

Long-Term Complications of the Neurogenic Bladder



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KEYWORDS

- Neurogenic bladder • Urinary diversion • Spina bifida • Neurogenic lower urinary tract dysfunction
- Urinary incontinence • Low bladder compliance • Spinal cord injury • Multiple sclerosis

KEY POINTS

- Patients with neurogenic bladder are at highest risk for long-term complications, particularly upper urinary tract deterioration, including spinal cord injury, myelomeningocele, transverse myelitis, and other conditions in which there is a high burden of spinal disease.
- The greatest underlying contributing factor is the loss of coordinated bladder storage and emptying function, typically mediated by the pontine micturition center.
- Evaluation of the patient with neurogenic lower urinary tract dysfunction should involve an assessment of their upper urinary tract, their bladder safety, their continence status, and quality-of-life concerns.

INTRODUCTION

Mere decades ago, urologic sequelae were primarily responsible for the high mortality rates among patients with neurogenic bladder (NGB). As recently as the 1950s, upper urinary tract (UUT) damage was the number one cause of mortality in patients with spinal cord injury (SCI). Renal failure and urinary tract infections (UTIs) were the major culprits.¹ Children born with spina bifida (SB) were rarely expected to reach adulthood, often because of the severity of urologic complications. Since then, advancements in UTI treatment, implementation of regimented bladder management strategies, and the use of diagnostic tools such as urodynamics have brought about a dramatic reduction in previously high rates of mortality due to NGB complications: 80% of patients with SCI in the 1940s to 3% of renal-

related mortality in this population nearly 4 decades later.²

Although the successful reduction in mortality for this population has now been observed, NGB management still confers a high degree of morbidity and greatly impacts psychosocial well-being. Recently, the conversation has transitioned from mortality reduction to improving quality of life. These concerns are less binary and require a more nuanced approach. The goal for the urologist caring for the NGB population continues to be the prevention and management of long-term complications, with the added responsibility of balancing this goal with a compassionate focus on preserving quality of life. Successfully reconciling these 2 goals requires an understanding of the long-term urologic complications of NGB, particularly in the high-risk patient.

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Within the NGB population, certain patients will have higher risk of complications secondary to their underlying disease neurophysiology. The American Urological Association (AUA) Guidelines statement on urodynamics outline those individuals who have a higher likelihood of lower urinary tract dysfunction resulting in complications: SB, SCI, high burden of spinal cord disease (a de facto SCI due to demyelinating disease, tumor burden, infarction, or other causes), transverse myelitis, and men with multiple sclerosis (MS).³

The pathophysiology of the neurologic injury and its interaction with coordinated micturition creates the background for lower urinary tract dysfunction. First, the injury or deficit disrupts communication between the bladder and brain, specifically disrupting the pontine micturition center (PMC). The severity of this interruption correlates directly with how the lower urinary tract can execute a coordinated storage and voiding mechanism. The PMCs role in bladder emptying, via urethral sphincter relaxation and detrusor contraction, is well known and often reviewed. However, the PMC also has a pivotal role in the bladder's storage function. Without direct PMC feed-forward inhibition of detrusor contractility, the bladder loses its ability to maintain low pressures during filling. Over time, its normal elasticity is lost, leading to decreased compliance manifested at gradually lower filling volumes. The presence of poor compliance is likely the single greatest risk factor for devastating long-term complications, although no study has linearly correlated poor compliance with incidence of long-term UUT complications. However, it is the incidence of low compliance that separates the high- and low-risk NGB categories. For high-risk patients, long-term complications may be an added source of morbidity if not adequately anticipated or treated.

Specifically, the complications found in greater incidence in high-risk patients with NGB are upper tract disease, urinary incontinence, stones, and UTIs. UUT deterioration occurs as a direct result of decreased bladder compliance. The relationship between impaired compliance, detrusor leak point pressure, and renal dysfunction was first reported by McGuire and colleagues⁴ in 1981. It was further described in the late 1980s, when Gormley² noted that poor compliance on urodynamics (UDS) predicted poor renal outcomes in children with myelodysplasia. The sum of the findings of this era suggested a close association between elevated outlet pressures, via either the fixed sphincter activity or the detrusor sphincter dyssynergia, and the incremental loss of detrusor compliance resulting in the "high-pressure bladder." In turn, increased

detrusor pressure impairs delivery of urine from the kidneys. In addition, vesicoureteral reflux (VUR) can develop as a "pop-off" mechanism, ultimately resulting in UUT impairment. The validity of this connection was bolstered by several studies that demonstrated stabilization or improvement in upper tract deterioration when outlet pressures were pharmacologically or surgically lessened. In addition to UUT deterioration, other complications can occur concomitantly, especially in the long-term period. Urinary incontinence is multifactorial but can often occur in the setting of detrusor overactivity.²

Although this longer-term impact makes vigilance imperative to the provider, quality-of-life data also affirm additional psychosocial impact to the patient. Patient-reported outcome measures among individuals with NGB consistently demonstrate that nonfatal conditions, such as lack of social continence, presence of an indwelling catheter, frequent hospitalizations, and recurrent UTIs, can have profoundly devastating effects on a patient's satisfaction with their life.^{5,6} Extending life expectancy without also working to ensure that those years of life are considered of substantial quality to the patient can potentially downplay any mortality reduction.

The goal of this article is to introduce the reader to the pathophysiology that informs lower urinary tract dysfunction among patients with NGB, specifically focusing on those at highest risk for complications; characterize the complications associated with lower urinary tract dysfunction in these patients; and evaluate the evidence in support of interventions aimed at curtailing the long-term urologic manifestations of NGB.

GOALS OF MANAGEMENT IN THE NEUROGENIC BLADDER PATIENT

At the authors' institution, a fundamental premise is that management recommendations for the patient with NGB should balance the patient's own social goals and desires with the provider's assessment of their specific risk of complications. Balancing these priorities results in management strategies that are often patient specific and dependent on a wide set of variables. Even so, the driving principles rest on a foundation of balancing the patient's quality-of-life goals with their health and safety. Preserving renal function, promoting urinary continence, minimizing risks for associated sequelae such as UTIs and bladder stones, and enhancing the patient's quality of life are primary concerns from both a clinician and a patient perspective and form backbone of the primary "checklist" used when evaluating these patients (**Box 1**). Addressing the first 2 goals requires knowledge

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