

## The AUA/SUFU Guideline on Adult Neurogenic Lower Urinary Tract Dysfunction: Diagnosis and Evaluation

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**Purpose:** The clinician treating patients with neurogenic lower urinary tract dysfunction (NLUTD) needs to balance a variety of factors when making treatment decisions. In addition to the patient's urologic symptoms and urodynamic findings, other issues that may influence management options of the lower urinary tract include cognition, hand function, type of neurologic disease, mobility, bowel function/management, and social and caregiver support. This Guideline allows the clinician to understand the options available to treat patients, understand the findings that can be seen in NLUTD, and appreciate which options are best for each individual patient. This allows for decisions to be made with the patient, in a shared decision-making manner, such that the patient's quality of life can be optimized with respect to their bladder management.

**Materials and Methods:** A comprehensive search for studies assessing patients undergoing evaluation, surveillance, management, or follow-up for NLUTD was conducted from January 2001 through October 2017 and was rerun in February 2021 to capture newer literature. The primary search returned 20,496 unique citations. Following a title and abstract screen, full texts were obtained for 3,036 studies. During full-text review, studies were primarily excluded for not meeting the PICO criteria. One hundred eight-four primary literature studies met the inclusion criteria and were included in the evidence base.

**Results:** This guideline was developed to inform clinicians on the proper evaluation, diagnosis, and risk stratification of patients with NLUTD and the non-surgical and surgical treatment options available. Additional statements on urinary tract infection and autonomic dysreflexia were developed to guide the clinician. This Guideline is for adult patients with NLUTD and pediatric NLUTD will not be discussed.

**Conclusions:** NLUTD patients should be risk-stratified as either low-, moderate-, high-, or unknown-risk. After diagnosis and stratification, patients should be

### Abbreviations and Acronyms

AD = Autonomic dysreflexia

AUA = American Urological Association

BPH = Benign prostatic hyperplasia

CAUTI = Catheter-associated urinary tract infection

CIC = Clean intermittent catheterization

CT = Computerized tomography

IDSA = The Infectious Disease Society of America

LUTS = Lower urinary tract symptoms

NLUTD = Neurogenic lower urinary tract dysfunction

PICO = Populations, Interventions, Comparisons, Outcomes

PVR = Post void residual

SCI = Spinal cord injury

SUFU = Society of Urodynamics, Female Pelvic Medicine & Urogenital Reconstruction

UA = Urinalysis

UDS = Urodynamics

US = Ultrasound

UTI = Urinary tract infection

VUR = Vesicoureteral reflux

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monitored according to their level of risk at regular intervals. Patients who experience new or worsening signs and symptoms should be reevaluated and risk stratification should be repeated.

**Key Words:** neurogenic bladder (or neurogenic lower urinary tract dysfunction), urodynamics, intermittent catheterization, autonomic dysreflexia, urinary tract infection

## INTRODUCTION

The term neurogenic lower urinary tract dysfunction (NLUTD) refers to abnormal function of either the bladder, bladder neck, and/or its sphincters related to a neurologic disorder. Prior terminology commonly used “neurogenic bladder” to describe this condition. With the understanding this is not just an issue confined to the bladder, NLUTD is the preferred way to describe the various voiding issues seen in patients with a neurologic disorder. In addition to lower urinary tract symptoms (LUTS), such as urinary incontinence and retention, patients with NLUTD may experience recurrent urinary tract infection (UTI) and autonomic dysreflexia (AD), which this Guideline will address. Non-urinary conditions such as sexual dysfunction, infertility, and bowel dysfunction are also common in patients with NLUTD but are not within this Guideline’s scope. Lastly, this is a Guideline for adult patients with NLUTD; pediatric NLUTD will not be discussed.

## GUIDELINE STATEMENTS

### Initial Evaluation of the Patient with NLUTD

**STATEMENT ONE: At initial evaluation, clinicians should identify patients as either:**

- a. low-risk, or
- b. unknown risk, who will require further evaluation to allow for complete risk stratification. *(Clinical Principle)*

Risk stratification is of utmost importance when following patients with NLUTD. The clinician needs to be aware of the various parameters that place patients at future risk for damage to the upper urinary tract. Clinicians should be able to assess the potential for risk and damage to the upper urinary tract and follow these patients accordingly based on this risk stratification (Figure 1, Table 1).

**STATEMENT TWO: At initial evaluation, all patients with NLUTD should undergo a detailed history, physical exam, and urinalysis. *(Clinical Principle)***

NLUTD represents a broad spectrum of medical conditions and illnesses which result in variable effects to the lower urinary tract. A thorough initial assessment of NLUTD patients is critical in directing subsequent evaluation and management. Important and notable factors to elicit in this population include cognitive ability; upper and lower

extremity function; spasticity and dexterity, which impacts the ability to do clean intermittent catheterization (CIC); mobility; supportive environment; and prognosis from the neurological condition (see Supplementary Materials 1, <https://www.jurology.com>). Urinalysis (UA; dipstick and/or microscopic) is performed to assess for hematuria, pyuria, glucosuria, proteinuria, and other findings which may prompt further evaluation.

**STATEMENT THREE: At initial evaluation, patients with NLUTD who spontaneously void should undergo post-void residual measurement. *(Clinical Principle)***

A post-void residual (PVR) should be performed at the time of diagnosis and may be checked periodically thereafter to monitor for changes in bladder emptying ability, regardless of symptoms, or at the discretion of the physician following management changes.<sup>1,2</sup> An elevated PVR potentially associated with a clinically relevant abnormality or condition (eg, LUTS, UTI, upper tract deterioration) should be confirmed with a second measurement at another visit.<sup>2,3</sup>

**STATEMENT FOUR: At initial evaluation, optional studies in patients with NLUTD include a voiding/catheterization diary, pad test, and non-invasive uroflow. *(Expert Opinion)***

A voiding diary is a simple, noninvasive, and inexpensive method of collecting somewhat objective information regarding LUTS and/or catheterization habits.<sup>4</sup> Patients who do not appear able to provide accurate intake and voiding information from recall should be directed to complete a diary.<sup>5</sup> The pad test is a noninvasive, inexpensive tool used to acquire objective data in confirming the diagnosis of incontinence, assessing its severity, aiding in treatment, and may be used as a diagnostic and outcomes tool. A non-invasive uroflow (uroflowmetry) integrates bladder function and bladder outlet function over time during a voiding event. Abnormalities in this test are indicative of a significant dysfunction in the voiding phase of micturition;<sup>2,3</sup> however, uroflowmetry only has value in individuals who spontaneously void.

**STATEMENT FIVE: At initial evaluation, in patients with low-risk NLUTD, the clinician should not routinely obtain upper tract imaging, renal function assessment, or multichannel urodynamics. *(Moderate Recommendation; Evidence Level: Grade C)***

In the initial evaluation of low-risk NLUTD, multichannel urodynamic studies (UDS) are unlikely to add

### Neurogenic Lower Urinary Tract Dysfunction Risk Stratification Flow Chart

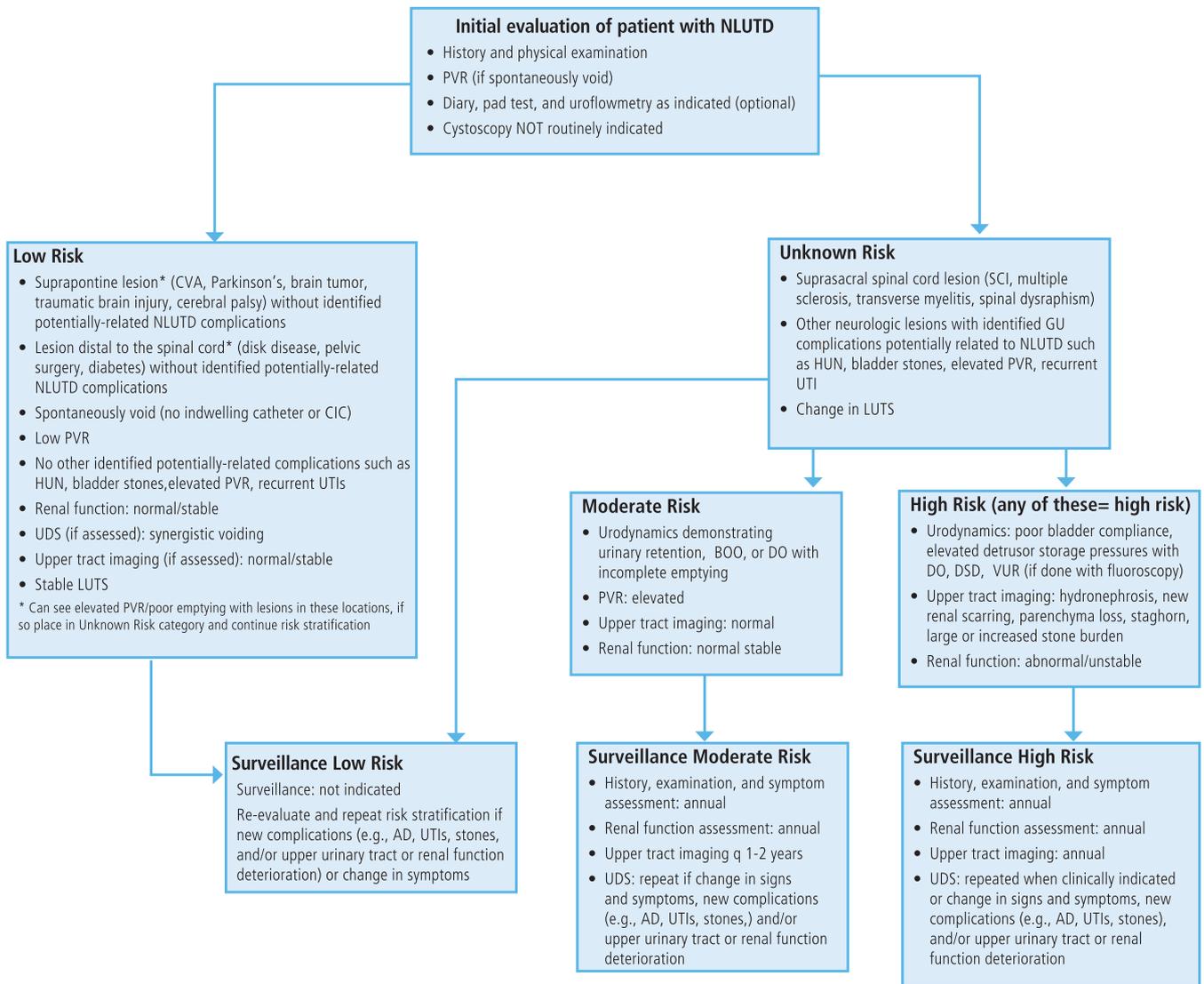


Figure 1. NLUTD risk stratification flowchart.

significant value as intravesical storage pressures are generally not elevated and prognosis is independent of UDS findings. UDS should be reserved for patients in whom the results would affect prognosis, change the diagnosis, or direct treatment,<sup>2</sup> or in those in whom additional urological pathology (eg, suspected obstruction) would alter management.<sup>6</sup> Urinary tract imaging and renal function studies in the low-risk NLUTD patient are likely to be normal and not indicated at the initial evaluation in the absence of other mitigating factors (Figure 1).

**STATEMENT SIX: At initial evaluation, in patients with unknown-risk NLUTD, the clinician should obtain upper tract imaging,**

**renal function assessment, and multichannel urodynamics. (Moderate Recommendation; Evidence Level: Grade C)**

In some individuals with NLUTD, the risk of complications remains unknown after the initial evaluation (Figure 1) and accurate risk stratification requires additional evaluation. Multichannel UDS (with detrusor leak point pressures when clinically relevant) is an essential tool in assessing lower urinary tract storage pressures for an accurate diagnosis, to assess prognosis, and to direct treatment in many cases. Unknown-risk NLUTD should also undergo upper tract assessment with imaging and functional studies.

**Table 1.** NLUTD risk stratification

	Low-Risk Normal/stable	Moderate-Risk Normal/stable	High-Risk Abnormal/unstable
PVR (voiding patients): Urinary tract imaging	Low Normal/stable (if assessed)	Elevated Normal findings	N/A Hydronephrosis, new renal scarring, loss of renal parenchyma, or staghorn/ large stone burden
Urodynamics	Synergetic voiding (if assessed)	Neurogenic retention DO with incomplete emptying	Poor compliance VUR (if UDS done with fluoroscopy) High storage pressures with DO and DSD

Patients are categorized into the highest risk strata they meet (eg, a patient meeting the high-risk criteria in any one category is high-risk).  
DO: detrusor overactivity; DSD: detrusor sphincter dyssynergia; PVR: post-void residual; UDS: urodynamic studies; VUR: vesicoureteral reflux  
NLUTD risk stratification

**STATEMENT SEVEN: In the patient with an acute neurological event resulting in NLUTD, the clinician should perform risk stratification once the neurological condition has stabilized. (Clinical Principle)**

Spinal shock following acute spinal cord injury (SCI) may last several days or months, and usually resolves in approximately 3-6 months, but the duration can be as long as 1-2 years. UDS may be delayed until the period of spinal shock has resolved. Following treatment and recovery from acute brain injury, reinvestigation with UDS weeks or months later may reveal considerable changes in the pattern of lower urinary tract dysfunction.<sup>7</sup> Risk stratification should not be performed during these periods and should be postponed until the neurological condition and consequences have stabilized.

**STATEMENT EIGHT: Clinicians should not perform routine cystoscopy in the initial evaluation of the NLUTD patient. (Clinical Principle)**

In the NLUTD patient, cystoscopy may be indicated at the initial evaluation in the setting of unexplained hematuria or pyuria; suspected urethral pathology such as stricture or false passage; bladder stones; or known or suspected bladder cancer. In the absence of mitigating factors from history, physical examination, or UA, as noted above, cystoscopy is unlikely to yield significant findings and is not recommended.

### Autonomic Dysreflexia

**STATEMENT NINE: During urodynamic testing and/or cystoscopic procedures, clinicians must hemodynamically monitor NLUTD patients at risk for autonomic dysreflexia. (Clinical Principle)**

Clinicians who are managing NLUTD patients should be able to recognize those at greatest risk for AD and these patients should be hemodynamically monitored continuously during testing.<sup>8</sup> Pharmacotherapy to manage AD should be accessible and readily available in the facility before every urologic procedure.<sup>9,10</sup> Bladder distension

that can result from urinary retention, catheter blockage, or lower urinary tract procedures is the most common trigger factor for AD and accounts for up to 85% of cases of AD.<sup>8</sup> The second most common trigger factor for AD is bowel distension due to fecal impaction.

**STATEMENT TEN: For the NLUTD patient who develops autonomic dysreflexia during urodynamic testing and/or cystoscopic procedures, clinicians must terminate the study, immediately drain the bladder, and continue hemodynamic monitoring. (Clinical Principle)**

For NLUTD patients who develop AD during urodynamic testing/and or cystoscopy examinations, the clinician should stop the inciting procedure immediately and drain the urinary bladder. These maneuvers should be considered first-line treatment and clinical improvement, as measured hemodynamically and clinically, is usually immediate once the noxious stimulus has been removed.<sup>9</sup> Blood pressure should be monitored at least every five minutes until the patient is stable with baseline vital signs. If hemodynamic improvement does not occur after first-line treatment, pharmacotherapy should be considered.

**STATEMENT ELEVEN: For the NLUTD patient with ongoing autonomic dysreflexia following bladder drainage, clinicians should initiate pharmacologic management and/or escalate care. (Clinical Principle)**

Clinicians should immediately initiate pharmacologic management and escalate care in patients with ongoing and persistent AD following bladder drainage. Patients with a systolic blood pressure greater than 150 mm Hg and/or 20 mm Hg above baseline who exhibit persistent classic symptoms such as flushing, sweating, headache, blurry vision, and a sense of impending doom are not adequately managed. The topical application of 1 to 2 inches of 2% nitroglycerine paste on the skin, above the level of the spinal cord lesion, is effective and can be easily removed in order to minimize the subsequent risk of hypotension once the hypertensive crisis subsides. Alternatively, nifedipine can be used.

**Surveillance of the patient with NLUTD**

**STATEMENT TWELVE: The clinician must educate patients with NLUTD on the signs and symptoms that would warrant additional assessment. (Clinical Principle)**

Patients with NLUTD can suffer from urological complications in the interval period between annual visits and should contact their clinician if they develop new or worsening AD or urinary incontinence, new or more frequent UTIs or infections associated with fever or flank pain, new upper tract findings such as stones or hydronephrosis/vesicoureteral reflux (VUR), and difficulties catheterizing.<sup>11</sup> Hematuria, even with catheterization, should be reported since this can be an early sign of bladder cancer<sup>12</sup> or urinary lithiasis. This should prompt consideration of a hematuria workup<sup>13</sup> since gross hematuria is the most common presenting symptom of bladder cancer in patients with NLUTD, occurring in 32% of cases of bladder cancer in NLUTD.<sup>14</sup>

**STATEMENT THIRTEEN: In patients with low-risk NLUTD and stable urinary signs and symptoms, the clinician should not obtain surveillance upper tract imaging, renal function assessment, or multichannel urodynamics. (Moderate Recommendation; Evidence Level: Grade C)**

Low-risk NLUTD patients do not require upper tract imaging, renal function assessment, or UDS at initial presentation or in subsequent follow up (Figure 1). It is highly unlikely that over time these patients will develop urological complications secondary to their NLUTD; hence, there is little utility in performing more advanced screening tests.<sup>7</sup> Should they develop a complication such as a renal stone, urinary retention, or a UTI, these conditions would present symptomatically, and further evaluation could be done as indicated (Figure 1). If low-risk patients develop new signs, symptoms, or complications during their follow-up period, risk re-stratification and appropriate evaluation can be done as indicated.

**STATEMENT FOURTEEN: In patients with moderate-risk NLUTD and stable urinary signs and symptoms, the clinician should assess the patient with:**

- a. annual focused history, physical exam, and symptom assessment.
- b. annual renal function assessment.
- c. upper tract imaging every 1-2 years.

**(Moderate Recommendation; Evidence Level: Grade C)**

Moderate-risk NLUTD patients have already been risk stratified. An annual focused history, physical exam, and symptom assessment, with or without applicable questionnaires, provides the opportunity to screen for complications and worsening or new symptoms that may require investigation or

a change in medical management (Figure 1). Renal function with serum creatinine is often performed with routine lab work obtained by other providers. Serum creatinine levels in SCI patients have been shown to be significantly lower than age and gender matched ambulatory individuals; therefore, a significant rise in serum creatinine from baseline, even within the normal range, should prompt careful assessment.<sup>15</sup> Cystatin C levels can also be used to estimate renal function and is thought to be superior to serum creatinine in patients with SCI.<sup>16</sup> Provided moderate-risk patients report no new complications or symptoms, a renal ultrasound (US) every 1-2 years is sufficient (Figure 1).<sup>17</sup>

**STATEMENT FIFTEEN: In patients with high-risk NLUTD and stable urinary signs and symptoms, the clinician should assess the patient with:**

- a. annual focused history, physical exam, and symptom assessment.
- b. annual renal function assessment.
- c. annual upper tract imaging.
- d. multichannel urodynamic studies, with or without fluoroscopy, which may be repeated when clinically indicated.

**(Moderate Recommendation; Evidence Level: Grade C)**

High-risk NLUTD patients (Table 1) are at substantial risk of renal deterioration, worsening bladder parameters, and UTIs. An annual clinical assessment with their urological provider is the minimum clinical follow-up recommendation for this high-risk group. High-risk patients require upper tract imaging annually given their risk of new stones, increasing stone burden, or renal parenchymal loss in a potentially already compromised upper tract (Figure 1). UDS may need to be repeated in high-risk patients, even in those with stable symptoms. Worsening of bladder compliance and/or detrusor storage pressures, or the development of VUR, can be silent but are serious conditions requiring constant monitoring and action as needed.

**STATEMENT SIXTEEN: In patients with low-risk NLUTD who present with new onset signs and symptoms, new complications (eg, autonomic dysreflexia, urinary tract infections, stones), and/or upper tract or renal function deterioration, the clinician should re-evaluate and repeat risk stratification. (Clinical Principle)**

Low-risk NLUTD patients do not require routine upper tract imaging, renal function assessment, or UDS (Figure 1); however, they are not at zero risk of urological manifestations of NLUTD. These patients may develop new incontinence or difficulty emptying, recurrent UTIs, stones, or upper tract/renal function deterioration. These signs, symptoms, and complications may

be the result of NLUTD or a manifestation of unrelated urological disease such as BPH or stress urinary incontinence. If their urinary tract condition has changed over time, and a clinical assessment changes their risk stratification, they should be followed up according to their new category.

**STATEMENT SEVENTEEN: In patients with the moderate- or high-risk NLUTD who experience a change in signs and symptoms, new complications (eg, autonomic dysreflexia, urinary tract infections, stones), or upper tract or renal function deterioration, the clinician may perform multichannel urodynamics. (Clinical Principle)**

UDS performed for specific symptoms or cause often yield important findings that may result in treatment changes. In multiple studies following NLUTD patients with sign or symptom changes such as increased incontinence, recurrent UTIs, changes in renal function, or new hydronephrosis, UDS revealed changes in bladder function that required a change in bladder management method or medical or surgical therapy.<sup>18</sup> UDS findings may result in a change in risk stratification to high-risk if concerning features are found (see Table 1).

**STATEMENT EIGHTEEN: In the NLUTD patient with concomitant hematuria, recurrent urinary tract infections, or suspected anatomic anomaly (eg, strictures, false passage), clinicians should perform cystoscopy. (Moderate Recommendation; Evidence Level: Grade B)**

Any patient with painless gross hematuria requires upper tract imaging (i.e., CT urogram or renal US) and a cystoscopy. Patients with indwelling catheters or those who perform CIC are at risk of urinary tract irritation or catheter trauma, but this cannot be determined without cystoscopic investigation. Benign bladder lesions, urethral strictures, or calculi will also be effectively diagnosed with a cystoscopy. NLUTD patients with difficult urethral catheter passage or hematuria with catheterization can have urethral strictures or a false passage from catheter trauma. Cystoscopy can effectively diagnose these conditions and may prompt treatment of a stricture or a change in catheterization technique after careful observation of the patient performing CIC.

**STATEMENT NINETEEN: In NLUTD patients, clinicians should not perform screening/surveillance cystoscopy. (Strong Recommendation; Evidence Level: Grade B)**

**STATEMENT TWENTY: In NLUTD patients with a chronic indwelling catheter, clinicians should not perform screening/surveillance cystoscopy. (Strong Recommendation; Evidence Level: Grade B)**

NLUTD bladder cancer patients often present with advanced disease at a younger age and with

unfavorable pathology, such as squamous cell carcinoma which is responsible for 25-81% of bladder cancers in the SCI population.<sup>19</sup> It has been suggested that surveillance cystoscopy in this population might be beneficial in the early detection of bladder cancer. However, a systematic review of nine studies has shown that cystoscopy and cytology are poor screening tests for bladder cancer in NLUTD patients<sup>15</sup> and overall, there remains an absence of high-level evidence that supports initial or annual cystoscopic surveillance for bladder cancer in this population.<sup>19</sup> A urologic history alone is likely a better screening tool than cystoscopy.<sup>14</sup>

**STATEMENT TWENTY-ONE: In NLUTD patients with indwelling catheters, clinicians should perform interval physical examination of the catheter and the catheter site (suprapubic or urethral). (Moderate Recommendation; Evidence Level: Grade C)**

Indwelling catheters are chronic foreign bodies present in the urinary tract and their site of entry is inherently at risk for complications. The urethra is at risk for catheter hypospadias (i.e., penile spatulation) in men and dilation of the bladder outlet and urethral loss in women. Patients with NLUTD are at particular risk; up to 23% of men with NLUTD and a urethral catheter suffer from urethral erosion.<sup>20,21</sup> Securing the catheter properly is one method to reduce this risk.<sup>22</sup> Suprapubic catheters avoid urethral complications but can erode through the abdominal wall if improperly secured.

**STATEMENT TWENTY-TWO: In NLUTD patients with indwelling catheters who are at risk for upper and lower urinary tract calculi (eg, patients with spinal cord injury, recurrent urinary tract infection, immobilization, hypercalciuria), clinicians should perform urinary tract imaging every 1-2 years. (Moderate Recommendation; Evidence Level: Grade C)**

Indwelling catheters increases the risk of UTIs<sup>23</sup> and is a source of chronic bacteriuria, both of which are risk factors for bladder and upper tract calculi. Bladder stones prevalence ranges from 8% to 41%<sup>20,23-26</sup> in patients with indwelling catheters and can go undetected without imaging until they are very large. The advantage of detecting stones when small is that they can be irrigated in clinic, while those that are slightly larger can be managed with a simple cystolitholapaxy. Upper tract stones are also common in this patient population occurring in 6-32% of patients.<sup>23,24,26</sup> For this reason, renal and bladder ultrasound are required in moderate- or high-risk NLUTD patients with an indwelling catheter.

## Urinary Tract Infection

**STATEMENT TWENTY-THREE:** In asymptomatic NLUTD patients, clinicians should not perform surveillance/screening urine testing, including urine culture. (*Moderate Recommendation; Evidence Level: Grade C*)

The rationale to screen asymptomatic NLUTD patients is to treat those with positive urine cultures with antibiotics, to reduce bacteriuria, and to prevent the development of a future symptomatic UTI. However, the risk of developing a UTI in this patient population appears to be low enough to not justify treatment, eliminating the need for screening.<sup>27</sup> Data suggests that while most patients may have urinary bacterial colonization, only a small proportion go on to develop a UTI. Additionally, given the pressing concerns of antibiotic resistance and need for antibiotic stewardship, avoiding surveillance/screening urine cultures will decrease the likelihood of patients receiving unnecessary antibiotics and developing resistant bacteria.<sup>28</sup>

**STATEMENT TWENTY-FOUR:** Clinicians should not treat asymptomatic bacteriuria in patients with NLUTD. (*Moderate Recommendation; Evidence Level: Grade C*)

Antibiotic resistance is a significant problem in patients with NLUTD, given the high frequency of antibiotic use. The unnecessary use of antibiotics, such as for treating asymptomatic bacteriuria, should be avoided at all costs. Treatment of asymptomatic bacteriuria in catheter-free patients with SCI is followed by early recurrence of the bacteriuria with more resistant strains.<sup>29</sup> In addition, this treatment has no effect on the rate of subsequent asymptomatic bacteriuria or UTI in SCI patients performing CIC.<sup>30</sup> The exception to treating asymptomatic bacteriuria in NLUTD patients is in patients who are pregnant and prior to urologic procedures, in which urothelial disruption or upper tract manipulation is anticipated.<sup>18</sup>

**STATEMENT TWENTY-FIVE:** In NLUTD patients with signs and symptoms suggestive of a urinary tract infection, clinicians should obtain a urinalysis and urine culture. (*Moderate Recommendation; Evidence Level: Grade C*)

There are challenges of diagnosing UTI with symptoms alone in the NLUTD patients with altered and decreased sensation. The Panel recommends that patients with signs and symptoms suggestive of a UTI should have a UA and urine culture, allowing for optimal diagnosis and the ability to use culture-specific antibiotics. Obtaining a urine culture allows clinicians to treat UTIs with culture-specific antibiotics and reflects good antibiotic stewardship, which is especially applicable to patients with NLUTD who may be at greater risk of harboring resistant organisms.<sup>31 32 33</sup>

**STATEMENT TWENTY-SIX:** In NLUTD patients with a febrile urinary tract infection, clinicians should order upper tract imaging if:

- a. the patient does not respond appropriately to antibiotic therapy.
- b. the patient is moderate- or high-risk and is not up to date with routine upper tract imaging, regardless of their response to therapy. (*Clinical Principle*)

Clinicians need to maintain a high degree of concern when NLUTD patients have a febrile UTI. NLUTD patients with a febrile UTI that does not respond to appropriate antibiotic therapy should undergo upper tract (eg, US, CT) evaluation to evaluate for diagnoses such as stones and hydronephrosis. Patients with moderate-risk NLUTD should have upper tract imaging every 1-2 years and patients with high-risk NLUTD should have upper tract imaging annually (see Figure 1). Appropriate radiographic assessment in these patients is still required, even if they respond to antibiotics.

**STATEMENT TWENTY-SEVEN:** In NLUTD patients with a suspected urinary tract infection and an indwelling catheter, clinicians should obtain the urine culture specimen after changing the catheter and after allowing for urine accumulation while plugging the catheter. Urine should not be obtained from the extension tubing or collection bag. (*Clinical Principle*)

In 2009, The Infectious Disease Society of America (IDSA) published guidelines for the diagnosis, prevention, and treatment of CAUTI in adults, which recommends obtaining urine specimens aseptically through a freshly placed catheter port in patients with short-term indwelling catheterization and suspected UTI.<sup>34</sup> Short-term is not defined in the IDSA document, but would not apply to NLUTD patients who manage their bladder with a chronic indwelling urethral/suprapubic catheter. Due to concerns related to biofilm possibly impacting adequate urine assessment, the recommendation from the IDSA is to obtain urine for culture from a freshly placed catheter. In addition, it is specifically stated that urine should not be obtained from the drainage bag.

**STATEMENT TWENTY-EIGHT:** In NLUTD patients with recurrent urinary tract infections, clinicians should evaluate the upper and lower urinary tracts with imaging and cystoscopy. (*Clinical Principle*)

It is considered good clinical practice to evaluate both the upper and lower urinary tracts for sources of recurrent UTI. Imaging is needed for examining the upper urinary tracts. Since the risks of lower urinary tract evaluation via cystoscopy are low, it is a necessary part of the evaluation of recurrent UTIs. *The AUA Guideline for Recurrent Uncomplicated UTIs in Women*<sup>35</sup> defines recurrent UTI as two episodes of

acute bacterial cystitis within six months or three episodes within one year; there is no clear-cut definition of recurrent UTI in the NLUTD patient population.

**STATEMENT TWENTY-NINE: In NLUTD patients with recurrent urinary tract infections and an unremarkable evaluation of the upper and lower urinary tract, clinicians may perform urodynamic evaluation. (Conditional Recommendation; Evidence Level: Grade C)**

Patients with NLUTD have an increased risk of recurrent UTI with an estimated rate of 2.5 episodes of infection per patient per year.<sup>36,37</sup> It is appropriate to obtain UDS in patients with recurrent UTIs who have an unremarkable evaluation of the upper and lower urinary tract. UDS is also helpful in the identification and evaluation of elevated PVR and VUR, which can commonly be seen with patients with NLUTD; there is evidence that both increased PVR and VUR can increase the risk of UTI incidence in patients with NLUTD.<sup>38–42</sup>

**STATEMENT THIRTY: In NLUTD patients who manage their bladder with an indwelling catheter, clinicians should not use daily antibiotic prophylaxis to prevent urinary tract infection. (Strong Recommendation; Evidence Level: Grade B)**

A systematic review by Morton et al. evaluated the use of antimicrobial prophylaxis in 15 studies of

acute and non-acute SCI patients or those with other chronic conditions resulting in spinal cord dysfunction. The authors found that antimicrobial prophylaxis did not significantly decrease symptomatic infections in patients but did result in approximately a two-fold increase in antimicrobial-resistant bacteria.<sup>43</sup>

**STATEMENT THIRTY-ONE: In NLUTD patients who manage their bladders with clean intermittent catheterization and do not have recurrent urinary tract infections, clinicians should not use daily antibiotic prophylaxis. (Moderate Recommendation; Evidence Level: Grade B)**

This recommendation is largely based on two systematic reviews that did not find evidence to support the use of prophylactic antibiotics for patients with NLUTD who manage their bladder with CIC and do not have issues with recurrent UTI. One found that antibiotic prophylaxis did not significantly decrease the rate of symptomatic UTIs and resulted in an approximate 2-fold increase in bacterial resistance.<sup>43</sup> The other found that there was not adequate evidence to make recommendations to this practice.<sup>44</sup> Based on this data and guidance from other medical societies, the Panel does not recommend prophylactic antibiotics in NLUTD patients without recurrent UTI who manage their bladder with CIC.<sup>45–48</sup>

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