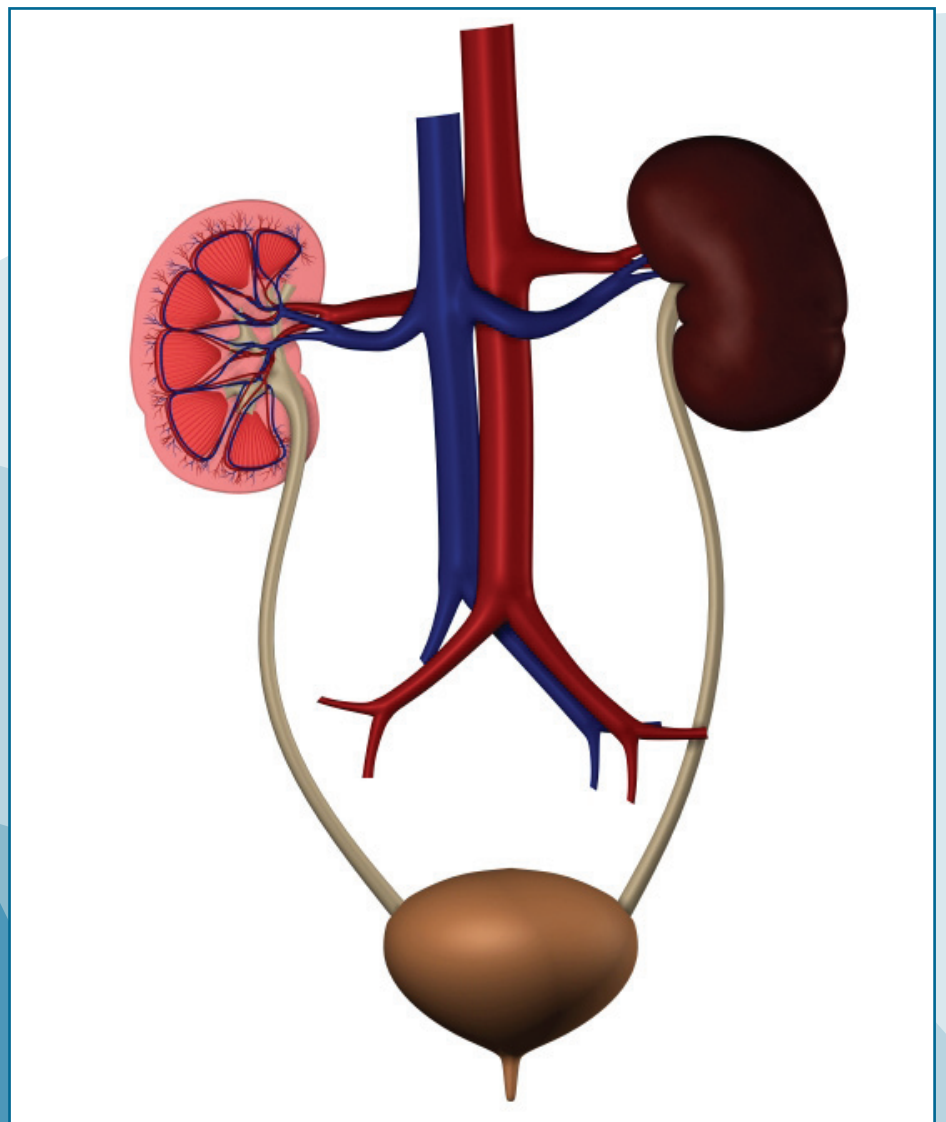




# Management of the Neurogenic Bladder for Adults with Spinal Cord Injuries



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Produced by: ACI State Spinal Cord Injury Service

SHPN (ACI) 140015  
ISBN 978-1-74187-961-2

Further copies of this publication can be obtained from the  
Agency for Clinical Innovation website at: [www.aci.health.nsw.gov.au](http://www.aci.health.nsw.gov.au)

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Published: November 2014  
HS13-120

# ACKNOWLEDGEMENTS

## **First (2002) and Second (2004) Editions:**

This document was originally published as a fact sheet for the Rural Spinal Cord Injury Project (RSCIP), a pilot healthcare program for people with a spinal cord injury (SCI) conducted within New South Wales involving the collaboration of Prince Henry & Prince of Wales Hospitals, Royal North Shore Hospital, Royal Rehabilitation Centre Sydney, Spinal Cord Injuries Australia and the Paraplegic & Quadriplegic Association of NSW. It was first published in June 2002, as part of a series of fact sheets for the RSCIP, and revised in 2004. We wish to acknowledge Dr Stella Engel, Dr Sue Rutkowski, Dr Jane Watt and Vivienne Van Dissel for their contribution to the original factsheet.

Project originally funded by the Motor Accidents Authority of NSW.

## **Third edition, 2014:**

Revised and updated in 2013 by the authors currently at the Rehabilitation Studies Unit, Sydney Medical School - Northern. The revision was funded by the NSW Agency for Clinical Innovation.

The work by Selina Rowe, Manager, NSW Spinal Outreach Service, Royal Rehab, Ryde, and Frances Monypenny, ACI Network Manager, State Spinal Cord Injury Service, Chatswood, NSW, Australia, in coordinating and managing the project to review and update this fact sheet, one of 10 fact sheets, is acknowledged.

All recommendations are for patients with SCI as a group. Individual therapeutic decisions must be based on clinical judgment with a detailed knowledge of the individual patient's unique risks and medical history, in conjunction with this resource.

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# 1. INTRODUCTION

Neurogenic bladder is a general term applied to a malfunctioning urinary bladder due to neurologic dysfunction, or insult, resulting from internal or external trauma, disease or injury. It has been recommended that any patients with known neurologic disease should be evaluated for neurogenic bladder dysfunction not only when urinary symptoms occur but also as a standard diagnostic approach.<sup>(1)</sup>

The majority of people with spinal cord injury (SCI), even those who are able to ambulate and who have very incomplete impairment, have abnormalities in bladder function which may cause upper and lower urinary tract complications, such as recurrent urinary tract infections, renal calculi, hydronephrosis and even renal failure. Therefore, important goals when developing a bladder management program include: preserving the upper urinary tracts, minimising lower tract complications and using a suitable method for voiding/drainage that is compatible with the person's lifestyle. It is essential that individuals with SCI understand the advantages and disadvantages of different methods of bladder management. Patient education should include a balanced discussion of the effect each method will have on health, lifestyle, and sexuality.<sup>(2)</sup>

## 2. FUNCTIONAL ANATOMY OF THE LOWER URINARY TRACT

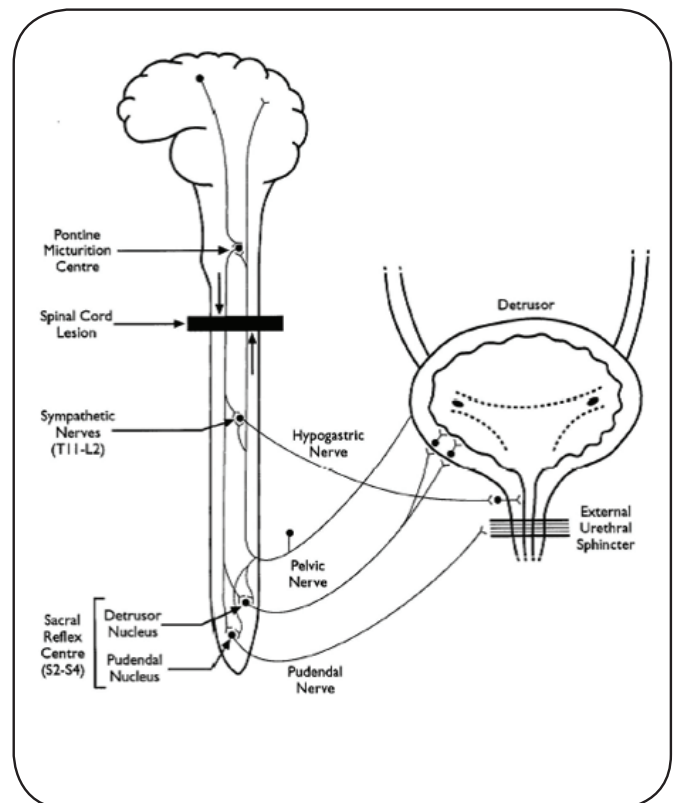
The urinary system is divided into upper and lower tracts. The upper urinary tract is made up of the kidneys and the ureters, while the lower urinary tract consists of the bladder and the urethra. The bladder acts as a reservoir normally storing up to 400 to 500mls of urine under low pressure before voluntary voiding is allowed to occur at a socially convenient time. Under normal circumstances the dynamic phases of bladder filling and emptying involve the bladder (detrusor muscle) and its outlet (bladder neck, proximal urethra and striated muscles of pelvic floor) acting reciprocally. During storage of urine, the bladder neck and proximal urethra are closed to provide continence with the detrusor relaxed to allow low pressure filling, whereas during voiding initial relaxation of the pelvic floor with opening of the bladder neck is followed by detrusor contraction until the bladder is completely emptied.

Co-ordination of micturition involves control by three main centres in the central nervous system:

1. the *sacral micturition centre*, located in the sacral spinal cord (typically at S3–S4 levels), which is a reflex centre in which efferent parasympathetic impulses to the bladder cause a bladder contraction and afferent impulses provide feedback on bladder fullness
2. the *pontine centre* in the brainstem, which is responsible for co-ordinating relaxation of the external sphincter with bladder contractions
3. the cerebral cortex, which exerts the final control by directing micturition centres to initiate or delay voiding, depending on the social situation.

SCI disrupts descending motor and ascending sensory pathways, preventing normal control of micturition (illustrated in **Figure 1**).

**Figure 1 – Loss of voluntary control of micturition, co-ordinated voiding and bladder sensation due to the sacral reflex centre being isolated from the higher centres\***



\*Adapted from DeLisa JA, Gans BM. *Rehabilitation medicine: principles and practice*. Philadelphia: Lippincott-Raven; 1988.

# 3. BLADDER IMPAIRMENT FOLLOWING SPINAL CORD INJURY

The different types of bladder impairment caused by damage to the spinal cord are broadly summarised in **Table 1**. It is important to remember that different underlying impairments may lead to a similar outward appearance of bladder dysfunction. For example, detrusor hyperreflexia (overactivity), poor bladder compliance (with increased resistance to filling) or bladder neck insufficiency all can cause storage failure. Similarly, detrusor-external

sphincter co-contraction (called dyssynergia), a non-contractile bladder, myogenic detrusor insufficiency from chronic overdistension or mechanical outlet obstruction from benign prostatic hypertrophy or urethral stricture may cause voiding failure.<sup>(3)</sup>

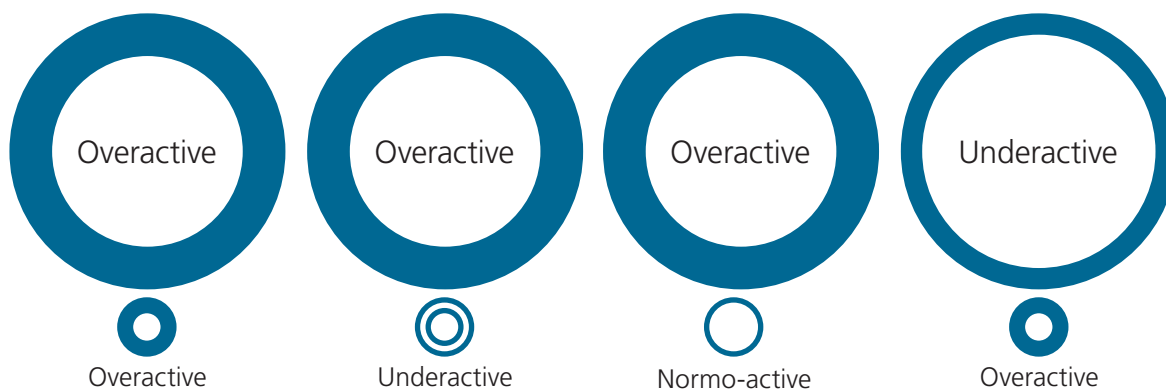
**Figure 2** shows an alternative current more complex classification used to describe neurogenic bladder dysfunction. The terminology used in this guideline is outlined in **Table 2**.

**TABLE 1 – Types of Neurogenic Bladder Impairment**

<b>Suprasacral (Infrapontine) Bladder</b>
An upper motor neurone lesion (releasing automatic sacral reflex micturition centre from descending inhibition) results in: <ul style="list-style-type: none"> <li>• detrusor hyperreflexia (overactivity).</li> <li>• detrusor-external sphincter dyssynergia (DESD), referring to inappropriate co-contraction of the external urethral sphincter (EUS) with voiding detrusor contraction.</li> </ul>
<b>Mixed Neurogenic Bladder (Type A)</b>
A lesion in the conus medullaris with damage to detrusor (parasympathetic) nucleus causes: <ul style="list-style-type: none"> <li>• detrusor hyporeflexia (underactivity) with external sphincter hyperreflexia.</li> <li>• characteristically large volume with overflow incontinence.</li> </ul>
<b>Mixed Neurogenic Bladder (Type B)</b>
A lesion in the conus medullaris involving pudendal (somatic) nucleus causes: <ul style="list-style-type: none"> <li>• detrusor hyperreflexia with external sphincter hypotonia.</li> <li>• small volume, high frequency, incontinence.</li> </ul>
<b>Infrасacral Bladder</b>
A Lower Motor Neurone lesion from conus medullaris and/or cauda equina damage results in: <ul style="list-style-type: none"> <li>• areflexia (not atonia) of detrusor (due to post-ganglionic fibres being in bladder wall) and areflexia with atonia of pelvic floor muscles.</li> <li>• may have isolated increase in bladder neck/internal sphincter resistance (intact T11-L2 sympathetics).</li> <li>• non-contractile bladder with leakage from overflow.</li> </ul> <p>(NB. May also be sequelae to recurrent bladder overdistensions.)</p>

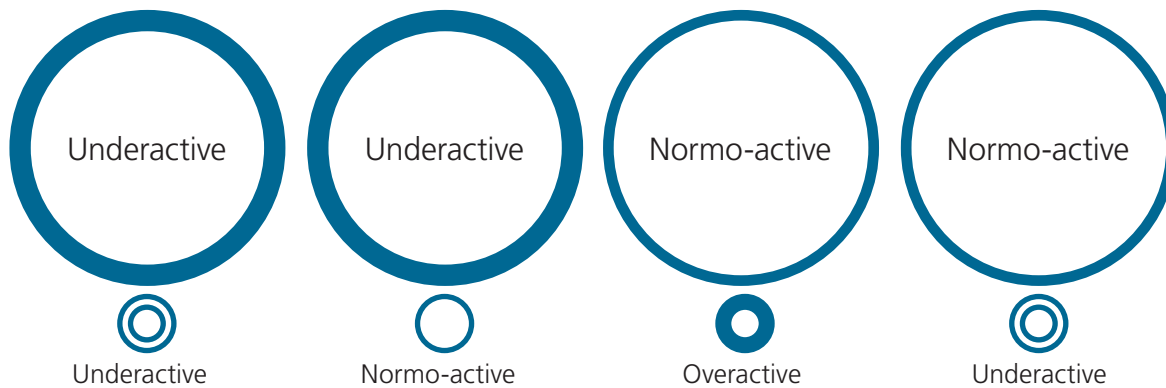
**Figure 2 – The European Association of Urology (EAU) – Madersbacher functional classification system based on urodynamic and clinical findings\***

**Detrusor**



**Urethral Sphincter**

**Detrusor**



**Urethral Sphincter**

*\*Adapted from Madersbacher H. The various types of neurogenic bladder dysfunction: an update of current therapeutic concepts. Paraplegia. 1990; 28(4):217-29.*



**TABLE 2 – Definitions and terminology useful in clinical practice\***

<b>Urodynamic studies</b>
Normally take place in the laboratory (outpatient urology clinic setting) and usually involve artificial bladder filling and measurements of various parameters such as intra-vesical pressure.
<b>Detrusor overactivity</b>
Is a urodynamic observation characterised by involuntary detrusor contractions during the filling phase which may be spontaneous or provoked.
<b>Detrusor underactivity</b>
Is defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying and/or a failure to achieve complete bladder emptying within a normal time span.
<b>Detrusor pressure</b>
The component of intravesical pressure that is created by forces in the bladder wall. It is estimated by subtracting abdominal pressure from intravesical pressure.
<b>Bladder compliance</b>
Describes the relationship between change in bladder volume and change in detrusor pressure.
<b>Detrusor sphincter dyssynergia</b>
Is defined as a detrusor contraction concurrent with an involuntary contraction of the urethral and/or peri-urethral striated muscle. Occasionally, flow may be prevented altogether.
<b>Indwelling catheterisation</b>
An indwelling catheter remains in the bladder, urinary reservoir or urinary conduit for a period of time longer than one emptying.
<b>Intermittent (in/out) catheterisation</b>
Is defined as drainage or aspiration of the bladder or a urinary reservoir with subsequent removal of the catheter either performed by the person himself/herself or an attendant. Clean intermittent catheterisation implies ordinary washing techniques and use of disposable or cleansed reusable catheters while aseptic sterile technique implies genital disinfection and the use of sterile catheters and instruments/gloves.
<b>Bladder reflex triggering</b>
Comprises various manoeuvres performed by the patient or the therapist in order to elicit reflex detrusor contraction by exteroceptive stimuli. The most commonly used manoeuvres are suprapubic tapping, thigh scratching and anal/rectal manipulation.
<b>Bladder expression</b>
Comprises various manoeuvres aimed at increasing intravesical pressure in order to facilitate bladder emptying. The most commonly used manoeuvres are abdominal straining, Valsalva's manoeuvre and Crede manoeuvre.

\* Adapted from *The standardisation of terminology of lower urinary tract function: report from the Standardisation Subcommittee of the International Continence Society, Abrams P et al. Neurourol Urodyn 2002;21:167–78.*

# 4. BLADDER MANAGEMENT

## 4.1 Goals for Bladder Management

The goals for bladder management include:

- protecting upper urinary tracts from sustained high filling and voiding pressures (i.e. >40cm water)
- achieving regular bladder emptying, avoiding stasis and bladder overdistension and minimising post-voiding residual volumes to less than 100mls (ideally <50mls)
- preventing and treating complications such as urinary tract infections (UTIs), stones, strictures and autonomic dysreflexia
- maintaining continence and avoiding frequency and urgency
- choosing a technique which is compatible with person's lifestyle

Choice of definitive bladder management will be determined by the following factors:

- type of bladder impairment (**Table 1**): determined by level and extent of neurological lesion on clinical examination (which may include assessing perianal sensation and sacral reflex activity such as anal tone/reflex and bulbo-cavernosus reflex), as well as urodynamic testing.<sup>(4)</sup>  
NB. It may be difficult to assess bladder and sphincter behaviour (**Figure 2**) on the basis of neurologic exam alone without urodynamic testing; in addition, urodynamic parameters are valuable for predicting development of renal complications
- status of upper urinary tracts/renal function
- functional ability: particularly mobility, sitting balance and hand function
- patient's cognitive ability, motivation and lifestyle
- Bladder management recommendations may change over the patient's lifetime independent of their initial pinal cord neurological assessment.

## 4.2 Recommendations for Bladder Management

The following provides some general principles with discussion regarding indications, advantages and disadvantages of the most common methods of bladder management to help guide selection of an appropriate method that best suits the person with SCI and their individual circumstances. **Table 3** provides a summary of pharmacological and non-pharmacological options to manage various types of lower urinary tract dysfunction following spinal cord injury.

### 4.2.1 Intermittent Catheterisation

During the first few weeks after injury, overdistension of the bladder should be avoided by continuous drainage of the bladder with an indwelling urethral catheter or percutaneous suprapubic drainage until after the post-injury diuresis (usually 7-10 days after injury) has occurred. After this period, regular intermittent catheterisation may be commenced, helping to maintain bladder capacity and compliance.

Long term in both male and female patients with paraplegia or males with tetraplegia and sufficient hand function, clean intermittent self-catheterisation (CISC) every 4-6 hours is the preferred method, accompanied by taking anticholinergic medication to relax overactive detrusor smooth muscle contractions, maintaining safe pressures during bladder filling and preventing incontinence between catheterisations.

Factors important for self-catheterisation, apart from well-controlled detrusor activity, include good bladder capacity, adequate bladder outlet resistance, absence of urethral sensitivity to pain with catheterisation and patient motivation. Intermittent catheterisation, whether performed acutely or chronically, has the lowest complication rate<sup>(5)</sup> although urethral complications and epididymoorchitis occur more frequently in those using intermittent catheterisation than other methods.<sup>(2)</sup> Pre-lubricated and hydrophilic catheters may have advantages over standard catheter types, being associated with fewer

UTIs, as well as less urethral microtrauma.<sup>(5)</sup>

The most frequently prescribed first line anticholinergic medication is Oxybutynin hydrochloride (5mg tds) given 30 minutes before or 2 hours after a meal. Side effects such as dry mouth, blurred vision, and constipation are quite common and increased aperients may be required. If oxybutynin is poorly tolerated orally, Oxybutynin (Oxytrol) transdermal delivery (3.9 mg/24 hours patch) twice weekly can reduce these side effects, although skin reactions with itchiness and local erythema at the site of application may occur. Alternatively, other oral medications, such as Tolterodine (1-2mg bd) or Solifenacin (5-10mg mane), may be better tolerated, although are not listed on the Pharmaceutical Benefits Scheme. All the anticholinergic medications should be used with caution in older patients due to possibility of cognitive impairment or exacerbation of a co-morbid condition (for example, glaucoma). When oral medications are ineffective or cannot be tolerated, chemodenervation with multiple intravesical botulinum toxin injections into detrusor via a cystoscope has been proven safe and efficacious and is being used increasingly, although efficacy often begins to wear off around 6 months post-injection, needing to be repeated.<sup>(5)</sup>

Intermittent catheterisations should be avoided in individuals with SCI who have abnormal urethral anatomy such as stricture, false passages, and bladder neck obstruction, poor cognition, little motivation, adverse reaction to passing a catheter into the genital area multiple times a day or inability or unwillingness to adhere to the catheterisation time schedule.<sup>(2)</sup>

## 4.2.2 Reflex Voiding and Bladder Expression Techniques

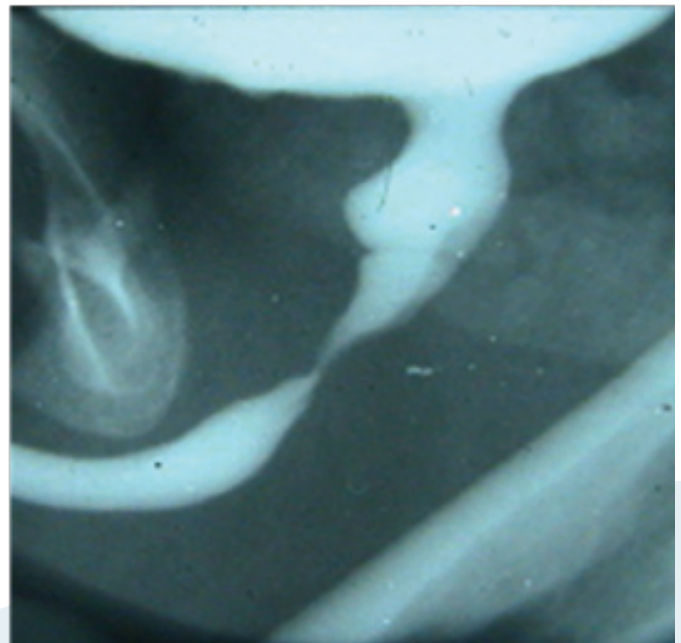
In males with tetraplegia and insufficient hand dexterity to perform CISC, drainage by reflex voiding with triggering manoeuvres such as suprapubic tapping, stroking inner thigh and use of an external urinary collection device is possible. However, this technique is generally no longer recommended and men with tetraplegia using reflex voiding techniques with condom drainage should be monitored for balanced bladder function (see below) to ensure complete emptying and low pressure drainage, to reduce risk of urinary infections and upper tract deterioration. Valsalva or Crede (pressing over the bladder) are discouraged as they may produce high intra-vesical pressure, increasing the risk for long-term complications.<sup>(5)</sup>

If employing bladder training to achieve balanced reflex

voiding, use of cholinergic medication (short-term only) such as Bethanecol (10-20mg tds) to enhance detrusor tone with an alpha adrenergic blocker such as Phenoxybenzamine (10-20mg bd) or Prazosin (0.5-2mg bd) to reduce internal sphincter spasm and/or a muscle relaxant such as Baclofen (10-25mg qid) or Diazepam (2.5-5mg bd or tds) or botulinum toxin may be required. In addition, a sphincterotomy or urethral wall stent may also be required to help manage **detrusor-external sphincter dyssynergia (DESD)**, which is shown in **Figure 3**.

Common clinical presentations of DESD include high residual urine volumes with recurrent urinary tract infections, needing to use greater amounts of percussion (suprapubic tapping) to initiate voiding, autonomic dysreflexia (AD) (with sweating on voiding), increased spasticity and posture-related difficulty in voiding. Late complications include vesico-ureteric reflux, hydronephrosis, pyelonephritis and deterioration of renal function. Often hydronephrosis is asymptomatic until well advanced in this patient group.

**Figure 3 – Cystogram showing contraction of external sphincter during voiding.**



**TABLE 3 – A summary of pharmacological and non-pharmacological options to manage various types of lower urinary tract dysfunction following spinal cord injury are listed.**

<b>Detrusor Hyperreflexia</b>
<ul style="list-style-type: none"> <li>• Oral anticholinergic medications (e.g. Oxybutynin, Tolterodine, Solifenacin). (Comment: Transdermal Oxybutynin may also be used).</li> <li>• Denervation (typically using intravesical Botulinum toxin).</li> <li>• Sacral deafferentation (surgical division of sacral posterior roots). This may sometimes be required to control detrusor hyperreflexia with associated AD. Comment: neuromodulation shows some promise, but requires further study.</li> </ul>
<b>Low Bladder Compliance/Capacity</b>
<ul style="list-style-type: none"> <li>• Anticholinergic medications (as above).</li> <li>• Bladder augmentation surgery ('Clam' ileocystoplasty).</li> <li>• Ileal conduit.</li> </ul>
<b>Bladder Neck/Sphincter Insufficiency</b>
<ul style="list-style-type: none"> <li>• Alpha agonist medication (e.g. Imipramine).</li> <li>• Peri-urethral injection of macropastique polymer.</li> <li>• Sub-urethral sling/taping procedure.</li> <li>• Artificial sphincter (inflatable cuff) device.</li> </ul>
<b>Bladder Neck/Sphincter Obstruction</b>
<ul style="list-style-type: none"> <li>• Alpha adrenergic antagonist medications (e.g. Phenoxybenzamine, Prazosin).</li> <li>• Spasmolytic agents (e.g. Baclofen, Diazepam, Botulinum toxin injection).</li> <li>• Local anaesthetic (Xylocaine gel per urethra).</li> <li>• External sphincterotomy/urethral wall stent.</li> <li>• Prostatectomy/urethrotomy (for mechanical causes such as benign prostatic hypertrophy or urethral stricture).</li> </ul>

### 4.2.3 Indwelling Catheterisation (Urethral and Suprapubic)

Female patients with tetraplegia, due to greater difficulty with CISC and lack of a satisfactory external collecting device, generally use either a suprapubic or an indwelling urethral catheter, which for the same reasons may also be most suitable in some women with paraplegia. In addition, increasingly in males with tetraplegia, where there are concerns about long-term complications that may be associated with high intravesical pressures from unbalanced reflex voiding, suprapubic catheters are being recommended. Anticholinergic medications are usually recommended to control detrusor overactivity and maintain

some bladder compliance and capacity, particularly for when the catheter becomes blocked and the person may develop AD. With diligent care and ongoing medical follow-up, indwelling suprapubic catheterisation may be an effective and satisfactory bladder management choice for some people, though there is insufficient evidence to report lifelong safety of such a regime.<sup>(5)</sup>

If an indwelling catheter is to be used long-term, a suprapubic catheter is generally preferred to avoid creation of fistulous tracts from the urethra or the bladder to the skin, damage to the sphincter muscles resulting in total incontinence, dilation of the urethra with leakage around the catheter, penile tip erosion and splitting of the penis, called traumatic hypospadias.

# 5. RECOMMENDATIONS FOR BLADDER EVALUATION AND FOLLOW-UP

- There is no clear consensus on the appropriate urological follow-up of individuals after spinal cord injury and there is little consensus about how individuals with SCI should be monitored in the long-term to detect urological complications at an earlier stage. No studies have examined the optimum frequency of follow-up evaluations. Many evaluate upper and lower tract functioning on an annual basis. Urological evaluations are done more frequently when an individual is having problems, changing medications or bladder management is being altered in some way. The important components of the urologic evaluation are an assessment of both the upper and lower tracts.<sup>(6)</sup>
- Upper tract evaluations include tests that evaluate function such as renal scans, and tests that evaluate anatomy, such as an ultrasound, CT scan and intravenous pyelogram (IVP). Lower tract evaluations include video/urodynamics to determine bladder and sphincter function, cystograms to evaluate for vesicoureteral reflux and cystoscopy to evaluate bladder anatomy.
- It should be noted that an urodynamic study (UDS) is an important evaluation for determining bladder function and should be performed after injury following passage of spinal shock and return of spinal reflexes to classify bladder type and to guide decision making regarding the method of bladder management such as intermittent catheterisation. The question of the recommended frequency has not been clearly answered. Most perform baseline UDS and routine annual, biannual or periodic UDS depending on the change in symptoms and the risk of upper tract deterioration.
- There is sufficient evidence to recommend ultrasound of the kidneys and urinary tract as a useful, cost-effective, non-invasive method for routine long-term follow-up to detect upper urinary tract problems in individuals with SCI. Compared with IVP or renal scan, ultrasound has good sensitivity for diagnosing upper tract abnormalities and it does not expose patients to radiation. If ultrasound is positive, further testing should be done by renal scan.<sup>(6)</sup>
- Serum creatinine is not sensitive for detecting early renal function deterioration in patients with SCI. Creatinine clearance, determined by a 24 hour urine sample, is one method of establishing the glomerular filtration rate to measure renal function in those with SCI but the equation applied should use the proper correction factors.<sup>(7)</sup>
- Bladder cancer is a rare and potentially lethal occurrence in patients with SCI. It tends to present at an earlier age and at a more advanced pathological stage than bladder cancer in the general population. Presenting symptoms may be atypical and early recognition is important to improve prognosis with surgical resection. Patients with a long-standing SCI, smoking history, a history of frequent UTIs or indwelling catheter usage for more than 5 years may be at the highest risk for bladder cancer. Although screening these patients is a common practice, there is no evidence that the use of annual urinary markers or cystoscopy is effective, or that these investigations meet the principles of a screening test.<sup>(8)</sup> The potential benefit of detecting an early malignancy needs to be balanced with the inconvenience and potential risks associated with screening practices in this population.

## 5.1 Urinary Tract Infection in Patients with Spinal Cord Injury

- There are a number of definitions of urinary tract infections that exist. The National Institute on Disability and Rehabilitation Research (NIDRR) Consensus Statement (1992) definition states that three criteria must be met for an individual to be considered as having a UTI: (1) significant bacteriuria, (2) pyuria (increased white blood cells >10 per high power field in the urine), and (3) signs and symptoms.<sup>(9)</sup>
- Criteria for significant bacteriuria (the number of bacteria that signify that the bacteria are truly from the bladder and not just a contaminant) depend on the method of bladder management being used: for those on intermittent catheterisation =  $10^2$  colony forming units (cfu); for those using clean-void specimens from catheter-free males who use external condom collecting devices =  $10^4$  cfu; and for those with specimens from indwelling catheters, any detectable concentration.<sup>(2)</sup>

- Indwelling or suprapubic catheters should be changed just prior to urine collection so as to limit the amount of false positive urine tests. Urinalysis and urine culture results of SCI patients are not likely to be affected by sample refrigeration (up to 24 hours). It is uncertain if dipstick testing for nitrites or leukocyte esterase is useful in screening for bacteriuria to assist treatment decision-making.<sup>(5)</sup>
- Symptoms of UTI in the general population include fever, dysuria, frequency, urgency, voiding of small volumes, supra-pubic pain, and loin pain. In spinal injured patients, unless the lesion is very incomplete, symptoms may be altered or absent. Relevant symptoms should be unexplained by other intercurrent pathology and may include fever, autonomic dysreflexia, increased frequency of muscle spasms or spasticity, failure of usual control of urinary incontinence and new abdominal discomfort.<sup>(9)</sup>
- It is generally accepted that asymptomatic bacteriuria in patients with spinal cord injury should not be treated, even in cases of intermittent catheterisation. For symptomatic episodes of infection in patients with SCI only a few studies have investigated the most appropriate agent and duration of therapy. Currently, 7-10 days of therapy is most commonly used. There is no superiority of one agent or class of antimicrobials in this group of patients.<sup>(10)</sup>
- The greater likelihood of the involvement of resistant microorganisms in complicated UTIs is another feature that is related to the fact that patients with a complicated UTI tend to have recurrent infection. For these reasons, before and after the completion of the antimicrobial treatment, urine cultures must be obtained for the identification of the microorganisms and the evaluation of susceptibility testing.<sup>(10)</sup>
- Oral methenamine hippurate or cranberry, either alone or in combination, have been shown to not be effective for UTI prevention, and the role of prophylactic treatment is still controversial.<sup>(5)</sup>



# 6. QUIZ

**Q1. Which statement is TRUE? Coordination of micturition involves:**

- a) the sacral micturition centre in which afferent parasympathetic impulses provide feedback on bladder fullness;
- b) the brainstem that coordinates contraction of the bladder with relaxation of the sphincter;
- c) the cerebral cortex that prevents incontinence of urine during forceful activities such as coughing;
- d) the pontine centre that exerts the final control to initiate or delay voiding;
- e) the peripheral somatic efferent nerves that cause bladder contraction.

**Q2. Which statement is TRUE regarding bladder impairment following spinal cord injury?**

- a) An upper motor neurone lesion typically results in a non-contractile bladder with overflow incontinence;
- b) A lower motor neurone lesion from cauda equina damage commonly results in detrusor sphincter dyssynergia;
- c) Detrusor underactivity is defined as a contraction of reduced strength and/or duration, resulting in prolonged bladder emptying;
- d) Detrusor overactivity is a urodynamic observation characterised by voluntary detrusor contraction during filling phase to prevent incontinence;
- e) Detrusor overactivity, poor bladder compliance or bladder neck insufficiency can all present with voiding failure.

**Q3. The choice of bladder management post spinal cord injury depends on all the following, EXCEPT:**

- a) level of injury;
- b) completeness of neurological impairment;
- c) status of lower urinary tracts;
- d) cognitive ability;
- e) urodynamic findings.

**Q4. Which of the following recommendation is TRUE regarding neurogenic bladder evaluation and follow up in individuals with spinal cord injury?**

- a) Annual ultrasound is useful to detect lower urinary tract complications such as vesicoureteric reflux;
- b) Urodynamic study is an important evaluation that might need to be done periodically;
- c) KUB radiography is a reliable tool to evaluate for urinary tract stones;
- d) Serum creatinine is sensitive for detecting early renal function deterioration;
- e) Annual cystoscopy is a good screening tool for bladder cancer for those on long term indwelling catheter.

**Q5. Which statement is TRUE regarding urinary tract infection (UTI) in individuals with spinal cord injury?**

- a) The NIDRR consensus definition of UTI requires the presence of significant bacteriuria, pyuria or signs and symptoms;
- b) The presenting symptoms can be that of autonomic dysreflexia;
- c) Asymptomatic bacteriuria in patients performing intermittent catheterisation should be treated;
- d) Urine for urinalysis and culture should be collected from the collecting device just prior to changing the catheter;
- e) Prophylactic antibiotics are strongly indicated in those with recurrent UTIs.

**QUIZ ANSWERS:**  
Q1. B - The brainstem (pons) coordinates contraction of the bladder with relaxation of the sphincter. Q2. C - Detrusor underactivity is defined as a contraction of reduced strength and/or duration resulting in prolonged bladder emptying. Q3. B - Completeness of impairment does not have a significant impact on choice of bladder management compared to all the other listed factors. Q4. B - Urodynamic study is an important evaluation that might need to be done periodically. Q5. B - The presenting symptoms of UTI in persons with SCI can be that of autonomic dysreflexia.

# 7. REFERENCES

1. Wyndaele JJ, Kovindha A, Madersbacher H, Radziszewski P, Ruffion A, Schurch B, et al. Neurologic urinary incontinence. *Neurourol Urodyn*. 2010;29(1):159-64. Epub 2009/12/22.
2. Consortium for Spinal Cord Medicine. Bladder management for adults with spinal cord injury: a clinical practice guideline for health-care providers. *J Spinal Cord Med*. 2006;29(5):527-73. Epub 2007/02/06.
3. Wein AJ. Classification of neurogenic voiding dysfunction. *J Urol*. 1981;125(5):605-9. Epub 1981/05/01.
4. Watanabe T, Rivas DA, Chancellor MB. Urodynamics of spinal cord injury. *Urol Clin North Am*. 1996;23(3):459-73. Epub 1996/08/01.
5. Wolfe DL, Legassic M, McIntyre A, Cheung K, Goettl T, Walia S, et al. Bladder health and function following spinal cord injury. In: Eng JJ, Teasell RW, Miller WC, Wolfe DL, Townson AF, Hsieh JTC, et al., editors. *Spinal Cord Injury Rehabilitation Evidence*. Vancouver, Canada. 2012. p. 1-143.
6. Cameron AP, Rodriguez GM, Schomer KG. Systematic review of urological followup after spinal cord injury. *J Urol*. 2012;187(2):391-7. Epub 2011/12/20.
7. Chikkalingaiah KB, Grant ND, Mangold TM, Cooke CR, Wall BM. Performance of simplified modification of diet in renal disease and Cockcroft-Gault equations in patients with chronic spinal cord injury and chronic kidney disease. *Am J Med Sci*. 2010;339(2):108-16. Epub 2010/01/21.
8. Welk B, McIntyre A, Teasell R, Potter P, Loh E. Bladder cancer in individuals with spinal cord injuries. *Spinal Cord*. 2013;51(7):516-21. Epub 2013/04/24.
9. National Institute on Disability and Rehabilitation Research Consensus Statement. The prevention and management of urinary tract infections among people with spinal cord injuries. *J Am Paraplegia Soc*. 1992;15(3):194-204.
10. Grabe M, Bjerklund-Johansen TE, Botto H, Çek M, Naber KG, Pickard RS, et al. Guidelines on urological infections. *EAU*. 2013:1-106.



# 8. ADDITIONAL RESOURCES

- ACI clinical practice guidelines: <http://www.aci.health.nsw.gov.au/networks/spinal-cord-injury/resources>
- Abrams P, Agarwal M, Drake M, El-Masri W, Fulford S, Reid S, et al. A proposed guideline for the urological management of patients with spinal cord injury. *BJU Int.* 2008;101(8):989-94. Epub 2008/02/19.
- Klausner AP, Steers WD. The neurogenic bladder: an update with management strategies for primary care physicians. *Med Clin North Am.* 2011;95(1):111-20. Epub 2010/11/26.
- Middleton JW, Leong G, Mann L. Management of spinal cord injury in general practice - part 1. *Aust Fam Physician.* 2008;37(4):229-33. Epub 2008/04/10.
- Stohrer M, Blok B, Castro-Diaz D, Chartier-Kastler E, Del Popolo G, Kramer G, et al. EAU guidelines on neurogenic lower urinary tract dysfunction. *Eur Urol.* 2009;56(1):81-8. Epub 2009/05/01.

