

O Papel da Medicina Física e de Reabilitação nas Disfunções do Trato Urinário Inferior em Idade Pediátrica

The role of Physical and Rehabilitation Medicine in Lower Urinary Tract Dysfunction in Pediatric Age

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Introduction

Lower urinary tract (LUT) dysfunction in pediatric patients is one of the most common reasons for consultation in pediatric urology and nephrology, affecting up to 40% of children assessed in these consultations¹. LUT dysfunctions are frequently associated with various comorbidities, such as recurrent urinary tract infections, vesicoureteral reflux, renal injury, constipation, among others. Moreover frequently contribute to social stigmatization, particularly during school age. Early identification and appropriate treatment of these conditions are crucial to mitigating their associated negative impacts. Physical and Rehabilitation Medicine (PRM), which includes interventions such as urodynamic evaluation, bladder training, and pelvic rehabilitation, traditionally applied to adult populations, can play a pivotal role in supporting medical specialties that manage LUT dysfunction in children. PRM contributes to both diagnosis and therapy, aiming to enhance bladder function and, consequently, improve the quality of life of affected children, while also preventing potential long-term sequelae in adulthood.²⁻⁴

Palavras-chave: Disfunção do Trato Urinário Inferior, Medicina Física e de Reabilitação, Criança, Reabilitação Pélvica, Uroterapia, Biofeedback

Keywords: Lower Urinary Tract Dysfunction, Physical Medicine and Rehabilitation, Children, Pelvic Rehabilitation, Urotherapy, Biofeedback

Maturation of Voiding Patterns in Pediatric Age and Epidemiology

The maturation of voiding patterns is a gradual process that develops alongside central nervous system growth, involving the coordination of spinal and brain centers responsible for micturition control. In infants, voiding is reflexive, lacking regulation and coordination. As the child matures, voiding becomes more voluntary, with improved control over urinary output, sphincter resistance, and bladder control mechanisms. By 2-3 years, children can voluntarily suppress detrusor contractions. Daytime continence is typically achieved by 4 years, and nighttime continence by 5-7 years. Factors influencing urinary continence acquisition include education, environment, social, familial, psychological, and genetic factors⁵⁻¹¹. Urinary incontinence in children is a relatively common condition, with prevalence rates declining with age. It is defined as at least one episode every two weeks and is more prevalent in females. The prevalence progressively decreases with age, dropping to 5% between the ages of 6 and 12 years, and to 4% between 12 and 18 years.² Associated comorbidities include recurrent urinary tract infections, vesicoureteral reflux, renal injury, constipation, psychological disorders and obesity.^{2,3,5,9}

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Etiology

LUT dysfunction can have multiple etiologies such as neurogenic causes (congenital or acquired alterations in the central or peripheral nervous system), anatomical causes (structural anomalies such as ectopic ureter, posterior urethral valves or vesicoureteral reflux) or functional causes (idiopathic bladder dysfunction without identified neurological or anatomical cause)^{5,7,8}.

Terminology and Concepts

The International Children's Continence Society (ICCS) describes symptoms related to LUT dysfunction, categorizing them according to the phase of the micturition cycle.^{9,10} In the storage phase include altered voiding frequency (≥ 8 or ≤ 3 voids/day in children over 5 years), incontinence (continuous or intermittent; primary or secondary), urgency and nocturia. In the voiding phase include elimination difficulties such as hesitation, weak stream, intermittency and straining. Other associated symptoms include holding maneuvers, feeling of incomplete emptying, urinary retention, spraying (splitting) of the urinary stream, post micturition dribble and pelvic pain or dysuria. Urinary incontinence in children is categorized as continuous or intermittent. Continuous incontinence is usually associated with congenital malformations or iatrogenic causes, such as vesicovaginal fistula. Intermittent incontinence is further divided into daytime incontinence or nocturnal incontinence (enuresis). Nocturnal incontinence is classified into two main types: monosymptomatic enuresis, which occurs exclusively at night and non-monosymptomatic enuresis, associated with other daytime urinary symptoms, such as urgency. Both forms of incontinence can be primary, when the child has never achieved continence or secondary, when continence has been achieved for at least six months before a relapse. Enuresis is defined as the intermittent and involuntary loss of urine during the night in children over five years of age, in the absence of congenital or acquired central nervous system abnormalities. It is a multifactorial condition, often associated with factors such as family history, hormonal imbalances, bladder control immaturity, psychosocial factors and constipation.^{8,9} Giggle incontinence is a rare clinical condition characterized by the sudden and uncontrollable loss of urine triggered by laughter. The etiology remains unclear, with investigations into potential neurogenic, non-neurogenic, or even psychological origins.¹² The association between constipation and bladder dysfunction is highly prevalent, forming what is known as dysfunctional elimination syndrome. Two theories suggest rectal distention increases bladder pressure, causing detrusor hyperactivity, or the urethra and anal sphincter as

a functional unit, where prolonged sphincter contraction leads to detrusor-sphincter dyssynergia, impairing bladder emptying¹³.

Evaluation

The ICCS emphasizes the importance of using specific tools to investigate micturition dysfunctions. The voiding diary is fundamental for an initial analysis and the renovesical ultrasonography, which evaluates post-void residual and bladder wall thickness, provides relevant anatomical and functional data. Uroflowmetry and cystometry provide essential information on LUT function.^{5,8}

Urodynamic Evaluation

PRM plays a significant role not only in the treatment but also in the diagnosis of LUT dysfunction. One of the key tools in this context is urodynamic studies, which provide a detailed assessment of LUT function.^{1,4} The main indications for performing urodynamic studies in children include: suspicion of neurogenic voiding dysfunction or occult neurological pathology; presence of voiding dysfunction associated with bladder hypertrophy, vesicoureteral reflux, or upper urinary tract abnormalities; daytime urinary incontinence refractory to conservative treatment; persistent nocturnal enuresis unresponsive to treatment; recurrent urinary tract infections; and vesicourethral malformations²⁻⁴. Urodynamic evaluation can be performed invasively or non-invasively. The non-invasive assessment includes uroflowmetry, which evaluates micturition by analyzing urinary flow, resulting from the interaction between detrusor muscle contraction and urethral resistance¹. It involves measuring the flow rate, volume voided, voiding time, and examining the pattern during urination into a uroflowmeter.^{1,8} In children, the patterns observed are more important than the values obtained: the presence of flow alterations (interrupted, tower, plateau and staccato) may indicate changes in detrusor and/or sphincter activity^{6,8}. At the end of micturition, it is important to perform an ultrasound evaluation of post-void residual and determine whether the micturition is normal or pathological.⁹ The invasive urodynamic evaluation is cystometry, which should be performed based on a careful analysis of the potential risks versus benefits, considering the need to obtain precise diagnostic information for therapeutic guidance, as this test involves bladder and rectal catheterization.^{1,4,6} Cystometry allows for the assessment of bladder pressures during filling and emptying. This examination helps evaluate bladder capacity, compliance, urge sensation and the activity of the detrusor muscle. Additionally, it enables the analysis of the

micturition process and the possible presence of post-void residual^{4,6}. In children this is a challenging test to perform, and its interpretation can often be complex. It is highly dependent on the child's collaboration, age, cognition, and maturity, as well as the involvement of the parents.^{3,7} Especially in this population, its use should be carefully considered, the uroflowmetry as the gold standard and cystometry performed only in well-selected cases.^{1,5} The performance of perineal electromyography (EMG) during micturition is an important tool and it can be associated with uroflowmetry or cystometry. When electrical activity is maintained or increases during micturition, this suggests a vesico-sphincteric/pelvic dysynergia or an artifact.^{6,8} Indeed, urodynamic evaluation plays a crucial role in understanding the function of the lower urinary tract, enabling the detection of pathologies, monitoring of treatments over time, and assessing the evolution of bladder behavior as the child grows.^{1,2} However, isolated urodynamic investigation is not sufficient to determine the causes and consequences of urinary dysfunctions. Integration with clinical data, such as symptoms, physical examination, voiding diary and imaging studies, is essential for an accurate diagnosis and an effective therapeutic approach. Therefore, its use should be carefully individualized, weighing the benefits and risks for each patient.^{3,5}

Urotherapy

Urotherapy is a conservative-based treatment for LUT dysfunction, and its primary objective is to normalize micturition and bowel patterns while preventing further functional disturbances through repeated training. *Standard urotherapy* is an approach based on adopting conservative and educational measures, including actions such as information, behavioral modification strategies, lifestyle advice and registration of symptoms/voiding habits and support. *Specific urotherapy* is a multidisciplinary approach that uses specialized interventions to treat LUT dysfunction that have not responded adequately to standard measures or present more complex conditions. Their components include psychological support and behavioral modification;

pelvic floor training, biofeedback, alarm treatment and neuromodulation. These options may eventually be combined with pharmacological therapy and/or intermittent catheterization. These interventions are personalized according to the individual's needs and generally require monitoring by a trained multidisciplinary team. Biofeedback is a non-invasive and well-tolerated intervention, making it a preferred approach recommended by the ICCS for treating LUT dysfunction in this population. Feedback can be provided on performance using perineal EMG or on results by visualizing micturition during uroflowmetry. Both visual and auditory feedback can be used, and when combined with the assessment, coaching, and encouragement from the therapist, the aim is to improve motor control^{2,8}. Studies indicate an improvement in the quality of life for children treated with biofeedback.¹¹ However, adherence to this therapeutic option depends on several factors, such as age, cognition, sensorimotor awareness, maturity, and motivation.^{2,8} According to the ICCS, further research is needed to define more efficient and personalized approaches for treating micturition dysfunctions in pediatric patients. They emphasize the limited available options, highlighting the importance of training more professionals, particularly urotherapists, and stressing the significance of continuous education in this field. They also note the great heterogeneity in the composition of the teams involved in guiding these children, underscoring the crucial need to standardize practices and interventions to ensure greater consistency and effectiveness in treatments, as well as coordination among all professionals involved.^{2,8}

Conclusion

PRM can play a significant role in the diagnosis and treatment of LUT dysfunction in pediatric patients, collaborating with the medical specialties involved in managing these conditions. It is an area with great potential for development. Early identification and treatment are crucial, and this approach can significantly contribute to the prevention of severe disorders, ultimately improving the quality of life.

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