Conscious control over voiding is gained as child grows. At the age of 3 years, a child should be able to control the micturition reflex and urinate at a convenient time and place.[5] Most voiding disorders can be diagnosed once the child reaches the age of 5, as this age is the deadline for a healthy child to achieve full control over voiding during the day and night. Bladder volume increases with age. Normal expected bladder capacity (EBC) can be calculated according to the formula[6]:

$$EBC = (\text{age in years} + 1) \times 30$$

EBC - expected bladder capacity

For children aged older than 12 years, EBC is assumed to be 390 mL. Normal daytime voided volumes are usually 65% to 150% of expected bladder capacity.[7,8]

Terminology

In 2006, ICCS published guidelines on the terminology of voiding disorders in children. Unambiguous terminology should be used when taking care of a patient with functional micturition disorders, in order to facilitate communication between centers and to standardize diagnostic and therapeutic procedures.[9,10]

The following is a brief description of individual lower urinary tract symptoms (LUTS) in children. Some symptoms are characteristic for functional micturition disorders.[11] Other symptoms may suggest involvement of organic diseases. The rest of the article describes the most common types of voiding disorders, their clinical picture, diagnostics and treatment.

Storage symptoms

1. Increased or decreased voiding frequency. A child who achieved bladder control should void 3 to 7 times a day. Fluid intake should also be considered.
2. Incontinence manifests itself as unintentional passing of urine through the urethra and can be divided into continuous and intermittent incontinence. Urinary tract defects and neurological disorders must be excluded in patients with continuous incontinence. Continuous incontinence can be diagnosed even in infants, as the child should remain dry between voids at this age. Intermittent urinary incontinence can occur during the day (daytime incontinence), night (nocturnal incontinence/enuresis).
3. Urgency manifests as a sudden, strong urge to urinate in patients who achieved bladder control. Nevertheless, child does not always signal the need to urinate and may perform holding maneuvers to maintain urine in the bladder.
4. Nocturia manifests itself as waking up in order to urinate. It often occurs in schoolchildren and should not necessarily be considered a disorder.

Voiding symptoms

1. Hesitancy is trouble in starting voiding. Most often, it manifests as a prolonged time from willing to void till urine passage
2. Straining. Micturition is supported by contraction of abdominal muscles.
3. Weak stream. This symptom may be observed already in infants.
4. Intermittency. During one micturition, urine is passed in several portions.
5. Dysuria. Pain, burning and discomfort when passing urine.

Other symptoms include

1. Holding maneuvers. Patient performs maneuvers in order to maintain urine in the bladder, such as squatting, clutching the perineum, leg crossing. These maneuvers mechanically increase the muscle tone of the external urethral sphincter, as well as stimulate beta-adrenergic receptors that relax the detrusor muscle. This symptom may suggest urinary urgency.[12]
2. Feeling of incomplete bladder emptying. It manifests itself as a need to urinate, shortly after micturition.
3. Urinary retention is defined as inability to urinate despite full bladder
4. Post micturition dribble. This symptom usually occurs in girls due to vaginal reflux.

Table 1. Alarm symptoms in child voiding disorders.

1. Secondary nocturnal enuresis (after a 6-month "dry" period)
2. Weak urine flow, intermittent miction, straining to void—anatomical and neurological causes should be excluded
3. Systemic symptoms, such as weight loss, nausea, excessive thirst—chronic kidney disease, diabetes should be excluded
4. Glucosuria, proteinuria, leukocyturia, erytrocyturia
5. Skin changes in the lumbar region, sensory disturbances in the perineum

5. Spraying (splitting) of the urinary stream. Urine is passed in split stream, which may indicate anatomical abnormalities of the urethra.

Bladder and bowel dysfunction

Relationship between the urinary tract and the gastrointestinal tract is stressed in the pathophysiology of lower urinary tract symptoms. Functional voiding disorders often coincide with constipation and/or stool incontinence. Bladder and bowel dysfunction may be recognized in children who have achieved toilet training.[13]

Diagnosis

According to clinical manifestation a specific type of functional voiding disorders may be suspected. However, all relevant organic causes should be excluded prior to diagnosis of functional disturbances, therefore additional tests such as urinalysis and abdominal ultrasound should be performed.

Medical interview should include a detailed description of the complaints and should focus on their duration and frequency. Furthermore, age of obtaining bladder and bowel control, urinary tract infections, urinary tract defects, neurological and other chronic diseases, past injuries and operations, medications intake, co-occurring symptoms (such as constipation, fecal incontinence) should be considered. Physical examination should also include assessment of the perineum and urinary meatus, as well as the lumbar region. Abnormalities such as gluteal cleft anomalies, lipoma, abnormal hair, and congenital dermal sinus should alert the pediatrician.[2] Further diagnostics is compulsory once any of the alarm symptoms (Table 1) are present.

Most often, parents seek pediatrician's help due to enuresis or daily incontinence, sometimes other lower urinary tract symptoms. Given the reported symptoms, analysis of the voiding diary and alternatively uroflowmetry, a specific voiding disorder can usually be diagnosed.

The voiding diary is a 48-hour record of urinary output and fluid intake. Voiding diary allows to analyze number of mictions and daily diuresis. Furthermore, volume of each miction

Table 2. Pathomechanism of monosymptomatic nocturnal enuresis.

NIGHT POLYURIA	DETRUSOR OVERACTIVITY
Reduced secretion of vasopressin at night, causing increased diuresis during sleep.	Uncontrolled excessive contractions of the detrusor at night, leading to involuntary urination.
Usually one incident at night	Usually several incidents at night

and nocturnal diuresis should be assessed.[1,8] Nocturnal diuresis, defined as first morning urine plus night micturition (eg, diapers weight if night incontinence occurs), should be smaller than 130% expected bladder capacity.[14]

Uroflowmetry is a non-invasive test which evaluates voiding in near-natural conditions. The flow curve is a product of detrusor contraction strength and bladder outlet resistance. A normal non-obstructed flow curve is bell-shaped. Abnormal curves are plateau-shaped, tower-shaped, interrupted-shaped, staccato-shaped. Staccato curve is typical for dysfunctional voiding. Tower- shaped curve suggests overactive bladder, whereas a plateau-shaped curve indicates anatomical obstruction or insufficient sphincter relaxation. Uroflowmetry allows to assess parameters of urinary flow such as maximum and average flow rate. Normograms of these parameters exist for various age groups and both sexes. During urowflometry post-voiding residual urine should also be assessed using ultrasound.[9,15]

Types of Functional Voiding Disorders in Children

In order to simplify, voiding disorders were divided into those, where nocturnal enuresis is the predominant problem and those with daytime incontinence.

Enuresis

Enuresis may be primary or secondary, and monosymptomatic or non-monosymptomatic.

Primary enuresis is defined as a lack of a 6-month dry period in a child older than 5 years. If enuresis occurs after a 6-month dry period in a child older than 5 years, secondary enuresis is diagnosed. Secondary nocturnal enuresis is mostly of functional origin. However, it is associated with higher incidence of congenital defects and urinary tract diseases, than primary enuresis.[16]

Monosymptomatic enuresis (MNE) is diagnosed in children older than 5 years, with no other lower urinary tract symptoms. These patients constitute about 80% of bedwetting children. A total of 10% of children at the age of 7 years are affected by this problem.[1]

Although psychological and/or psychiatric problems coincide with MNE, nowadays it is emphasized that enuresis more often causes psychological problems through low self-esteem.[17]

Two pathomechanisms of MNE are distinguished (Table 2).

Nocturnal polyuria is diagnosed if nocturnal diuresis is greater than 130% of EBC.[14]

If MNE is suspected and no alarm symptoms are present, it is usually sufficient to perform a urinalysis, abdominal ultrasound, bowel habit assessment and voiding diary analysis.

Management: the basis of treatment is the use of urotherapy, the principles of which are described later in the article. Some patients respond well to treatment of constipation. A regularly filled bedwetting calendar should be used in order to assess the effectiveness of the above treatment. Bedwetting calendar includes information about the number of wet nights, fecal incontinence, constipation. If no improvement is noted after maximum 3 months of compliance to non-pharmacological recommendations, then bedwetting alarm or desmopressin treatment should be started.[16] Nevertheless, urotherapy should be continued throughout the entire period of treating voiding disorders.[1]

The bedwetting alarm is intended to prevent involuntary voiding at night. Alarm starts ringing once the device detects the onset of voiding. The child must wake up and consciously urinate. Treatment with bedwetting alarm should be continued for 2 to 3 months. Therapy should be discontinued after obtaining 14 consecutive dry nights, and the effectiveness of the procedure should be assessed. The bedwetting alarm is more effective in patients with reduced bladder volume.[1,8,16]

If night polyuria is the cause of nocturnal enuresis, treatment with vasopressin analog—desmopressin should be started. Its strong anti-diuretic effect is due to increased water resorption in the renal tubules.[18] Desmopressin should be given 1 hour before bedtime and may be administered sublingually—120 mcg/day (maximum 240 mcg/day) or orally in the form of tablets 0.2 mg/day (maximum 0.4 mg/day). Dose may be increased to maximal if no improvement is noted. Treatment should be discontinued (by slowly reducing the dose) after 3 months of dry nights. Combined therapy using bedwetting alarm and desmopressin is considered in children without improvement after single therapy.[18]

Non-monosymptomatic enuresis (NMNE)—is diagnosed in patients older than 5 years who, in addition to nighttime incontinence, have other lower urinary tract symptoms, such as daytime incontinence, urgency, urinary frequency, small voided volumes. This type of enuresis is less common, but requires more specialized diagnostics to exclude disturbances in the function of the lower urinary tract or organic diseases.[1]

Management: Urotherapy is the basis of NMNE treatment. Treatment should focus on dissolving the daily symptoms, which are described later in the article. Etiology of NMNE is

varied, and therefore requires extensive diagnostics. Once organic diseases are excluded majority of NMNE may be treated by urotherapist or pediatrician.

Daily incontinence accompanied by other lower urinary tract symptoms

Overactive bladder (OAB)—urgency is the dominant symptom and its presence is compulsory to diagnose overactive bladder. Other complaints include daytime or nighttime incontinence, urinary frequency and nocturia. Small voiding volumes are recorded in the voiding diary. A tower-like shape flow curve can be observed in uroflowmetry.[9,15] Overactive bladder is most often a result of overactive detrusor muscle. However, detrusor overactivity can only be confirmed using a full urodynamic examination, while OAB is a symptomatic diagnosis.

Management: treatment of overactive bladder includes urotherapy and usually pharmacological treatment, mainly antimuscarinics. These inhibit the contraction of detrusor muscle by blocking cholinergic receptors. Mainly oxybutynin (0.3-0.6 mg/kg) and solifenacin (1.25-10 mg) are recommended in the pediatric population.[19] Side effects include constipation, mucosal dryness and visual disturbances, and these result from anticholinergic effect of drugs.[9] In 2012 the selective beta-3 agonists (mirabegron), where introduced in treatment of OAB in adults. Despite ongoing clinical trials therapy remains off label in children.[20,21]

Voiding postponement—Urinary incontinence is due to overfilling of bladder. The child often performs holding maneuvers to prevent incontinence. Micturitions are usually rare, often these patients reduce fluid intake to decrease urine output. Voiding postponement may coincide with mental disorders.[9] Diagnosis of this disorder requires careful observation of the child by caregivers.

Management: only urotherapy is used. Treatment aims to change child's habits, as well as achieve mictions in regular time intervals (timed voiding) and regular bowel movements. Management of constipation is described later in the article. Psychological care is often recommended.

Under-active bladder—mainly manifested by weak urine flow, strained micturition, and difficulties in initiation of voiding. Patients may report a feeling of incomplete voiding.[22] Uroflowmetry reveals a flattened or interrupted flow curve and post-void residual is detected using ultrasound.[9] Underactive bladder is usually a result of detrusor muscle insufficiency, which may be confirmed only with full urodynamic examination.[9]

Management: only urotherapy is used. Particularly emphasized is regular bladder emptying, sometimes double voiding is recommended (second micturition couple minutes after the first). In severe cases, where patients suffer from significant post-void residual volumes and recurrent urinary tract infections, intermittent catheterization may be considered.[23]

Dysfunctional voiding—manifests as habitual contractions of the external urethral sphincter and urogenital diaphragm during urination. The main symptoms include: feeling of incomplete bladder emptying, daytime incontinence, urinary leakage after voiding, and genital pain. Recurrent urinary tract infections may coincide with dysfunctional micturition.[20] Uroflowmetry reveals a stacatto-shaped curve.

Management: Standard urotherapy is recommended. If no improvement is noted, full urodynamic examination with electromyography of diaphragm muscles should be carried out and biofeedback therapy should be implemented. This treatment involves learning to consciously contract and relax pelvic floor muscles during urination.[13,24]

Bladder outlet obstruction—manifests as difficulties in initiation of voiding, feeling of incomplete emptying of the bladder, weak urine flow, urine leakage after voiding. In addition, patients often report urgency, urinary frequency, dysuria, nocturia, which are a result of secondary bladder overactivity.[25] The bladder obstruction can be anatomical or functional. Uroflowmetry reveals plateau- or interrupted-shaped curves with low amplitude.[9] Urodynamic examination shows pressure and flow curves typical for obstruction (high pressure/low flow).[15]

Management: urological intervention is usually necessary in the case of an anatomical obstruction. Once anatomical obstruction is resolved, urotherapy and pharmacological treatment is suggested. Alpha-blockers (usually doxazosin) are recommended, specifically in primary bladder neck dysfunction.[13,19]

Stress incontinence—manifests as urinary incontinence in situations associated with increased intra-abdominal pressure, such as coughing and sneezing. They should be differentiated from overactive bladder and voiding postponement.[9] It may be associated with benign joint hypermobility syndrome.[26]

Management: standard urotherapy or biofeedback therapy is used. If standard therapy fails laparoscopic colposuspension must be considered.[27]

Urethrovaginal reflux is a result of urine reflux in the vagina during voiding and is characterized by urine leakage within minutes after assuming upright posture. It is often a result of an anatomical defect (labial synechia), but may be due to incorrect position during urination and obesity (tightly apposed labia during voiding).[28]

Management: after excluding anatomical causes of urethrovaginal reflux, urotherapy is recommended, with particular emphasis on assuming correct body position during voiding.[29]

Giggle incontinence—manifests as incontinence during laughter. Bladder function remains normal in other situations. This disorder is probably due to stimulation of the micturition centers in the CNS during laughter.

Management: standard urotherapy or biofeedback therapy is recommended. As central nervous system is involved, use of methylfendidate should be considered.[30]

Table 3. Urotherapy recommendations for patients with voiding disorders.

1. Correct daily fluid intake (4-8 y: 1000-1400 mL; 9-13 y girls: 1200-2000 mL, boys 1400-2300 mL; 14-18 y girls: 1400-2500 mL, boys 2000-3000 mL)
2. Avoid fluid intake 2 h before bedtime and at night
3. Avoid carbonated, caffeine-rich drinks
4. Eat regular meals throughout the day
5. Diet with correct amount of protein and salt
6. Avoid constipation—if necessary, pharmacological treatment of constipation
7. Micturition at regular 2-3 h intervals
8. Avoid urine retention in the bladder. Nowadays, bladder training is not recommended (holding urine in the bladder in longer intervals in order to increase its volume)
9. Appropriate posture during urination—straightening the torso during micturition. The height of the toilet adapted to the child that enables proper support of the feet

Urotherapy

Treatment of all child's functional voiding disorders should start with educating and implementing non-pharmacological recommendations—standard urotherapy. This should be recommended and discussed in detail by a primary care pediatrician, while further diagnostics and therapy often takes place in specialist centers and its detailed discussion goes beyond the scope of the article.

The implementation of urotherapy aims to improve the functioning of the child's lower urinary tract, before undertaking more aggressive therapeutic methods. It is unacceptable to administer drugs without first attempting non-pharmacological treatment. Effectiveness of urotherapy is usually evaluated after 3 months.

Education of both caregiver and patient is crucial. The structure and function of the urinary tract should be explained in a manner and in language that is appropriate to child's age. Symptoms and their causes should be analyzed. Furthermore, doctor should reduce the child's feeling of guilt and shame. It is important to motivate both caregivers and the patient to follow the recommendations. Supportive attitudes should be promoted and any punishments must be avoided. The child can be rewarded and praised for dry nights, but cannot be criticized for wet nights. Parents should be instructed how to properly fill in the voiding diary and the enuresis calendar. Support and encouragement of the patient and caregiver via regular follow-up is an integral part of urotherapy.

Children must be educated to void regularly: every 3 hours and when feeling urge to urinate. Holding maneuvers must be avoided (if performed, child should urinate). Child should assume correct posture during voiding (feet should be resting on a flat surface, torso straightened). Fluid intake must be adequate for child's age, drinking 2 hours prior bedtime should be limited (Table 3). Caffeine, chocolate and citrus fruits consumption should be restricted. High-fiber diet with adequate intake of fruits and vegetables should be recommended in order to achieve regular bowel movements. In case of constipation initial therapy should be directed at evacuating the colon, either with high doses of polyethyleno glycol (PEG—initially 1-1.5 g/kg daily during first 3 days) or Enema per rectum. Laxative therapy with PEG should be continued for at least 2 months (0.25-0.5 g/kg daily).[31] A summary of the urotherapy recommendations is presented in Table 3.[7,9,10,12,21,32]

Summary

Every pediatrician will encounter children with voiding disorders. The main role of the primary care physician is to isolate a group of patients who may have an organic cause of the disorder and as a result may require urgent diagnostics and pharmacological or surgical intervention. In other cases, functional voiding disorders such as MNE, can usually be diagnosed and treated in primary care conditions. Urotherapy principles and possible origin of symptoms must be thoroughly discussed with the patient and caregiver. If no improvement is noted after 3 months, other therapeutic methods are recommended.

ORCID iD

Magda Rakowska-Silska https://orcid.org/0000-0003-3471-141X

REFERENCES

1. Kuwertz-Bröking E, Von Gontard A. Clinical management of nocturnal enuresis. *Pediatr Nephrol*. 2018; 33:1145-1154.
2. Dorsher PT, McIntosh PM. Neurogenic bladder. *Adv Urol*. Published online February 8, 2012. doi:10.1155/2012/816274
3. de Groat WC, Yoshimura N. Anatomy and physiology of lower urinary tract. *Handb Clin Neurol*. 2015;130:61-108.
4. Fowler CJ, Griffiths D, de Groat WC. The neural control of micturition. *Nat Rev Neurosci*. 2008;9:453-466.
5. Christophersen ER, VanScoyoc S. Toilet training and toileting problems: how do we advise parents. *AAP Sect Dev Behav Pediatr Newsl*. 2008;17:7-10.
6. Hjälmås K. Micturition in infants and children with normal lower urinary tract: a urodynamic study. *Scand J Urol Nephrol*. 1976;suppl 37:1-106.
7. Caldwell PHY, Lim M, Nankivell G. An interprofessional approach to managing children with treatment- resistant enuresis: an educational review. *Pediatr Nephrol*. 2018;33:1663-1670.
8. Caldwell PHY, Deshpande AV, Von Gontrad A. Management of noctural enuresis. *BMJ*. 2013;347:f6259.
9. 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: 471-481.
10. Neveus T, Von Gontard A, Hoebeke P, et al. The standardization of terminology of lower urinary tract function in children and adolescents: report from the standardization committee of the International Children's Continence Society. *J Urol*. 2006;176:314-324.
11. Linde JM, Nijman RJM, Trzpis M, Broens PMA. Prevalence of urinary incontinence and other lower urinary tract symptoms in children in the Netherlands. *J Pediatr Urol*. 2019;15:164e1-164e7.
12. Igawa Y, Aizawa N, Homma Y. Beta 3-adrenoceptor agonists: possible role in the treatment of overactive bladder. *Korean J Urol*. 2010;51: 811-818.
13. 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 Childern's Continence Society. *Pediatr Nephrol*. 2018;33: 2207-2219.
14. Nankivell G, Caldwell PHY. Paediatric urinary incontinecne. *Aust Prescr*. 2014;37:192-195.
15. Rakowska M, Jobs K, Paruszkiewicz G, Jung A. Interpretation of uroflowmetry in the paediatric population. *Pediatr Med Rodz*. 2017;13:40-52.

16. Sinha R, Raut S. Management of noctural enuresis – myths and facts. *World J Nephrol*. 2016;5:328-338.
17. Neveus T. Pathogenesis of enuresis: towards a new understanding. *Int J Urol*. 2017;24:174-182.
18. Neveus T, Eggert P, Evans J, et al. Evaluation of and treatment for monosymptomatic enuresis: a standardization document from the International Children's Continence Society. *J Urol*. 2010;183:441-447.
19. Chang SJ, Van Laecke E, Bauer SB, et al. Treatment of daytime urinary incontinence: a standardization document from the International Children's Continence Society. *Neurourol Urodyn*. 2017;36:43-50.
20. Blais AS, Nadeau G, Moore K, Genois L, Bolduc S. Prospective pilot study of mirabegron in pediatric patients with overactive bladder. *Eur Urol*. 2016; 70:9-13.
21. Fuentes M, Magalhães J, Barroso U Jr, et al. Diagnosis and management of bladder dysfunction in neurologically normal children. *Front Pediatr*. 2019;7:298.
22. Uren AD, Drake MJ. Definition and symptoms of underactive bladder. *Investig Clin Urol*. 2017;58:S61-S67.
23. Chase J, Austin P, Hoebeke P, McKenna P; International Children's Continence Society. The management of dysfunctional voiding in children: a report from the standardisation committee of the international children's continence society. 2010;183:1296-1302.
24. Duel BP. Biofeedback therapy and dysfunctional voiding in children. *Curr Urol Rep*. 2003;4:142-145.
25. Dmochowski RR. Bladder outlet obstruction: etiology and evaluation. *Rev Urol*. 2005;7:S3-S13.
26. Smith MD, Hussain M, Set JH, Kazkaz H, Panicker JN. Stress urinary incontinence as the presenting complaint of benign joint hypermobility syndrome. *JRSM Short Rep*. 2012;3:66.
27. Dean N, Ellis G, Herbison GP, Wilson D, Mashayekhi A. Laparoscopic colposuspension for urinary incontinence in women. *Cochrane Database Syst Rev*. 2017;7:CD002239.
28. Warade M, Majid Y, Dayananda L, Gupta K. Vesicovaginal reflux: a case report. *Indian J Radiol Imaging*. 2009;19:235-237.
29. Hoebeke P. Twenty years of urotherapy in children: what have we learn? *Eur Urol*. 2006;49:426-428.
30. Berry AK, Zderic S, Carr M. Methylphendidate for giggle incontinence. *J Urol*. 2009;182:2028-2032.
31. Jiles KA, Hamrick MC. Evaluation and management of pediatric constipation. *Curr Treat Options Pediatr*. 2017;3:69-76.
32. Tekgul S, Stein R, Bogaert G, et al. EAU-ESPU guidelines recommendations for daytime lower urinary tract conditions in children. *Eur J Pediatr*. 2020; 179:1069-1077.