FULL-TEXT GUIDELINE AVAILABLE AT *CUAJ.CA*. PRIOR TO PUBLICATION, THIS GUIDELINE UNDERWENT REVIEW BY THE CUA GUIDELINES COMMITTEE, EXPERT EXTERNAL REVIEWERS, AND THE CUA EXECUTIVE BOARD.

2023 Canadian Urological Association/ Pediatric Urologists of Canada guideline: Pediatric patients with neurogenic lower urinary tract dysfunction

Abridged version

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Full-text guideline available at *cuaj.ca.*

BACKGROUND, DEFINITION, AND SCOPE OF THE GUIDELINE

The Canadian Urological Association (CUA) and the Pediatric Urologists of Canada (PUC) have collaborated on the development of an extensive clinical practice guideline (CPG) concerning pediatric neurogenic lower urinary tract dysfunction (NLUTD). This CPG is created using the ADAPTE method, incorporating AGREE II evaluation of existing CPGs[1-7] with de novo recent evidence search and appraisal; subsequently, the key recommendation statements were generated with a modified Delphi method involving the PUC members.[8-11] The CPG aims to provide evidence-based recommendations tailored to pediatric urologists, clinicians, and allied healthcare professionals engaged in managing children afflicted with NLUTD.[12,13] The scope encompasses children with various neurological conditions, such as spina bifida, spinal cord injury, and cerebral palsy, among others, who suffer from urinary dysfunction. Specifically, for this CPG, the definition of bladder hostility encompasses bladders that are considered high risk for urological morbidity, and are summarized in Table 1, with additional relevant definitions and terminology for pediatric NLUTD.

DIAGNOSIS AND EVALUATION

The guideline emphasizes the importance of antenatal, postnatal management, and a multidisciplinary approach to diagnosis. Furthermore, the guideline addresses the significance of history-taking, physical examination, and imaging studies, such as renal and bladder ultrasonography, video-urodynamic or urodynamic with voiding cystourethrography, in identifying structural abnormalities and upper urinary tract changes. Other diagnostic assessment of renal function is also discussed. Table 2 summarizes the investigations recommended for different age ranges in pediatric NLUTD.

CONSERVATIVE MANAGEMENT

Conservative management plays a pivotal role in the care of pediatric NLUTD patients. The guideline advocates for prompt intervention and emphasizes a proactive approach, such as early initiation of clean intermittent catheterization (CIC). Pharmacological interventions, such as anticholinergic medications, are presented as a valuable adjunct to conservative management. The guideline outlines the appropriate use of antibiotic prophylaxis and indications for anticholinergics and onatobotulinum A detrusor injection, as well as their potential side effects, and dosing strategies in pediatric NLUTD patients (Table 3).

SURGICAL INTERVENTIONS

Surgical interventions aim to manage NLUTD and enhance bowel control, which ideally results in favorable long-term effects on patient outcomes and quality of life. These interventions can improve urinary function by augmenting bladder capacity, decreasing intravesical pressures, and enhancing voiding capabilities. Consequently, there is a reduction in urinary incontinence, diminished susceptibility to urinary tract infections, and preservation of upper urinary tract health. By effectively addressing urinary and bowel dysfunction, these interventions enhance functional autonomy and quality of life. The guideline stresses the importance of a tailored approach to surgery, considering each patient's specific needs and medical history. Table 3 provides an overview of the considerations for surgical interventions in pediatric NLUTD.

LONG-TERM FOLLOWUP AND CONTINUITY OF CARE

Pediatric NLUTD requires lifelong care and monitoring. The guideline highlights the necessity of long-term followup to ensure optimal outcomes for these patients. Regular evaluations, urodynamic assessments, and renal function monitoring are emphasized to promptly detect and manage potential complications. The guideline also underscores the significance of a patient-centered approach to transitional care. It emphasizes effective communication and education to empower patients and their families to understand the condition and its management. Finally, we advocate for shared decision-making, taking into account the patient's and family's preferences, values, and cultural considerations.

CONCLUSIONS

The collaborative effort of the CUA and PUC has resulted in a comprehensive guideline for the diagnosis and management of pediatric NLUTD. A table providing the summary of all the adapted and modified key recommendation statements from existing CPGs and newly searched recent evidence on the diagnosis and management of pediatric NLUTD is presented in the full-text version of the guideline (available at *cuaj.ca*). Although the guideline represents a contemporary approach to the appropriate management of pediatric NLUTD, further well-designed clinical trials are necessary to provide high-quality evidence and refine the guidelines, ensuring they remain relevant and effective over time. Furthermore, the guideline's successful implementation will require careful consideration of local concerns, stakeholder perspectives, patient preferences, and individual clinical circumstances. Ultimately, successful implementation will reduce the burden on

Table 1. Indicators of NLUTD patient characteristics potentially at higher risk of urological morbidity

Basis of high-risk diagnoses	Features of bladder hostility
Etiology of neurogenic bladder	SCI, SB, advanced MS, SCI patients with autonomic dysreflexia associated with bladder function
Bladder management method	Valsalva/Credé/reflexive bladder emptying, indwelling catheter
VideoUrodynamics (VUDS) or urodynamics + voiding cystourethrogram (VCUG)	DSD, NDO, impaired compliance (cystometric bladder capacity/ end filling pressure <20 mL/cmH_2O), DLPP >40 cmH_2O, VUR, trabeculated irregular bladder wall on VUDS/ VCUG
Renal-bladder imaging	New-onset/worsening hydronephrosis, stone disease, renal atrophy/ scarring, abnormal bladder morphology
Renal function	New-onset/worsening renal insufficiency

Additional definitions and terminologies
- Detrusor overactivity is the occurrence of involuntary detrusor contractions during filling cystometry.
- Detrusor underactivity denotes a voiding contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete emptying within a normal time span.
- Compliance is calculated by dividing the volume change (ΔV) by the change in detrusor pressure (ΔPdet) during that change in bladder volume (C=ΔV/ΔPdet). Compliance is expressed as ml per cmH_2O.
- High DLPP (e.g.,>40 cmH_2O) is associated with reduced bladder muscle compliance and poses a risk for upper urinary tract deterioration.
- DSD is discoordination between the detrusor and external urethral sphincter muscles during voiding (i.e., detrusor contraction synchronous with contraction of the urethral and/or periurethral striated muscles).

Adopted from Kavanagh et al, 2019, with permission.[14] Additional caveat definition from ICCS 2016.[12] DLPP: detrusor leak point pressure; DSD: detrusor sphincter dyssynergia; MS: multiple sclerosis; NDO: neurogenic detrusor overactivity; NLUTD: neurogenic lower urinary tract dysfunction; SB: spina bifida; SCI: spinal cord injury; VCUG: urodynamics + voiding cystourethrogram; VUDS: video-urodynamics; VUR: vesicoureteral reflux.

Table 2. Summary of recommended investigations in a pediatric patient with NLUTD

Age (years)	Recommended studies
0–3 months	• Baseline renal/bladder ultrasound • Baseline serum creatinine • DMSA scans if febrile UTI or vesicoureteral reflux
3–12 months	• Repeat renal/bladder ultrasound (every 3–6 months) • Baseline video urodynamic (or urodynamic + VCUG) testing • Serum creatinine if a change in upper urinary tract findings
1–2 years	• Renal/bladder ultrasound every six months • Annual urodynamic testing • Serum creatinine if a change in upper urinary tract findings
2–5 years	• Annual renal/bladder ultrasound if stable without UTIs or imaging changes • Additional ultrasound as needed for recurring symptomatic UTIs or bladder hostility identified by urodynamic testing • Serum creatinine if a change in upper urinary tract findings or clinical suspicion of renal function deterioration • Annual urodynamic testing till three years • Urodynamic testing between 3–5 years only if upper tract changes, recurring UTIs, patient and family's interest in beginning a urinary continence program
Five years and above	• Serum creatinine yearly if concern for CKD or changes in upper urinary tract findings • Urodynamic testing if initiating a urinary continence program; or if hydronephrosis or renal scarring, recurring symptomatic UTIs, or changes in urinary continence status

CKD: chronic kidney disease; DSMA: dimercapto succinic acid; NLUTD: neurogenic lower urinary tract dysfunction; UTI: urinary tract infection; VCUG: urodynamics + voiding cystourethrogram.

Table 3. Overview of the considerations for different surgical interventions in pediatric NLUTD

Surgical option	Purpose	Benefits	Considerations	Patient characteristics
Vesicostomy	Diversion of urine through an abdominal stoma	Prevention of upper urinary tract damage	Incontinent form of urinary diversion	Suitable for infant/ young toddlers with poor bladder emptying, recurrent UTIs, or inability to perform CIC
Mitrofanoff continent catheterizable channel (appendicovesicostomy)	Continent urinary diversion	Improved bladder management Preservation of upper tract function Improved independence without indwelling catheters	Potential for stomal complications (i.e., stricture, leak, infection, or mucosal prolapse)	Suitable for patients with intact appendix or alternative suitable structures (i.e., ileum- Monti) for catheterizable conduit
Augmentation cystoplasty	Increase the bladder storage capacity and compliance	Improved bladder function Reduction in intravesical pressures Enhanced urinary continence Prevention of upper urinary tract damage	Risk of persistent urinary incontinence Dependence on catheterization The potential need for metabolic evaluation, treatment of electrolytes imbalance Assess for compliance	Suitable for patients with low bladder capacity and poor compliance, without contraindications (e.g., inflammatory bowel disease, significant prior small bowel resection). Able to perform CIC and compliant with regular irrigation to prevent complications (mucus plug, stone, recurrent infection, or rupture)
Slings	Restoration of urinary continence	Effective treatment for sphincteric incompetence	Consideration of autologous material choice and potential complications of the donor site.	Suitable for patients with moderate stress incontinence due to sphincteric incompetence and adequate abdomino-detrusor pressure to overcome outlet resistance
Bulking agents	Restoration of urinary continence	Less invasive treatment option and lower complication rate than other surgical options	Limited long-term results	Suitable for patients with mild SUI and poor response to conservative treatments
Artificial urinary sphincter	Restoration of urinary continence	High success rates for stress incontinence Improved quality of life	Risk of mechanical failure and revision surgery A potential complication of urethral erosion and infection	Suitable for patients with moderate to severe incontinence due to sphincteric incompetence, normal cognitive abilities, and manual dexterity to manipulate the device
Malone antegrade continence enema (MACE) or cecostomy	Facilitation of bowel management Creation of continent catheterizable conduit for bowel cleanout	Improved bowel continence Enhanced quality of life	Risk of stomal complications (i.e., stenosis, leakage, and mucosal prolapse)	Suitable for patients with neurogenic bowel dysfunction and poor response to conservative treatments, with an intact appendix for catheterizable conduit for MACE, cecostomy for preference of device or appendix may not be available

CIC: clean intermittent catheterization; NLUTD: neurogenic lower urinary tract dysfunction; SUI: stress urinary incontinence; UTI: urinary tract infection.

the healthcare system, improve the quality of life of affected children, and promote the standardization of the management of pediatric patients with NLUTD.

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REFERENCES

1. Joseph DB, Baum MA, Tanaka ST, et al. Urologic guidelines for the care and management of people with spina bifida. *J Ped Rehab Med* 2020;13:479-89. https://doi.org/10.3233/PRM-200712
2. National Institutes of Health. Urinary incontinence in neurological disease: management of lower urinary tract dysfunction in neurological disease: Royal College of Physicians (UK); 2012.
3. Governey S, Culligan E, Leonard J. The health and therapy needs of children with spina bifida in Ireland. Temple Street Children's University Hospital: Dublin, Ireland. 2014.
4. Stein R, Bogaert G, Dogan HS, et al. EAU/ESPU guidelines on the management of neurogenic bladder in children and adolescent part I diagnostics and conservative treatment. *Neurourol Uradyn* 2020;39:45-57. https://doi.org/10.1002/nau.24211
5. Stein R, Bogaert G, Dogan HS, et al. EAU/ESPU guidelines on the management of neurogenic bladder in children and adolescent part II operative management. Neurourol Urodyn 2020;39:498-506. https://doi.org/10.1002/nau.24248
6. Bauer SB, Austin PF, Rawashdeh YF, et al. International Children's Continence Society's recommendations for initial diagnostic evaluation and follow-up in congenital neuropathic bladder and bowel dysfunction in children. *Neurourol Urodyn* 2012;31:610-4. https://doi.org/10.1002/nau.22247
7. Rawashdeh Y, Austin P, Siggaard C, et al. International Children's Continence Society's recommendations for therapeutic intervention in congenital neuropathic bladder and bowel dysfunction in children. *Neurourol Urodyn* 2012;31:615-20. https://doi.org/10.1002/nau.22248
8. Brouwers MC, Kerkvliet K, Spithoff K, Consortium ANS. The AGREE reporting checklist: A tool to improve reporting of clinical practice guidelines. *BMJ* 2016;352. https://doi.org/10.1136/bmj.i1152
9. Clyne B, Tyner B, O'Neill M, et al. ADAPTE with modified Delphi supported developing a national clinical guideline: Stratification of clinical risk in pregnancy. *J Clin Epidemiol* 2022;147:21-31. https://doi.org/10.1016/j.jclinepi.2022.03.005
10. Collaboration A. The ADAPTE process: Rsource toolkit for guideline adaptation. Version 2.0. Berlin: Guideline International Network. 2009.
11. Yadav P, Alsabban A, de Los Reyes T, et al. A systematic review of pediatric neurogenic lower urinary tract dysfunction guidelines using the Appraisal of Guidelines and Research Evaluation (AGREE) II instrument. *BJU Int* 2023;131:520-9. https://doi.org/10.1111/bju.15902
12. 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;35:471-81. https://doi.org/10.1002/nau.22751
13. Abrams P, Khoury S. International consultation on urological diseases: Evidence-based medicine overview of the main steps for developing and grading guideline recommendations. *Neurourol Urodyn* 2010;29:116-8. https://doi.org/10.1002/nau.20845
14. Kavanagh A, Baverstock R, Campeau L, et al. Canadian urological association guideline: diagnosis, management, and surveillance of neurogenic lower urinary tract dysfunction-full text. *Can Urol Assoc J* 2019;13:E157-76. https://doi.org/10.5489/cuaj.5912

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