











Post-COVID-19 neurogenic lower urinary tract dysfunction in pediatrics: A case series of clinical manifestations resembling Elsberg syndrome

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Abstract

Background: Among the numerous complications associated with post-coronavirus disease 2019 (COVID-19) syndrome, neurogenic lower urinary tract dysfunction (NLUTD) has been rarely reported, particularly in the pediatric population.

Case Presentation: This report presented three pediatric cases of NLUTD that developed following severe acute respiratory syndrome coronavirus 2 infection, with clinical features resembling Elsberg syndrome. These cases were notable for the severity of their urinary symptoms, which required specialized and individualized bladder management strategies. This case series aims to raise awareness of this emerging clinical condition, which may be underdiagnosed in children recovering from COVID-19. Pediatricians, general practitioners, and urologists should be vigilant in considering NLUTD as a potential diagnosis in children presenting with new or unexplained urinary symptoms. Early diagnosis and timely management are crucial to address these symptoms effectively and prevent potential complications, such as irreversible upper urinary tract damage or long-term bladder dysfunction. **Conclusion:** Further investigations are warranted to clarify the pathophysiological mechanisms underlying post-COVID-19 NLUTD. Moreover, long-term follow-up studies are needed to better understand the natural history and implications of this condition in the pediatric population, as well as to develop effective strategies for prevention and treatment.

Keywords: Voiding dysfunction, Children, Post-coronavirus disease 2019, Neurogenic bladder, Elsberg syndrome

1. INTRODUCTION

From the initial spread in December 2019 until November 2024, more than 776.8 million cases and 7 million deaths related to pandemic severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) have been notified to World Health Organization (WHO) [1]. The clinical presentation of coronavirus disease 2019 (COVID-19) is highly variable, though it most commonly manifests as a flu-like illness that can progress to severe pneumonia and respiratory distress. Along with these frequently observed symptoms, the involvement of other organs with a broad spectrum of clinical manifestations has been reported in the literature, afflicting both adults and children [2]. The dysregulated immune response in COVID-19 can lead to various complications, including endothelial dysfunction and a Kawasaki-like disease, termed SARS-CoV-2-related inflammatory multisystem syndrome

[3,4]. Neurological involvement in COVID-19 is mainly described in adults and includes severe manifestations such

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as febrile seizures, convulsions, change in mental status, encephalitis, Guillain-Barré syndrome, and acute necrotizing encephalopathy. In contrast, only a few pediatric cases have been reported in the literature [3,5].

The urological involvement, presenting as neurogenic lower urinary tract symptoms (NLUTS) and dysfunction (NLUTD), has been occasionally described [6-8]. Some authors have proposed a potential link to Elsberg syndrome, a rare viral lumbosacral radiculitis associated with herpesvirus infection. Elsberg syndrome can cause sudden urinary retention, constipation, radicular pain, and paresthesia. Although functional impairment may remain, urological symptoms generally resolve within weeks [9,10]. Given the affinity of SARS-CoV-2 for the angiotensin-converting enzyme 2 (ACE-2) receptor, the virus may interfere with the renin-angiotensin-aldosterone system, affecting podocytes and tubular epithelial cells and leading to renal injury [3].

We presented a series of pediatric cases of NLUTD observed following COVID-19 infection. Our aim was to increase awareness for this emerging clinical entity among general practitioners and pediatricians, encouraging prompt urological management when necessary to prevent further development of complications in the urinary system.

2. CASE PRESENTATION

2.1. Overview

This case series included three pediatric patients, who were all aged under 18 years and referred to our division between the onset of the COVID-19 pandemic and March 2024. Each patient presented with NLUTS on confirmation of SARS-CoV-2 infection. The clinical presentations ranged from acute urinary retention to urinary incontinence, highlighting the diverse manifestations of this condition. None of the patients had been vaccinated against SARS-CoV-2, and no alternative causes for their urological symptoms were identified.

A comprehensive diagnostic approach was employed, including blood renal function tests, urinary ultrasound, urodynamic studies, cystoscopy, and cerebral and spinal magnetic resonance imaging (MRI). This systematic evaluation was crucial for identifying the underlying bladder dysfunction and guiding appropriate management strategies. The mean follow-up period for the three patients lasted for 1.4 years (range: 1–2 years).

The main demographic and clinical characteristics of the patients are summarized in [Table 1](#). These details provide an overview of the variability in presentations, diagnostic findings, and follow-up durations. Each case is subsequently detailed to highlight the specific clinical course, interventions, and outcomes.

2.1.1. Case 1

A 12.9-year-old male presented with sudden urinary retention, requiring immediate catheterization. His COVID-19 infection was complicated by multisystem inflammatory syndrome in children (MIS-C), and MRI findings revealed acute disseminated encephalomyelitis (ADEM). Ultrasound examination showed hydronephrosis and bladder wall thickening, while cystoscopy identified mild bladder trabeculation. Video-urodynamic studies confirmed a neurological bladder pattern.

Management included standard urotherapy, which consisted of behavioral instructions on diet, urinary and bowel habits, as well as clean intermittent catheterization (CIC). However, the patient was unable to tolerate CIC, necessitating the placement of an endoscopic button cystostomy. In addition, intradetrusor onabotulinum toxin A (BTX-A) injections were administered to improve bladder function. The patient also suffered from constipation, which was managed with laxatives and enemas.

After a follow-up of 2 years, the patient regained partial bladder sensation but continued to rely on the cystostomy for regular bladder emptying. No renal function impairment was observed.

2.1.2. Case 2

A 9.5-year-old female presented with sudden urinary retention, requiring catheterization. Her COVID-19 infection had a flu-like course, with no abnormalities detected on MRI. Ultrasound revealed hydronephrosis, and urodynamic studies demonstrated dyssynergia and a hypocontractile detrusor. Cystoscopic findings were normal, and video-urodynamic studies confirmed a neurological bladder pattern.

The patient was managed with standard urotherapy and CIC, supplemented by percutaneous tibial nerve stimulation to improve bladder control. Over a course of 1 year, gradual improvement in bladder function was achieved, with no renal function impairment.

2.1.3. Case 3

An 8.6-year-old female presented with progressive dysfunctional voiding and urinary incontinence. Her COVID-19 infection followed a mild, flu-like course, with no abnormalities detected on MRI. Ultrasound findings were normal; however, cystoscopy revealed erosive cystitis, which was confirmed on biopsy. Video-urodynamic studies indicated a neurological bladder pattern.

Management consisted of standard urotherapy and CIC to address bladder dysfunction. After a follow-up period of 1.3 years, the patient achieved complete recovery of bladder function, with no evidence of renal function impairment.

Table 1. Patient characteristics

Pt	Sex	Age ^a	LUTS	Urinary US	UD	Cystoscopy	Follow-up
1	M	12.9	Urinary retention	Hydronephrosis/bladder wall thickening	Overactive bladder with dyssynergia	Mild trabeculae	2 years
2	F	9.5	Urinary retention	Hydronephrosis	Dyssynergia; hypocontractile detrusor	Normal	1 year
3	F	8.6	Urinary incontinence	Normal	Dyssynergia	Erosive cystitis at biopsy	1.3 year

Note: ^aAge at onset of urinary symptoms

F: Female, LUTS: Lower urinary tract symptoms, M: Male, Pt: Patient, UD: Urodynamic examination, US: Ultrasound.

3. DISCUSSION

According to the literature, COVID-19 infection in the pediatric population typically results in mild clinical symptoms, with children generally considered at low risk for hospitalization and life-threatening complications. Nevertheless, severe cases have been reported, including instances of post-infection MIS-C [2].

3.1. Pathophysiological mechanisms of post-COVID-19 neurogenic LUTS

Several hypotheses have been proposed to explain the pathophysiological mechanisms of post-COVID-19 NLUTD. SARS-CoV-2 is thought to contribute to neuronal demyelination in both the central and peripheral nervous systems, either through direct viral infection or through the release of pro-inflammatory molecules. Central nervous system involvement can lead to severe manifestations such as seizures, encephalitis, and ADEM [5]. These manifestations may be associated with the onset of new urological symptoms, including neurogenic bladder dysfunction. In addition, dysfunction of the autonomic nervous system or pudendal nerve neuropathy may play a role, potentially due to sympathetic overactivation caused by proinflammatory cytokines or altered autonomic receptor function induced by abnormal antibodies [8]. Abrams *et al.* [9] reported a case of suspected Elsberg syndrome associated with COVID-19, which presented with unusual neurological and autonomic manifestations. Other authors have focused on the expression of ACE-2 receptors in the luminal or basal urothelial cells, which are the primary receptors for SARS-CoV-2. This expression may lead to endothelitis and local inflammation [12,13], with subsequent increases in urinary inflammation cytokines (*e.g.*, interleukin-6 and interleukin-8) and activation of mast cells in response to the cytokine storm. In addition, psychological aspects, such as fear and depression, related to prolonged hospitalization, may exacerbate symptoms.

3.2. Diagnostic insights and therapeutic interventions

In our study, MRI and urodynamic evaluations were prioritized due to their reliability in detecting neurogenic and functional bladder abnormalities. However, additional diagnostic tools, such as electromyography and pudendal sensory-evoked potentials, could provide further insights

into the pathophysiology of NLUTD in these patients. The inclusion of these modalities in future studies would likely offer a more comprehensive understanding of the condition, particularly concerning autonomic and peripheral nerve involvement.

The preservation of renal function in our patients, despite significant LUTD, likely reflects the effectiveness of early interventions, including CIC, derivations [11] and urotherapy. These measures were implemented to protect upper urinary tract health, underscoring the importance of prompt and proactive management to preserve renal function in the cases of NLUTD.

3.3. Post-COVID-19 neurogenic LUTS in literature

To date, only a few reports have described post-COVID-19 NLUTD in pediatric patients, each with a different clinical evolution. Tiryaki *et al.* [6] reported 20 children who developed a sudden onset of significantly increased frequency and/or urinary incontinence after COVID-19 infection, which gradually and spontaneously resolved within 6 months. In contrast, Selvi *et al.* [7] described three children who presented with urinary retention, requiring CIC approximately 3 months after COVID-19 infection. Most recently, Emordi *et al.* [8] reported five patients who developed urinary and/or fecal incontinence shortly after COVID-19 infection, all of whom showed spontaneous improvement during follow-up. This report, while confirming the possible association between new-onset NLUTS and COVID-19 infection, also highlighted that COVID-19 could contribute to the new onset of fecal incontinence. However, in our series, only one patient exhibited gastrointestinal symptoms, specifically constipation.

3.4. Future perspectives

The exact mechanisms linking the occurrence of LUTS, or the worsening of pre-existing symptoms, with COVID-19 infection, need to be clarified.

Although our sample size was limited, our aim was to provide initial insights and raise awareness about post-COVID-19 NLUTD in children. These findings underscore the need for larger, prospective studies to confirm and expand on these preliminary observations, ideally incorporating genetic, immunological, and imaging assessments. Comparing data such as urinary and blood-based cytokines, microbiome

composition, and types of bacteria involved in urinary tract infections across different populations, specifically pediatric patients in the acute phase of COVID-19 infection, post-COVID-19 pediatric patients, symptomatic and asymptomatic, could help clarify the underlying mechanisms, particularly regarding inflammatory and immunological markers and their impact on neurogenic pathways. In addition, investigating whether vaccination reduces the incidence or severity of NLUTD may be beneficial, as none of our patients were vaccinated, which could have influenced their post-infection outcomes. Furthermore, long-term follow-up of these post-COVID-19 patients with NLUTD could help us understand the progression of their LUTS [14].

4. CONCLUSION

COVID-19 infection may be a possible cause of NLUTD in children, either as a sole manifestation or in the context of Elsberg syndrome. The clinical presentation can vary, ranging from sudden urinary retention or incontinence to milder symptoms [9,15]. In cases of post-COVID-19 NLUTD, a neurological basis should be considered, and prompt management (such as urotherapy, CIC, oxybutynin, or BTX-A), may help prevent upper urinary tract damage and promote bladder function recovery [16].

Further studies with longer follow-up periods are needed to better understand the clinical course of post-COVID-19 NLUTD. However, we believe that clinicians, including general practitioners and pediatricians, should remain aware of this potential complication to avoid underestimating its impact.

The limitations of the present study include its small sample size, which reflects a single-center experience. Furthermore, the study was of retrospective design without a control group, and the follow-up time was relatively short. While we believe that the value of our report lies in highlighting the occurrence of NLUTD as a potential complication of post-COVID-19 infection in children, the limitations of the study make it difficult to draw broad conclusions regarding the prevalence and significance of post-COVID-19 NLUTD.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This retrospective case series received approval (exemption) from our Institutional Review Board (RAP-2024_0003; March 20, 2024). Written consent for the anonymous publication of data and participation was obtained from the guardians of all patients.

CONSENT FOR PUBLICATION

Consent for publication was obtained from the guardians of all patients.

AVAILABILITY OF DATA

Additional data used in this case series are available from the corresponding author on reasonable request.

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