Diagnostic Evaluation of Children With Daytime Incontinence

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Purpose: This article is one of the standardization documents of the International Children's Continence Society, and discusses how anatomical/iatrogenic and functional/urodynamic causes of daytime incontinence in children of all ages are to be diagnosed, how neurogenic bladder dysfunction or urinary tract infection is excluded as a cause of the wetting, and how further diagnostic evaluation of children with disturbances such as overactive bladder, voiding postponement and dysfunctional voiding is performed. The roles of history taking (including prenatal and perinatal issues and family history), physical examination, diagnostic bladder diaries, noninvasive urodynamic investigations and radiological imaging are delineated but therapy is not within the scope of this document.

Materials and Methods: This document was designed and written by an international panel of authors with a large experience in assessment of children with incontinence.

Results: The best evidence was retrieved from the literature and assembled in a standardization document.

Conclusions: Assessment of children with daytime symptoms is discussed. A noninvasive approach in these children allows us to select patients who will need a more invasive assessment.

Key Words: child, diurnal enuresis, ultrasonography, urinary incontinence, urodynamics

Abbreviations and Acronyms

LUT = lower urinary tract
Qave = average flow rate
Qmax = peak flow rate
US = ultrasound
VCUG = voiding cystourethrography

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DAYTIME urinary incontinence in children is a common condition. In contrast to the adult population, where incontinence is always considered a pathological condition, incontinence in children has to be evaluated within the context of patient developmental age and early urological history.

Assessment of children with lower urinary tract symptoms in general, and daytime incontinence in particular, should consist of a detailed and structured history (natal, developmental, urological and medical), a frequency/volume/wetting chart (voiding diary) and a thorough physical examination.[1] Urinalysis, uroflowmetry, uroflowmetry with pelvic floor electromyography, and pre-void and post-void bladder ultrasound can be added. After this screening patients who will benefit from further urodynamic and/or imaging studies can be selected. A flow chart is provided in the figure. Patients with other conditions, such as neurogenic bladder, structural anomalies of the lower urinary tract and urinary tract infections, should be identified after this screening.

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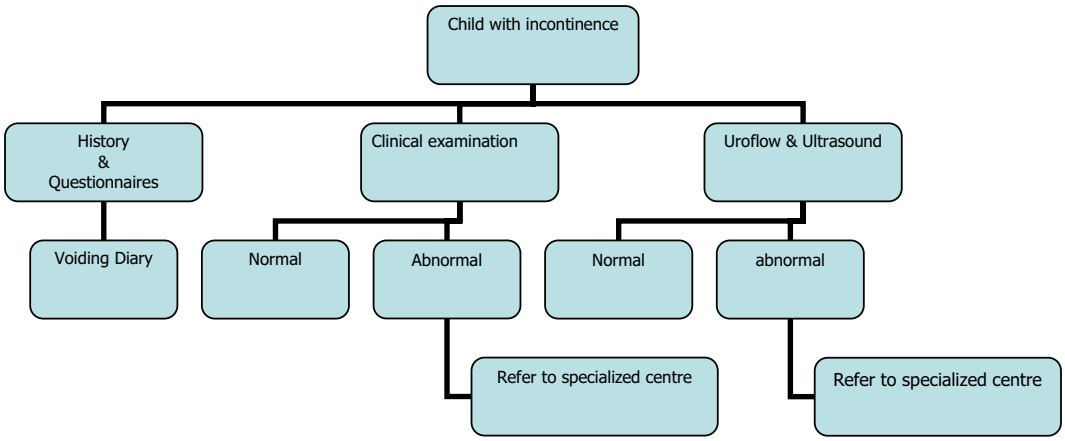

Algorithm for noninvasive assessment of child with daytime lower urinary tract symptoms

HISTORY

Medical History

Literature on this topic is sparse, with a few comments included in the standardization report of the International Children's Continence Society.[1] History taking in children with LUT dysfunction should be detailed and structured, and must be allotted enough time. When possible the history is obtained from the child. Patient information can be checked and completed with information provided by the parents.

Incontinence should be assessed following standardized criteria of the International Children's Continence Society. Clear distinction should be made between continuous and intermittent incontinence, and between urine loss when the child is asleep and awake.

Quantification of urine loss is subjective, and when necessary a pad test may help to make it more objective. However, there is no consensus in the literature regarding whether pad tests in children are reliable.[2,3]

Medical history should start with obstetric history regarding possible fetal distress, anoxia, birth trauma, prenatal hydronephrosis and oligohydramnios. Age appropriateness of developmental milestones should be evaluated. Information on toilet training and ages at which continence was achieved during the day and night can be useful to distinguish children at risk for LUT dysfunction. Voiding frequency, maximum voided volume, urine loss frequency, urge and reactions to urge should also be assessed. These data should be verified by the data obtained from the voiding chart.

Toileting behavior and subjective quantification of the urinary stream are important parameters. Is the urinary flow continuous or interrupted? Staccato voiding is difficult to distinguish by the patient, although fractionated voiding is well recognized. Does the child have to strain during voiding? How strong is the urinary stream?

Post-void dribbling, and wet buttocks and thighs in girls after each void can be signs of labial fusion, a deep positioned meatus or a hymen covering the meatus. Urge and reactions to urge should be assessed. Most parents will report that their child waits too long to go to the toilet. However, instead the bladder generally contracts too early. Parents must be informed that overactive bladder contractions can occur at any stage of bladder filling and that the urge disappears when the contractions stop. Children with an overactive bladder often squat during bladder contractions and deny any urge to void after the contraction has subsided. This mechanism should be explained to parents.

Previous urinary tract infections and relevant surgery should be elicited. Bowel function (obstipation, soiling) as well as menstrual and sexual function, if applicable, should be assessed. For evaluation of bowel function the Bristol stool scale is a useful tool in children.[4] Familial history, which often is positive in pediatric LUT dysfunction, should be included. General history taking includes questions relevant to neurological and congenital abnormalities. All diagnostic and therapeutic actions that have been performed before should be assessed.

Questionnaires and Scoring Systems

Scoring systems for pediatric incontinence are not popular among pediatric urologists, despite the fact that scoring systems in general provide a more standardized assessment of voiding pathologies. Since LUT dysfunction became recognized as a clinical entity affecting many children, 2 scoring systems have been published. The first scoring system, used by the International Reflux Study group, was described by van Gool et al.[5] This scoring system, which was developed to interpret data obtained from

the International Reflux Study, was not validated and did not constitute a true scoring system, but rather a diary of lower urinary tract symptoms. A more recently published scoring system devised by Akbal et al is based on this tool.[6] A second scoring system, from the Toronto group, was published in 2000.[7] It is a validated questionnaire consisting of 10 items with good sensitivity and specificity for diagnosing dysfunctional voiding. The same group published a study on the use of their scoring system to predict outcome of reflux after treatment of dysfunctional voiding.[8]

Practitioners who deal with children with LUT dysfunction on a daily basis often have the skills, learned through experience, to diagnose these conditions. For the less experienced a scoring system can indicate that LUT dysfunction might be present and that further investigations such as voiding diary and uroflowmetry are needed. In addition to facilitating diagnosis, a scoring system is a tool to measure LUT dysfunction during therapy allowing us to compare the effectiveness of different therapies and, thus, helping us to provide the best therapy to our patients, based on evidence.

It is recommended that questionnaires not be used as a single investigation. They should be combined with a more objective examination such as a repeat voiding diary or flow study. The available scoring systems have methodological flaws and further studies are needed.

FREQUENCY/VOLUME CHART OR VOIDING DIARY

The frequency/volume chart is a diary recording fluid intake and urine output during a 24-hour period. Episodes of urgency and urine loss should also be recorded. Urine loss is quantified by recording if clothing had to be changed after the urine loss (important urine loss) or not. The chart gives information about fluid intake, number of voids, voided volume and urine loss. It can be used for diagnostic and therapeutic purposes. For diagnostic purposes the chart should cover at least 3 days of registration.

A bowel movement chart is also important, either separate from or in conjunction with the voiding diary. In therapy it is important that the child take responsibility for filling out the chart, which enhances motivation and participation in training. Important information can de obtained from these charts, including voiding frequency, total voided volume in 24 hours, average voided volume, largest and smallest voided volume, distribution of urine volume through the day and night, urine loss and fluid intake.

CLINICAL EXAMINATION

In addition to a general pediatric examination focusing special attention on abdominal palpation to assess for bladder distention and fecal impaction, some neurological clinical examination can be done. The perineal region is supplied by the sacral segments S1 to S5, which also supply part of the bladder and the urethral sphincter. Neurologically perianal and perineal sensation and some reflexes (anal sphincter tone, anal reflex) can be tested in the perineal region in children, although they have a limited role.

Complete evaluation of the back should include assessing for bony misalignment and impaired ability to bend over at the waist (suggesting tethered cord). Special attention should be given to identifying cutaneous manifestations of an underlying occult spinal dysraphism (deep sacral dimple, lipoma, vascular skin discoloration, hair tuft).[9] Examination of the lower extremities can reveal lesions compatible with neurogenic diseases affecting the spinal cord. Muscle atrophy, foot deformities, foot drop, any asymmetry of the buttocks or the lower extremities, or any disturbance of gait must draw attention to the possibility of an underlying neuropathological condition. Genital examination should also be done, consisting of inspection of the introitus in girls with special attention to the position of the urethral meatus and appearance of the hymen, and inspection of the penis in boys.

ULTRASOUND

All children with proved LUT dysfunction should undergo a screening US, which should be performed with the bladder full/before voiding and after voiding. Pre-void views also contribute to overall assessment of the bladder wall, lower ureteral dilatation and bladder neck appearance. Furthermore, ultrasound of the bladder can indicate if the bladder is sufficiently full to allow a normal void.

Evaluation of the bladder after voiding can demonstrate residual urine. To be reliable, the post-void US should be done immediately after voiding. A residual amount of more than 10% of expected bladder capacity for age (in ml) is considered significant. Bladder wall thickness can be measured with a full and empty bladder. However, normal values are not available. Bladder wall thickness depends on degree of bladder filling. Some authors have tried to correlate bladder wall thickness with LUT dysfunction, with good specificity.[10] In daily clinical practice a thickened bladder wall alerts the clinician to long-standing problems with urine storage and emptying.

US can detect structural anomalies of the urinary tract and internal genital structures. Upper tract dilatation, which can signify increased bladder storage pressures, vesicoureteral reflux or obstruction at

the ureterovesical or ureteropelvic junction, can be detected.

Finally US of the bladder gives additional information on the presence and severity of constipation. An impression of the bladder base and a rectal width of more than 30 mm in the absence of the urge to pass stools is a strong signal for constipation as a comorbidity. Advanced dynamic ultrasound can also give information on the ability to contract and relax the pelvic floor at will. Many children with LUT symptoms are unable to perform this maneuver. However, this evaluation is not part of the standard assessment for children presenting with LUT symptoms.[11,12]

URINALYSIS

Urinalysis may provide information that could be missed by the clinical assessment. It can help to rule out urinary tract infections, diabetes and kidney damage/disease causing proteinuria. Asymptomatic bacteriuria is sometimes observed in the wet child. Infection can be the consequence of dysfunctional voiding, especially when the bladder is not emptied completely or regularly. Since the sequelae of infection include epithelial inflammation, recurrent infection can be the origin of some irritative bladder symptoms and altered bladder habits. In a child with extraordinary urinary frequency or general irritative symptoms it may be useful to evaluate urine pH and calcium levels.[13]

UROFLOW

Uroflow studies consist of measurement of urine flow during voiding and are described in terms of volume voided, post-void residual, rate and pattern. Uroflowmetry is the least invasive of all urodynamic methods and, therefore, is perfect for pediatric use.[14] It measures the urinary stream during the emptying phase of voiding, gives an idea about bladder function and outlet function, and quantifies the volume of fluid expelled through the urethra per unit of time. Qmax refers to peak or maximal flow rate (ml per second) and Qave reflects average flow per unit of time. As a rule, Qave is usually more than 50% but less that 85% of the Qmax value.

It has been shown that uroflow curves change when the voided volume is less than 50% of expected bladder capacity for age.[15] Uroflowmetry is the perfect instrument for revealing voiding disorders in children.[16] It is also the perfect tool for followup of bladder training and biofeedback training in dysfunctional voiding.[17–19] Especially when combined with pelvic floor electromyography the information obtained is even more accurate.

The normal urinary flow curve of a healthy child is bell shaped regardless of gender, age and voided volume. The shape of the flow curve is the most important factor to analyze when evaluating the flow curve of a child.[1] For instance in case of a static anatomical obstruction the obtained curve is often continuous but the flow parameters will be lower than normal and the flow curve will be extended in time. Fixed urethral obstruction, as seen in urethral strictures, tends to be restrictive in pattern with Qmax and Qave approaching one another. A dynamic obstruction, as occurs with abnormal sphincter activity (internal or external sphincter), will interrupt the continuous flow pattern and/or cause the bell shape to disappear at the point Qmax occurs, which is normally during the first half of voiding (but not immediately at the start). As defined by standardized terminology, a staccato flow curve and interrupted flow curve can be distinguished from each other.[1] However, the true cause behind that particular abnormal pattern is better appreciated when simultaneous pelvic floor electromyography is being conducted.

Qmax is of greater importance in adult urology. In pediatric urology there often is a poor correlation between Qmax and outflow resistance, because an increase in outflow resistance can be compensated for by a strong detrusor contraction, resulting in a relatively normal Qmax.[20] Pressure flow studies could be more adequate in this regard, although nomograms for children are not available.

It is important to obtain more than 1 curve before drawing conclusions, and 3 curves are advised.[1] A child must be toilet trained before he or she can void on the flowmeter. Specific adaptations for children are needed so that they can void in a relaxed position that is normal for them. Other adaptations include a smaller (size appropriate), softer potty seat and, if needed, a stool either to stand on or to rest the feet on. The child should be allowed to become accustomed to the place (ideally warm, child friendly, safe/nonthreatening and private) where the flowmeter is installed. With younger children it sometimes helps to let the mother stay during voiding. When the child is distracted during voiding it may affect the shape of the curve, as will voiding in/out of the flow commode, trying to keep the flow from overshooting the flowmeter and trying to reduce the sound made by urine. Every attempt should be made to measure the post-void residual within a minute of voiding, preferably with real-time ultrasound.

After this noninvasive screening it is possible to select patients who will benefit from further urodynamic investigation. A full urodynamic evaluation, including video fluoroscopy when available, should be administered in children presenting with a thickened bladder wall on ultrasound with depressed flow patterns suggesting obstruction, dilated lower ureters suggesting reflux or increased storage pres-

sures, suspected bladder neck dysfunction, failure of empirical therapy, a neurological history (ie cerebral palsy) or anatomical problems (eg posterior urethral valve).

VOIDING CYSTOURETHROGRAPHY

VCUG has no routine place in the assessment of urinary incontinence. In children with recurrent symptomatic urinary tract infections VCUG can be added to diagnose vesicoureteral reflux. In children with US anomalies, such as double systems, ureterocele and upper tract dilatation, VCUG can give additional information on vesicoureteral reflux and bladder outlet or urethral anomalies. Whenever VCUG is planned in a child with incontinence a combined examination with urodynamics should be considered.

CONCLUSIONS

The assessment of children with daytime symptoms was discussed, with an overview provided in the figure. A noninvasive approach in these children will allow us to select those requiring more invasive assessment.

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