

A Primary Care Provider's Guide to Management of Neurogenic Lower Urinary Tract Dysfunction and Urinary Tract Infection After Spinal Cord Injury

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Abstract: Neurogenic lower urinary tract dysfunction (NLUTD), previously termed neurogenic bladder dysfunction, is a common secondary complication of spinal cord injury (SCI). It is associated with significant morbidity, reduced quality of life, increased health care costs, and mortality. Primary care providers (PCPs) play an important role in optimizing urohealth over the life span. This article will review NLUTD in SCI, its complication, surveillance, and management. PCPs should be aware of SCI-related NLUTD, its complications, management, and surveillance recommendations, and when to refer to a specialist. **Key words:** neurogenic bladder, primary care, spinal cord injury, urinary tract infection

Health Maintenance Checklist

1. Regularly review patient's bladder care/program (at least annually)
2. Annual creatinine to assess renal function
3. Renal ultrasound to assess upper tracts every 1-2 years
4. Urodynamics at baseline and when change in function (urinary tract infections, incontinence, difficulty catheterizing, autonomic dysreflexia, stones)
5. Consider cystoscopy in patients with long-term indwelling catheters due to increased prevalence of bladder cancer

Episodic Care Considerations

1. Asymptomatic bacteriuria is very common. To avoid overtreatment and antibiotic resistance, do not perform routine urinalysis and culture in those without symptoms.
2. Symptoms of UTI may be atypical in people with SCI (autonomic dysreflexia, increased spasticity, change in frequency/incontinence, fever, abdominal discomfort, malaise).
3. Presence of signs and symptoms of UTI with urine culture findings (leukocyturia and positive urine culture) is the gold standard for guiding management in symptomatic UTI.

Case Report

Paul is a 24-year-old with a T8 American Spinal Injury Association Impairment Scale (AIS) A spinal cord injury (SCI) sustained 5 years ago. He presents to his primary care provider (PCP) "feeling unwell," with cloudy urine and increased spasticity. He reports that when he has these symptoms he has a urinary tract infection (UTI) and needs antibiotics. He tells you that he has received antibiotics three times in the past 9 months. He performs clean intermittent self-catheterization every 6 hours. He sometimes has incontinence between catheterizations. His blood pressure is 106/70 mm

Hg (normal for him), heart rate 74 beats per minute, and temperature 37.0°C. He is not in distress.

Introduction

PCPs and other health providers face uncertainty about neurogenic lower urinary tract dysfunction (NLUTD) in SCI and its complications such as UTI due to the complexity of the condition and lack of clear evidence-based guidelines.^{1,2} The goal of this article is to provide insight into SCI-related NLUTD and its management.

For individuals with SCI, NLUTD and UTI are common secondary complications that

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result in significant morbidity and can greatly affect quality of life.^{1,3} They are also associated with significant health care system costs due to preventable emergency department visits and hospitalizations.^{2,4,5} The vast majority of individuals with SCI experience bladder dysfunction.⁶⁻⁸ Even those who are ambulatory with incomplete SCI may have abnormalities in bladder function.⁸

The goals of NLUTD management include the following^{1,7-9}:

- Prevention of upper urinary tract deterioration (eg, hydronephrosis/hydronephrosis, renal failure)
- Maintenance of continence
- Preservation of quality of life
- Prevention or early recognition and management of symptomatic UTI and secondary complications

Pathophysiology

During normal volitional voiding, the neurologically intact bladder, specifically the detrusor muscle, contracts and the external sphincter simultaneously relaxes allowing urine to pass. In NLUTD, the control and coordination of this normal process can be interrupted. There can, however, be great variance in presentation of the bladder dysfunction across patients.^{1,9,10}

There are two main types of dysfunction associated with a neurogenic bladder after SCI: (1) a failure to store urine, and (2) a failure to empty the bladder of urine.¹⁰ Neurogenic detrusor overactivity (NDO), also referred to as hyperreflexic or spastic bladder, is a failure to store urine. NDO occurs with a spinal lesion at L1 or above. Increased storage pressure caused by uncoordinated contractions and relaxation of the detrusor and external sphincter can result in detrusor sphincter dysynergia (DSD). This can cause excessively increased intravesicular pressure. Complications can include incontinence, incomplete emptying, bladder thickening, renal stones, UTIs, hydronephrosis/nephrosis, and renal failure.

Areflexic bladder or flaccid bladder is a failure to empty the bladder and is caused by detrusor underactivity. It can occur with spinal lesions below L1, including a portion of those with cauda equina injuries. The loss of contractility in the detrusor and normal or decreased external

sphincter tone can result in bladder overdistension and incontinence.

Methods of Managing NLUTD

It is important for PCPs to have a working understanding of the various methods of management of NLUTD. The management approach may depend on many factors, including the level and completeness of SCI, gender, individual and caregiver preference, cognitive ability, and cost.^{3,8,10}

Clean intermittent catheterization

Clean intermittent catheterization (CIC) involves periodic catheterization by the individual or another party usually four to six times per day. CIC is often considered the preferred method as it may have the lowest risk of symptomatic UTIs and long-term complications.^{1,3,10-12} Successful CIC requires appropriate hand dexterity.^{10,11} Furthermore, the cost of catheters can be a barrier that may lead many individuals to re-use catheters.¹⁰ In those performing intermittent catheterization, there is some evidence that hydrophilic-coated (a polymer coating that reduces friction and inflammation) catheters may reduce UTIs compared to noncoated catheters.^{1,2,12}

Indwelling catheterization

Indwelling catheterization includes urethral and suprapubic catheters. These may be chosen if CIC cannot be consistently and reliably performed by the patient or caregiver.⁸ Suprapubic catheters, unlike urethral catheters, bypass the issues of catheter-related urethral damage and disruptions to sexual activity.^{10,11} Indwelling catheters are associated with higher rates of complications (eg, UTIs, calculi).^{3,10-12} There are inconclusive data regarding recommended frequency of catheter replacement; typically most are changed every 2 to 4 weeks.²

External catheterization

Condom catheters/external catheters can be used in select patients who rely on spontaneous detrusor contractility for "reflex voiding." Urodynamic testing should ensure that bladder pressures are

not dangerously high prior to use. Complications can include the condom falling off, skin irritation, incomplete emptying, and UTIs.¹⁰

Assisted bladder emptying

Assisted bladder emptying involves techniques such as Credé maneuvers, Valsalva maneuver, or triggered reflex voiding using suprapubic pressure to assist voiding. These strategies are generally discouraged as they can induce high bladder pressures, affect the pelvic floor musculature, and cause UTIs.^{3,10}

Pharmacologic approaches

Common pharmacologic methods to assist bladder function include the use of anticholinergic agents to promote detrusor relaxation, increase the capacity of a hyperactive detrusor muscle, and promote improved urine storage (Table 1).^{13,14} They are used in both intermittent and indwelling catheter users.^{3,8,15} Botulinum toxin A injections into the detrusor muscle can be recommended when anticholinergic agents are insufficient or cause intractable side effects.^{3,10}

Alpha-adrenergic antagonists, or alpha-blockers, may be used when there is a need to decrease outlet resistance and aid in bladder emptying.^{3,8,10} Botulinum toxin injections into the external

sphincter can also improve voiding.^{2,10} It should be noted that botulinum toxin has a temporary effect of approximately 3 to 4 months, and repeated treatments are often necessary. It is important to consider the possible side effects with each class of medications and how they might affect other aspects of care such as bowel function.³ These medications should be prescribed by clinicians experienced in their use and familiar with their potential side effects in SCI.

Surgical approaches

Surgeries to allow easier self-catheterization (eg, ileal conduit diversion or Mitrofanoff channel) or to facilitate emptying (eg, transurethral sphincterotomy or artificial sphincter) are options for carefully selected patients.^{3,10,16}

Urohealth Monitoring in NLUTD

Complications of NLUTD such as UTI, renal and bladder calculi, upper tract dysfunction (hydronephrosis), renal failure, bladder distension or thickening, strictures, and urethral trauma cause significant morbidity and mortality.^{1,3,10} The literature suggests an increased risk of bladder cancer in SCI patients with long-term catheters, however there is recent debate about this risk.^{1,17}

Table 1. Commonly used pharmacologic agents used to assist bladder function^{13,14}

Class	Examples	Therapeutic function	Common side effects
Alpha-adrenoreceptor antagonist (ie, alpha-blocker)	<ul style="list-style-type: none"> • Doxazosin • Terazosin • Tamsulosin 	Improve urodynamics by reducing outlet resistance	<ul style="list-style-type: none"> • Nasal congestion • Dizziness • Postural hypotension
Beta-3 selective adrenoreceptor agonist	<ul style="list-style-type: none"> • Mirabegron 	Improve urine storage by targeting the main adrenoreceptor involved in detrusor muscle relaxation	<ul style="list-style-type: none"> • Not recommended for patients with uncontrolled hypertension • Milder side effects versus anticholinergic medications • Mean rise in blood pressure
Muscarinic acetylcholine antagonists (ie, anti-cholinergic or anti-muscarinic agents)	<ul style="list-style-type: none"> • Darifenacin • Fesoteridine • Oxybutynin • Tolterodine • Trospium 	Improve urine storage by relaxing detrusor muscle tone	<ul style="list-style-type: none"> • Dry mouth • Constipation • Dry eyes • Blurry vision • Confusion • Dyspepsia
Botulinum toxin A	<ul style="list-style-type: none"> • Botox 	Injections at external sphincter enhance voiding, or injections into detrusor muscle decrease detrusor overactivity	<ul style="list-style-type: none"> • UTIs • Urinary retention • Repeat injections required for therapeutic effect

Note: UTIs = urinary tract infections.

The rate of mortality due to renal failure has decreased with regular surveillance, however there is no consensus to optimal frequency of urological testing.^{1,3,7,16,18} Commonly used screening tests include urodynamics, renal imaging, and blood tests. They are used to assess risk factors associated with the aforementioned complications. Recommendations for urohealth screening are detailed in **Table 2**. In some regions (Veterans Health Administration in the United States), an annual comprehensive physical examination is offered to all individuals with SCI.¹⁹

A urology referral should be considered in all patients with neurogenic bladder.¹ Absolute indications for urology referral include:

- three or more UTIs per year,
- upper tract dysfunction or presence of chronic kidney disease,
- renal/bladder calculi,
- persistent hematuria,
- urethral trauma, and
- ineffective current bladder management.

Urinary Tract Infection

UTIs, as defined by a presence of signs and/or symptoms of UTI with laboratory findings of a UTI (bacteriuria, leukocyturia, and positive urine culture), are a common complication associated

with NLUTD.^{1,3,8,10,12,20} They are important to identify and treat as they are a risk for autonomic dysreflexia, renal complications, unnecessary hospital visits, and mortality.^{1,3,4} However, there is no clear consensus regarding the diagnosis of UTI in persons with NLUTD.^{1-3,12} Furthermore, asymptomatic bacteriuria is very common in SCI-related NLUTD, and avoidance of overtesting and treating asymptomatic bacteriuria is critical to avoid antibiotic resistance.^{1-3,10,21-23} Identifying symptomatic UTIs is challenging for most clinicians in the setting of NLUTD.

Figure 1 defines significant bacteriuria and outlines an office approach to diagnosis and management of symptomatic UTI. However, several factors challenge the ability to distinguish clinically significant UTI from asymptomatic bacteriuria in the context of SCI. Many individuals after SCI will have altered sensation and thus have atypical signs and symptoms.^{1,3,13,24} As mentioned, bacteriuria is common and impacts the interpretation of results as individuals will commonly have positive urine cultures.^{1-3,10,25} PCPs face pressure to treat UTIs given the inability of individuals with SCI to accurately predict when they have a UTI, challenges in obtaining a timely urine sample and culture, and fear of a serious infection.^{10,12,25} Clinicians and patients have a shared responsibility to avoid overtesting and overtreatment asymptomatic bacteriuria. Studies

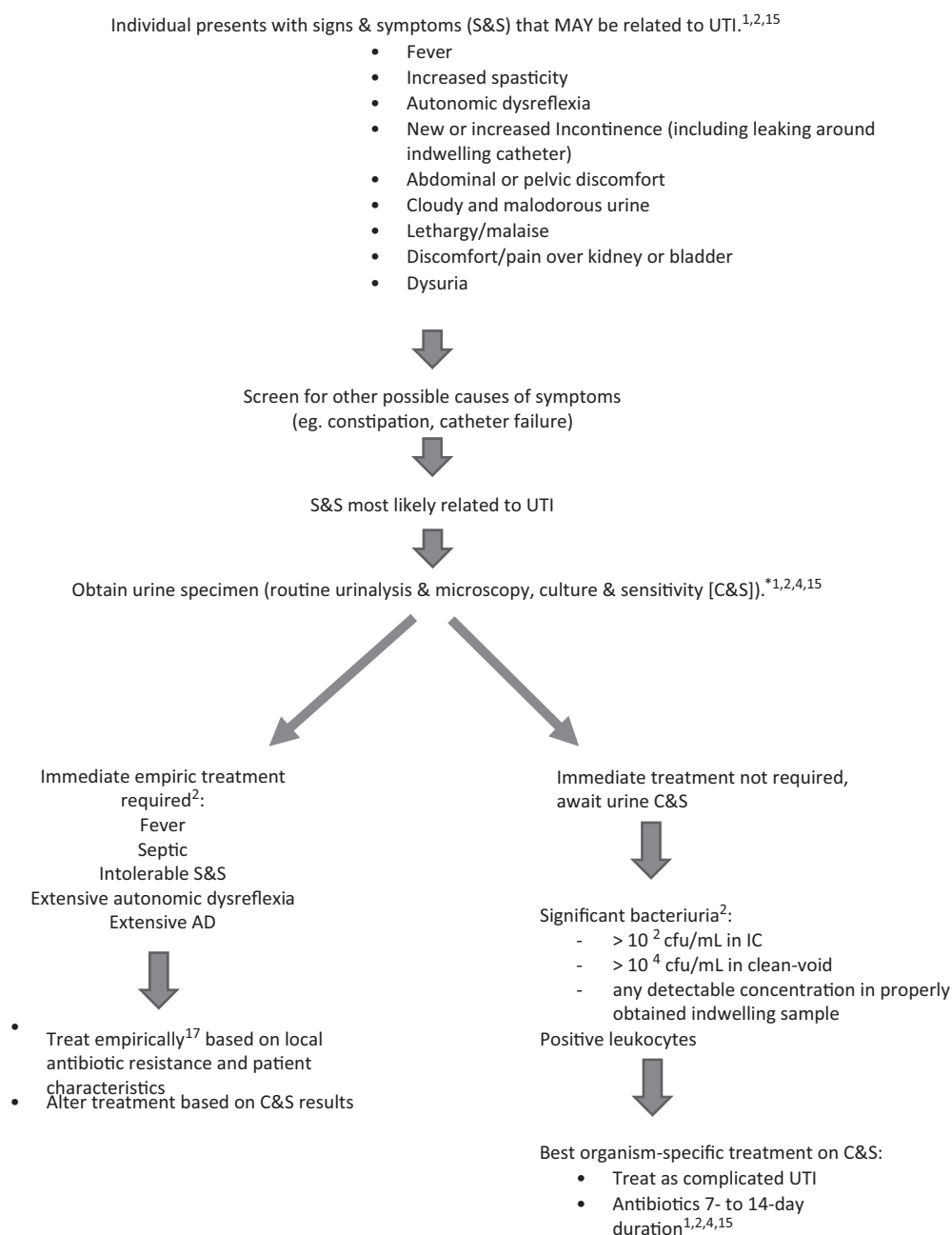
Table 2. Recommendations for urohealth screening in primary care

Recommendation	Details	Frequency
Review bladder management with patients after SCI	<ul style="list-style-type: none"> • Assess method of bladder management, continence, satisfaction, complications (eg, UTIs, hematuria).^{1,9} 	Annually (more often if there are complications)
Renal function tests	<ul style="list-style-type: none"> • Assess serum markers of renal function such as creatinine. • Creatinine may be unreliable or falsely low due to low muscle mass; watch for an upwardly trending creatinine.^{1,19} 	Annually
Renal/Upper tract imaging	<ul style="list-style-type: none"> • Assess for the presence of hydroureter/hydronephrosis, stones.^{1,9} • Renal ultrasound is noninvasive and readily available. It may also assess for bladder stones, debris, or trabeculations (suggestive of high pressure over time). 	Annually or biannually
Urodynamics	<ul style="list-style-type: none"> • Perform at baseline and when indicated by changes such as increased UTIs, difficult catheter insertion, incontinence, or urinary calculi.^{1,9,25} 	Baseline
Cystoscopy	<ul style="list-style-type: none"> • Assess as needed based on symptoms and clinical signs. • There is increased prevalence of muscle invasive bladder cancer in patients with neuro-urological bladder.³⁰ 	As needed based on signs and symptoms
Urinalysis/urine culture	<ul style="list-style-type: none"> • Obtain only when symptomatic.^{1,21} 	As needed based on signs and symptoms

Note: UTIs = urinary tract infections.

in catheter-associated UTIs from asymptomatic bacteriuria within non-SCI populations may be useful in developing improved diagnostic approaches and algorithms for managing UTIs among individuals with SCI.²⁶⁻²⁸

Obtaining a urine sample for culture and antibiotic sensitivity is the gold standard in an individual who presents with signs and symptoms that may reflect a UTI.^{1-3,8,10,11,24} A urine sample can be refrigerated for up to 24 hours without affecting the result,



*C&S gold standard, urine dipstick may be useful to exclude UTI
(if nitrites, leukocytes both negative)^{2,4,25}

Figure 1. Diagnosis of symptomatic urinary tract infection in neurogenic lower urinary tract dysfunction.

thereby assisting in the challenge of obtaining a timely culture.¹⁰ The use of urine dipstick testing is controversial but can be useful to exclude a UTI if both nitrites and leukocytes are negative.^{10,24}

Treatment

UTIs that occur in NLUTD are considered complicated UTIs, and antibiotic treatment of 7 to 14 days is often recommended.^{1-3,12,16} Treatment should be based on culture and sensitivities; however, if prompt treatment is required, then individual and local antibiotic resistance characteristics should be considered.³

Prevention of UTI

A recent study by Kennelly et al¹² has described a risk factor model for UTIs in individuals with NLUTD performing IC, identifying four areas that increase risk: general conditions (eg, high intravesical pressures and impaired bladder compliance, host deficiencies, or bowel dysfunction), local urinary tract conditions (eg, bacterial virulence, previous UTIs), user compliance/adherence (eg, non-hygienic practices, frequency, or fluids), and intermittent catheters (eg, catheterization introduces pathogens, catheter-associated trauma, or postvoid residual). Managing these risk factors may help reduce UTIs.

There is lack of evidence for interventions such as cranberry juice in UTI prevention.^{1-3,10} Long-term antibiotic prophylaxis is generally not successful and is discouraged to avoid antibiotic resistance.^{12,25} It should only be considered on an individual basis by a specialist.^{2,3} Since the presence of an indwelling catheter increases risk, the Infectious Disease Society of America (ISDA) suggests that indwelling catheters should be used only when indicated.² Generally, indwelling catheters are not recommended for bladder voiding in individuals with SCI unless self-catheterization is unachievable. Such scenarios may present for individuals with high-level tetraplegia or for individuals with structural urethral abnormalities.²⁹

Recurrent UTI (≥ 3 UTIs/year) may indicate a suboptimal method of management, reuse of equipment, improper technique, or other causes

including constipation or change in functional ability and should prompt re-assessment of current voiding program or referral.^{1,3,25}

Case Resolution

Further assessment indicates that Paul may be constipated, and you wonder if this may be related to his feeling of malaise and reported spasticity. You advise changes to his bowel program. You advise that you will collect a urine sample but will not treat unless it shows an infection and symptoms do not improve. On his follow-up visit, Paul's urine culture is nonconclusive showing "mixed growth," and Paul reports he is feeling better since improving his constipation. You review his voiding program and discuss the approach to diagnosing UTIs and avoiding overtreatment. You give him an ultrasound requisition, bloodwork for creatinine, and referral to a urologist for further assessment as these have not been repeated since Paul sustained his injury.

Conclusion

NLUTD affects quality of life and can cause many preventable secondary complications. PCPs should have an understanding of the prevention, management, and treatment of NLUTD and its complications after SCI.

Key Take Home Points

1. Goals of neurogenic lower urinary tract dysfunction management are prevention of upper urinary tract deterioration (hydronephrosis/hydronephrosis, renal failure), maintenance of continence, preservation of quality of life, prevention or early recognition of symptomatic urinary tract infection and secondary complications.

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