



Neurogenic Bladder following Spinal Cord Injury

A Resource for Health Service Providers

WA State Spinal Injury Unit

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This document has been developed to provide health service providers with a sound understanding of the anatomy, physiology and management of the Neurogenic bladder following SCI.

Key points

- Following spinal cord injury (SCI) most patients experience some degree of bladder dysfunction
- Urinary issues remain one of the highest causes of readmission to hospital following SCI
- Following SCI the bladder may present as being reflexic (upper motor neuron), flaccid (lower motor neuron) or mixed depending on the level and extent of your injury –
- All patients with SCI will have urodynamics (bladder pressure test) and renal ultrasound performed post injury and as part of lifelong health maintenance
- Regular complete emptying of the bladder prevents UTI's
- Adequate fluid intake (2L per day minimum) is essential to long term urological health
- Straining to empty the bladder is not recommended following SCI, unless recommended by a Urologist specialising in the area of SCI, as it may be dangerous & lead to kidney problems and / or incontinence in the future
- Regular follow up by a urology team (minimum annually) after discharge is essential to maintaining long term urological health
- Bladder activity may change within the first few years post injury

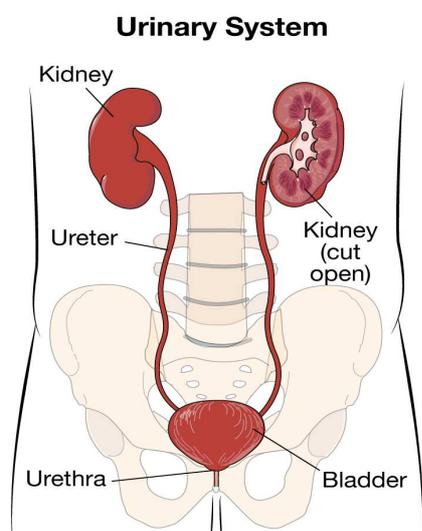
Introduction

Following SCI there is an interruption of signals between the bladder and the brain via the spinal cord resulting in some degree of bladder dysfunction in the majority of cases.

The amount of dysfunction experienced will be dependent on the level and completeness of SCI.

To ensure compliance with bladder management long term it is essential that there is a balance between the lifestyle and psychosocial needs of the patient with the medical evidence for management.

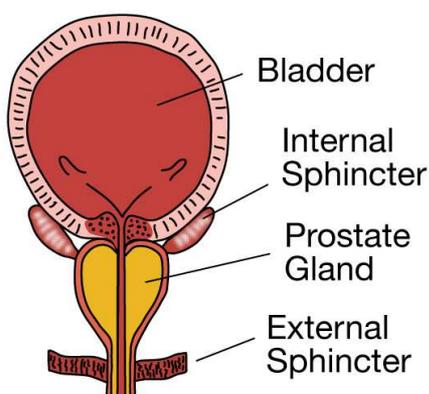
Anatomy and physiology of the lower urinary system



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- Kidneys – Produce urine by filtering waste, such as salt and water from the blood. They are located on either side of the spine at the back of the abdomen
- Ureters – Narrow tubes that carry urine from kidney to the bladder
- Bladder – A round muscular reservoir that stretches to store urine. The amount of urine the bladder can hold varies but on average is 500mls.
- Detrusor – This is the muscle of the bladder that contracts causing the bladder to empty effectively
- Urethra – This carries the urine from the bladder out of the body. It is approx 20cm long in males and 4cm long in females.

Urinary Sphincters



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- Sphincters – These are 2 muscles that contract when the bladder is filling to ensure continence and relax when voiding to allow free flow of urine.
 1. Internal Urethral Sphincter – This is located at the neck of the bladder where the urethra opening is. This is under involuntary control
 2. External Urethral Sphincter – This sphincter sits below the internal urethral sphincter and is under voluntary control.

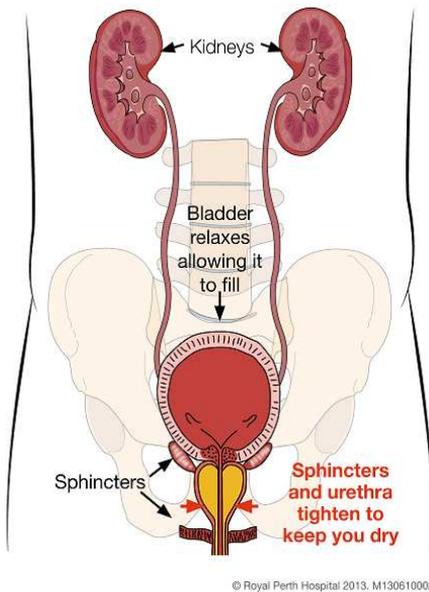
Prostate (in men only) – This gland wraps around the urethra and if it is enlarged it can partially block the urethra leading to obstruction of urine flow

Normal nervous control of the Urinary System

The nerves that control the bladder are at the lowest point of the spinal cord. (Sacral Nerves 2, 3 and 4).

The nervous system (brain and spinal cord) controls urination, and there are two key issues, storage of urine and emptying of the bladder.

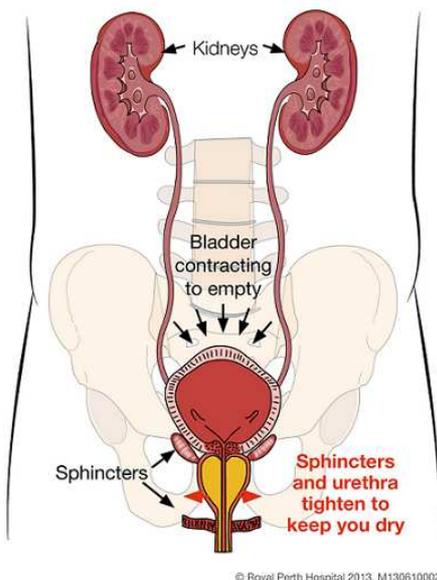
Storage of Urine



The bladder normally relaxes itself whilst it is filling with urine. This action is controlled by the nerves at approximately T12 level of the spinal cord.

At the same time the internal urethral sphincter contracts to keep you dry. Both these actions are involuntary, i.e. they happen automatically. When the spinal cord is intact the bladder remains relaxed until it is full, approximately 500mls. At this point stretch receptors in the bladder send a message to the brain via the 'reflex voiding centre' at Sacral nerves 2, 3, & 4 in the spinal cord. This message tells the brain the bladder is full and wants to automatically contract. The brain however has the ability to override this action if it is not ready, e.g. you are not near a toilet.

Emptying of the Bladder



Voluntary and involuntary actions allow you to empty your bladder. When the bladder sends a message to the brain that it is full and it is an appropriate place to pass urine;

1. The bladder will contract to expel the urine.
2. At the same time both sphincters relax allowing urine to pass freely.

The bladder is controlled by 3 areas of the central nervous system;

1. *Cerebral Cortex (CC)*

- This provides the highest level of control and is responsible for social and voluntary control of voiding

2. *Pontine Micturition Centre (PMC)*

- Located in the brainstem
- Fullness detected here
- Main control in babies who feel the urge to void and do so but have not yet developed cerebral cortex, ie no social control yet.
- Coordinates the synergy between the detrusor and sphincter to allow free flow of urine. Ie when the detrusor muscle contracts to empty the bladder the sphincter relaxes to allow the urine to flow.

3. *Sacral Micturition Centre (SMC)*

- Responsible for detrusor contraction in response to filling

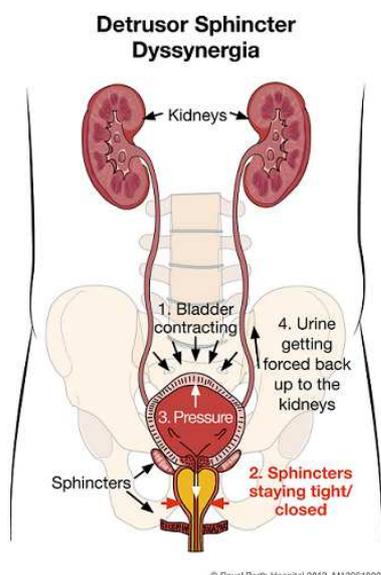
Bladder dysfunction following SCI

Following SCI (up to 6 weeks post injury) the body experiences a period of spinal shock. During this time the bladder becomes 'flaccid'. It is important during this time to ensure the bladder is regularly emptied to prevent it being damaged due to being over-stretched.

Depending on the level and completeness of the SCI, the bladder will present and function differently. Changes in bladder function may continue for up to 2 years post injury. It is not possible to determine exactly how the bladder will behave post SCI and therefore individual assessment is essential. There are however common ways the bladder behaves which are summarised below;

1. Upper Motor Neuron Bladder

- This is also referred to as *reflexic, spastic, overactive, hyper-reflexic* or *suprasacral*
- Occurs when SCI is at or above T12/L1 or above the conus level where the spinal cord ends, i.e. injury is within the cord, resulting in the reflexes of the bladder remaining intact
- Results in reflex bladder contraction generated by the sacral micturition centre which is uninhibited by the brain. This may cause incontinence. This increased contraction of the bladder is called *neurogenic* (pertaining to the spinal cord) *detrusor* (bladder muscle) *overactivity* (contract more than normal).



- The other problem which can occur is that the sphincters stay tight when the bladder contracts preventing it from flowing freely. When this happens the pressure inside the bladder goes up. Like if you were squeezing a balloon that was tied off. If this happens the urine may go up the ureter back to the kidneys. If this continues, it puts the kidneys in danger of being damaged. This is called Detrusor Sphincter Dyssynergia (does not occur together).

3 Lower Motor Neuron Bladder

- This type of bladder generally occurs when the spinal cord damage is at or below T12/L1 level, below the end of the spinal cord. It is here the one cord split into bundles of nerves called cauda equina ('horses tail', which is what it looks like)
- It is often called *flaccid, floppy, areflexic* or *infrasacral*
- This means the bladder will not contract no matter how much you fill it up.
- If the bladder is overfilled it may result in incontinence or urine going back up the ureters to the kidneys causing them damage. So it is important not to overfill the bladder

3. Mixed Bladder

- Depending on the extent and location of nerve damage it is possible to have a mixed bladder.
- Try to think about this from a sensory (feeling) and a motor (movement) perspective. You may or may not get a sensation of fullness (sensory), likewise you may or may not have any control over your ability to pass urine (motor).
- There may also be elements of a Upper motor neurone and lower motor neurone presentation. For example increased tone in external urethral sphincter as seen in UMN bladders with Detrusor hyporeflexia as seen in LMN bladders or reduced sphincter tone with detrusor overactivity
- A mixed bladder relies on accurate clinical assessment of presenting symptoms

Tests to assess bladder function

Bulbocavernosus Reflex Test – This test is performed by nursing / medical team to detect the presence of intact reflex activity through the sacral nerves which control your bladder, bowel and sexual function. This helps determine if the patient will have a UMN or LMN bladder and if they remain in spinal shock. [See Anatomy and Physiology Section](#)

Testing of S345 Nerves – Involves assessment of light touch and sharp/dull differentiation in the S345 dermatomes including assessment of anal tone and sensation. This helps determine if the nerves controlling the bladder are intact. [See Anatomy and Physiology Section](#)

Renal Ultrasound – Performed after injury as baseline to determine any presenting abnormalities and as a reference for ongoing surveillance.

Urodynamics – Performed approximately 6 weeks after injury to allow time for spinal shock to resolve. Is repeated at 12 weeks to see if any changes have occurred or early if required. Once a person is discharged from inpatient care, depending on the long term bladder management you opt for, you may need to have urodynamics yearly to monitor for changes or complications. [See Urodynamics Fact Sheet](#)

KUB X-ray – This is an xray of your **K**idneys, **U**reters and **B**ladder. It may be done for many reasons, the most common being to look for kidney or bladder stones.

Fluid management

Fluid management is an important part of good bladder management.

In the initial stages following SCI fluid intake will be monitored and sometimes restricted, as what goes in must come out. This is to ensure the bladder does not get over distended.

Once a decision on which long term bladder management is made and implemented this will change.

It is important however to maintain 2L of water a day to ensure adequate flushing of the kidneys to prevent urinary tract infections and stone formation. [See Fluid Management Fact Sheet](#)

Factors affecting long term Bladder management

A person's ability to manage their bladder function is dependent on a range of factors including

1. **Fluid Intake** – It is very important to maintain 2L of water intake a day. This ensures adequate flushing of the kidneys to help prevent Urinary Tracts Infections (UTIs) and stone formation. Depending on type of management it will also help prevent complications such as catheter blockages
2. **Regular complete emptying of the bladder** – If urine remains in the bladder for long periods of time the bacteria in it will multiply more rapidly which may lead to infection. The bladder should therefore be completely emptied every 4-6 hours
3. **Trunk Stability** – to enable adequate positioning to undertake bladder management
4. **Hand Function** – people require some independent hand function to hold a catheter or empty a bag independently
5. **Level and completeness of injury** – i.e. type of bladder
6. **Use of spinal braces** – wearing of spinal braces can restrict movement and access and may delay independent management
7. **Previous urological history or problems** – can impact on capacity post SCI
8. **Lifestyle.** It is important bladder management fits into an individuals life and their life does not revolve around their bladder management.
9. **Gender and age.** It is much easier for a male to access his urethra to perform intermittent catheterisation than it is for a female. Problems of aging may also impact on bladder function.
10. **Psychological wellbeing** – willingness to commit to the time and effort required for management options
11. **Personal choice**

Management options

See Fact Sheets on management options

- Self Intermittent Catheterisation
- Suprapubic Catheter
- Memmokath
- Botox in the Neurogenic Bladder
- Mitrofanoff

Complications

Urinary Tract Infection (UTI)

Recurrent UTI's can lead to permanent kidney damage or formation of stones the bladder or kidneys. Conversely overtreatment of UTI can lead to antibiotic resistance requiring treatment with intravenous antibiotics and should be avoided. Prevention, early identification and appropriate management of UTI's in SCI patients is essential.

Signs and Symptoms of a Urinary Tract Infection

- ◆ Feeling unwell
- ◆ Increased incontinence
- ◆ Offensive or smelly urine
- ◆ Cloudy or sedimented urine
- ◆ Blood in urine, or pink tinged urine
- ◆ Decreased skin tolerance, ie skin may mark easily
- ◆ Sweating / shivering
- ◆ Increased spasm
- ◆ High temperature / fever
- ◆ Pain on passing urine or in kidneys (if you have sensation)
- ◆ Increased frequency of needing to pass urine (if you have sensation)

What to do if UTI is suspected

- ◆ Send a urine sample
- ◆ Increase fluid intake to try and flush it out. Note – increased frequency of bladder emptying will be required to prevent bladder distension
- ◆ Consider the use of over the counter preparations such as Ural
- ◆ Consider the use of antibiotics.

Note – Antibiotics should only be used if the UTI is symptomatic. Including but not limited to;

- Fevers
- Increased unexplained urinary incontinence
- Autonomic Dysreflexia or Abdominal discomfort with nil other identified cause
- Haematuria

Due to artificial means of emptying the bladder urine samples will in many cases detect a simple bacteraemia as opposed to a systemic UTI. Clinical assessment is therefore important to determine if antibiotic treatment of UTI is warranted

If the patient has an indwelling catheter

- It is best practice to obtain a urine from a new catheter or an intermittent catheter as if collected from catheter in-situ the culture will report the bacteria living within the actual catheter and not necessarily within the bladder. A sterile catheter once inserted is colonised with bacteria after 48hrs.
- If antibiotics are prescribed the catheter should be changed mid antibiotic course

Strictures or False Passage

A stricture is the formation of scar tissue along the urethra restricting urine flow or the passing of a catheter.

A false passage or urethral fistula is often caused by being forceful with a catheter resulting in the formation of a tract diverting from the urethra.

Symptoms of Stricture may include increased difficulty or inability to insert catheter or reduced flow. If this is suspected please contact the patients Urology team at the State Spinal Injury Unit as flexible cystoscopy may be indicated.

Renal Calculi

Also known as renal stones, renal calculi are hard masses (stones) that form from mineral deposits in the urine. Crystals that separate from the urine build up to form a stone. The best way to prevent them is to stay infection free and ensure adequate fluid intake of 2L per day. Annual Renal U/S is encouraged in all patients with SCI to monitor for any signs of calculi and allow early detection. This should occur prior to their annual review by the Urology team at the State Spinal Injury Unit.

Haematuria

Blood in the urine can mean many things from a UTI, trauma secondary to catheterisation or pulling of permanent catheter, over distension of the bladder to more sinister things such as bladder carcinoma. If it persists follow up with the Urology team at the State Spinal Injury Unit.

Vesico-Ureteric Reflux

Vesico-Ureteric reflux describes urine travelling back up the ureters from the bladder to the kidney. It usually occurs because of bladder overactivity in this patient group.

Hydronephrosis

This is when the kidneys become swollen. It may either be due to reflux or due to inhibition of urine flow through the kidneys (e.g. a stone blocking the urine passage). This can often develop without any signs, particularly given the lack of sensation people with

SCI have, but will be picked up on surveillance ultrasounds performed annually. It can lead to other problems and most seriously kidney failure.

Autonomic Dysreflexia

See section on [Autonomic Dysreflexia](#)

Bladder Cancer

Patients with permanent indwelling catheters (urethral or suprapubic) have an increased risk of bladder cancer. Therefore annual surveillance flexible cystoscopy will be commenced 10 years after their establishment as long term management to monitor for any changes to the bladder mucosa.

Ongoing follow up

Follow up is important to ensure prevention and early identification of urological complications. Annual surveillance ultrasound and clinic appointment is recommended for all SCI patients. Other investigations such as Urodynamics, blood tests, urine samples, Xrays, CT's may also be require to ensure long term urological health.

Useful resources

Spinal Cord Medicine – Clinical Practice Guidelines Consortium for Spinal Cord Medicine Paralyzed Veterans of America March 1998 – Neurogenic Bladder Management in Adults with Spinal Cord Injury.

Middleton, J. Management of the neurogenic bladder for adults with spinal cord injury. Rural Spinal Cord Injury Project. 2002

Royal Perth Hospital Nursing Practice Standard - Acute Management SCI

Agency for Healthcare Research and Quality - National guidelines clearinghouse provides structured, standardized summaries containing information derived from guidelines.

Guidelines on neurogenic lower urinary tract dysfunction.

- o <http://guideline.gov/content.aspx?id=34062&search=neurogenic+urinary+tract>

SCIRE Bladder Management. The Spinal Cord Injury Rehabilitation Evidence (SCIRE) project is a Canadian research collaboration between scientists, clinicians and consumers. SCIRE reviews, evaluates, and translates existing research knowledge into a clear and concise format to inform health professionals and other stakeholders of best rehabilitation practices following SCI.

- o http://www.scireproject.com/sites/default/files/bladder_management.pdf

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