Journal of Life Care Planning, Vol. 16, No. 3, (13-16)

2018 Int'l Assoc. of Rehab Professionals

Understanding and Treating Neurogenic Bladder

Alyssa C. Mixon, DO
Karen Mandzak Fried, MSN, RN, CRRN
Guy W. Fried, MD

Abstract

The urinary system is divided into the upper urinary tract (kidneys and ureters) and the lower urinary tract (bladder, urethra and internal/external sphincters). As urine fills the bladder, signals are transmitted to and from the brain to encourage bladder muscle contraction and sphincter relaxation. Neurogenic bladder is due to interruptions in these messages, as seen in spinal cord injury, multiple sclerosis, Parkinson's, and diabetes. The three main types of neurogenic bladder include: uninhibited, upper motor neuron, and lower motor neuron dysfunctions. The patient's functional status and diagnosis dictate the bladder management plan from catheterization methods to medication administration.

Understanding the Urinary System

To understand the diagnosis of neurogenic bladder, one must first understand a normal bladder including the anatomy and physiology of the urinary system. This can be divided into two parts: the upper and lower. The upper urinary tract consists of the kidneys and the ureters. The kidneys excrete waste and maintain physiologic balance. The ureters propel the urine down into the bladder. The vesicoureteral junction prevents reflux of urine back up into the ureters and kidneys. The lower urinary tract consists of the bladder, the urethra, and the internal and external sphincters. Normal voiding relies on the coordination of information traveling through the neural pathways from the brain, through the spinal cord, to the bladder, to control voiding.

In normal voiding, urine is made in the kidneys and travels down both ureters into the bladder. The bladder is a muscular organ with a detrusor muscle shaped like a balloon that stores urine until it gets full. The sphincter is like a rubber band around the bladder to keep in urine. While the bladder fills up, nerves from the bladder send messages to the brain as the desire to urinate becomes stronger. The brain senses this and in response, sends signals to the sphincter muscles to relax. It also sends signals to the bladder's detrusor muscle to contract and squeeze the urine out through the urethra. When these signals are interrupted, the result can lead to a neurogenic bladder.

Introduction to Neurogenic Bladder

Neurogenic bladder is the name given to a number of urinary conditions in people who lack bladder control due to neurologic damage. This nerve damage can be the result of various pathologies including: Spinal cord injury/spina bifida, stroke, multiple sclerosis (MS), Guillain-Barre syndrome, amyotrophic lateral sclerosis, Parkinson's disease, diabetes, and infections of the brain or spinal cord. One of the major concerns with neurogenic bladder is the risk of urinary tract infections. Urinary tract changes and infections are common in rehabilitation patients. Historically, renal failure was a common cause of death after SCI. The decline in the death rate from urologic complications is due to improved knowledge and treatments including intermittent catheterization, catheter free status, improved control of urinary infection, specialized centers of care, long-term renal surveillance, and urodynamic testing. In addition to improving complications and mortality, improved bladder management also minimizes issues for many patients because incontinence also impacts social interactions, work, and leisure activities.

In a neurogenic bladder, there are three parts of the urinary system that continue to function normally because they are under involuntary control: the kidneys, the ureters, and the urethra. However, damage in the pathway from the brain or spinal cord interferes with normal bladder function and voluntary control. Due to the neurologic damage to the brain and neurologic reflex centers, the patient may not "feel" the urge to go and they no longer have the neurologic coordination to voluntarily control voiding.

Types of Neurogenic Bladder

To further classify this condition, neurogenic bladders can be divided into the uninhibited neurogenic bladder, the upper motor neuron bladder, and the lower motor neuron bladder. These three divisions are discussed below.

Uninhibited

In this bladder dysfunction, the normal inhibitory control of the detrusor muscle by the central nervous system is damaged. The patient feels the sensation, but the urge may be sudden and uncontrolled.

Upper Motor Neuron Neurogenic Bladder

The upper motor neuron neurogenic bladder is caused by lesions between the brain and conus cord causing a spastic, reflexive bladder (usually seen with injuries at T6 and above). The patient does not feel the sensation to urinate and there is a hyperactive detrusor and sphincter resulting in reduced bladder capacity and a reflex that triggers the bladder to empty without voluntary control. The patient may also have detrusor-sphincter dyssynergia and autonomic dysreflexia (AD). Instead, the sphincter muscles do not relax when the bladder contracts. Instead, the sphincter also contracts creating pressure commonly leading to "reflux" or urine backing up into the kidneys. High pressure can cause retention or even back flow of the urine through the ureters into the kidneys. Over time, the bladder muscle wall will hypertrophy, and a thick bladder laced with collagen replaces the normal histology. Lesions higher than T6 level are most commonly associated with autonomic dysreflexia, which is a massive sympathetic overflow in response to noxious stimuli usually below the level of injury which can be life-threatening (Dolinak & Balraj, 2007). Noxious stimuli may not be perceived at all because of the spinal cord injury; however, it may lead to blood pressures going to critical levels (Eltorial, Kim, Vulpe, Kasravi & Ho, 1992).

Lower Motor Neuron Neurogenic Bladder

Lower motor neuron neurogenic bladder is the third bladder classification and is caused by lesions damaging the sacral micturition reflex center in the spinal cord, causing a flaccid, areflexive bladder. It is usually seen with spinal cord injuries below T6. The patient does not feel and there is flaccid paralysis of the bladder and pelvic muscles, often leading to over-distention and resulting in reflux.

Bladder Management Program

Diagnosing a neurogenic bladder is necessary to implement effective bladder management. Three important goals when deciding on a bladder management program are preserving renal function, minimizing complications of the kidneys and bladder, and being compatible with the person's lifestyle (Simpson, Eng, & Hsieh, 2012). To cater to each patient individually, one must consider their unique anatomy and level of activity. The goal is to provide a socially acceptable and convenient method of bladder drainage, to prevent complications, and to preserve upper tract function on a long-term basis considering the patient's abilities and caregiver support.

Assessing the upper urinary tract involves reviewing renal scans or CT scans. Assessing the lower urinary tract involves obtaining urine analysis studies, urodynamics to determine bladder function, cystograms to determine reflux, and cystoscopies to evaluate bladder anatomy. These tests may be performed on an annual basis; however, the frequency is often adjusted according to individual patient-specific issues and physician practices (Cameron, Lai, Saigal & Clemens, 2015; Cameron, Rodriguez, & Schomer, 2012; Consortium for Spinal Cord Medicine, 2006; Przydacz, Chlosta & Corcos, 2018).

The term urodynamics refers to a group of tests that measure the transport, storage, and elimination function of the urinary tract. A cystometrogram (CMG) provides assessment of the bladder filling and storage capacity. A CMG measures the volume of liquid stored/emptied versus the intravesical pressure.

A cystogram is an x-ray of the pelvis while contrast is in the bladder. Reflux can be identified where contrast flows from the bladder to the kidneys.

An ultrasound is used to evaluate kidney, ureters, and bladder and can determine the anatomic size of these structures. It can diagnose hydronephrosis with dilatation of the ureters. A post-void residual can be determined by ultrasound of the bladder after voiding.

A computed tomography (CT) scan of the kidney, ureter, and bladder may be done to give high quality anatomic images. They, however, have significant radiation exposure.

A nuclear renal scan is a test that measures the symmetrical function of kidneys. It may measure the glomerular filtration rate. This is a test performed after injecting a radioactive tracer into the bloodstream and measuring activity with a gamma camera.

A cystoscope is a thin tube with a camera inserted through the urethra to visualize the urethra and bladder. Biopsies may be performed. Table 1 below captures the various types of tests and the purpose of each.

Table 1. *Urological Tests and Purpose of Tests*

Name of Test	**Purpose of Test**
Cystometrogram	Measures bladder Storage and voiding Pressures
Kidney Ureter Bladder Ultrasound	Non-invasive Sound waves to visualize bladder Evaluates hydro nephrosis and post-void residuals
CT Scan Kidney Ureter Bladder	High quality anatomic image Useful to detect stones in kidneys, ureters or bladder Significant radiation exposure
Nuclear Renal Scan	Determines symmetrical renal function Estimates glomerular filtration rate
Cystoscope	Physician procedure where camera on a thin tube visualizes bladder Can biopsy tissue Can inject BOTOX

Treatments for Neurogenic Bladder

Uninhibited Neurogenic Bladder Treatment

The goals for treating uninhibited neurogenic bladder include improving warning time and continence. This involves removing obstacles in the environment (e.g., using a bedside commode), using medications to inhibit the detrusor muscle, and performing Kegel exercises, defined as squeezing the pelvic floor as if holding back a bowel movement or stopping the flow of urine. Medications often used for an uninhibited/upper motor neuron bladder include anticholinergics like Ditropan (Oxybutynin) and Detrol (Tolterodine), which slow bladder contractions. They can have side effects such as dry mouth, constipation, and urinary retention and carry the risk of shutting down the bladder, especially if too high of a dose is administered. Another medication is Botox (Onabotulinum Toxin), which blocks the acetylcholine receptor in the bladder wall. If incontinence continues, the next step is to use external condom catheters which consist of a condom with a tube in it that adheres to the penis. It is possible to use this if pressures are acceptable as indwelling catheters are less ideal for these patients.

Upper Motor Neuron Neurogenic Bladder Treatment

When it comes to treatment of upper motor neuron neurogenic bladder, one must consider the patient's hand function. If hand function is good, an individual can learn to perform self-intermittent catheterization, which involves inserting straight catheter tubing through the urethra into the bladder, typically 4-6 times a day. The bladder is used as a passive reservoir and pressures usually stay relatively low. If the hand function is not good, another person can perform catheterization for the patient. The advantage of Intermittent Catheterization (ICP) is there is no indwelling tube and therefore there is a lower infection rate.

Depending upon the detrusor and sphincter activity, a condom catheter may also be used. Condom catheters can be safe and effective only if the sphincter (voiding) pressures are relatively low. Kegel exercises may also be effective, if the spinal cord injury is incomplete (Fried, Goetz, Potts-Nulty, Cioschi & Staas, 1995).

If there is poor hand function and no one else to do intermittent catheterization, an indwelling catheter or a suprapubic catheter may be required. A suprapubic catheter enters through the abdominal skin just above the pubic bone into the bladder and may be used in place of a catheter in the urethra.

One of the risks of chronic indwelling catheters is urethral erosion, which is why a suprapubic catheter is a potential alternative. Medications commonly used for upper motor neuron bladder are the same as those used for uninhibited neurogenic bladder include anticholinergics like Ditropan (Oxybutynin) and Detrol (Tolterodine). Cystoscopic Botox would be an option. If there is sphincter dyssynergia in these patients, the goal is to relax the sphincter. Medications that can help target this muscle include Hytrin (Terazosin) and Flomax (Tamsulosin). These, however, may cause hypotension.

Lower Motor Neuron Areflexic Neurogenic Bladder Treatment

Many of the treatments used for upper motor neuron and uninhibited neurogenic bladder, such as intermittent catheterization, are also used for lower motor neuron areflexic neurogenic bladder treatment for patients who have the ability to self-catheterize. Patients are often taught pelvic floor strengthening exercises such as Kegels as well as the Crede maneuver, which involves applying external pressure over the bladder to help with voiding. However, this carries a risk of potential reflux. Urecholine (Bethanechol) is often used to stimulate the parasympathetic nervous system and increase detrusor contractions (which unfortunately carries gastrointestinal side effects and the risk of hypotension).

Treatment Advantages and Disadvantages.

There are advantages and disadvantages to each of the above treatment plans. All bladder management programs require time, effort, commitment, and meticulous monitoring of changes in a patient's status. Urinary complications and urinary tract infections are the leading reason for emergency visits and re-hospitalizations. This is seen at varying degrees with condom catheters, foley catheters and intermittent catheterization programs (Cardenas, Hoffman, Hinshblum, & McKinley, 2004).

Condom catheters for men are convenient, with a relatively low infection rate, if the bladder has acceptable voiding pressures. One can check the voiding pressures with a cystometrogram. The condom catheter can cause skin breakdown on the penis, especially if the condom falls off and the patient is unaware, thus causing them to void, with wetness and potential skin maceration or other skin issues.

Foley catheters are considered a convenient, passive system and used for patients who do not want to be bothered with intermittent catheterizations. Patients are usually told to stay hydrated, so there is no stasis of urine. This is a popular system in nursing homes. Disadvantages of the indwelling catheter are bacteria take only three days to colonize the entire bladder, stones can form in the bladder around the balloon and fistulas are possible from the persistence of erosion. Long-term, there is an increased incidence of bladder cancer due to the persistent presence of a foreign body.

Intermittent catheterization programs are commonly used and considered a safe and effective way for bladder maintenance. If done correctly, this method has the least risk of infection and bladder stones, because there is no indwelling foreign body in between catheterizations. Challenges with this method include the need for the patient to be motivated and have good hand function or to have a caregiver available to perform the task. Catheterization can be inconvenient, depending on the patient's lifestyle. If the patient's hand function is poor or the patient's emotional compliance is poor, and assistance is unavailable the indwelling catheter may be the most practical alternative.

Conclusion

Understanding the role that nerves play in communication between the bladder and the brain is important to understanding neurogenic dysfunction. Interruptions in these messages from etiologies including spinal cord injuries, multiple sclerosis, Parkinson's and diabetes, can lead to these three main classifications: uninhibited, upper motor neuron, and lower motor neuron bladder dysfunctions. The patient's physical and mental capabilities will help to determine which bladder management protocol will be best for them and what medications will be needed to optimize their bladder care.

References

Cameron A.P., Lai J., Saigal C.S., Clemens J.Q. (2015). Urological surveillance and medical complications after spinal cord injury in the United States. Journal of Urology, 86(3), 506-510. doi:10.1016;j.urology.2015.06.005.

Cameron, A.P., Rodriguez, G.M., Schomer, K. G (2012). Systematic review of urological follow up after spinal cord injury. *Journal of Urology, 187*(2), 391-397. Doi: 10.10/j.juro.2011.10.020.

Cardenas, D.D., Hoffman, J., Hinshblum, S., & McKinley, W. (2004). Etiology and incidence of rehospitalization after traumatic spinal cord injury: A multicenter analysis. *Physical Medical Rehabilitation, 11*(85), 1757-1763. https://doi.org/10.1016/j.apmr. 2004, 03.016.

Consortium for Spinal Cord Medicine (2006). Bladder management for adults with spinal cord injury. The Journal of Spinal Cord Medicine, 29(5), 528-541.

Dolinak, D. & Balraj, E. (2007). Autonomic Dysreflexia and sudden death in people with traumatic spinal cord injury. *The American Journal of Forensic Medicine and Pathology, 28*(2), 95-98. doi:10.1097/PAF.0b013e3180600f99.

Eltorial, I., Kim, R., Vulpe, M., Kasravi, H. & Ho, W. (1992). Fatal cerebral hemorrhage due to autonomic dysreflexia in a tetraplegic patient: Case report and review. *Paraplegia, 30*(5), 355-360. doi:10.1038/sc.1992.82.

Fried G.W., Goetz G., Potts-Nulty S., Cioschi H.M., & Staas W.E. (1995). A behavioral approach to the treatment of urinary incontinence in a disabled population. *Archives of Physical Medicine & Rehabilitation, 76*(12), 1120-1124.

Przydacz, M., Chlosta, P., & Corcos J. (2018). Recommendations for urological follow-up of patients with neurogenic bladder secondary to spinal cord injury. International *Urology and Nephrology, 50*(6), 1005-1016. doi:10.1007/s11255-018-1852-7.

Simpson, L. Eng, J. & Hsieh, J. (2012). The health and life priorities of individuals with spinal cord injury: A systematic review. *Journal of Neurotrauma, 28*(8), 1548-1555. https://doi.org/10.1089/neu.2011.2226

Author Note: Communication about this manuscript can be sent to gfried@mageerehab.org