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### Voiding dysfunction in children with acute transverse myelitis

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#### ABSTRACT

Voiding dysfunction is a common and often distressing complication in pediatric patients with Acute Transverse Myelitis (ATM), a rare inflammatory disorder of the spinal cord. This dysfunction, which may present as urinary retention, urgency, or incontinence, results from disruptions in the neural pathways that regulate bladder control. In the acute phase, nearly 95% of children with ATM experience voiding dysfunction, frequently requiring Clean Intermittent Catheterization (CIC). Although the initial management often includes anticholinergic medications and CIC, persistent bladder dysfunction remains prevalent long after the acute phase, with many children continuing to rely on CIC for bladder emptying due to voiding issues. Early intervention, including CIC, plays a critical role in preserving renal function and preventing further complications. Psychological evaluation is also essential, as voiding dysfunction can contribute to emotional and behavioural problems, potentially exacerbating anxiety, depression and social difficulties. Long-term follow-up with pediatric urologists and neurologists is essential for managing urinary health, improving quality of life and enhancing functional recovery.

**Key Words:** Acute transverse myelitis, Voiding dysfunction, Bladder dysfunction

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#### Introduction

Voiding dysfunction is a broad term indicating a voiding pattern that is abnormal for the child's age. The symptoms include urinary urgency, frequency and incontinence as well as infrequent voiding [1]. Acute Transverse Myelitis (ATM) is a rare, acquired focal inflammatory disorder characterized by inflammation of the spinal cord, presenting with rapid onset focal neurological deficits [2]. In pediatric patients, voiding

dysfunction is a significant and often distressing complication of ATM, resulting from disruption of neural pathways that regulate bladder control [3].

#### Literature Review

The spinal cord is essential for coordinating bladder function. During bladder filling, stretch receptors send signals *via* pelvic nerves to the spinal cord, which maintains detrusor relaxation and sphincter contraction to store urine. The brainstem's pontine storage center enhances this control by preventing premature contractions. When the bladder is full, stronger signals activate the micturition reflex, prompting the pontine micturition center to signal detrusor contraction and sphincter relaxation, allowing voiding. Lesions above the sacral spinal cord, for instance, may cause detrusor overactivity and detrusor-sphincter dyssynergia due to loss of inhibitory control from higher brain centers [4]. Meanwhile, injuries to the sacral cord or lower spinal

regions can interrupt reflex arcs, resulting in detrusor areflexia, urinary retention, and overflow incontinence [5].

Pediatric ATM is a rare condition, characterized by sensory, motor, and/or autonomic dysfunction, with an incidence of 1.7-2 per million children annually. Children account for approximately 20% of all ATM cases. ATM may be idiopathic or, most commonly, post-infectious (a prodromal infection within the preceding 30 days is reported in up to 66% of cases). It can also be associated with systemic autoimmune inflammatory disorders or acquired demyelinating diseases such as multiple sclerosis. While males are more frequently affected (male-to-female ratio 1.1–1.6:1), a female predominance is noted among teenagers in regions with a higher risk for multiple sclerosis and neuromyelitis optica, such as the United States, Canada and Europe.

ATM often presents with back pain as the first symptom, followed by motor and sensory deficits or bladder/bowel dysfunction. Only a limited number of studies have focused specifically on bladder dysfunction caused by ATM in the pediatric population. In some cases, a micturition disorder can be the presenting symptom. During the acute phase, approximately 95% of patients develop voiding dysfunction, particularly urinary retention, requiring bladder drainage by clean intermittent catheterization. It occurs due to disruption of signaling between the micturition center in the pons and the spinal pathways [6-8].

Pediatric patients with ATM can also present with a combination of detrusor-external sphincter dyssynergia, which leads to difficulties with voiding and detrusor hyperreflexia, resulting in urge incontinence. Management typically involves a combination of anticholinergic medications to address detrusor overactivity and Clean Intermittent Self-Catheterization (CIC) to assist with bladder emptying. Anticholinergic medications, such as oxybutynin or tolterodine, are the primary treatment for detrusor hyperreflexia. However, these drugs can worsen the obstructive symptoms caused by detrusor-sphincter dyssynergia. Patients with both conditions may need a combined approach using

anticholinergic therapy along with CIC to effectively empty the bladder and maintain urinary continence [9,10]. No definitive guidelines exist for the urological evaluation and follow-up of pediatric patients with ATM. A comprehensive evaluation, including video urodynamics, is essential to identify bladder and urethral dysfunction and define appropriate management plans. General recommendations suggest performing a renal and bladder ultrasound within the first three months and urodynamic studies within six months after disease onset. The primary goals in managing urinary tract dysfunction are to protect renal function and achieve urinary continence.

Over time, patients who initially cannot void may regain the ability to void voluntarily but often experience residual symptoms such as urinary urgency, frequency, or urge incontinence. Despite this recovery, over half of the patients requiring CIC at initial presentation continue to need it one year later. Following immunotherapy, pain is typically the first symptom to resolve, followed by motor deficits. Sensory deficits and bladder dysfunction often require more time to improve [11]. Early implementation of CIC may play an essential role in preserving renal function. Surgical procedures involving the urinary tract may be needed to maintain low bladder pressures and volumes in order to protect the kidneys. In rare cases where long-term bladder catheterization is required, a suprapubic cystostomy can be used instead of a urethral catheter.

The potential benefit is preventing genital injuries associated with extended use of urethral catheters. However, there is no strong published evidence proving that suprapubic cystostomy is superior to urethral catheterization [12]. Long-term use of indwelling bladder catheters adversely affects the bladder epithelium and increases the risk of bladder cancer [13]. A cutaneous vesicostomy or cystostomy buttons are only a temporary measure for patients in whom CIC has not been possible [14]. Continent procedures that achieve continence and low bladder pressure such as injection of botulinum A toxin can be used in some countries for children with detrusor overactivity who are on CIC and exhibit poor

response to anticholinergic agents in hopes of reducing intravesical pressures and augment dry periods between catheterization. Recent studies indicate a 33%-45% increase in bladder capacity with a corresponding reduction in detrusor pressure, but these changes remain insufficient to fully protect the upper urinary tract in patients with severe bladder dysfunction [15]. Catheterization has a prominent role in the management of neurogenic bladder of all etiologies. Independence from caregivers to perform bladder catheterization every 4 h is important for quality of life. Furthermore, children with cervical level spinal cord lesions often have impaired hand function and depend on attendants to perform catheterization. A continent catheterizable channel could be an alternative option to sphincterotomy and external collection devices, suprapubic cystostomy, ileal conduit and ileovesicostomy as methods to provide controlled bladder drainage.

While 38%-50% of children achieve complete motor recovery, urinary symptoms persist in 90%-100% of cases beyond the acute phase. Additionally, up to half of these children experience persistent bladder dysfunction during follow-up periods ranging from 6 months to 3 years [16,17]. The return of lower extremity reflexes has been identified as an indicator of bladder function improvement. Additionally, recovery of motor function within 20 days of symptom onset has been associated with a more favourable prognosis and less severe urinary sequelae. Long-term follow-up with pediatric urologists and neurologists is critical for monitoring bladder function, preventing complications, and adjusting management as the condition evolves [18,19].

## **Results and discussion**

Bladder dysfunction in pediatric patients with ATM is a prevalent and challenging complication, often leading to long-term urological issues despite possible recovery of other neurological functions. As outlined in the literature, the voiding dysfunction in myelitis typically results from disruptions in the neural pathways responsible for bladder control, particularly between the brainstem, spinal cord, and bladder. This dysfunction manifests as a combination of symptoms,

including urinary retention, incontinence, urgency and frequency, which significantly impact the patient's quality of life and overall health. In the acute phase, bladder drainage through CIC is often necessary. As reported, over half of the patients continue to require CIC one year after the onset of symptoms. This long-term dependency on catheterization underscores the importance of early intervention in preventing kidney damage and maintaining bladder function. Surgical interventions may be required to maintain low bladder pressures, while suprapubic cystostomy can reduce genital injuries compared to urethral catheters, evidence of its superiority is lacking. Botulinum toxin injections can increase bladder capacity and reduce detrusor pressure but remain insufficient for upper tract protection. Independence in catheterization is essential for improving quality of life, especially in children with impaired hand function where the continent catheterizable channel can be an option to the suprapubic cystostomy in children without caregivers available to carry out five or six catheterizations a day.

Persistent dysfunction, detrusor overactivity and low bladder compliance, can remain evident even as motor recovery progresses. Interestingly, some studies suggest lower extremity reflexes may serve as an early indicator of bladder function recovery. Furthermore, the timing of motor recovery has also been associated with urinary function prognosis. Long-term follow-up is critical to ensuring that these children maintain bladder health and continue to experience optimal motor and urological recovery. Psychological evaluation should be considered in this group of children, as voiding dysfunction may contribute to or exacerbate emotional and behavioural issues. Persistent bladder dysfunction can lead to significant distress and impact a child's mental health, potentially resulting in anxiety, depression, or social difficulties. Ultimately, while bladder dysfunction may persist, proper management can help mitigate its impact, leading to improved quality of life and functional independence [20].

## **Conclusion**

Bladder dysfunction is a common neurologic

complication of ATM in children and usually persists despite motor recovery. Voiding dysfunction results in significant implications for health and quality of life. A multidisciplinary approach involving timely diagnosis and personalized management is essential in order to preserve renal function, obtain functional independence and reduce long-term sequelae.

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