Neurogenic Bladder

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INTRODUCTION

Many patients with spinal cord injury (SCI) will have problems with emptying the bladder and/or storing urine; some of these issues are obvious, some are not. It is critical for primary care providers to work with patients to develop an effective voiding routine to avoid both acute and long-term complications of inadequate bladder management.
This module will enable clinicians to:

- Become familiar with various methods of bladder voiding in neurogenic bladder
- Prescribe medications to assist in the storage of urine
- Identify and manage common complications of neurogenic bladder
- Determine appropriate follow-up and screening for patients

CASE

PAUL, AGE 24

Paul is a 24-year-old male who presents to the office with vague abdominal discomfort and a general sense of "feeling unwell". He has an incomplete T4 spinal cord injury sustained within the last year. He is otherwise healthy. His vital signs are stable, with a heart rate of 65 and a blood pressure of 100/70. He is afebrile.

What further information would you like to know on history?

- *Has he ever had symptoms like this before and if so what was the cause? What is his current bladder management routine? Be specific! How does he empty his bladder and how often? Any constipation? Has he ever had autonomic dysreflexia (AD)? AD can occur in patients with SCI at level T6 or above, and bladder problems are the most frequent cause of AD. Has he had other symptoms suggestive of a UTI e.g., any change in urine colour, fever, sudden change in urinary symptoms, increased spasticity, or change in his ability to hold or void urine?*

Paul self-catheterizes every eight hours. Generally, each catheterization results in around 600 mL of urine, and recently his urine has been cloudy with a slight odour. He also reports that he reuses catheters as they are expensive, and he does not always wash them between uses. He has not had AD in the past. Paul's bowel movements have been normal.

What are your next steps?

- *Vitals, palpate his abdomen for distension, if he had an indwelling catheter you could check catheter and urine colour. Obtain a urine sample. Ideally, have Paul use a new catheter prior to providing urine sample. Do not use urine dipstick, as it is unhelpful in guiding management. Discuss fluid & food with high water content intake – how much, how often & perhaps limiting intake.*

Paul asks if you think he has a urinary tract infection. If so, he would like a prescription so he can start taking his antibiotics now before his symptoms get any worse.

What can you do to manage Paul?

- *Advise Paul that his symptoms sound suspicious for a UTI. Since he is stable and clinically well, a prescription for antibiotics will be delayed until confirmed by urine culture and sensitivities. In the meantime, if he experiences worsening symptoms e.g., fever, hematuria, signs of AD, to seek medical care. It should be noted that if Paul presented clinically unwell, then empiric treatment would be appropriate. Recommend he catheterize more often (every four to six hours), and if volumes are higher than 500 mL he may need to catheterize even more frequently. He may take acetaminophen or ibuprofen for symptomatic relief.*

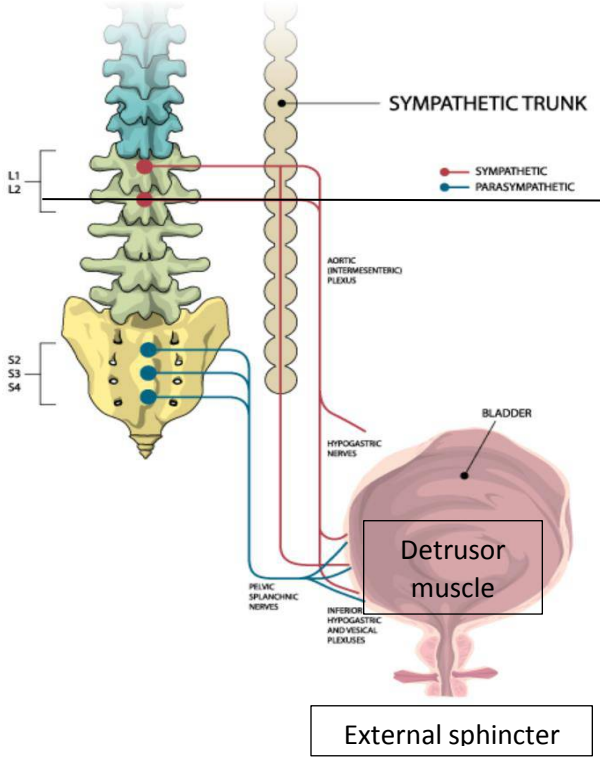
INFORMATION SECTION

Introduction

All patients with a complete spinal cord injury (SCI) and the majority of individuals with an incomplete SCI will experience some degree of bladder dysfunction, referred to as a neurogenic bladder.[1] Neurogenic bladder results in problems relating to the storage and release of urine.

Pathophysiology

Normally, when the detrusor muscle contracts, the external sphincter relaxes, allowing the passage of urine. There are two main types of neurogenic bladder: hyperreflexic bladder (also known as spastic bladder often associated with detrusor external sphincter dyssenergia) and areflexic bladder (also referred to as flaccid bladder).[2]



Hyperreflexic Bladder (lesion at ***L1 or above***)

- more common than areflexic
- contraction of both the detrusor muscle and the sphincter which blocks the flow of urine and creates increased pressure inside the bladder
- can result in reflux of urine toward ureters and kidneys, incontinence, incomplete bladder emptying
- increased risk of urinary tract infections, pyelonephritis, renal stones, hydronephrosis, and renal failure

Areflexic Bladder (lesion ***below L1***)

- less common than hyperreflexic
- commonly, loss of tone in the detrusor muscle and normal tone in the external sphincter
- can result in increased risk of incontinence with activities involving increased intraabdominal pressure (e.g., coughing, transfers)

Note: internal sphincter tone can be normal, which can result in incomplete emptying even if external suprapubic pressure is applied

Figure 1: Hyperreflexic vs Areflexic Bladder

***Clinical Pearl*:** the level of bony lesion does not always correlate with the neurogenic bladder classification. The level of spinal cord lesion needs to be determined clinically.

Methods of achieving effective bladder control

Most patients with SCI require assistance with emptying and/or storing urine. Although the methods to manage neurogenic bladder are primarily initiated by specialists, it is important for family physicians to have a basic understanding of the various techniques, which are outlined in the following section.

Clinical pearl: Refer to Spinalcordessentials.ca -- for helpful patient handouts for various catheterization techniques

Intermittent catheterization (IC)

IC is the preferred method as it has the lowest risk of long-term complications.[2,3] IC can be used by patients who have adequate hand function or an able and willing caregiver, who are motivated, who can tolerate catheterization multiple times a day, and who do not experience autonomic dysreflexia with low bladder volumes.[4] Ideally IC is performed every four to six hours and is combined with anticholinergic medication to relax an overactive detrusor muscle.[2,3] The goal is to keep bladder volume <500 mL; if it is consistently over 500 mL, the frequency of bladder emptying should be increased or another method used.[4] Patients can use the following table as a guide for timing of catheterization:

Urine Volume[5]	Next IC[5]
<400	6 hours
400-600	4 hours
>600	3 hours

Table 1: Urine volume and timing of catheterization
From spinalcordessentials.ca

A new catheter should be used each time; however, re-use is common, primarily due to cost. Unfortunately, cleaning or sterilization of catheters is also not always done if re-used. There are various options for cleaning catheters, including soap and water, boiling, microwave sterilization or soaking in antiseptic solution.[6] Unfortunately, catheters do not come with cleaning instructions or recommendations regarding the re-use of catheters. Of note, there can be increased risk of urethral complications and epididymoorchiditis with IC.[2] Intermittent catheterization may be combined with anticholinergic therapy.

Clinical pearl: Catheters are expensive! The following resources are available to help fund catheters for patients:

- For Ontario Disability Support Program recipients: Mandatory Special Necessities form
- For patients who have a WSIB claim, submit receipts to WSIB
- Private insurance plans

Clinical pearl: Choosing the right catheter for IC: Hydrophilic and pre-lubricated catheters ease insertion compared to traditional poly vinyl catheters. These newer catheters can decrease the frequency of UTIs. Pre-lubricated catheters are also associated with a decreased risk of urethral bleeding, decreased pyuria and improved satisfaction.[2] For some patients, cost of catheters may be prohibitive because not all costs are covered. Inquire about the individual's coverage to influence catheter choice.

Indwelling catheterization

Indwelling catheters may be used by individuals with tetraplegia who cannot perform IC; suprapubic rather than urethral (Foley) catheters are preferred as there are generally fewer complications and their use allows sexual activity.[2,3] Indwelling catheters, particularly urethral catheters, are associated with higher rates of complications, such as calculi, urinary tract infections, epididymitis, hydronephrosis, and bladder cancer.[2,3] Most patients change indwelling catheters every month.[7]

Condom catheterization

Condom catheterization is often used to overcome incontinence; however, patients will require adequate penile length and normal BMI. Complications include incomplete voiding, increased bladder pressures, urinary tract infections,[2] skin irritation, and leaking/falling off.[5]

Reflex voiding

Reflex voiding is not often recommended, as high bladder pressures have been documented with these techniques and, if used, careful monitoring advised (urodynamics).[2]

Anticholinergics

Medications are often taken by patients who use IC or indwelling catheters to help with the storage of urine and to prevent high filling pressures. Anticholinergics are first-line therapy for hyperreflexic bladder. Available options include:[8]

Medication	Dose	Special considerations
Oxybutynin	2.5-5 mg TID	Can be applied transdermally (36mg) q3-4 days (2x per week) – similar efficacy as oral preparation but causes less dry mouth[2]
Oxybutynin XL	5-10 mg OD (adjust dose at 5 mg increments – max 30 mg/ d)	
Tolterodine	1-2 mg BID or extended release 2- 4 mg OD	
Solifenacin extended release	5-10 mg OD	Maximum dose of 5 mg OD in patients with severe renal impairment.
Trospium chloride	20 mg BID or extended release 60 mg OD	Maximum dose of 20 mg qhs in older patients or patients with severe renal impairment.
Mirabegron	25-50 mg OD	May cause increase in BP – periodic BP measurements are recommended

		Mirabegron is a CYP2D6 inhibitor - caution with patients taking metoprolol, desipramine, thioridazine, flecainide & propafenone Dose should not exceed 25mg in patients with severe renal impairment and/or moderate hepatic impairment (Child-Pugh class C)

***Table 2**: Medications for treatment of hyperreflexic bladder*

Botulinum toxin

Botulinum toxin can be administered by some urologists in hyprerreflexic bladder into the detrusor or external sphincter (less common). It has local effect on bladder and may last 6-12 months;[2] however, repeat administration is may be required after 3-4 months.

Surgical methods for urinary diversion

Surgical methods may also be considered for bladder management, particularly for females with tetraplegia who cannot do IC and who experience persistent incontinence.

Complications of Neurogenic Bladder:

Urinary tract infections (UTI):

Patients with SCI have a higher risk of UTIs.[9] Additional risk factors include: being female, IC performed by someone else, low frequency and high volume catheterization, and having an indwelling catheter (UTD, 30, 40, 41).[10-12] UTIs are important to identify and treat in patients with SCI as they are a common cause of autonomic dysreflexia, septicemia and emergency department visits.[13]

Patients with SCI often have atypical clinical presentations of UTI and high rates of bacterial colonization in those that use some form of catheterization. It is critical to avoid treating asymptomatic bacteriuria to avoid antibiotic resistance; therefore the **gold standard is to obtain a urine culture and sensitivity prior to treating.**

***Clinical Pearl*:** It is common for patients who use catheters to have asymptomatic bacteriuria. To avoid treating asymptomatic bacteriuria, patients must have signs and symptoms consistent with UTI, significant bacteriuria, and ideally a culture and sensitivity prior to treating (provided patient is well).

Assessment of UTI at a Glance:

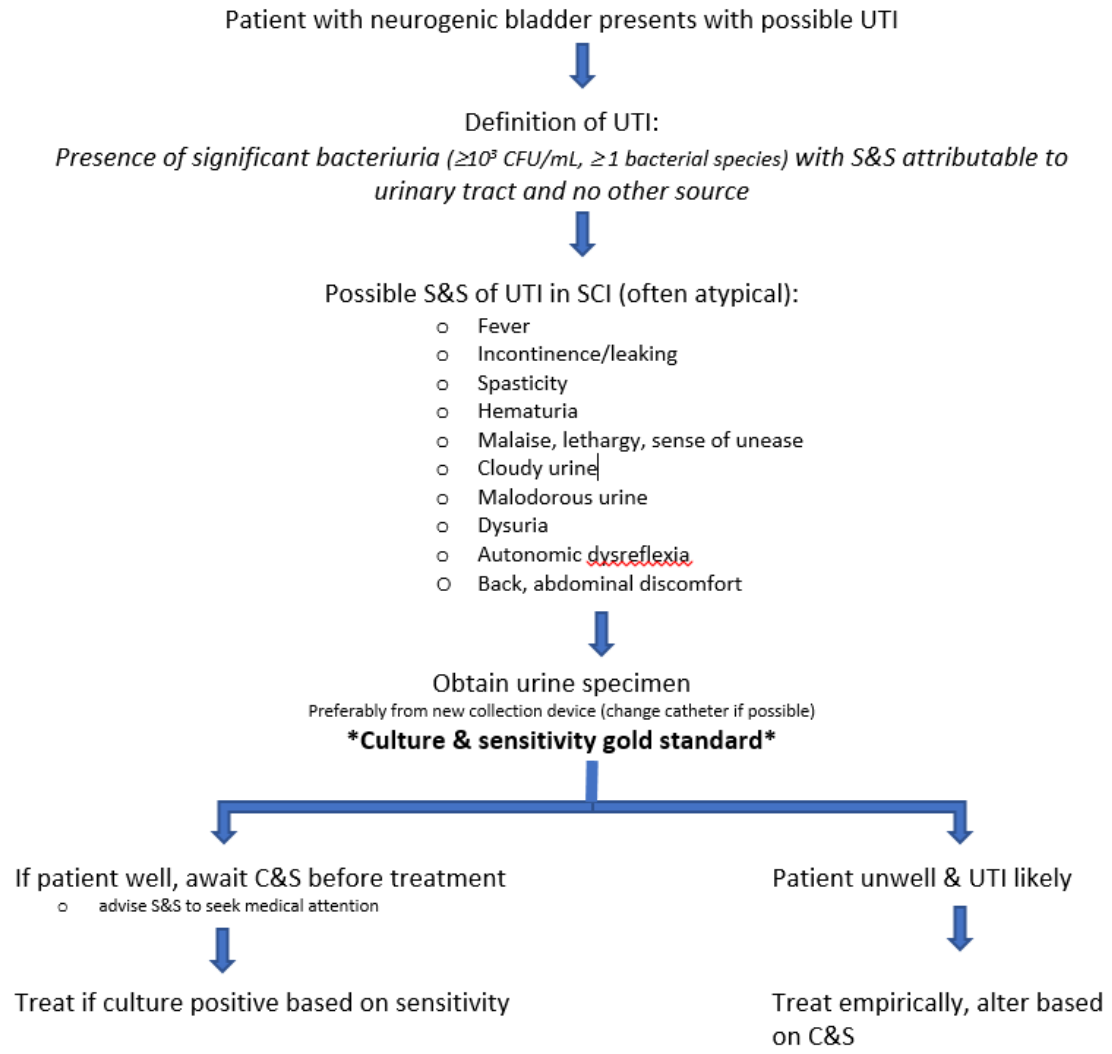


***Figure 2*:** Treatment algorithm of UTI

The presence of at least 10^3 CFU/mL of ≥1 bacterial species in a single catheter urine specimen (the collection of urine from freshly changed catheter) in a patient with signs and symptoms of a UTI and no other identified source of infection confirms the diagnosis of UTI.[14] In the absence of signs and symptoms of UTI, a more conservative cut off of 10^5 CFU/mL can be used.[14]

Clinical pearl: **Special considerations when treating UTI in patients with SCI**:
Urine dipstick – Urine dipstick testing is not recommended to guide decisions regarding UTI in this population.
Urine sample - Consider giving patients urine containers, as urine can be stored in the refrigerator for up to 24 hours. It is recommended that patients change catheters **prior** to providing a urine sample.

Flags*:* More than three UTIs in one year, or the presence of hematuria should warrant further investigation and referral.
Consideration: For patients with a good understanding of the signs and symptoms of UTI and/or live in a remote area, prophylactic antibiotic prescription can be considered. The patient must understand they are not to begin antibiotic therapy prior to urine culture.

Treatment:

Treatment for patients with SCI is the same as treating "complicated UTIs". Ideally, it is based on culture and sensitivities, provided the patient is systemically well. If the patient presents with fever, is systemically unwell, or has other risk factors for a complicated UTI e.g., solitary kidney, treat empirically. Do not treat asymptomatic bacteriuria. The IDSA recommends treatment with antibiotics for 7 days for most UTI, and for 10-14 days for more severe infections or delayed response.[7] Of note, cranberry has not been shown to be effective in preventing or treating UTIs in this population.

Antibiotic	Dose	Length of Treatment & Considerations
First Choice		
Ciprofloxacin	500mg BID or 1000mg XL OD	7-14 days Caution with use as Cipro may slow the metabolism of tizanidine (spasticity)
Ofloxacin	2000mg	7-10 days
Norfloxacin	400mg	14 days More resistance
Alternatives		
TMP/SMX	1 DS tab BID or 2 tabs BID	7-14 days Resistance often seen
Nitrofurantoin	Macrobid 1000mg BID	3-7 days Not active against many strains
Cephalexin	500mg QID	7-14 days
Cefixime	400mg OD	10-14 days
Fosfomycin	3g (1 sachet)	1 dose

Table 3: Antibiotic treatments of UTI
Note: continuous antibiotic prophylaxis (i.e daily Septra) is controversial and should only be determined by a specialist.[2]
Note: Although Fluoroquinolones are first line and are used most frequently for treatment of UTIs among patients with SCI, rare cases of tendonitis, tendon rupture and peripheral neuropathy are known.[15] Patients should be informed of the risks and advised to monitor for symptoms such as numbness and tingling, or muscle or joint pain.

Clinical Pearl: Make a note of the resistance patterns in your area (different geographic areas may have different resistance patterns). Culture and sensitivity reports in individuals with SCI often show more resistance than the general population and a higher dose of antibiotics or rotation of antibiotics may be considered.

Complications continued:

In addition to UTI, neurogenic bladder increases the risk of:

- Renal calculi
- Reflux/hydronephrosis
- Strictures
- Renal failure
- Bladder cancer (specifically, in patients with indwelling catheters)

Evaluating efficacy of bladder management routine

An effective bladder management regimen should result in the following:

- Satisfaction for the individual, his/her circumstances and daily activities
- Regular emptying to avoid stasis and overdistension
- Preservation of the upper tracts by avoiding high pressures
- Prevention of complications of neurogenic bladder

Indications for referral

Consider referral to urologist if:

- >3 UTIs per year
- Concerns regarding pathology, e.g., hematuria in the absence of a UTI, either persistent microscopic or gross
- Hydronephrosis or renal impairment
- Indwelling catheter >15 years (consideration of cystoscopy due to increased risk of bladder cancer)
- Current methods of bladder management (catheterization and/or medications) are ineffective, as other more invasive management strategies are available, including but not limited to botulinum toxin, stent placement, and surgery[16]

Screening

There are no studies examining the optimal frequency of monitoring neurogenic bladder long-term in patients with SCI. Currently, experts would suggest the following, however these recommendations should be tailored to each individual situation[2-4,16]:

- Review bladder management with patients with SCI at least annually
    - Method, continence, satisfaction, UTIs, hematuria
- Annual Cr/eGFR, electrolytes (caution: Cr may be falsely low due to low muscle mass – watch for an upwardly trending Cr)
- Consider urodynamics after injury and if there are any changes in bladder control.
- Consider ultrasound of kidneys/bladder q1-2 years to assess for the presence of hydronephrosis, stones[18,19]
- Consider cystoscopy 10-15 years post-injury or if there are any changes in bladder routine, symptoms that cannot be controlled or a question of diagnosis for those with indwelling catheters due to the potential increased rate of bladder cancer (20 times increased risk)[18,20]
- If a patient has >3 UTIs/year or hematuria, a referral to a urologist should be made, and initiation of further investigations could be considered (e.g., KUB US)

SUMMARY

- Neurogenic bladder results in problems relating to the storage and release of urine
- Achieving bladder control can be done via intermittent, indwelling, or condom catheterization, reflex voiding, anticholinergic medication, botulinum toxin or surgical methods
- Patients with SCI are at a higher risk of UTI than non-SCI individuals
- Consider referral to urologist if:
    - >3 UTIs per year
    - Concerns regarding pathology, e.g., hematuria in the absence of a UTI, either persistent microscopic or gross
    - Hydronephrosis or renal impairment
    - Indwelling catheter >15 years (consideration of cystoscopy due to increased risk of bladder cancer)
    - Current methods of bladder management (catheterization and/or medications) are ineffective, as other more invasive management strategies are available, including but not limited to botulinum toxin, stent placement, and surgery

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