

Rural Spinal Cord Injury Project

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Management of the **NEUROGENIC BLADDER** for adults with spinal cord injuries



Targeting Health Professionals

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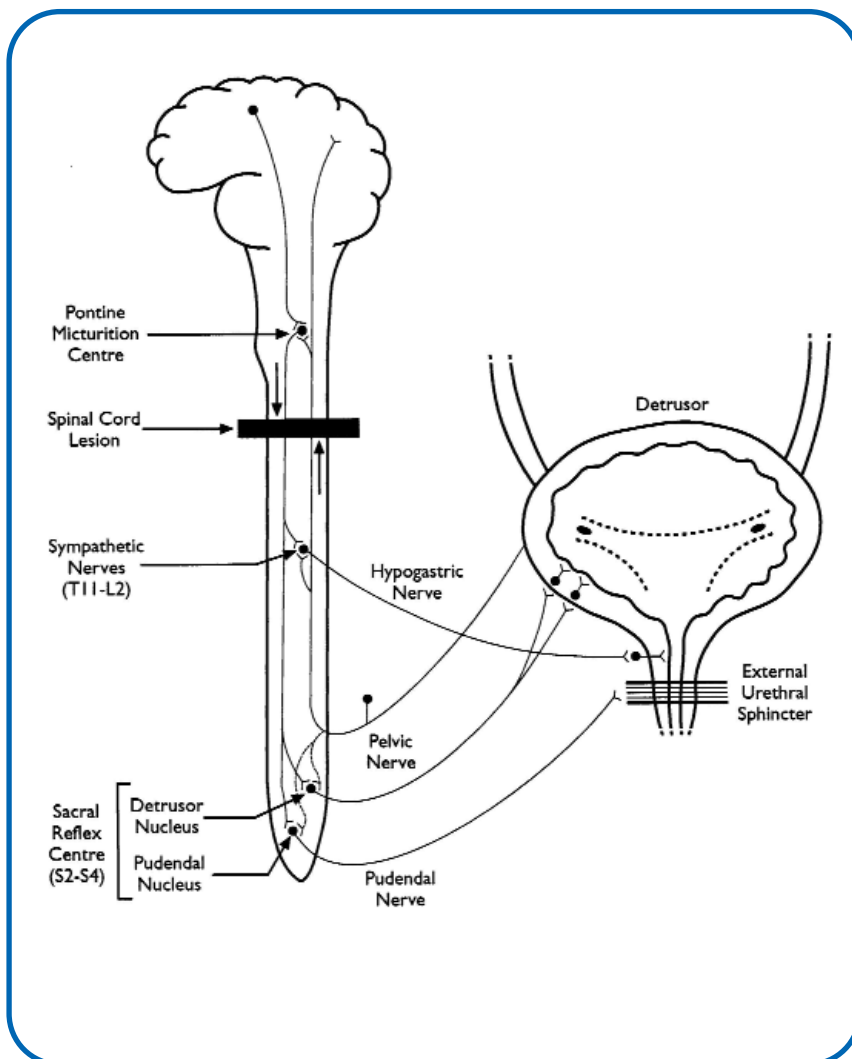
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FUNCTIONAL ANATOMY OF THE LOWER URINARY TRACT

The bladder acts as a reservoir normally storing up to 400-500mls of urine under low-pressure before voluntary voiding occurs 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.



Coordination of micturition involves control by two main centres in the CNS:

(1) the **Pontine Centre** in the brainstem, which is responsible for co-ordinated activity between the detrusor and the bladder outlet, and

(2) the **Sacral Centre** which controls local reflexes and initiates detrusor contraction.

Spinal cord injury (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 J.A. Ed., Rehabilitation Medicine: Principles and Practice. J.B. Lippincott Co., Philadelphia, 1988).

BLADDER IMPAIRMENT FOLLOWING SCI

The different types of bladder impairment caused by damage to the spinal cord are summarised in Table 1. It is important to remember that different underlying impairments may lead to a similar outward appearance of bladder dysfunction. For instance, detrusor hyperreflexia (overactivity), poor bladder compliance (with increased resistance to filling) or bladder neck insufficiency all cause **storage failure**. Similarly, (ie. detrusor-external sphincter co-contraction or dyssynergia {DESD}), 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** (Wein, 1981).

Suprasacral (Infrapontine) Bladder

An **Upper Motor Neurone** lesion (releasing automatic sacral reflex micturition centre from descending inhibition) results in:

- detrusor hyperreflexia (overactivity)
- detrusor- external sphincter dyssynergia (DESD), referring to inappropriate co-contraction of the external urethral sphincter (EUS) with voiding detrusor contraction.

Mixed Neuropathic Bladder (Type A)

A lesion in the conus with damage to **detrusor (parasympathetic)** nucleus causes:

- detrusor hyporeflexia (underactivity) with external sphincter hyperreflexia
- characteristically large volume with overflow incontinence

Mixed Neuropathic Bladder (Type B)

A lesion in conus involving **pudendal (somatic)** nucleus causes:

- detrusor hyperreflexia with external sphincter hypotonia
- small volume, frequency, incontinence

Infrasacral Bladder

A **Lower Motor Neurone** lesion from conus medullaris and/or cauda equina damage results in:

- areflexia (not atonia) of detrusor (due to post-ganglionic fibres being in bladder wall) and areflexia with atonia of pelvic floor muscles
- may have isolated increase in bladder neck/internal sphincter resistance (intact T11-L2 sympathetics)
- non-contractile bladder with leakage from overflow

(NB. May also be sequelae to recurrent bladder overdistensions)

TABLE 1 - Types of Neuropathic Bladder Impairment

BLADDER MANAGEMENT

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 (eg. "Cystocath"), until after the post-injury diuresis (usually 7-10 days after injury) has occurred. After this period, intermittent clamping of the catheter or regular intermittent catheterisation by an attendant may be commenced with appropriate fluid restriction, helping to maintain bladder capacity and compliance.

Assessment includes a baseline intravenous pyelogram and urine specimen for culture and sensitivities. Urodynamic assessment (cystometry/anal sphincter EMG or x-ray videocystography) is performed several months after injury following passage of spinal shock and return of spinal reflexes to classify bladder type.²

Goals for **bladder management** include:

- protecting upper urinary tracts from sustained high filling pressures (ie. >40cm water)
- minimising post-voiding residual volumes to less than 100mls (ideally <50mls)
- preventing urinary tract infections
- avoiding bladder overdistension
- maintaining continence
- 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):** level and extent of neurological lesion is based on clinical examination (including perianal sensation, anal tone/reflex, bulbo-cavernosus reflex) and urodynamic testing (Watanabe, Rivas, Chancellor, 1996). (NB. It may be difficult to assess bladder and sphincter behaviour on the basis of neurologic exam alone; in addition, urodynamic parameters are valuable for predicting development of renal complications).
- **functional ability:** particularly mobility, sitting balance and hand function.
- **status of upper urinary tracts.**
- **patient's cognitive ability, motivation and lifestyle.**

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**, with anti-cholinergic medication such as oxybutynin hydrochloride (5mg tds) or propantheline bromide (15-30mg tds or qid) to relax the detrusor and prevent incontinence between catheters. Other 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.

In males with tetraplegia and insufficient hand dexterity to perform CISC, drainage by reflex voiding with suprapubic tapping, using an external urinary collection device such as a uridome, or by indwelling urethral or suprapubic catheter is possible. Other methods such as Valsalva or Crede manoeuvre (pressing over the bladder) may exacerbate haemorrhoids and vesico-ureteric reflux and are no longer recommended.

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.

Methods of possible bladder management for individuals with different impairments are summarised in Table 2.

TABLE 2 - Bladder Management versus Neurological Level

Paraplegic (male/female) and Tetraplegic C6 level & below (male)

- Clean intermittent self-catheterisation
- Anti-cholinergic medication
- Fluid restriction (approx. 1.8-2 litres/day)
- Regular fluid intake/catheterisation schedule

Tetraplegic (female/male above C6 level)

- Permanent suprapubic catheter (indwelling urethral catheter discouraged)
- Anti-cholinergic medication
- Intermittent catheter clamping with Staubli/Flip-flow valve may be useful

Tetraplegic Male

- Voiding by reflex (and tapping) wearing uridome
- ± cholinergic medications (short-term only) and alpha blockers (long-term)
- ± sphincterotomy/urethral wall stent

NB. Check residuals (less than 100 mls) and monitor upper tracts diligently

If employing bladder training to achieve balanced reflex voiding, use of short-term cholinergic medication such as bethanecol (10-20mg tds) to enhance detrusor tone with an alpha adrenergic blocker such as phenoxybenzamine (10- 20mg 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) is frequently required. In addition, a sphincterotomy or urethral wall stent may also be required to help manage detrusor-external sphincter dyssynergia (DESD). Common clinical presentations of DESD include high residuals and recurrent urinary tract infections, greater amounts of percussion (suprapubic tapping) required, autonomic dysreflexia (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.

Antiseptic medications, such as Hiprex (dissociating to hippuric acid and methenamine) in combination with vitamin C for urinary acidification or Cranberry juice tablets, which in addition appear to inhibit bacterial adhesion, are often prescribed particularly in patients using reflex emptying or CISC. Anecdotally, altering urinary pH regularly between acidification and alkalinisation may prove helpful when above strategies have failed to prevent recurrent urinary tract infection. A low-dose antibiotic medication may be prescribed when other measures have proven unsuccessful. However, prophylaxis with a low-dose antibiotic is only recommended in those patients suffering frequent, disabling urinary tract infections due to an increased risk of developing resistant bacteria. The most important advice for patients with permanent catheters is to ensure a high fluid intake and urinary output is maintained. Whereas for patients who void by reflex or expression, the most critical factor in reducing infection risk is to minimise the residual volume of urine left behind in the bladder after voiding (Table 3).

TABLE 3 - Prophylaxis for urinary tract infection

- Unless CISC, maintain high fluid intake (approx. 3-3.5 litres/day)
- Ensure residual urine volumes less than 100mls (preferably < 50mls)
- Urinary antiseptics (scientific evidence currently lacking)
 - Hiprex ± Vitamin C (max 2gm/day)
 - Cranberry Juice tablets (which may be combined with Hiprex)
 - Hiprex and/or Cranberry alternating with Ural fortnightly
- Low-dose antibiotic (eg. Trimethoprim, Keflex or Macroclantin)

TREATMENT OF BLADDER DYSFUNCTION

Bladder dysfunction can be classified into either a failure to store urine (incontinence) or failure to effectively void and empty the bladder. As previously mentioned, different underlying causes may be responsible for the same manifest symptom/s of bladder dysfunction and require quite different pharmacological or surgical treatment (Table 4).

TABLE 4 - Causes of Bladder Dysfunction and Possible Treatment Options

Management of Storage Failure

Detrusor Hyperreflexia

- oral anticholinergic medications (oxybutynin, propantheline)
- intravesical anticholinergics (oxybutynin, atropine)
- intravesical desensitisation (capsaicin)
- denervation (nerve blocks using transvesical phenol, botulinum toxin)
- sacral deafferentation (surgical division of sacral posterior roots)

Low compliance/capacity

- anticholinergic medications
- bladder augmentation surgery (clam ileocystoplasty, myomectomy)

Bladder neck/sphincter insufficiency

- alpha agonist (ephedrine, imipramine)
- periurethral injection of macropastique
- artificial sphincter (inflatable cuff) device

Management of Voiding Failure

Detrusor insufficiency

- cholinergic medications (bethanecol, distigmine bromide)

Acontractile bladder

- CISC, IDC or SPC

NB. Straining should be discouraged due to complications such as stress incontinence, haemorrhoids and rectal prolapse

Outlet obstruction

- alpha adrenergic antagonist (phenoxybenzamine, prazosin)
- spasmolytic agents (baclofen, diazepam; botulinum toxin injection)
- local anaesthetic (xylocaine gel per urethra)
- sphincterotomy/urethral wall stent
- prostatectomy/urethrotomy (for mechanical causes such as benign prostatic hypertrophy or urethral stricture)

Urinary tract infection should always be excluded whenever new bladder symptoms arise, particularly incontinence in a reflex bladder, although an infection may also cause failure to void due to DSD. Drinking and voiding schedules should be reviewed along with post-voiding residual urine volumes. Cessation of fluid intake after 6pm may help to prevent urinary incontinence overnight in those performing CISC.

Review of medications is recommended. It is not uncommon for patients to reduce or even cease prescribed anti-cholinergic medication after discharge when experiencing side effects, such as a dry mouth or constipation. As a consequence, bladder compliance and capacity may decrease overtime. Unwanted side effects from other commonly prescribed medications may occur; for instance, urinary retention and autonomic dysreflexia in a male voiding by reflex can be precipitated by Amitriptyline, prescribed for pain management. Depending on the desired effect, alpha adrenergic agonist or antagonist medications may be prescribed to increase or decrease bladder neck tone (Table 5).

TABLE 5 – Commonly prescribed medications for urinary dysfunction

Action (Indication)	Drug Name	Usual Dosage	Side Effects & Precautions
Decrease detrusor activity (anticholinergic medication used to suppress bladder overactivity and prevent incontinence)	Oxybutynin HCl (Ditropan)	5mg t.d.s. a.c.	Dry mouth, blurred vision, drowsiness, confusion, nausea, vomiting, constipation, restlessness, urinary retention and decreased sweating (causing body temperature to rise). Care must be taken to avoid overheating during exercise or hot weather. Caution with operating machinery or driving.
	Propantheline Br (Probanthine)	15-30mg q.i.d.	
	Tolterodine (Restricted access)	1-2mg b.d.	
Increase detrusor activity (cholinergic medication used for 6-8 weeks only to increase smooth muscle tone and strengthen bladder contractions)	Bethanechol Cl (Urecholine, Urocarb)	10-20mg t.d.s	Abdominal cramps, diarrhoea, nausea and belching, flushing, sweating. Not to be used in asthmatics or person with IHD.
Decrease bladder outflow resistance (alpha-adrenergic antagonist to relax bladder neck)	Phenoxybenzamine HCl (Dibenyline)	10-20mg b.d.	Postural hypotension and dizziness, drowsiness, fatigue, nasal congestion, blurred vision, inhibition of (or retrograde) ejaculation.
	Prazosin HCl (Minipress)	0.5-2mg b.d.	
Increase bladder outflow resistance (alpha-adrenergic and mild anti-cholinergic action)	Imipramine HCl (Tofranil)	10-25mg t.d.s	Dry mouth, blurred vision, confusion, nausea, vomiting, abdominal cramps.
Urinary antiseptic (to prevent urinary tract infection)	Hiprex (Hexamine hippurate)	1g b.d.	Nausea, stomach upset, rash, stomatitis.
	Cranberry	1 tablet b.d.	No significant known side effects.

SYMPTOMATIC URINARY TRACT INFECTION

Urinary tract infection (UTI) is the most common complication suffered by the majority of individuals with spinal cord injury. Symptoms of UTI in the general population include: fever, dysuria, frequency, urgency, voiding of small volumes, abrupt onset, supra-pubic pain, and loin pain (Stamm, 1991). In spinal injured patients, unless the lesion is very incomplete, symptoms may be altered or absent. Relevant symptoms should be unexplained by other inter-current pathology and include: fever, autonomic dysreflexia, increased frequency of muscle spasms or spasticity, failure of usual control of urinary incontinence and new abdominal discomfort (NIDRRS 1992).

Treatment should be based on a urine specimen, culture and sensitivity. Colonisation and asymptomatic bacteriuria is common in populations with permanent catheters in situ, particularly with low-pathogenic organisms like *Pseudomonas aeruginosa* or mixed growth. Unnecessary or over-treatment using single antibiotics should be avoided as this may result in development of antibiotic resistant strains over time. Criteria to help guide clinical decision making appear in Table 6. Note: to avoid contamination, urine specimen should be taken at a fresh catheter change.

TABLE 6 - Criteria for diagnosing symptomatic urinary tract infection

Suggested by findings on microscopy WCC > 100 OR Leukocyte esterase of +++ to ++++ on urology dipstick (with culture confirming pure growth of organism)

AND

One "Category 1" Symptom OR Two "Category 2" Symptoms:

"Category 1" Symptoms:

- **Temperature:**
Greater than 38°C core
(37.5°C per axilla)
- New or increasing symptoms of **Autonomic Dysreflexia**, as detected by any of the following signs:
Pulse < 50 or increased flushing or sweating or headache AND
increased Systolic or Diastolic Blood Pressure > 25% above baseline.

OR

"Category 2" Symptoms:

- Increased frequency of muscle spasms or spasticity
- Failure of usual control of urinary incontinence (including increased bladder spasm, leaking around catheter sites)
- New abdominal discomfort unexplained by other pathology

* Modified by Dr B Lee (RNSH Spinal Unit) and Dr G Kotsiou (RNSH Microbiology Department) from the 1992 National Institute on Disability and Rehabilitation Research Statement on symptomatic urinary tract infections in the spinal cord injured.

If symptomatic UTIs become recurrent despite adequate treatment, patient hygiene and catheterisation techniques should be reviewed. Other investigations such as a bladder/renal ultrasound or cystoscopy may be required to exclude other sources of recurrent infection, such as calculi, bladder diverticulum or catheter cystitis (if permanent catheter in situ).

Urinary tract calculi are a common complication that should be suspected when difficulty clearing or recurrent urinary tract infections with the same or different organisms, particularly urea-splitting *Proteus*. These will require removal by lithopaxy, lithotripsy or rarely open methods.

LONG TERM MANAGEMENT

Regular monitoring of upper renal tracts by ultrasound or intravenous pyelogram is recommended, particularly in individuals using reflex voiding/expression techniques to monitor for early signs of hydroureter/hydronephrosis. Imaging should be performed on a yearly basis in persons voiding by reflex, but may only be required every 2-3 years in those using CISC or a permanent catheter, unless indicated more frequently because of a previous abnormal study.

Early signs suggestive of possible hydronephrosis should be followed up early (Staskin, 1991). It must be remembered that the classical symptom of flank pain will be absent with a lesion above about the T6 level. This may result in a delayed and non-specific presentation, including feeling unwell, abdominal discomfort, increased spasms, sweating and autonomic dysreflexia. Other possible complications which may occur include renal and/or bladder calculi, epididymo-orchitis, urethral fistulae, false passages and strictures. Patients managed long-term by permanent indwelling or suprapubic catheterisation to drain the bladder are exposed to 5-fold greater risk of developing bladder cancer than those managed by intermittent catheterisation or condom drainage, with onset reported on average 20 years, but as early as 12 years, post injury (Groah, Weitzenkamp, Lammertse, Whiteneck, Lezotte, Hamman, 2002). The increased incidence of bladder cancer in this group warrants regular screening by cystoscopy, particularly 20 years or more after injury. Tests and investigations that may prove helpful for the diagnosis and management of various complications are listed in Table 7.

TABLE 7 - Useful urinary tests and investigations

- Serum creatinine
- Urine culture/sensitivities
- Residual urine volumes
- Plain abdominal (KUB) x-ray
- Renal/bladder ultrasound scan
- Intravenous pyelogram
- Isotope renogram
- Cystometrogram
- Cystourethrogram
- Video-urodynamics

Specialised investigations include cystometry to assess sensation of fullness, bladder compliance, capacity and detrusor pressures (NB. low compliance is a significant risk factor for development of upper tract complications) and video-urodynamics to identify problems such as DESD or reflux by fluoroscopy during voiding. A filling and voiding cystourethrogram (with or without tapping) can provide useful information when video-urodynamics is not readily available to assess bladder configuration, trabeculation and diverticulum,

presence of vesico-ureteric reflux, bladder neck opening, DESD, and urethral stricture.

READING

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RURAL SPINAL CORD INJURY PROJECT

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This document was published as a fact sheet for the Rural Spinal Cord Injury Project (RSCIP), a pilot healthcare program for people with spinal cord injuries (SCI) conducted within New South Wales. It is not a stand alone resource but part of a series of eight fact sheets produced by specialists to fulfil the educational components of the project.

All recommendations are for spinal patients as a group. Individual therapeutic decisions must be made by combining the recommendations with clinical judgement, including a detailed knowledge of the individual patient's unique risks and medical history, as well as the resources available. This document is published as a guide only and does not take the place of advice from your regular health professional and /or medical practitioner.

