Review

Pediatric Lower Urinary Tract Dysfunction: A Comprehensive Exploration of Clinical Implications and Diagnostic Strategies

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Pediatric Lower Urinary Tract Dysfunction: A Comprehensive Exploration of Clinical Implications and Diagnostic Strategies

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Abstract: Lower urinary tract dysfunction is clinically important because it may cause urinary tract infections, mainly due to accumulation of residual urine, and adversely affect renal function. In addition, it may cause urinary incontinence, strongly affecting the child's quality of life. The function of the lower urinary tract is closely associated with function of the bowel because constipation is commonly present with bladder dysfunction. The interplay between the lower urinary tract and bowel function, coupled with common conditions such as detrusor overactivity and voiding dysfunction, requires a nuanced diagnostic approach. Detrusor overactivity, a benign but socially harmful condition, is the principal cause of daytime urinary incontinence in childhood. It needs to be differentiated from more serious conditions such as neurogenic bladder dysfunction or urethral obstruction. Voiding dysfunction, a habitual sphincter contraction during voiding, is common in children with detrusor overactivity, may be selflimiting but may also result in residual urine and urinary tract infections. It may resemble, in severe cases, the neurogenic bladder dysfunction, most often caused by spinal dysraphism which very often leads to recurrent urinary tract infections and high intravesical pressures, jeopardizing renal function. Voiding diary is crucial in the initial evaluation of lower urinary tract function in children.

Keywords: voiding disorders; urinary incontinence; lower urinary tract; children; voiding diary; urodynamics

1. Introduction

Pediatric lower urinary tract dysfunction (LUTD) encompasses a spectrum of conditions that significantly affect a child's health and well-being. This article provides an in-depth exploration of the clinical relevance of LUTD, focusing on its association with urinary tract infections (UTIs), renal function, and the profound impact on a child's quality of life [1–3]. The intricate relationship between the lower urinary tract and bowel function is emphasized, particularly in the context of constipation. Detrusor overactivity (DO), a common yet socially harmful condition, is identified as a leading cause of daytime urinary incontinence in childhood, necessitating careful differentiation from more severe conditions. Additionally, the article delves into voiding dysfunction, its manifestations, and potential complications, highlighting the importance of a comprehensive diagnostic approach, including voiding diaries, urodynamics, and various imaging modalities [4–7]. The purpose of the LUTD evaluation in children is to differentiate whether there is an abnormality in filling or emptying of the bladder or both and whether there is a bladder function abnormality; in the latter case the evaluation should determine the underlying cause. In addition, the assessment should distinguish between organic (anatomical or neurogenic) and functional causes of LUTD since therapy differs depending upon the cause. The evaluation for most children with LUTD can be done with a thorough history, physical examination, and noninvasive testing, such as a urinalysis and urine culture. However, in selected children, more extensive investigations include imaging studies and measurement of urinary flow and post-void residual. In most complex LUTD pediatric patients, urodynamic studies may be

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required in order to diagnose the underlying etiology and determine the most appropriate therapy [8].

2. Clinical Relevance of Pediatric Lower Urinary Tract Dysfunction

2.1. Urinary Tract Infections (UTI)

Pediatric LUTD is clinically relevant due to its association with recurrent UTIs. The accumulation of residual urine, a common consequence of LUTD, creates a conducive environment for bacterial growth, increasing the risk of UTIs. Recurrent infections not only pose immediate health risks but also elevate the likelihood of long-term complications, including renal damage [1]. In addition, UTIs with concurrent vesicoureteral reflux (VUR) are often seen in children with LUTD; in the latter, the therapy of VUR is more challenging [8] with higher failure rate of surgical correction, increased incidence of UTI and longer time for VUR resolution [9]. Treatment of LUTD, particularly overactive bladder, has been shown to improve spontaneous resolution of VUR, indicating that overactive bladder has role in development of VUR [9].

For this reason, urine analysis and urine culture should be performed in children presenting with LUTD in order to screen for UTI [9]. A causal relationship between UTI and LUTD has not been confirmed but it is accepted that UTIs may lead to LUTD [10] as well as LUTD predisposes children to recurrent UTI and kidney injury [11]. In addition, the risk of UTI is increased in children with incomplete bladder emptying due to dysfunctional voiding or underactive bladder as well as in children with primary neck bladder dysfunction with opening of the bladder neck during contraction [9].

2.2. Renal Function Impairment

Adverse effects of LUTD extend to renal function, emphasizing the significance of timely diagnosis and intervention. Accumulation of residual urine may lead to increased intravesical pressure, jeopardizing kidney function and potentially causing irreversible damage. Understanding the impact of LUTD on renal health is crucial for developing effective management strategies [2]. In addition, chronic kidney disease has been reported in children with LUTD, recurrent UTI and VUR [9].

2.3. Urinary Incontinence and Quality of Life

Pediatric urinary incontinence, often a consequence of LUTD, profoundly impacts a child's quality of life. Beyond physical discomfort, incontinence can lead to social and psychological challenges, affecting a child's self-esteem and interpersonal relationships. Addressing the psychosocial aspects of LUTD is crucial in providing comprehensive care [3].

2.4. Association with Bowel Function

The lower urinary tract's function is intricately associated with that of the bowel, with constipation commonly coexisting with bladder dysfunction in pediatric populations. Understanding this association is paramount in unraveling the complexities of LUTD and devising targeted interventions. For this reason, information regarding the child's bowel habits should be obtained. This includes the frequency of bowel movements, the consistency, size, and caliber of stool, presence of painful defection and any history of stool withholding behavior, fecal incontinence or soiling [8,12].

2.5. Detrusor Overactivity and Voiding Dysfunction: Clinical Manifestations and Complications

Detrusor overactivity (DO), a benign yet socially harmful condition, is the leading cause of daytime urinary incontinence in childhood. Distinguishing DO from more severe conditions such as neurogenic bladder dysfunction or urethral obstruction is crucial for appropriate management. Children with DO have involuntary detrusor contractions during the filling phase, with increased bladder pressure exceeding 15 cm of water. However, there are no other voiding abnormalities and

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these children have normal sphincter activity during both the filling and voiding phases, and normal detrusor contractions during voiding [8]. Studies in children with voiding dysfunction symptoms revealed DO, detected by urodynamic investigation, in 52-58 % of patients compared with only 5-18 % of asymptomatic children [11,13].

Voiding dysfunction, characterized by habitual sphincter contraction during voiding, is common in children with DO. While it may be self-limiting, severe cases may lead to complications such as residual urine and UTIs. In extreme instances, the manifestation of voiding dysfunction closely resembles neurogenic bladder dysfunction, often associated with spinal dysraphism, posing a significant threat to kidney function. However, dysfunctional voiding, a similar, yet different term, occurs in children with a neurologic lesion, often called detrusor sphincter dyssynergy, or children without a neurologic lesion, named non-neurogenic dysfunctional voiding. There is abnormal contraction of the urethral sphincter during voiding but normal detrusor function during both the filling and voiding phases and normal sphincter contraction during the filling phase in all of them [8].

3. Diagnostic Approaches: A Comprehensive Toolbox for Evaluation

3.1. History

A detailed history is of utmost importance in diagnostic evaluation of LUTD. The history should be adapted to the age and the appropriate stage in development of bladder control of the patient. The history should focus on the following [8]:

- *voiding schedule*, including information about the frequency of voids and the frequency of incontinent episodes (in toilet-trained children). An estimation of the voided volume should be obtained as well, if feasable. Large capacity bladder are present in children with underactive bladder or polyuria, presenting with large volumes of voided urine [8];
- *symptoms of bladder dysfunction*, such as urgency, painful urination, hesitancy, holding maneuvers, dribbling, straining, and an intermittent or weak urinary stream. Table 1 presents the definitions for these symptoms [2,3,9];

Table 1. Definitions of symptoms of bladder dysfunction.

Symptom of bladder dysfunction	**Definition**
Daytime frequency	Increased: voiding more than seven times during waking hours; decreased: less than four voids
Pollakiuria	abnormally frequent small voids in a previously toilet-trained child but with no polyuria or UTI
Incontinence	uncontrolled leakage of urine (continuous or intermittent)
Urgency	the sudden and unexpected experience of an immediate need to void
Nocturia	awakening to void at night
Hesitancy	difficulty in the initiation of voiding in children who have achieved bladder control regardless of age
Straining	the use of abdominal pressure by the child to initiate and maintain voiding
Weak stream	the observed ejection of urine with a weak force
Intermittent stream	a voiding stream of urine occuring in several discrete bursts rather than the normal continuous stream (a normal physiologic pattern in children less than four years of age)

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Dysuria	burning or discomfort during voiding
Holding maneuvers	observed behavior used to either postpone voiding or suppress urgency, such as standing on tiptoe, forcefully crossing the legs, or squatting with a hand pressed into the perineum (Vincent's curtsy) in children with bladder control regardless of age.
Postmicturition dribbling	involuntary urine leakage immediately after completion of voiding in children with bladder control regardless of age

Abbreviations: UTI - urinary tract infections.

- there are several *surveys and questionnaires* available in order to assess daytime incontinence, bowel habits, urgency, voiding habits, dysuria and quality of life. They have been shown to be equivalent when evaluating response to treatment and to correlate with clinical impression of physicians, however, the mean symptom scores from these surveys and questionnaires were higher than the physician's rating for symptom severity;
- *family history* that should screen for any kidney or urologic disorders including LUTD and also the age that other family members achieved urinary continence in order to confirm or exclude a familial maturational delay in achieving bladder control;
- *perinatal and neonatal history*, searching for evidence of any perinatal or neonatal insult, such as perinatal anoxia or congenital infection that could impact the central and peripheral nervous system normal coordination of bladder function;
- *diet intake*, including information about the amount and type of fluid intake. Excessive fluid intake and/or fluid intake during the nighttime, for example, may suggest diabetes mellitus, polyuria due to a concentrating defect, or, rarely, primary polydipsia;
- *neurodevelopment delay and psychological disorders* may delay gaining voluntary bladder control. There is an increased risk of LUTD in children with psychological disorders, such as attention deficit hyperactivity disorder (ADHD), depression and anxiety. However, the majority of children with LUTD do not have behavior problems;
- *functional causes* of LUTD often originate from behavioral issues arising from toilet training or personal stress, arising from a conflict between the parent or caregiver and child;
- *toilet training history*, especially if it was prolonged, delayed, stressful or with a period of dryness after toilet training. Anatomic causes of urine incontinence, such as an ectopic ureter, typically lack a period of complete dryness after toilet training [8].

3.2. Voiding Diary

The use of a voiding diary is emphasized as a crucial tool in the initial evaluation of lower urinary tract function in children, in addition to history and physical examination. This detailed record of voiding patterns and associated symptoms provides valuable insights, aiding in the diagnosis and management of LUTD [4]. A three-day voiding diary is useful for obtaining a record of urinary voiding and defecation patterns. It should include the time and volume of each void, every episode of incontinence, fluid intake, every defecation and any episode of fecal soiling [8].

Uroflow is especially useful for children old enough to void on command, especially in cases of weak stream or the need to strain to void or with recurrent UTIs secondary to incomplete bladder emptying or therapy-resistant incontinence. Fort his purpose, a child will void on a toilet that measures the flow rate, and immediately afterward, the residual urine in the bladder is assessed with ultrasound (US) device. A pathological curve needs to be repeated by uroflowmetry studies before conclusions may be drawn. When a noninvasive screening of the LUT function of infants and children before the age of bladder control is indicated, a 4-h voiding observation is the preffered method. For this purpose, the child is allowed to play and eat freely for 4 hours while every void is documented by weighing diapers, and US is used to measure post-void residual [5].

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3.3. Physical Examination

The purpose of physical examination is to detect neurologic, urologic and other abnormalities. It should include examination of various parts of a body, as presented in Table 2 [8]. It is worth mentioning that any abnormality of the neurologic examination may suggest a neurologic lesion, affecting also the bladder function due to an integrated neural network coordination [8]. In addition, sexual or physical abuse should be considered sometimes during examination since LUTD dysfunction may be a presenting sign for child abuse [14].

Table 2. Parts of physical examination [8].

Part of body examined	Typical findings
lower back	cutaneous signs of occult spinal dysraphism or sacral agenesis (presacral dimple, hair patch, lipoma, asymmetric gluteal cleft)
neurologic examination	lower extremity strength and deep tendon reflexes, gait, fine-motor coordination, perineal and anal sensation, rectal tone assessment.
external urological and perianal examination	meatal stenosis in boys, labial adhesions in girls (may cause bladder outlet obstruction); signs of skin excoriation or redness (may indicate continuous or severe urinary leakage)
perianal inspection	position of the anus, the presence of gluteal cleft deviation, dermatitis and perianal fissures, feces or hemorrhoids
abdominal examination	tenderness due to colonic distension secondary to fecal impaction
digital rectal examination	rectal distension (full of stool), information about perianal sensation, tone and function of the anal sphincter
urinary stream observation	signs of LUTD: hesitancy, dribbling, weak urinary stream or intermittency of voiding, especially if observed during voiding

Abbreviations: LUTD - lower urinary tract dysfunction.

3.4. Laboratory Investigations

Initial laboratory testing includes urinalysis and urine culture. Results of urinalysis, optimally performed on a first morning void, may reveal diseases due to a renal concentrating defect or glycosuria due to diabetes mellitus where polyuria is a main symptom. A urine culture should also be obtained, especially if leukocyte esterase, pyuria and nitrite are present in the urinalysis, due to increased risk of UTI in children with LUTD. Serum laboratory studies, such as creatinine concentration, are usually not done initially since kidney function impairment is rare in children with a normal urinalysis. However, abnormal result of urinalysis, such as proteinuria or a low specific gravity, indicates kidney disease, malformation or injury and demands a serum electrolytes and creatinine concentration measurement in order to estimate the glomerular filtration rate [8].

3.5. Imaging Studies

Ultrasound (US) of a kidney and bladder, a noninvasive investigation, is the most commonly used imaging study in the evaluation of children with LUTD and should be done in every child with a suspected neurologic or anatomical lesion, UTI or symptoms indicative of an obstructive uropathy, such as weak or interrupted urinary stream. US can give various information, including detection of anatomical abnormalities (hydronephrosis, duplicated collecting system with or without an ectopic ureter, kidney scarring, to name just a few of them), measurement of post-void residual volume (suggesting incomplete bladder emptying when a volume exceeds 20 ml after repeat measurement, present in underactive bladder, for example) and measurement of bladder wall thickness, indicating

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(if thickened) outlet obstruction due to an anatomical or functional abnormality or, most commonly, overactive bladder [8].

Voiding cystourethrogram (VCUG) is a contrast study, using either x-ray or ultrasound contrast agent, that involves urethral catheterization and is able to assess the bladder during the filling and voiding phases, to detect VUR and posterior urethral valves (PUV) and to give information on bladder shape, capacity and bladder emptying. We use it in children with UTI and in boys suspected of having PUV [8].

Magnetic resonance imaging (MRI) should be done in children with neurologic signs and symptoms in order to look for occult neurologic lesions. It is worth to mention that a normal physical exam does not necessarily exclude occult spinal cord disorders. This has been proven in a study in children with LUTD, refractory to medical therapy and a normal physical examination, where 39 % of them had pathologic findings on MRI [15]. According to that, a lumbosacral MRI is indicated in children suspected of having a neurologic abnormality and in those who do not respond to therapy or manifest urodynamic findings consistent with a neurologic defect [8].

Alltogether, these techniques offer valuable insights into the anatomical aspects of the lower urinary tract. This is especially important in cases resembling neurogenic bladder dysfunction, particularly those associated with spinal dysraphism, where a thorough evaluation is necessary [7,8,13].

3.6. Urodynamics

Urodynamic studies play a vital role in differentiating between various lower urinary tract dysfunctions, contributing to a more nuanced understanding of the condition. These studies involve invasive (cystometry) and non-invasive measurements (uroflowmetry, residual urine measurement and voiding observation) to assess bladder and sphincter function [6].

Uroflowmetry (measurement of urinary flow) can give information about urine flow pattern that is often diagnostic of an etiology, thus enabling us to avoid doing more invasive urodynamic testing. In addition, it gives information about the emptying phase of the bladder, however, it can give no data about the filling phase. For this purpose, children are asked to wait until they feel a strong desire to void and then to void into a special vessel, producing a urinary flow curve, which can give information regarding the shape of urine flow, voided volume, flow time, maximum flow rate (Qmax) and average flow rate. Electromyographic (EMG) activity of the urethral sphincter and pelvic floor musculature can also be studied during voiding. The sphincter activity during voiding, which is absent normally, suggests dysfunctional voiding. It must be pointed out, however, that there is a weak correlation between urinary flow and clinical response to therapy, probably due to fact that only a minority of children with urinary incontinence have a failure of the emptying function of the bladder, which is assessed by uroflowmetry. Urine flow patterns generally correlate with the etiology of daytime urinary incontinence. Another parameter that can be obtained durig this study is bladder capacity. It can be decreased in children with overactive bladders and increased in those with underactive bladder [8].

Cystometry is performed by simultaneously measuring bladder pressure via a transurethral catheter, intra-abdominal pressure via a transrectal probe, and sphincter activity via perineal patch electrodes. The bladder is filled at a slow rate while pressure is being monitored continuously. Variables including presence of overactive contractions, bladder filling pressures, leak point pressure, voiding pressure, post-void residual volume, and relaxation of the sphincter muscle are recorded. These data allow thorough evaluation of LUT function [5]. This investigation detects abnormalities during the filling as well as voiding phase and can differentiate between overactive bladder, a filling phase abnormality that is more common, and dysfunctional voiding, a consequence of sphincter dysfunction or pelvic floor musculature contraction during voiding. In addition, it can detect voiding abnormalities in most children with daytime incontinence who do not respond to treatment. It is mainly indicated in more challenging cases with a known or suspected neurologic lesion, severe LUTD with evidence of renal injury or hydronephrosis, high imperforate anus and abnormalities in urinary tract anatomy [8].

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4. Differentiation of Specific LUTD Subtypes

Specific LUTD subtypes, such as detrusor-sphincter dyssynergia, underactive bladder, and non-neurogenic dysfunctional voiding, require specialized diagnostic approaches. These may include invasive and non-invasive urodynamic measurements tailored to the specific characteristics of each subtype [13]. Table 3 presents urodynamic patterns in normal and abnormal bladder conditions [17].

Table 3. Urodynamic patterns in normal and abnormal bladder conditions.

	Filling of the bladder		**Empying of the bladder**	
	Detrusor contractions	**sphincter activity**	**Detrusor contractions**	**sphincter activity**
Normal	-	+	+	-
Abnormalities, discovered during urodynamic investigation				
Overactive bladder	+	+	+	-
detrusor-sphincter dyssynergy	-	+	+	+
Non-neurogenic dysfunctional voiding	-	+	+	+
Underactive bladder	-	+	Insufficient, incomplete emptying	-

* Abbreviations: + present; -absent.

Children with overactive bladder have involuntary detrusor contractions during the filling phase, called DO (mentioned above), characterized by increased bladder pressure. Dysfunctional voiding occurs in children with a neurologic lesion, where it is called detrusor sphincter dyssynergy, or patients without a neurologic lesion, named non-neurogenic dysfunctional voiding. There is abnormal urethral sphincter contraction during voiding in all of them but normal other urodynamic parameters, as shown in Table 3. Children with an underactive bladder have increased bladder capacity and incomplete bladder emptying during voiding due to decreased detrusor contraction but with normal sphincter function during both the filling and voiding phases [8].

5. Chronic Kidney Disease and Prognosis

Pediatric LUTD, if left unmanaged, can lead to chronic kidney disease, underscoring the importance of early detection and intervention. Regular monitoring of renal function through urinalysis, serum creatinine levels, and imaging studies is essential for assessing prognosis and tailoring therapeutic strategies [18].

6. Conclusions

Pediatric LUTD is a multifaceted condition with significant clinical implications. Understanding its association with urinary tract infections, renal function, and its impact on a child's quality of life is crucial for comprehensive care. The interplay between the lower urinary tract and bowel function, coupled with common conditions such as detrusor overactivity and voiding dysfunction, requires a nuanced diagnostic approach. Utilizing a comprehensive toolbox, including voiding diaries, urodynamics, and various imaging modalities, is essential for accurate evaluation and tailored

management. Early detection and intervention are paramount to prevent complications such as chronic kidney disease and ensure a favorable prognosis for affected children.

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References

1. Yeung, C.K.; Sreedhar, B. Pediatric voiding dysfunction: Diagnosis, classification, and management. *J Pediatr Urol* **2008,** *Aug;4(4),* 261-275.
2. Nevéus, T.; von Gontard, A.; Hoebeke, P.; Hjälmås, K.; Bauer, S.; Bower, W.; et al. The standardization of terminology of lower urinary tract function in children and adolescents: report from the Standardisation Committee of the International Children's Continence Society (ICCS). *J Urol* **2006**, *Oct;176(4 Pt 2),* 3143-3151.
3. Austin, P.F.; Bauer, S.B.; Bower, W.; Chase, J.; Franco, I.; Hoebeke, P.; 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. *J Urol* **2014,** *Oct;192(4),* 1103-1111.
4. Franco, I.; von Gontard, A.; De Gennaro, M.; et al. Evaluation and Treatment of Nonmonosymptomatic Enuresis: A Standardization Document From the International Children's Continence Society. *J Urol* **2017,** *Nov;198(5),* 1128-1136.
5. Neveus, T.; Estrada, C.R.; Austin, P.F. Bladder Disorders. In: *Pediatric Nephrology*, 8th ed.; Emma, F., Goldstein, S.L., Bagga, A., Bates, C.M., Shroff, R., Eds.; Cham: Springer Nature, Switzerland, 2022; pp. 1399-1410.
6. Koff, S.A. Urodynamic testing in infants and children: A review. *Urology* **1995**, *Feb;45(2),* 159-172.
7. Yeung, C.K.; Sreedhar, B. Urodynamic findings in children with lower urinary tract dysfunction: A reappraisal based on current evidence. *Neurourol Urodyn* **2021**, *Jan;40(1),* 103-110.
8. Nepple, K.G.; Cooper, C.S. Evaluation and diagnosis of bladder dysfunction in children. UpToDate. 2023. Available online: https://www.uptodate.com/contents/evaluation-and-diagnosis-of-bladder-dysfunction-in-children/print?csi=06da35fa-d761-493d-8af8-8e3f9d9d68bd&source=contentShare (accessed 11 August 2023)
9. Nepple, K.G.; Cooper, C.S. Etiology and clinical features of bladder dysfunction in children. UpToDate. 2024. Available online: https://www.uptodate.com/contents/etiology-and-clinical-features-of-bladder-dysfunction-in-children?csi=133a5301-f4e0-4eb1-8dd5-09cdf95baa36&source=contentShare (accessed 15 February 2024)
10. Bauer, S.B. Special considerations of the overactive bladder in children. *Urology* **2002** *Nov;60(5 Suppl 1):43-48;* discussion 49. doi: 10.1016/s0090-4295(02)01793-4. PMID: 12493352.
11. Hoebeke, P; Van Laecke, E; Van Camp, C; Raes, A; Van De Walle, J. One thousand video-urodynamic studies in children with non-neurogenic bladder sphincter dysfunction. *BJU Int* **2001** *Apr;87(6),* 575-580. doi: 10.1046/j.1464-410x.2001.00083.x. PMID: 11298061.
12. 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,** *Jul;190(1),* 29-36. doi: 10.1016/j.juro.2013.01.001. Epub 2013 Jan 9. PMID: 23313210.
13. Wen, JG; Tong EC. Cystometry in infants and children with no apparent voiding symptoms. *Br J Urol* **1998,** *Mar;81(3),* 468-473. doi: 10.1046/j.1464-410x.1998.00544.x. PMID: 9523672.
14. Ellsworth, P,I; Merguerian, P,A; Copening, M,E; Sexual abuse: another causative factor in dysfunctional voiding. *J Urol* **1995**, *153*, 773.
15. Arikan, N; Soygür, T; Selçuki, M; et al. Role of magnetic resonance imaging in children with voiding dysfunction: retrospective a;nalysis of 81 patients. *Urology* **1999**; *54*: 157.

 doi:10.20944/preprints202403.0678.v1

16. El-Ghoneimi, A.; Desgrippes, A.; Luton, D.; et al. Value of urologic evaluation in patients with neurovesical dysfunction and normal neurological findings. *J Urol* **2004,** *Oct;172(4 Pt 2),* 1672-1675.
17. McKenna, P.H. The underactive bladder: clinical and urodynamic issues. *J Urol* **2003,** *Sep;170(3),* 823-828.
18. Zaffanello, M.; Malerba, G.; Cataldi, L.; et al. Pediatric urological management in spina bifida. *Pediatr Surg Int* **2011,** *Apr;27(4),* 363-371.

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