MANAGING URINARY RETENTION IN THE ACUTE CARE ENVIRONMENT

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INTRODUCTION

The purpose of this acute care clinical manual is to assist clinicians in the management of urinary retention (UR) in the acute care setting—hospitals and rehabilitation facilities. It was written to provide clinicians with the most recent medical information on managing patients with urinary retention or incomplete bladder emptying, with emphasis on post-operative urinary retention and the use of non-invasive bladder volume monitoring.

This manual provides staff with a carefully guided understanding of the genito-urinary system, causes of acute and chronic urinary retention, and the problem of post-operative urinary retention, assessment, and management. The manual is based on standard medical concepts combined with the newest theoretical and practical knowledge. The focus of this information is safe patient care through the application of non-invasive bladder management.

This is timely and important information because the use of an indwelling urinary catheter is a very common procedure for managing acute care patients with urinary retention. However, the use, or misuse, of these catheters can lead to catheter-associated urinary tract infections (CAUTIs), a common infection acquired in hospital, nursing home, and home care settings.

Since 2008, the Centers for Medicare & Medicaid Services (CMS) has held acute care hospitals accountable for failing to avert preventable harms resulting from medical care and is withholding and denying additional payments to hospitals for "serious preventable events." One of the eight costly and sometimes deadly preventable hospital-acquired conditions identified by CMS is a catheter-associated urinary tract infection. Hospitals are now at risk for a financial loss (nonpayment for additional costs) if a catheter-associated infection occurs. The additional payments at stake can be substantial, because they make up a substantial proportion of the base payment the hospital would receive for an otherwise uncomplicated admission.

Applying infection control-based practices to complications from an indwelling catheter should enhance patient safety and is important for clinical effectiveness and quality improvement. Monitoring the bladder with an ultrasound bladder volume instrument such as a BladderScan® device, and avoiding the use of catheterization, can improve patient safety while minimizing unreimbursable acute care costs.

This acute care clinical manual provides the knowledge for your hospital staff clinicians that will allow them to provide safe patient care to your patients and to prevent adverse events.

We wish you, your staff, and your patients success!

ANATOMY & PHYSIOLOGY OF THE GENITO-URINARY SYSTEM

To understand abnormal bladder function, it is first important to understand the anatomy and physiology of the genito-urinary system.

ANATOMY & PHYSIOLOGY

The urinary system is a highly efficient mechanism for removing waste products from the blood and excreting them from the body. It is composed of the upper and lower tracts shown in Figure 1.

Figure 1.   Upper and Lower Urinary Tract System
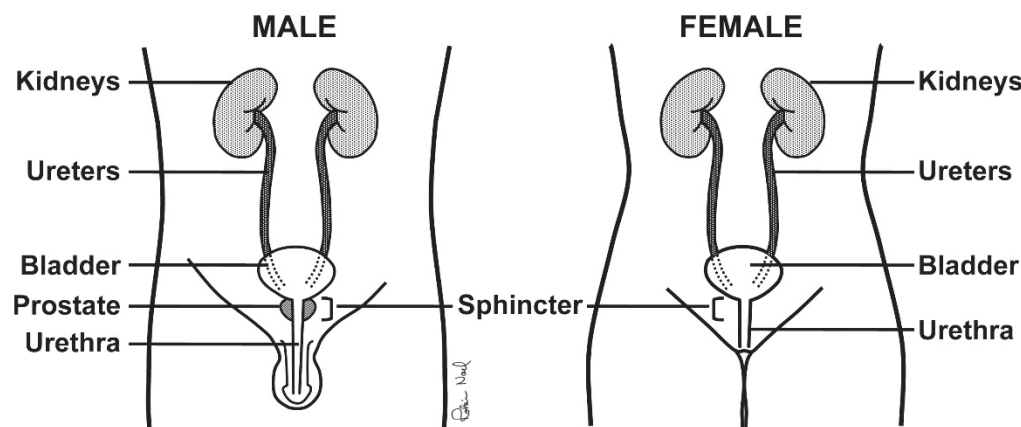
The upper urinary tract includes two kidneys and two ureters.

The kidneys are a pair of fist-sized organs that filter impurities from the blood, combine them with water, and convert them into urine. The kidneys also regulate the chemical makeup of the blood and preserve the correct balance between salt and water in the body.

Urine is transported from the kidneys, through the ureters, down to the bladder. The bladder fills and expands passively with urine that is passed via the ureters.

The lower urinary tract is composed of the bladder, prostate (men only), urethra, internal and external sphincters, and urethral meatus.

Bladder disorders, such as unresolved or chronic urinary retention and untreated urinary tract infections (UTIs), can cause upper urinary tract damage. UR can also affect the lower urinary tract.

BLADDER

The urinary bladder is a hollow muscular sac that is part of the lower urinary tract and is located in the pelvic region (Figure 2). It lies behind the pubic bone (or pelvic bone) when empty and rises above the level of the pubic bone when full, making it easily palpable. It is freely movable except at the base, where it is continuous with the urethra. The base of the bladder is composed of a triangular-shaped fibro-elastic muscle known as the

trigone. The trigone of the bladder, which contains the bladder's sensory nerves, is shaped like an upside-down triangle. The base of the triangle connects to the ureters from the right and left kidneys. The apex of the trigone is at the junction where the bladder muscle and the urethra meet (called the bladder neck).

Figure 2.   Lower Urinary Tract
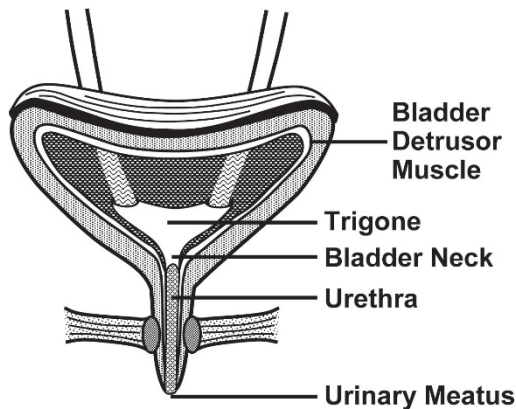
The wall of the bladder has three layers: an inner mucous layer, a central muscular layer, and an outer fatty layer. The central, muscular layer is made up of smooth muscle that is called the detrusor. The bladder is often referred to as the "detrusor." The detrusor stretches as the bladder fills with urine and then contracts to expel it. Smooth muscle is not under voluntary control, but contracts in response to certain reflexes.

The bladder's function is to fill, store, and then empty urine through the urethra. During the filling phase, the bladder muscle (detrusor) relaxes to accommodate increasing volumes. As the bladder reaches its capacity and becomes distended, the pressure inside (intravesicle pressure) increases. The bladder increases to the size of a softball when full. Normally, it can hold about 12-16 ounces (360-480 mL) of urine, which is called the functional capacity of the bladder. When empty, the bladder lies in folds. The bladder is held in place by ligaments attached to adjacent organs and bones of the pelvis.

URETHRA

The urethra is a thin muscular tube that leads from the floor (or neck) of the urinary bladder to the outside of the body (Figure 3). It is made up of smooth muscle and, therefore, is not under voluntary control. The urethral orifice or meatus is the opening of the urethra to the outside of the body. When not urinating, the urethral tube is collapsed and held closed by tiny but powerful internal and external sphincter muscles.

Figure 3.   Bladder, Urethral, and Sphincters
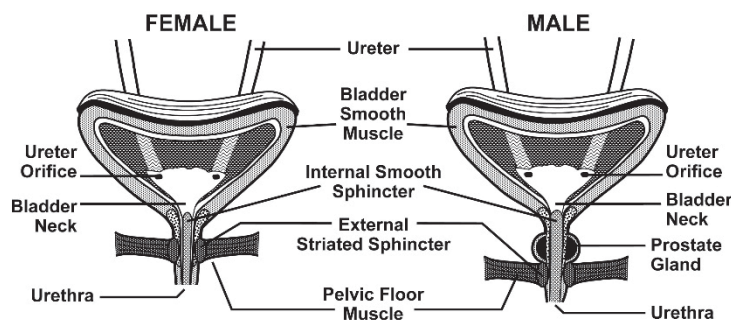
In women, the urethra is approximately 1.5 inches in length. The urethra runs from the neck of the bladder along the top of the vagina to the meatus. The meatus is located just between the clitoris and the vaginal opening, but with aging it generally moves toward the vaginal introitus. The mucosal lining of the urethra in women is different from the lining in men, in that it contains stratified squamous epithelium superficial (layer consisting of flat, scale-like cells called squamous cells), which is subject to effects of the estrogen hormone. After menopause, the lack of estrogen is reflected in poorer quality collagen, muscle tone, and skin tone and is thought to contribute to incomplete bladder emptying and urinary incontinence (UI).

Figure 4.   Female Perineum
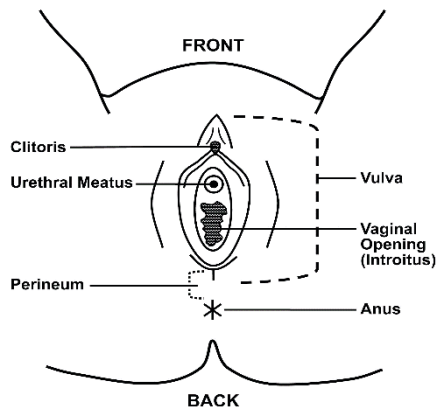
In men, the urethra is approximately 8 inches long (Figure 5). It begins at the base or bladder neck, passes downward through the prostate gland, the urogenital diaphragm, and the length of the penis, and ends at the urethral meatus at the tip or glans of the penis. The innermost portion (also called the prostatic or sphincteric urethra) is approximately 3 inches long, longer than the entire female urethra.

Figure 5.   Side View of Male Bladder and Urethra
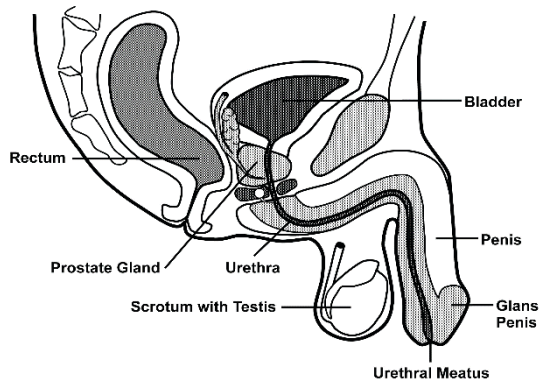
PROSTATE

The prostate is a walnut-sized gland located at the base of the bladder and surrounds the urethra like a donut. The portion of the prostate closer to the urethra can become enlarged, causing obstruction. This condition is called benign prostatic hyperplasia (BPH) and can lead to UR.

URINARY SPHINCTERS

The urethra is surrounded by two sphincter muscles, which prevent urine from leaving the bladder. The internal and external urethral sphincters aid storage and emptying of the urinary bladder. The inner ring of muscle, or internal sphincter, is involuntary (controlled by the central nervous system), while the outer ring, or external sphincter, is under voluntary control. Unlike smooth muscle tissue, which a person cannot consciously control, the muscles of the external sphincter can be voluntarily relaxed to facilitate emptying of the bladder, or voluntarily contracted to prevent urine leakage when abdominal pressure is increased, such as during coughing. Consciously relaxing the external sphincter can also aid in bladder emptying.

PELVIC FLOOR MUSCLE ANATOMY

The bony pelvis offers support and protection to the organs and structures located within the pelvis. The bladder itself lies deep in the bony pelvis, as do the lower two-thirds of the ureters. The major bones of the bony pelvis, the ileum, the ischium, the pubis, and the coccyx, provide a framework to contain the pelvic organs and to support the pelvic floor muscles.

The pelvic floor muscles (PFMs) are a group of muscles that extend from the front (anterior) to the back (posterior) of the bony pelvis, forming a sling that supports the pelvic organs (Figure 6). The PFMs are entirely under voluntary control and play an important role in maintaining continence. They can become weakened from childbirth, lack of use, a decrease in the hormone estrogen, aging, surgery, and injury.

Figure 6.   *Pelvic Floor Muscles in Woman*
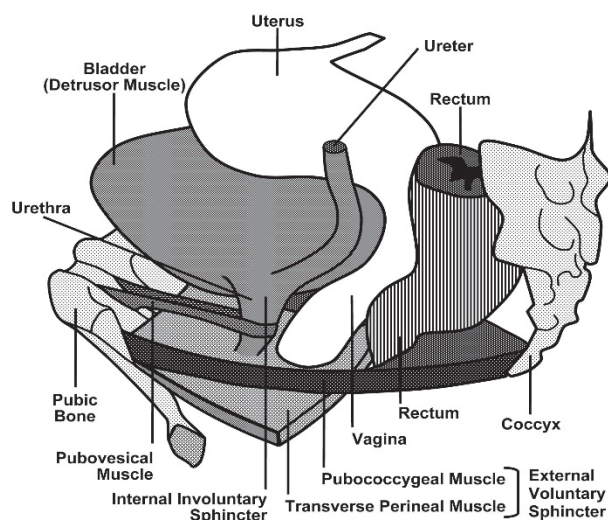
NERVOUS SYSTEM

The functions and neuro control of the lower urinary system are dependent upon an intact, functioning central nervous system and brain (Figure 7 and Figure 8). The nervous system is divided into central and peripheral parts. The central nervous system contains the brain and the spinal cord. The peripheral nervous system contains the autonomic and somatic peripheral nerves. The autonomic nervous system is not under conscious control and is often called the involuntary nervous system.

Figure 7.   Neuro Control

The brain sends nerve signals telling muscles to hold urine or let it out.

Nerves send signals to the brain. The signals tell when the bladder is full or empty.
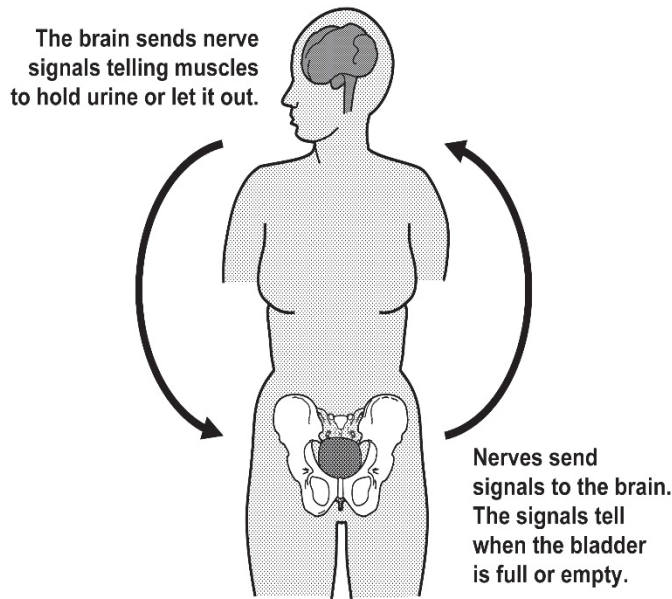
The involuntary (autonomic) nervous system contains the sympathetic and parasympathetic nervous systems. The sympathetic nervous system allows the bladder to store urine by (1) relaxing the bladder muscle, allowing it to fill with urine, and (2) contracting the internal urethral sphincter to prevent urine from entering the urethra. The parasympathetic nervous system promotes urination or bladder emptying by (1) stimulating the bladder muscle to contract, causing the urge sensation and (2) relaxing the internal urethral sphincter, which allows urine to enter the urethra.

Figure 8.   Connection Between the Nervous System and Bladder Function

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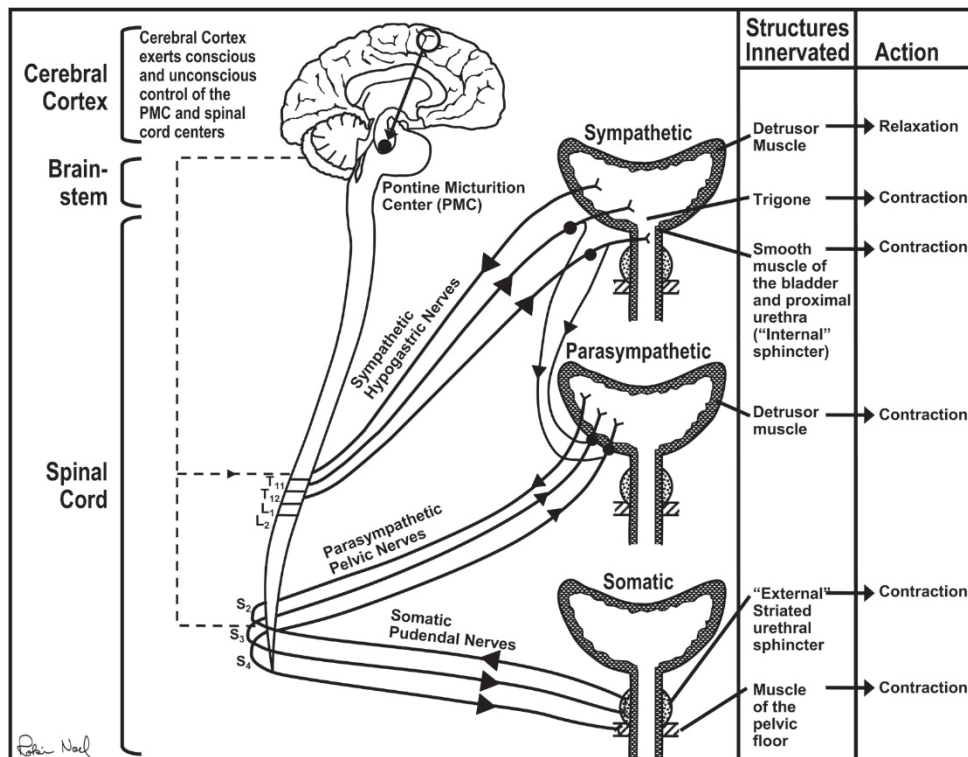
The somatic nerves are under voluntary control. The somatic nervous system signals the external urethral sphincter to either contract to prevent urine leakage, or to relax allowing the release of urine.

The nervous system functions on electrical impulses transmitted through the release of chemicals known as neurotransmitters. The primary one in the bladder is acetylcholine (ACH). When ACH is released, this causes bladder muscle contraction. The release of chemicals, in various combinations and locations, modifies the observed response of the nervous system.

The control of micturition (voiding or urinating) is a complex process involving multiple afferent and efferent neural pathways, reflexes, and central and peripheral neurotransmitters. In order to understand why UR occurs, it is important to understand how the bladder empties. Patients in acute care hospitals or rehabilitation facilities face a myriad of factors that may interrupt this process and promote the development of UR. Figure 9 depicts the phases of bladder storage and emptying.

Figure 9.   Storage and Emptying Phase
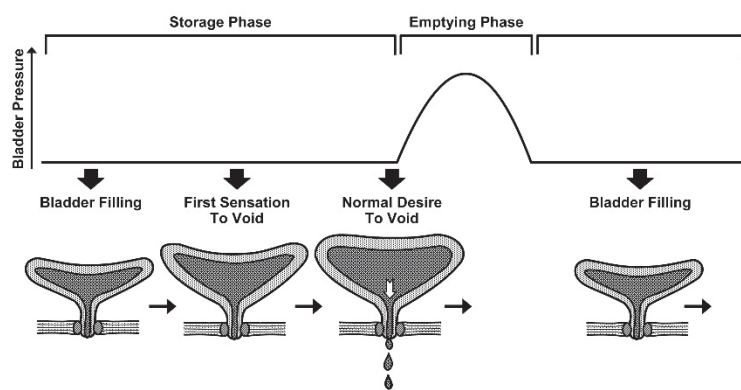
BLADDER STORAGE PHASE

Urine forms in the kidneys and flows to the bladder through the ureters. Peristaltic waves cause the urine to enter the bladder in small amounts, which is stored as follows:

1. Sympathetic impulses from the spinal cord:
   - Relax the detrusor muscle.
   - Contract the internal urethral sphincter, which keeps urine from entering the urethra.

2. Somatic nervous system sends signal to external urethral sphincter, which:
   - Contracts the external sphincter, helping prevent urine leakage.

3. Net effect is storage of urine.

BLADDER EMPTYING PHASE

As the urine volume increases, the bladder wall stretches causing impulses to be sent to the sacral spinal cord activating the parasympathetic nervous system, as follows:

1. Parasympathetic impulses from the spinal cord:
   - Stimulate the detrusor muscle to contract and produces the urge to void.
   - Relax the internal urethral sphincter, which allows urine to enter the urethra.

Anatomy & Physiology of the Genito-Urinary System

2. Somatic nervous system sends signal to the external urethral sphincter:

- Relaxes the external sphincter, allowing the release of urine.

3. Net effect is bladder emptying.

NORMAL MICTURITION OR VOIDING CYCLE

A normal voiding cycle is depicted below and requires a bladder that expands easily during the filling phase and then contracts to empty completely during the voiding phase.

Figure 10. Steps in Normal Micturition or Voiding Cycle
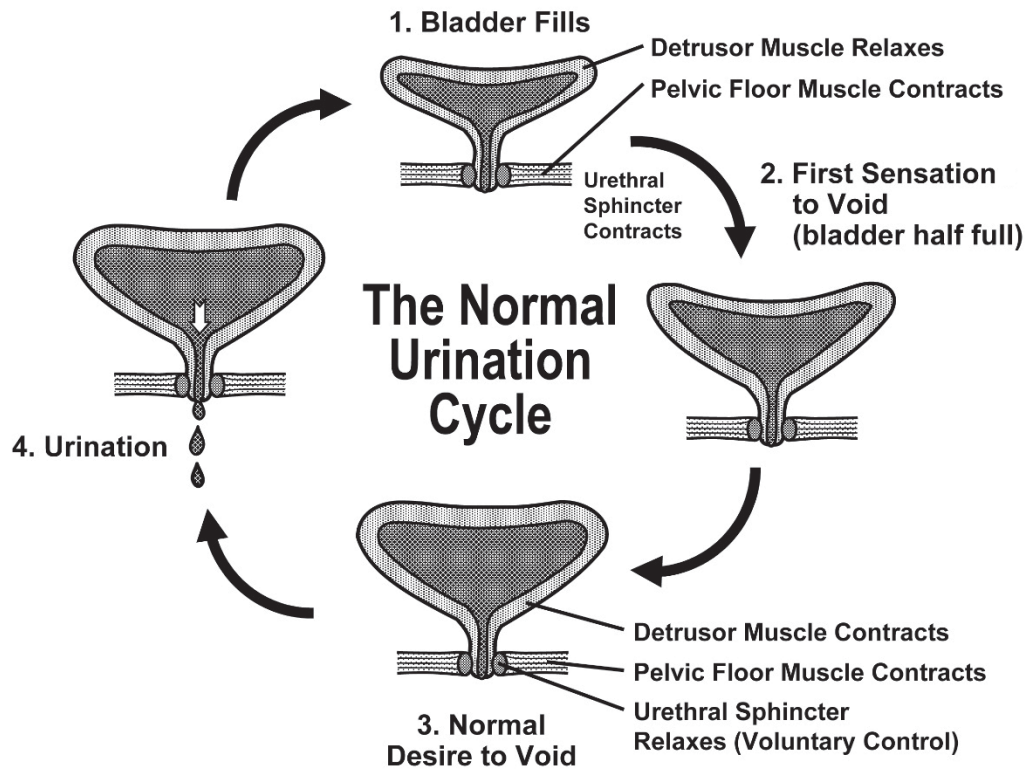
1. Detrusor (bladder) muscle relaxes as it fills with urine. Pelvic floor and urethral sphincter muscles remain contracted to prevent release of urine.

2. Bladder fills to capacity and nerves send messages to brain, causing the first sensation of need to void.

3. As voiding is voluntary, the individual makes a conscious decision to toilet or to delay voiding. If toileting occurs, the pressure in the bladder (detrusor) muscle increases, causing the bladder to contract and the urethral sphincter and pelvic muscle to relax.

4. Voiding occurs.

To maintain continence, the bladder pressure must be less than the pressure within the urethra.

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AGING & CHANGES IN THE URINARY SYSTEM

Although bladder disorders are common among hospitalized older adults, bladder disorders are not a normal part of aging and should not be a long-term result of a recent medical condition or surgical procedure. Therefore, when properly assessed and treated, UR can be avoided and/or suitably managed and controlled.

Physiological, psychological, and environmental changes accompany aging. While these changes do not directly cause the bladder to malfunction, they do predispose the elderly to an increased risk or incidence of disorders. Normal age-related changes that occur in the urinary system are:

- A decrease in the kidney's ability to filter blood and concentrate urine

- The sensory nerve tracts from the bladder (through the spinal cord) to the brain often "wear out," creating breaks in the neural pathway. Consequently, there is a "short-circuiting" of nerve firing, and messages from the urinary system may not completely reach the brain. In general, the nervous system takes longer to respond to sensory stimuli. This causes the bladder urge sensation (telling the person to void) to be delayed.

- Due to an incomplete nerve pathway, there is an increase in bladder spasms or bladder overactivity. These are small frequent contractions that create the urge to void before the bladder is full. These bladder contractions, which the person has no control over, cause urine leakage (urgency urinary incontinence) following urinary urgency.

- The bladder does not empty completely (called urinary retention) because the capacity of the bladder is decreased. This is the reason why older adults need to void often and in small amounts (urinary frequency). The urine that remains in the bladder after the person has voided (post void residual, or PVR) may become infected with bacteria. Hence, there is an increased incidence of UTIs.

- Because of the degenerative changes in the nervous system, the interval between the time the urge to void is felt and actual voiding occurs is shortened (called decreased "voiding time"). This shortened warning period is a problem for patients who experience urgency. Urgency, which in most persons is sudden and strong, causes the individual to rush when attempting to toilet.

- Increased nighttime urine production occurs (called nocturnal polyuria). During the night, there is a lower level of physical activity and the supine position promotes the movement of body fluids from dependent parts of the body (e.g., legs and feet) to the bloodstream. The kidneys filter the fluids and convert them into urine, causing an increase in the amount of urine in the bladder. In women who have delayed fluid excretion, > 50% of their 24-hour urine output is excreted during the night. Increased renal perfusion and excretion of excess renal fluid may cause an increase in the amount of urine in the bladder.

URINARY RETENTION

Urinary retention (UR) is a bladder disorder commonly seen in patients in the acute care setting (Gray 2000a, 2000b). This section provides a review of UR and details causes, types, and management strategies.

OVERVIEW

UR is defined as the inability or failure to empty the bladder completely. A PVR urine volume of > 75 to 100 mL is generally accepted as the criteria to define UR. However, in elderly patients, a PVR < 150 mL can be acceptable as the bladder does not empty as well and this amount should not cause a problem. UR is classified as either acute or chronic and the following is a summary of these two types:

ACUTE URINARY RETENTION

Acute urinary retention (AUR) is the sudden and complete inability to void despite the presence of urine in the bladder and the desire (urge sensation) to urinate. It is usually preceded by a history of progressively decreasing force of voided stream. An individual may have complaints of lower abdominal pain. In the acute care setting, AUR is seen in patients following surgery and is referred to as post-operative urinary retention (POUR). The bladder must be drained or emptied immediately or it can lead to acute renal failure or bladder rupture. Rapid decompression of the bladder is performed easily and has not been associated with an increased risk of complications. These patients are often managed by an indwelling urinary catheter (IUC) on a short-term basis (defined as < 30 days) until the retention resolves. Unless the bladder is drained by catheterization, AUR leads to acute renal failure or bladder rupture and should be considered a medical emergency.

The incidence of AUR varies significantly between men and women as it is less common in women (Aning et al., 2007). It is estimated that 10% of men in their seventies and a third in their eighties will have AUR within the next five years (Curtis et al., 2001). It is felt that at least one-third of women presenting for urogynecologic assessment experience an underlying degree of significant voiding difficulty before surgery (Haylen et al., 2007). AUR in women is mostly a result of recent surgery with the post-surgical UR rate between 5% and 25% of all surgeries and a higher incidence with pelvic surgeries (Manchana et al., 2009). Because of the low incidence in women and as a result of very little published information on the topic, evaluation and management of women with AUR is often inadequate.

The major etiologies for AUR in both men and women can be subdivided into obstructive, infectious, pharmacologic, and neurogenic (Table 1 and Table 2) (Ramsey & Palmer, 2006). In some cases, AUR appears at the time of a triggering event (also called 'precipitated' AUR), e.g. a surgical procedure of any kind (in this case several factors such as pain, general or epidural anesthesia and immobility may have contributed to the occurrence of AUR), excessive fluid intake (especially alcohol, which acts as a sympathetic stimulator), UTI, or intake of medications with sympathomimetic or anticholinergic effects. In men, in the majority of cases, AUR appears simply related to the natural history of BPH (also called 'spontaneous' AUR). The differentiation between spontaneous and precipitated AUR is clinically relevant, as AUR types differ in their outcomes. The risk of BPH-related surgery appears to be lower in cases of precipitated AUR.

Table 1.   Common Etiologies of AUR in Men

Obstructive	• Benign prostatic hyperplasia • Prostate cancer (invasive at bladder neck) • Urethral stricture, bladder neck contracture • Bladder tumor, urethral polyp, urinary meatal stenosis • Constipation
Neurogenic	• Traumatic brain injury • Spinal cord trauma • Diabetes mellitus • Neurological disorders (multiple sclerosis, Parkinson's disease)
Infectious	• Prostatitis • Urethral herpes • Periurethral abscess
Bladder Over-distension	• General anesthesia • Surgery (e.g. prostate, bladder) • Excessive fluid intake, especially ethyl alcohol • Postoperative pain
Medications	• Epidural anesthesia • Anticholinergic, opiates (Table 4 on page 18)

(Adapted from Bradway & Rodgers, 2009)

Table 2.   Common Etiologies of AUR in Women

Anatomic	• Pelvic organ prolapse (cystocele, rectocele, uterine prolapse) • Tumor (e.g. uterine fibroid, pelvic mass) • Constipation
Neurogenic	• Traumatic brain injury • Spinal cord trauma • Diabetes mellitus • Neurological disorders (multiple sclerosis, Parkinson's disease)
Operative	• Postoperative pain • General anesthesia • Postlumbar laminectomy • Post-incontinence surgery
Infectious	• UTI • Genital Herpes
Medications	• Epidural anesthesia • Anticholinergic medications • Anticholinergic, opiates (Table 4 on page 18)

(Adapted from Bradway & Rodgers, 2009)

CHRONIC URINARY RETENTION

Chronic urinary retention (CUR) is characterized by an ongoing inability to completely empty the bladder by micturition. In many cases, the patient remains able to partly urinate by a detrusor contraction or abdominal straining (bearing down or Valsalva maneuver), but in some cases the individual is completely unable to urinate. CUR may produce voiding dysfunction or the person may be entirely symptom-free, even while producing significant upper urinary tract distress. However, an elevated urinary residual volume (> 75 to 100 mL) may exist without producing any apparently harmful effects. CUR becomes clinically significant when it causes bothersome voiding dysfunction or when it leads to complications such as AUR, recurrent UTI, urinary or bladder calculi (stones), pyelonephritis, hydronephrosis, vesicoureteral reflux, or renal insufficiency. Reflux of urine into the ureters, which over time will cause kidney damage (hydronephrosis) due to very high bladder pressures. Unrecognized CUR retention can lead to overflow incontinence and may require intermittent catheterization (IC) leading to recurrent UTI and upper urinary tract damage. This is most likely due to inaccurate and varying definitions and differences in the diagnostic criteria and treatment modalities.

While CUR is frequently suspected among patients with lower urinary tract symptoms and known risk factors for obstruction, there is no one symptom, cluster of symptoms, or symptom assessment instrument that has been shown to identify the presence of CUR. Instead, one or more PVR residual volumes should be measured when evaluating a patient with voiding dysfunction who is as at risk for UR.

CAUSES OF URINARY RETENTION

There are many causes of both AUR and CUR. In most instances, a patient will present with AUR resulting from a chronic condition. The following is a review of these causes.

- In men, UR is frequently associated with some form of bladder outlet obstruction (BOO). Most often, obstruction occurs in middle-aged and older men with a pre-existing history of progressive lower urinary tract symptoms (LUTS); symptoms include decreased urinary stream, hesitancy, nocturia, dribbling) associated with BPH (Table 3 on page 15). Advanced prostate cancer, which invades the urethra or bladder neck, may also cause AUR. In men without LUTS/BPH, AUR may be triggered by other factors such as infection (for example, urinary tract infection or prostatitis), urethral stricture, post-operative pain, constipation, or excessive fluid intake, particularly excessive alcohol intake.

- Urethral strictures can present as AUR. The stricture is a circumferential scar of the mucosa and underlying corpus spongiosum and may be anywhere from the urethral meatus back to the bladder neck. Strictures usually arise secondary to previous urethral instrumentation, perineal trauma, or urethritis, but the etiology is frequently idiopathic.

- Prostatitis is an infectious cause of UR. Patients typically appear sick at presentation, displaying fever, dysuria, and perineal pain. Digital rectal examination (DRE) reveals an exquisitely tender, boggy prostate. Other infectious causes of UR include urethral herpes, periurethral abscesses, and tuberculous cystitis.

- Bladder stones or bladder tumors may also cause obstructive UR in both men and women. A bladder stone typically forms secondary to urinary stasis (because of bladder outlet obstruction) or a foreign body in the bladder. These patients typically complain of intermittency, because the stone acts as a ball valve at the bladder neck. They may also have hematuria and blood clot formation. As the clots solidify and increase in number, they may settle at the most dependent portion of the bladder (the bladder neck) and completely block outflow. Most patients have some interval of gross hematuria and pass a few clots before clot retention occurs.

- Pharmacologic agents may contribute to UR. The most common group includes anticholinergics which may act by blocking postganglionic impulses to the detrusor muscle and inhibiting bladder contraction. Common medications include atropine. Certain antihistamines, α-adrenergic agonists (commonly found in decongestants) including ephedrine and pseudoephedrine, cause bladder neck smooth muscle contraction and subsequent retention. Psychiatric medications including phenothiazine antipsychotics and monoamine oxidase inhibitors also have anticholinergic effects and may cause AUR. Withdrawal of the offending medication may ultimately relieve retention.

MANAGEMENT

Immediate management of UR (acute or chronic) includes bladder decompression, in most cases with an IUC. Once stabilized, patients should undergo a voiding trial (VT), which involves removal of the catheter while monitoring voiding and PVR. Patients with a PVR of >1,000 mL are likely to initially fail a VT and may need intermittent catheterization for a period of time. In men, if the history suggests BPH, a selective (tamsulosin, alfuzosin) or nonselective (terazosin, doxazosin) alpha-blocker with or without a 5-alpha-reductase enzyme inhibitor (finasteride, dutasteride) is recommended. Alpha blockers have been shown to increase peak urinary flow rates and improve symptoms in men. They act by relaxing the prostate and bladder neck smooth muscle, reducing outlet obstruction without adversely affecting bladder contractility. 5-alpha-reductase inhibitors block the conversion of testosterone to dihydrotestosterone, which plays a key role in the development of BPH. These drugs can potentially reverse or arrest the process of BPH. Women with some degree of incomplete bladder emptying may also benefit from a selective alpha-blocker (Table 6 on page 23) .

ASSESSMENT & EVALUATION OF URINARY RETENTION

There are many ways to assess for UR and they include assessment of symptoms or patient complaints, physical examination, bladder ultrasound, and bladder catheterization. Pre-operative assessment is helpful in predicting those patients at risk of UR postoperatively, so as they can be observed closely to prevent bladder overdistension.

History and physical examination should rule out possible etiologies. Essential elements include a review of all medications, bowel habits, LUTS, obstetric/gynecologic and surgical history (particularly gynecologic and urologic surgery); and neurological, abdominal (check for distended bladder), and pelvic (check for pelvic organ prolapse (POP)) exams.

MEDICAL HISTORY

A history checklist may be helpful when assessing if an acute care patient is at risk for developing UR. Symptoms associated with gradual deterioration of the lower urinary tract include urinary hesitancy, frequency, post-void dribbling, overflow UI, and a slow or poor quality urinary stream. Additional history should rule out other common etiologies of AUR such as a thorough medication review, identification of acute or chronic constipation, acute or recurrent UTI or prostatitis, and neurologic conditions including diabetes, stroke, multiple sclerosis, low back injury, and disk disease. The following checklist reviews the important areas to review during the patient's history.

- Patient shows signs and symptoms of incomplete bladder emptying such as pain and discomfort in the lower part of the abdomen and/or above the pubic bone. If so:
  - Obtain a history of the UR, including pre-hospitalization of voiding.
  - Ascertain onset of the bladder dysfunction, length of time patient has had problem with UI/UTI/UR.
  - Review other LUTS (e.g., urgency, frequency, nocturia, nocturnal enuresis, straining during voiding, hesitancy, dysuria, etc.) (Table 3 on page 15). Below are specific bladder storage and emptying symptoms with accompanying definitions.

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Table 3.   Lower Urinary Tract Storage and Emptying Symptoms

SYMPTOM	DEFINITION
Dysuria	Painful or difficult urination, often described by clients as "burning when passing my urine."
Frequency	Voiding more than 8 times in a 24-hour period.
Incontinence	Involuntary loss or leakage of urine.
Nocturia	Wakening from sleep to void more than twice a night.
Nocturnal enuresis	Urinary loss while asleep.
Pressure (bladder, suprapubic)	Feeling that the bladder is full and the urge to void will occur shortly.
Urgency	Sudden, compelling desire to urinate that is difficult to defer. In certain cases, it can lead to urge/urgency UI if the person does not void immediately. Should not be confused with "urge" or the normal desire or need to void.
Urinary retention	The inability or failure to empty the bladder completely.
Hesitancy	Difficulty in starting or initiating urine stream and delay in onset of voiding or in initiating urine stream when person wants to void.
Incomplete emptying	The sensation that urine remains in the bladder after micturition.
Intermittent stream	Stopping and starting of urine stream while voiding.
Postvoid dribbling ("terminal dribbling" or postmicturition voiding)	Intermittent urine loss immediately after voiding. Men will complain that this occurs as they leave the toilet and women complain that it happens when rising from the toilet.
Slow, weak, or "poor" stream	Decreased or reduced force of urine stream when compared to previous performance (rare in women). Patients may report that they have reduced and prolonged urine flow and may complain of not emptying their bladder.
"Sprayed" or "split" stream	Symptoms of double stream or spraying of the urinary stream.
Straining to void	Need to use intra-abdominal or muscular effort to initiate, maintain, or improve the urinary stream. Intra-abdominal pressure is increased during a Valsalva maneuver, which increases the intravesical pressure, and this can improve bladder emptying. The urinary stream may be impaired and intermittent. If straining occurs over many years, POP in women may occur.

(Adapted from Newman & Wein 2009)

Assessment & Evaluation of Urinary Retention

- Awareness of need to urinate:
  - Does the patient know or have a feeling or urge sensation to void?
- Characteristics of the urinary stream. Have the patient describe or observe the following:
  - Character of the stream: when and how it starts once patient voids, strength of urine stream (e.g. continuous or strong or starts and stops), strains or bears down when voiding?
  - Pain or discomfort (e.g., grimacing, wincing, and moaning) with urination?
  - Presence of post-void dribbling
- Prompting and Initiation of voiding:
  - Presence of post-void dribbling
  - Once on the toilet, can the patient initiate the stream within a minute?
  - Does it take coaxing, e.g., running water or other triggers?
  - What is the number of times that the patient actually urinates when on the toilet (positive response to a prompt to void)?
- Emptying of the bladder:
  - Does patient experience post-void dribbling (may be a sign of incomplete bladder emptying and/or UR)?
  - Does patient complain of feelings of incomplete bladder emptying after voiding?

Note: Only 46% of patients with a bladder volume >500 mL realize that their bladder is full and feel an urge to void (Lamonerie et al., 2004). The diagnosis of bladder distention by nurses has been shown to agree with ultrasound in only 54% of cases. The advent of a portable bladder volume instrument (e.g., BladderScan®) used to scan the bladder, allows rapid and accurate assessment of bladder volume and has aided in the diagnosis of post-operative urinary retention.

- Observation of patient voiding/toileting:
  - Is the patient able to suppress the urge long enough to reach the toilet or is the patient able to wait for assistance from nursing staff?
  - What type of assistance is needed for voiding (e.g., able to self-toilet, needs minimal assistance, uses a bedside commode, urinal, or absorbent incontinence product)?
- Identification of all primary and secondary medical problems to determine impact on lower urinary tract system (neurologic and psychiatric diseases, prostate disorders in men, prior genito-urinary GU and/or pelvic surgery).

- Mental Status:
    - Is the patient motivated to self-toilet and regain continence?
    - Is the patient alert enough to recognize bladder fullness (urge sensation)?
    - Can the patient remember the bathroom location and/or device (bathroom, urinal)?
- Bowel History:
    - Bowel dysfunction (e.g., constipation, diarrhea, fecal incontinence).
    - Type of laxatives used in the past (e.g., stool softeners, suppositories, enemas).
    - Previous problem with fecal impaction and intervention.
- Presence of risk factors:
    - Diabetes.
    - Neurologic diseases (Parkinson's, MS, spinal cord injury).
    - Men—Prostate problems (BPH, prostatitis, urethral stricture, cancer).
    - Women—POP, recurrent UTIs.
    - Psychiatric disorder.
    - GU disorders (calculi and stones, reflux nephropathy (upper urinary tract damage), pyelonephritis, renal failure).
- Prescribed medications that may affect bladder function (Table 4 on page 18):
    - Psychotropic drugs can accumulate in the elderly and cause sedation, confusion and immobility, resulting in UI.
    - Anticholinergics cause UR, urinary frequency, and overflow UI.
    - Calcium channel blockers reduce smooth muscle contractility, causing UR and overflow UI.
    - Narcotics can depress the central nervous system, causing sedation, confusion and immobility, leading to UR and UI.
    - Rapidly acting or loop diuretics, such as furosemide, overwhelm the bladder with rapidly produced urine, resulting in frequency and urgency.
    - Alpha antagonist (common ingredient in cold preparations) relaxes the sphincters, causing UI and UR in men.

Assessment & Evaluation of Urinary Retention

Table 4.   Medications that Can Affect Bladder Function (Generic/Brand)

Anticholinergics (selected)	Sympathomimetics (alpha-adrenergic agents)	Antiparkinsonian Agents	Miscellaneous
Atropine	Ephedrine sulfate (Marax, Tedral)	Trihexyphenidyl HCl (Artane)	Nifedipine (Procardia)
Scopolamine hydrobromide	Phenylephrine HCl (Neo-Synephrine)	Benztropine Mesylate (Cogentin)	Indomethacin (Indocin)
Belladonna	Phenylpropanolamine HCL (Contac)	Antihistamines (e.g., Benadryl)	Carbamazepine (Tegretol)
Homatropine methylbromide	Pseudoephedrine HCl (Sudafed, Actifed)	Amantadine HCl (Symmetrel)	Amphetamines
Anisotropine methylbromide (Valpin)	**Sympathomimetics (beta-adrenergic agents)**	Levodopa (Dopar, Sinemet)	Mercurial diruetics
Clidinium bromide (Quarzan)	Isoproterenol	Bromocriptine Mesylate (Parlodel)	Dopamine
Glycopyrrolate (Robinul)	Metaproterenol	**Hormonal Agents**	Vincristine
Mepenzolate bromide (Cantil)	Terbutaline	Progesterone	Morphine sulfate
Methantheline bromide (Banthine)	**Antiarrhythmics**	Estrogen	**Antidepressants**
Oxyphenonium bromide (Antrenyl)	Quinidine	Testosterone	Imipramine (Tofranil)
Propantheline bromide (Probanthine)	Procainamide	**Antipsychotics**	Nortriptyline (Aventyl)
Dicyclomine HCl (Bentyl)	Disopyramide	Haloperidol (Haldol)	Amitryptyline (Elavil)
Oxybutynin (Ditropan)	**Antihypertensives**	Thiothixene (Navane)	Doxepin (Adapin)
Flavoxate HCl (Urispas)	Hydralazine (Apresoline)	Thioridizine (Mellaril)	Amoxepine (Asendin)
Hyoscyamine sulfate (Anaspaz)	Trimethaphan (Arfonad)	Chlorpromazine (Thorazine)	Maprotiline (Ludiomil)
Antihistamines (selected)	**Muscle Relaxants**	Fluphenazine (Prolixin)	
Diphenhydramine HCl (Benadryl)	Diazepam (Valium)	Prochlorperazine (Compazine)	
Chlorpheniramine (Chlor-Trimeton)	Baclofen (Lioresal)		
Brompheniramine (Dimetane)	Cyclobenzaprine (Flexeril)		
Cyproheptadine (Periactin)			
Hydroxyzine (Atarax, Vistaril)			

(Adapted from: Verhamme et al., 2008; Curtis, et al., 2001)

BladderScan®

PHYSICAL EXAMINATION

Physical examination is essential to evaluate UR, in order to assess its severity and to help identify the cause(s). Essential components of the physical exam include abdominal inspection, palpation for bladder distention and an external genital exam to identify phimosis (penile foreskin is stenosed and cannot be retracted) or trauma that may contribute to AUR. It is also important to perform a DRE to identify the size, consistency, and contour of the prostate gland, however, this should be postponed until after immediate treatment of the AUR has occurred and the patient is more comfortable. In men with LUTS/BPH, a DRE will most likely reveal a smooth, enlarged prostate. In contrast, patients with prostate cancer typically have a nodular, indurated prostate and in some cases, palpable tumor on exam. A thorough neurological exam may also be included, particularly if neurogenic causes of AUR are suspected.

- General
  - Signs of dehydration (dry mouth, falling, weakness and fatigue, decreased urine output, headache, weight loss and increased confusion). Pedal edema and signs of congestive heart failure indicate problems with fluid redistribution that may cause nocturia and nocturnal enuresis.
- Abdominal examination:
  - Presence of masses.
  - Presences of abdominal bloating, discomfort or fullness.
  - Palpation and percussion in the suprapubic area lacks the sensitivity to provide an accurate measure of PVR volume. Dullness of the bladder to the level of the umbilicus provides a rough estimate of at least 500 mL of urine, but it can vary as much as 1,000 mL with dullness extending above the umbilicus. Deep palpation of the bladder is not recommended because it can produce significant discomfort and can elicit vagal reflexes evoked by pain. In addition, clinical evaluation has been shown to overestimate the bladder volume compared to ultrasound.
- External Genitalia
  - Testing of the bulbocavernosus reflex (used to evaluate integrity between the PFMs and sacral spinal nerves).
  - In women, pelvic examination includes a local neurologic examination (testing of perineal sensation, PFM tone and strength, presence of POP, and atrophic tissue).
- Rectal
  - Digital rectal examination for rectal sphincter tone.
  - In men, check prostate for enlargement and a urethral stricture may be palpable through the scrotal or perineal skin as a firm, indurated region of urethra.

BLADDER ASSESSMENT & MONITORING

POST VOID RESIDUAL URINE

Post Void Residual (PVR) is the volume of urine in the bladder within 10 to 20 minutes after voiding.

PVR is determined using straight catheterization or ultrasound. Ultrasound is preferred as it has been shown to provide an accurate assessment of bladder volume and a guide to the management of POUR. It also has been shown to decrease the number of catheterizations performed (Cutright, 2011).

There is no specific PVR urine volume that reliably predicts the presence of clinically significant UR in every patient. Since normal adult bladder capacity ranges from 400 to 500 mL, an upper threshold of 500 mL has been recommended. A PVR of < 75 to 100 mL is considered adequate voiding and > 200 mL is inadequate. Among older adults, a PVR of 150 to 200 mL or greater indicates the need for further assessment, and a PVR that is 25% or more of the total bladder capacity (voided volume plus residual volume) justifies similar assessment.

When checking PVR, it is helpful to measure the voided volume, since this permits calculation of the percentage of total bladder capacity voided as compared to the residual volume.

Because of the significant variability in residual volumes, it's usually best to measure the residual volumes two or three times before catheterization is considered.

For children < 3 years of age, a portable bladder volume instrument (e.g. BladderScan®) may underestimate the true volume of urine in the bladder due to the shape and location of the bladder in the smallest children. However, catheterization is not necessarily a better alternative in small children.

Note: Catheterization is an invasive procedure with the potential to cause complications, including CAUTIs, urethral trauma, prostatitis, and patient discomfort. There is good correlation between the volumes measured by bladder catheterization and by ultrasound. Ultrasound is also useful to monitor bladder volume before it becomes excessively large and over-distends the bladder.

ADDITIONAL TESTING

URINE TESTS

Diagnostic tests to consider include urine dipstick, urinalysis and urine culture to rule out infection. Obtaining a high-quality urine sample is important, because it helps determine whether a true infection exists. Urine samples should be obtained using a midstream, clean-catch technique during a first morning void. In patients with an IUC, specimens should be obtained from a specifically designed sampling port in the urinary catheter and it should be noted on the laboratory requisition. Urine samples should never be obtained from a drainage bag. Many experts feel that before obtaining a urine specimen from a patient with a suspected CAUTI, the old urine catheter should be removed. All urine specimens should be tested within 2 hours of collection.

BLOOD TESTS

A complete blood count should be obtained if there is any suspicion of infection. A basic chemistry panel should be sent to evaluate renal function and electrolyte status if there is a concern about prolonged obstruction with subsequent hydronephrosis. A prostate-specific antigen (PSA) in men to determine elevation caused by prostate cancer, BPH, prostatitis, and if AUR is present.

RADIOLOGY TESTS

Radiograph studies, such as abdominal ultrasound or a film of the kidneys, ureters, and bladder, may be helpful to determine degree and location of obstruction. Abdominal computerized tomography or pelvic ultrasound may be useful if there is suspicion of compression secondary to pelvic or abdominal mass. Lumbar spine films may be necessary to evaluate the presence of spinal masses or vertebral collapse. Retrograde cystourethrogram may be required if lower urinary tract abnormalities are suspected.

In children, evaluation and monitoring of the urinary tract includes regular renal and bladder ultrasonography, and voiding cystourethrography. The voiding cystourethrogram can rule out vesicoureteral reflux and assess the bladder outlet.

URODYNAMIC TESTS

Urodynamic testing is essential for all age groups. The urodynamics study is a functional evaluation of the bladder and the urethra and provides information related to bladder capacity, compliance, leak pressure, overactive bladder contractions, bladder areflexia, detrusor sphincter dyssynergia (DSD) and dyssynergy. These tests should be part of the evaluation of any patient who has UR. They provide baseline information, help detect early changes, identify those at high risk for kidney damage or poor bladder function, and assist in identifying a management plan.

Assessment & Evaluation of Urinary Retention

BLADDER OUTLET OBSTRUCTION & URINARY RETENTION

Obstruction of urinary outflow, called bladder outlet obstruction (BOO), can be caused by blockage by an anatomic lesion or contraction of the sphincter or periurethral (pelvic floor) muscles. Any condition that obstructs the flow of urine can cause incomplete bladder emptying, and if untreated, can lead to UR. In men, bladder outlet obstruction can be the result of an enlarged prostate or from a urethral stricture. Figure 11 depicts the structures of the male lower urinary tract.

Figure 11.   Male Lower Urinary Tract
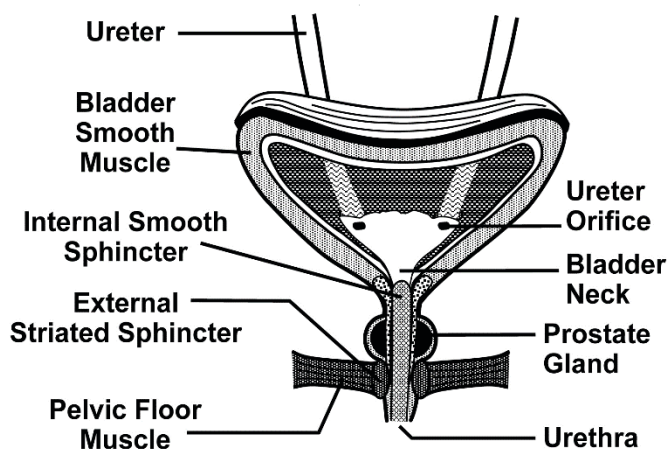
As men age, the normal prostate gland enlarges. This is called benign prostatic hyperplasia or (BPH) (Curtis, et al., 2001). More than 60% of 60-year-old men and more than 90% of 85-year-old men have benign prostatic hyperplasia (Chung & Sandhu, 2011). Of these men, approximately 60% will experience urinary symptoms. (Darrah et al., 2009). The enlarged prostate can obstruct the bladder neck, with narrowing and compression of the urethra. In both men and women, blockage or an obstruction in the urethra can also be from severe constipation with fecal impaction, or obstruction can occur in women with prolapse of the bladder or uterus, all of which can lead to UR or overflow UI.

CAUSES

Changes in the detrusor and in the bladder outlet contribute to the voiding symptoms associated with the obstruction. During the early stages of obstruction, the detrusor muscle is often able to compensate for heightened urethral outflow resistance by increasing the power and duration of its contraction. As a result, the patient may perceive hesitancy before urination, a heightened perception of pressure during voiding, and a diminished force of the urinary stream. If the obstruction remains mild or subsides, these voiding symptoms typically diminish and the bladder continues to empty completely. When obstruction persists over time or increases in severity, the bladder ultimately reaches a point at which the detrusor muscle is no longer able to overcompensate to empty the urine, and retention occurs.

With severe and prolonged bladder outlet obstruction, some patients develop poor detrusor contraction strength, which further increases UR. This will compromise detrusor muscle contraction strength by making the bladder wall less compliant (stiffer) and less able to efficiently empty. These changes render the patient more susceptible

to upper urinary tract distress and to episodes of AUR. The bladder may be palpable and is frequently distended with > 1000 mL of urine. Physical exam findings may indicate a distended bladder. In men, rectal examination may reveal a smooth, enlarged prostate, but there is no correlation between prostate size on rectal examination and degree of obstruction.

Table 5.   Common Causes of Acute Urinary Obstruction

- Benign prostatic hypertrophy
- Bladder calculi
- Bladder hematoma/clots
- Bladder neoplasm
- Cystitis
- Meatal stenosis
- Neurogenic etiologies
- Paraphimosis

- Penile trauma
- Phimosis
- Prostate cancer
- Prostatic trauma/avulsion
- Prostatitis
- Urethral inflammation post urethral procedures or manipulation
- Urethral strictures or foreign body

SYMPTOMS

Men with BPH will have extreme discomfort and may dribble small amounts of urine (overflow UI). These symptoms may include diurnal urinary frequency (voiding more often than 8 times while awake) and nocturia (awakening to urinate more often than once per night in people under age 65 or twice per night in persons 65 years or older). The force of the urinary stream may be perceived as poor or intermittent, and a post void dribble may occur. In addition, some patients report hesitancy when initiating a urinary stream, straining during urination, and a feeling of incomplete bladder emptying. When obstruction is particularly severe, patients may report a dribbling urinary leakage, called overflow UI. These symptoms are sometimes referred to as "obstructive voiding symptoms" and are listed in Table 3 on page 15.

Table 6.   Medications for BOO and BPH

DRUG (GENERIC/BRAND)	CHEMICAL STRUCTURE AND PRIMARY ACTION	USUAL DOSAGE
Dutasteride (Avodart)	5α-reductase inhibitors (5ARIs)	0.5 mg, once daily
Finasteride (Proscar)	5α-reductase inhibitors (5ARIs)	5 mg, once daily
Alfuzosin (Uroxatral)	α -Adrenoceptor Antagonists (α blockers)	10 mg, once daily
Doxazosin (Cardura)	α -Adrenoceptor Antagonists (α blockers)	4 mg or 8 mg, once daily
Prazosin (Minipres)	α -Adrenoceptor Antagonists (α blockers)	2 mg twice a day
Silodosin (Rappaflo)	α -Adrenoceptor Antagonists (α blockers)	4mg or 8 mg, once daily with food
Tamsulosin (Flomax)	α -Adrenoceptor Antagonists (α blockers	0.4 mg or 0.8 mg, once daily
Terazosin (Hytrin)	α -Adrenoceptor Antagonists (α blockers)	5 mg or 10 mg, once daily

BLADDER DYSFUNCTION IN ACUTE CARE

UR, specifically AUR, is common among hospitalized patients. In most cases, patients complain of inability to void, suprapubic pain and a palpable bladder. However, in CUR and in some cases of AUR—symptoms of voiding difficulties and signs of a palpable bladder are not reliable for diagnosing UR. Undetected UR can lead to renal impairment, UI, and recurrent UTIs, all of which are significant public health issues and of consequence to the person affected.

Some identified risk factors for the development of UR in acute care patients include gender (more common in men), age, local prostate or bladder pathology, neurologic diseases, cognitive impairment, functional limitations, use of anticholinergic medications, constipation, diabetes, and the aftermath of surgery. It is evident from a literature review that there are currently gaps in the knowledge about risk factors associated with UR and, more importantly, the value of screening and management of UR.

A secondary unresolved issue is the optimal ultrasound PVR volume that should trigger catheterization. Suggested volumes have ranged from 50 to 400 mL. The difficulty in establishing a threshold for intervention is that there is no clearly defined point where the benefits of catheterization outweigh the risks. These risks include discomfort, urethral trauma, and nosocomial infections, as well as the potentially unnecessary use of resources.

The Center for Disease Control and Prevention estimates that 1 of every 10 to 20 patients hospitalized in the United States develops a healthcare-associated infection (HAI) (Klevens et al., 2007). UTI, a type of HAI, accounts for more than 30% of infections reported by acute care hospitals in the United States (Edwards, et al., 2008). Virtually all hospital-associated UTIs are caused by instrumentation of the urinary tract, mainly from IUCs. Prevention of a CAUTI is a key component of an acute-care hospital's patient safety and quality improvement program.

The use of portable bladder ultrasound instruments in this setting offers a noninvasive, painless method with which to measure PVR urine. Many studies have evaluated the accuracy of the BladderScan® and have concluded that they are equal to straight (referred to as in-and-out) catheterization. (See a list of references in BladderScan References on page 64.)

BLADDER DYSFUNCTION IN REHABILITATION UNITS

Most patients admitted to rehabilitation units suffer from a neurologic disease that causes bladder dysfunction that presents itself as either urinary incontinence or urinary retention or both. In most cases, the disease has impacted the central nervous system causing a "neurogenic bladder."

NEUROGENIC BLADDER & URINARY RETENTION

Neurogenic bladder (NGB) is a general term referring to altered bladder function resulting from interrupted innervation due to a lesion of the central (brain and spinal cord) or peripheral nervous system.

From a urologic perspective, NGB can lead to incomplete bladder emptying or UR.

One of the most common causes of a NGB is spinal cord injury (SCI) which occurs in more than 200,000 patients (10,000 cases /year) in the United States (Linsenmeyer et al., 2006; National Spinal Cord Injury Statistical Center. Facts and Figures. Retrieved April 2, 2011 http://www.spinalcord.uab.edu/show.asp?durki=116979). The main causes of SCI are motor vehicle accidents (42.1%) and falls (26.7%) (Jin Joeng et al., 2010). Another cause of NGB is traumatic brain injury and more than 2 million individuals in the United States were admitted to the emergency room due to traumatic brain injury with about 50% of the patients suffering moderate to severe injuries (Tolonen et al., 2007).

Another common cause of NGB is multiple sclerosis (MS), a neuro-inflammatory disease that affects the central nervous system. The initial onset of neurologic symptoms in patients with MS typically occurs between ages 20 and 50 years, and presentation at an age older than 40 may be associated with a greater risk of progressive disability. Women are 2 to 4 times more commonly affected than men (Noonan, et al., 2010). Urinary urgency is usually the most prevalent reported bladder symptom for MS patients but up to 25% of patients report UR. (Stoffel, 2010).

Urinary retention (UR) is a common problem of patients admitted to rehabilitation units and it is felt that clinicians miss an elevated PVR in approximately 20% of patients (Samson & Cardenas, 2007). Reasons for failing to detect a distended bladder could be lack of a complaint or symptoms reported by the patient (with UR developing insidiously over a prolonged period of time).

Lower urinary tract symptoms seen range from urinary urgency, frequency, and/or urgency incontinence to complete urinary retention. Normal bladder function can be altered by damage to nerve pathways at any point between the cortical center in the brain and the bladder, leading to incomplete bladder emptying or UR (Figure 8 on page 6). The type of bladder dysfunction depends on the exact site and the extent of the lesion.

CAUSES & TYPES OF NEUROGENIC BLADDER

Most neurological diseases that affect the spinal cord and some that affect the brain will cause bladder dysfunction, which, if untreated, may lead to UR and/or UI. Neuropathic bladder dysfunction (also referred to as neurogenic bladder) is classified to the site of the lesion and the types are as follows:

- Spastic or Reflex Bladder occurs in patients with lesions in the spinal cord, above the sacral micturition center (above S2 to S4 called suprapontine lesions). In this condition, the voiding reflex is intact but hyperactive, since the normal inhibiting influence of the cerebral center is blocked at the level of the spinal lesion. Detrusor-sphincter-dyssynergia non-coordination of the external urethral sphincter, which contracts during detrusor contraction, may occur. In this condition, reflex bladder contractions are accompanied by simultaneous spasm of the urinary sphincters. Patients with complete spinal cord injury above the S2 to S4 area commonly present with a spastic or reflex bladder. The spastic bladder has decreased storage capacity and impaired emptying secondary to sphincter dyssynergia.

  Other lesions found above the brain stem that cause bladder spasticity include dementia, Parkinson's disease, cerebrovascular accidents, multiple sclerosis, tumors and inflammatory disorders such as meningitis. Up to 80% of MS patients will have cervical spinal cord involvement and are likely to display some urinary hesitancy and UR (Moy & Wein, 2007). This causes hypertrophy of detrusor smooth muscle (trabeculation) as a result of the frequent, high-pressure, sustained detrusor contractions in the presence of obstruction. Patients with detrusor overactivity and DSD not only experience UR and UI, but may also develop long-term effects of high intravesical pressures, giving rise to ureteric reflux or obstruction, or both, and resulting in renal damage and failure.

- Peripheral lesions, injury or disease can be caused by diseases of the nerve roots or peripheral nerves, below the sacral micturition center, affecting the local nerve supply to the bladder. This is especially common in those patients with diabetes mellitus, which can affect both sensory and motor pathways. Similarly, extensive pelvic surgery can disrupt peripheral nerves. As a result, the bladder fails to empty unless voiding is assisted by straining. In patients with such lesions, the external urethral sphincter may fail to relax (isolated distal sphincter obstruction) and may also be weakened, giving rise to UI. Peripheral nerve lesions that commonly lead to UR include diabetic neuropathy; intervertebral disk herniation (specifically L4-5 or L5-S1); and pelvic surgery (abdomino-perineal resection for colon cancer, radical hysterectomy), which may inadvertently injure the pelvic plexus.

- Flaccid or Atonic Bladder is frequently seen after acute spinal cord injury, due to spinal shock. During the stage of spinal shock, which may persist from a few weeks to 6 months, all reflex activity below the level of injury ceases. The smooth muscle of the bladder and rectum are affected. This includes bladder contractions, which are normally stimulated through the voiding reflex and housed in the S2 through S4 nerve segments. Since the bladder fails to contract in response to even high levels of filling, the result is AUR. As spinal shock subsides, reflex bladder function should return, except when the actual site of the injury involves the S2 to S4 segments or cauda equina.

  When the spinal reflex is permanently disrupted by an injury to this area, the atonic or flaccid bladder persists, resulting in CUR. Whether this condition is temporary or chronic depends upon the extent to which nerve remyelination occurs. In cauda equine syndrome, patients will present with decreased sensation over the buttocks, posterior-superior thighs, and perineal region. It also may present as UR, and overflow UI. Neurologic findings consistent with cauda equina syndrome include saddle anesthesia, bilateral radiculopathy, bilateral leg weakness, urinary retention and overflow UI, and fecal incontinence.

The diagnosis of NGB disorders requires an understanding of the underlying neurological abnormality, which will be apparent in most patients. However, some patients will present with the symptoms of a neuropathic bladder but with no overt neurological cause. In this situation, it is important to consider the possibility of an undiagnosed neurological condition, such as multiple sclerosis or spinal cord lesion, as neuropathic bladder may be the

presenting symptom. In patients with cervical lesions, especially those with complete spinal cord injury, it may be difficult to assess symptoms because many will be atypical or unconscious rather than the classic bladder 'urge' type symptoms.

Assessment of patients in rehab units should include symptom identification and physical examination with bladder ultrasound screening which will result in a diagnosis of UR. So all patients admitted to a rehabilitation unit should be assessed via a portable bladder ultrasound (e.g. BladderScan®) so that appropriate interventions can be implemented.

A suggested algorithm and clinical decision tool for bladder management in rehabilitation units is shown in Figure 12.

Figure 12. Bladder Management Clinical Decision Tool
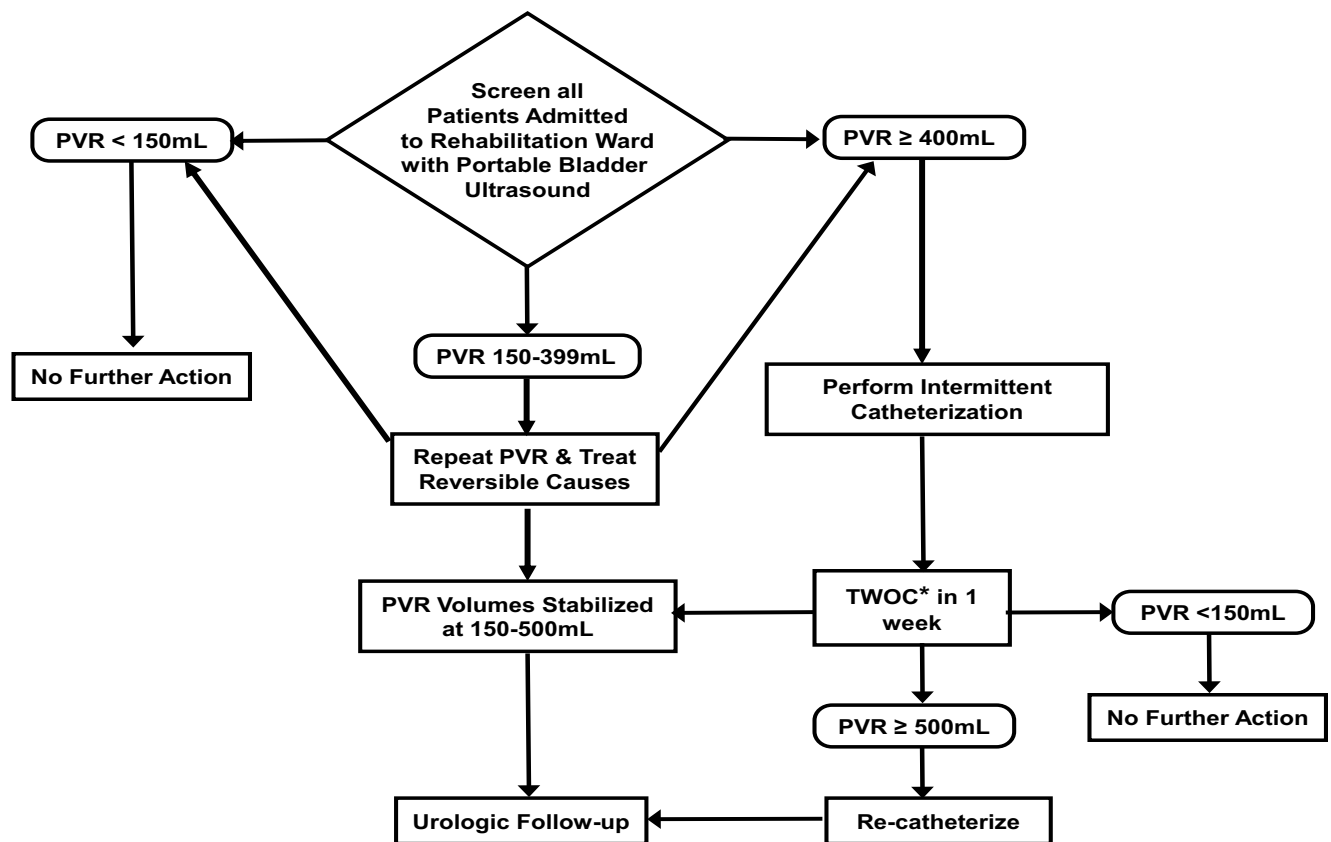
* TWOC – Trial Without Catheter

While there is agreement that PVRs <100 mL imply adequate bladder emptying, there is no consensus on the maximum PVR volume that would be considered normal. Similarly, appropriate intervention for high PVR is not well studied. In rehabilitation, intermittent self-catheterization (ISC) has been suggested for management of UR, however, this is may not be viable option for many patients in rehabilitation who have poor hand function, poor vision, and/or cognitive impairment.

Appropriate management of this group includes frequent PVR checks to ensure that the patient is not developing severe UR (>500mL). In the interim, attempts to correct reversible causes of UR could be made (e.g., treating constipation, ceasing anticholinergic medications, improving mobility). If UR does not reverse, then it would be appropriate to refer this group to a urologist for further investigation and management. Insertion of an IUC may be indicated on a case-to-case basis, especially if it is causing some voiding dysfunction or has the potential to produce renal impairment.

All patients with neurogenic bladder causing bladder dysfunction resulting in UR are susceptible to renal damage if the intravesical pressure is not adequately controlled. Yearly follow-up with at least ultrasonography of the upper urinary tracts and measurement of serum creatinine is therefore essential (Stohrer et al., 2009). Patients who manage the bladder with any form of catheterization (e.g., IUCs or ICs) should undergo a yearly cystoscopy.

Several medications have been evaluated for treating bladder overactivity and diminished bladder compliance in the NGB (Cameron, 2010). Antimuscarinic (aka anticholinergic) medications (Table 7) have been the mainstay of pharmacologic therapy for neurogenic bladder overactivity because they decrease the overactivity and significantly increase bladder capacity, reduce bladder filling pressure, improve bladder compliance, reduce urgency urinary incontinence episodes and help to protect the upper urinary tracts. These medication may be used in patients who are performing ISC for UR as many will persist with LUTS of urgency and frequency.

Table 7. Medications (Antimuscarinic) for Neurogenic Bladder Overactivity

DRUG (GENERIC/BRAND)	CHEMICAL STRUCTURE AND PRIMARY ACTION	USUAL DOSAGE
Darifenacin (Enablex)	Tertiary amine	7.5 or 15 mg once daily
Fesoterodine (Toviaz)	Tertiary amine	4 or 8 mg, once daily
Oxybutynin (Ditropan XL, Oxytrol, Gelniquel)	Tertiary amine Some calcium antagonist properties	Immediate release: 2.5 or 5 mg twice or three times daily Sustained release: 5–30 mg once daily Transdermal patch: 3.9 mg per 24 hours, replaced every 3 days Transdermal gel: 4 mg packet, applied once daily
Solifenacin (VESIcare)	Tertiary amine	5 or 10 mg once daily
Tolterodine (Detrol)	Tertiary amine	2 mg twice a day
Trospium (Sanctura)	Tertiary amine	Immediate release: 20 mg twice daily Sustained release: 60 mg daily

Alpha blocker medications (Table 6 on page 23) are widely used for the treatment of BPH since they relieve the voiding symptoms and associated bladder storage symptoms of urgency, frequency, and nocturia (Linsenmeyer, et al., 2006). They can also be used in treatment of poor bladder compliance, emptying difficulty, and autonomic dysreflexia, so they are recommended as a possible treatment for NGB.

EMERGENCY DEPARTMENT

The Emergency Department (ED) may at times function as a walk-in clinic, providing a simple way for patients to seek medical care. In this situation, any of the voiding complaints outlined in Table 3 on page 15 may be seen.

Acute urinary retention (AUR) is a common complaint on presentation to the ED and is most often seen in patients over the age of 60 years (Vilke et al., 2008). Most patients with AUR are men over the age of 60 years, and the risk of AUR increases significantly with age (Hargreave et al., 2005). It is estimated that at least one episode of AUR will develop in 10% of men in their 70s and 33% of men in their 80s largely due to BPH (Rosenstein & McAninch, 2004).

Another cause of AUR is the ingestion of the drug ecstasy (3,4 methylenedioxymeth-amphetamine or MDMA) a synthetic amphetamine analog that has been used as an appetite suppressant (Beuerle et al., 2008; Delgado et al., 2004). MDMA ingestion increases the release of serotonin, dopamine, and norepinephrine from presynaptic neurons and delays their metabolism by inhibiting monoamine oxidase. Adverse effects include hyperthermia, hyponatremia, and syndrome of inappropriate antidiuretic hormone secretion. The UR seen in this group is usually transient.

Patients usually present to the ED with AUR during evening hours or night time, as one of the more common causes is failure to void after catheter removal, either post-urological procedure or after hospital discharge. AUR is characterized by a sudden inability to urinate despite a distended bladder, and patients often present with marked discomfort, difficulty voiding, and a physical examination revealing a palpable, enlarged bladder. A portable bladder volume instrument (e.g. BladderScan®) can determine UR and is an important part of screening a patient who arrives in the ED and UR is suspected.

As treatment of AUR consists of immediate bladder decompression, it is most often treated with placement of an IUC and in men, a urological consultation. According to Fakih et al., (2010), the emergency department is the main entry point for patients admitted to the hospital and is the unit where a significant number of IUCs are placed. If ED staff would avoid the placement of unnecessary IUCs, there would be a reduction in inappropriate IUC utilization on the general medical-surgical units.

MEDICAL UNITS

Urinary retention (UR) is seen in patients admitted to medical units. Assessment for UR by determining post void residual should be considered in patients at risk including elderly patients, women who have had previous anti-incontinence surgery, those who have significant pelvic organ prolapse or neurologic diseases, and those who are taking medications that can affect bladder emptying (Table 4 on page 18).

There are other considerations in monitoring certain populations who may be admitted to a medical unit. Lower urinary tract symptoms, such as AUR, are a common source of morbidity in the HIV population and tend to worsen as the disease progresses. UR may be secondary to sacral sensory loss, which may occur with acute HIV infection.

Oncology patients may develop severe or acute chemical cystitis leading to UR as a complication of certain chemotherapeutic agents. A bladder volume instrument (e.g. BladderScan®) is very useful in establishing the adequacy of the bladder filling and emptying.

BladderScan®

POSTOPERATIVE URINARY RETENTION

Postoperative urinary retention (POUR) is defined as the inability to void at a bladder volume of 600 mL detected by bladder ultrasound during the post-operative period. It is a significant clinical problem since it can lead to bladder dilation, prolonged hospital stay, genitourinary tract infection, and sometimes sepsis. Reported rates of UR among the mixed surgical populations of large hospitals vary from 4% to 29% (Darrah et al., 2009; Lau, et al., 2004; Keita, et al., 2005) with 16-24% of patients having UR (defined as a volume of 500 to 600 mL) upon discharge from the post-anesthesia care unit (PACU) (Keita et al., 2005; Lamononerie et al., 2004). The reported incidence of POUR is between 10% and 60% after major surgery (Baldini et al., 2009). A recent study in 773 consecutive hospitalized patients who had undergone orthopedic, abdominal, gynecological or plastic surgery without an IUC found the incidence of POUR to be 13% (Hansen et al., 2011). In non-ambulatory patients discharged from the PACU, the UR rate is 16% to 24%. The following Table 8 provides the incidence of POUR after common surgeries.

Table 8.   Incidence of POUR

TYPE OF SURGERY	INCIDENCE OF POUR
Low-risk ambulatory surgery	**0.50%**
Gynecological surgery	0.00%
High-risk ambulatory surgery	**5.0%**
Herniorrhaphy	
Local anesthesia with sedation	0.37%
Regional anesthesia	2.42%
General anesthesia	3.00%
Endoscopic hernia repair	**4.00%–22.20%**
Anorectal surgery	**16.00%–20.00%**
Mixed nonambulatory surgery	
On PACU entry	28.70%
On PACU discharge	16.00%–23.70%
Gynecological surgery	**9.20%**
Orthopedic	
Total knee arthroplasty	19.70%
Lower-limb joint replacement	18.10%

(Adapted from Darrah et al., 2009).

POUR can have dramatic long-term consequences. Over-distending the detrusor muscle may cause permanent damage, incomplete emptying and increased risk of UTIs. The degree and duration of bladder over-distension contribute to contractility impairment of the detrusor muscle.

POUR contributes to many problems, including increased hospital costs incurred as a result of longer duration of hospital stay. The need for catheterization can lead to patient discomfort, and risks damage to the prostate in men and the urethra in both men and women. Also, if an IUC is used, a hospital-acquired UTI is a common occurrence.

The degree of POUR depends on a patient's age, co-morbidity, type of surgery, and type of anesthesia (Baldini, et al., 2009). Anesthesia, sedation, and analgesics interfere with the afferent limb by dulling the sensation and perception of bladder fullness, allowing painless UR to develop; 61% of post-operative patients fail to experience discomfort or a strong urge to void even as their bladder volume, as determined by ultrasound bladder scanning (e.g. BladderScan®), exceeds 600 mL.

Age has always been an independent variable for the development of UR. The incidence of POUR increases with age, with the risk increasing by 2.4 times in patients over 50 years of age (Evron et al., 2008). Diabetes is an independent risk factor for developing POUR (Dreijer et al., 2011). Other risk factors include immobility, previous history of bladder problems, enlargement of the prostate, urethral strictures, pain, large amount of intravenous fluids, long duration of surgery, diabetes for more than 15 years and cholinergic medication, analgesics, and constipation (Shadle et al., 2009).

A higher incidence of POUR has been reported in men (4.7%) compared to women (2.9%). Possible reasons for such age and gender differences include age-related progressive neuronal degeneration leading to bladder dysfunction and gender-specific pathologies such as BPH in men among others. As previously mentioned, a common risk factor, especially in men, is bladder outlet obstruction.

POUR can complicate any surgical procedure and is not just seen in patients with pre-existing urinary symptoms. Bladder over-distension leads to an alteration in bladder function. Usually an IUC is inserted but there may be a delay in return to normal bladder physiology after catheter removal. Although often regarded by clinicians as a trivial or minor complication, UR can be a significant source of patient anxiety and discomfort. Retention prolongs a hospital stay, increases costs, and may result in significant morbidity. In elderly patients, UR can be associated with restlessness, confusion, and potential development of delirium. Urethral catheterization to treat post-operative retention conveys the risk of acquiring a CAUTI, which increases every day a catheter remains in place.

The mechanism of POUR is not completely understood. As noted in the section Anatomy & Physiology of the Genito-Urinary System on page 2, bladder emptying depends on relaxation of the urethral sphincter and contraction of detrusor muscle in response to increased bladder pressure. The process of voluntary urination relies on coordinated control of central, peripheral, and autonomic nervous systems. POUR can be provoked by intra-operative damage of the pelvic autonomic nerve, usage of sympathomimetic and anticholinergic drugs in the peri-operative period, and stress-induced activation of inhibitory sympathetic reflexes. The mechanism for voiding dysfunction seems to be related to inhibition of bladder afferents at the dorsal horn by spinal opioids. In addition, activation of receptors located in the sacral parasympathetic nervous system attenuates bladder sensation and may delay the initiation of the micturition reflex, which is normally induced as the volume exceeds the micturition threshold, and leads to detrusor muscle relaxation and an increase in maximal bladder capacity.

BEST PRACTICE FOR SCREENING FOR POUR

Postoperative urinary retention is best diagnosed noninvasively with a portable bladder ultrasound instrument (e.g. BladderScan), which permits rapid and accurate measurement of bladder volume. This approach has been shown to be superior to diagnosis dependent on physical exam or patient symptoms and avoids unnecessary catheterization of patients with minimal bladder volumes who have failed to void (Palese et al., 2010).

Urinary catheterization is a common procedure during major surgery as it allows monitoring of urine output, guides volume resuscitation, and serves as a surrogate marker of hemodynamic stability. Intermittent catheterization is the recommended type of catheterization recommended for management of UR while waiting for resolution of voiding function. To minimize POUR, it is important to identify pre-operatively patients at risk of developing POUR so preventative measures can be implemented. It is recommended that once patients arrive in the recovery room, assessment of bladder contents should be performed using a bladder volume instrument (e.g. BladderScan) to determine POUR (Hansen et al., 2011).

BladderScan®

ANALGESIA & POUR

Anesthesia affects the incidence of POUR. Both general and regional anesthesia is known to impair normal bladder function, as evidenced by the incidence of POUR (ranging from 3.8% to 24%) (Zaouter et al., 2009). The use of epidural anesthesia during and after surgery has been reported to be responsible for POUR, with an average incidence of 26% (Baldini et al., 2009).

GENERAL ANESTHETICS

General anesthetics cause bladder atony by acting as smooth muscle relaxants and by interfering with autonomic regulation of detrusor (bladder) tone. Some anesthetic agents have been shown to dramatically increase bladder capacity. Sedative-hypnotics and volatile anesthetics inhibit the pontine micturition center and voluntary cortical control of the bladder, suppressing detrusor contraction and the micturition reflex.

EPIDURAL INJECTION

Epidural injection and patient-controlled epidural anesthesia (PCEA) are widely used for efficient pain relief after major surgery and have both anesthetic and surgical advantages over general anesthesia alone. Advantages include a reduced incidence of post-operative deep-vein thrombosis, less intra-operative blood loss and excellent postoperative analgesia. However, epidural anesthesia may cause UR, leading to delayed removal of an IUC, increasing the patient's risk for developing a CAUTI and prolonging discomfort. Following epidural anesthesia, the current recommendations are that clinicians can safely discontinue IUC while the epidural is in place. The patient should be monitored by scanning the bladder using a bladder volume instrument (e.g. BladderScan®) but as the following case study illustrates, epidural anesthesia can lead to UR.

CASE STUDY

A 78-year-old male with a history of well-controlled diabetes and hypertension is admitted to the post-anesthesia care unit following a right inguinal herniorrhaphy. The procedure was accomplished under spinal anesthesia using 1.2 mL 0.5% bupivacaine. Blood loss was minimal and he received 1,200 mL of saline solution during the procedure. On admission to the PACU, patient was mildly sedated but awake and reports no pain. He has some sensation and movement in his feet, but his lower extremities are weak. Over 2 hours, as the spinal regressed, patient complains of moderate pain and inability to urinate. One hour later, he still cannot urinate. He notes to the nurse, that he has had some "prostate troubles" in the past. An ultrasound exam of the bladder indicated a volume of 250 mL. The nurse allowed the patient more time to void. After 2 hours, the patient voided 375 mL and PVR via BladderScan indicated 50 mL. The patient was discharged to home.

Local anesthetics act on sacral and lumbar nerve fibers in the cord, blocking afferent and efferent impulses to the bladder. Intrathecal local anesthetics interrupt the micturition reflex by blocking transmission of action potentials in the sacral spinal cord. Blockade of afferent nerves results in bladder analgesia, while lack of transmission in efferent fibers causes a detrusor blockade that outlasts motor blockade by as much as several hours. Most patients will experience decreased sensation of urgency and impaired bladder detrusor contraction and be incapable of spontaneous voiding until the sensory level has regressed to the S3 level.

The association between spinal anesthesia with long-acting local anesthetics and POUR has been discussed in the medical literature. Recovery of bladder function after spinal injection of low-dose, shorter-acting local anesthetics occur early enough to prevent bladder over-distention and resulting UR in most cases. Studies assessing the incidence of UR with concurrent use of epidural analgesia have focused mostly on patients with lumbar epidural analgesia for labor or for lower-extremity surgery (Dolin & Cashman, 2005). Weiniger et al., (2006) reported that 83% of women with lumbar epidural analgesia for labor required bladder catheterization.

But the most current clinical experience (Ladak, et al., 2009; Zaouter, et al., 2009) suggests that patients receiving epidural analgesia for thoracotomy are at no greater risk of experiencing UR than those who did not receive epidural analgesia for postoperative pain management. Macdowell et al., (2004) also concluded that a peri-operative combination of bupivivaine and fentanyl as an epidural anesthetic does not increase the rate of UR necessitating urinary catheterization in patients undergoing total hip arthroplasty.

SPECIFIC EPIDURAL AGENTS

Intrathecal opoids also decrease the urge sensation and detrusor contraction thus increasing the bladder capacity and the PVR and altering sphincter function (Barretto, et al., 2007).

This results in impaired coordination between detrusor contraction and internal urethral sphincter relaxation. Opoids in epidural analgesia can cause side effects such as respiratory depression, itching, nausea, vomiting and UR. Epidural opiate can further increase the duration of analgesia into the post-operative period. This has led to common practices of leaving the IUC in the patient for the duration of PCEA.

Hydromorphone is an example of an opoid that affects bladder dysfunction. It is more hydrophobic than morphine and less lipophilic than fentanyl. Lumbar epidural hydromorphone can cause UR significantly less than lumbar epidural morphine and slightly more than lumbar epidural fentanyl (Kuipers et al., 2004). It is felt that the absorption of hydromorphone infused at the thoracic level is limited to only the thoracic and high lumbar segments and should not affect sacral innervation that controls bladder, urethral sphincter, and pelvic floor muscles and thus should not interfere with postoperative voiding.

Bupivacaine 0.1%, as the sole epidural agent, can also affect post-operative voiding and puts the patient at a higher risk for POUR (Kreutziger et al., 2010). It has duration of surgical analgesia of approximately 200 minutes.

Hyperbaric prilocaine 2% has been shown to cause POUR, at an incidence of 23% in patients undergoing ambulatory lower limb surgery (Kreutziger et al., 2010).

BEST PRACTICE TO PREVENT POUR
- Preoperative voiding whenever possible.
- Routine bladder scanning at arrival in the recovery room, especially after spinal anesthesia, emergency surgery, or when the anesthesia time exceeds 2 hours.

OBSTETRIC & GYNECOLOGIC UNITS

GYNECOLOGIC & PELVIC SURGERY

Pelvic surgery can result in temporary urinary retention (UR) or other voiding dysfunction by inadvertent damage to the pelvic plexus. It occurs most often after abdominoperineal resection and radical hysterectomy. Hysterectomy for non-malignant conditions is the most common gynecological surgery performed in women less than the age of 50 years. Most surgeons use continuous bladder drainage in women undergoing pelvic surgery and the protocol for post-operative removal varies.

The incidence of postoperative urinary retention (POUR) following pelvic surgery ranges from 0% to 60%, depending on the POUR definition used and the type of surgery performed. The reported rate of UR requiring catheter drainage for more than 1 month after radical hysterectomy is approximately 14% (Manchana et al., 2009).

Radical hysterectomy for treatment of cervical or endometrial cancer can lead to UR, usually secondary to disruption of the sympathetic innervation from the hypogastric plexus during inferolateral dissection of the cervix. UR is a common complication of POP surgery.

Although ambulatory gynecologic patients are frequently slow to void after surgery, they have been found to be at minimal risk for UR. The use of intermittent catheterization following urogynecological surgery is associated with a more rapid return to normal voiding and a shorter hospital stay.

POSTPARTUM (VAGINAL OR CAESAREAN DELIVERY) URINARY RETENTION

Postpartum UR, also known as puerperal UR, is a common condition in obstetrical care. When it occurs, it can pose significant maternal morbidity. The incidence varies between 0.5% and 15% with most of the data on POUR after vaginal delivery (Kekre et al., 2011). It is more common in women with prolonged labor, instrumental deliveries, lower genital tract lacerations and with the use of regional analgesia.

Caesarean section poses higher risk of postpartum UR than vaginal delivery. Risk factors include the indications of caesarean section which may be due to protracted labor, difficult delivery, or multiple previous caesarean sections with dense bladder adhesion to the lower uterine segment causing more urinary problems. The actual Caesarean section itself can cause bruising and edema of the bladder near the uterovesical area. There may also be intraoperative bladder injury. Another cause of UR in women delivered by caesarean section may be due to post-operative immobility and wound pain.

The pathophysiology of postpartum UR is poorly understood. The elasticity of the lower urinary tract seems to be increased during pregnancy, owing partly to a hormonal reduction of smooth muscle tone. Bladder capacity increases during pregnancy. Beginning in the third month of pregnancy, the muscles of the bladder lose tone and its capacity slowly increases (Glavind & Bjork, 2003). Traumatic events, such as damage to nerves, pelvic muscles, and bladder musculature during childbirth, increase the risk of UR in the postpartum period. This risk is assumed to be greater in connection with instrumental delivery, first vaginal delivery, birth canal and perineal trauma, and protracted deliveries. Epidural analgesia may diminish or obviate the urge sensation of the need to urinate during labor and the immediate postpartum period.

PREGNANCY & VOIDING

Pregnant women ordinarily have the first desire to void when the bladder contains 250–400 mL of urine, and maximum urinary urge often is not reached until 1000–1200 mL in the supine position (Glavind & Bjork, 2003). When the pregnant woman stands up, the enlarged uterus exerts pressure on the bladder. This places an added burden on the bladder, and therefore a doubling of bladder pressure has been observed in the 38th week, indicating a reduction in bladder capacity at that time; this disappears once the baby has been born. Without the weight of the pregnant uterus to limit its capacity, the postpartum bladder tends to be hypotonic. These changes persist for days to weeks.

ASSESSMENT

Recognition of bladder dysfunction in the early postnatal period is an important component of postnatal care. Bladder care pathways recommend the estimation of bladder volume when the woman has not voided 8 hours after delivery or if symptoms suggest UR. Traditionally, this has involved catheterization with its associated risks of infection. More recently, bladder volume has been estimated using ultrasound measurements with postpartum UR defined as a residual urinary volume greater than 100 – 200 mL. Ultrasound bladder volume estimation can be performed by using a portable ultrasound instrument (e.g. BladderScan®) to calculate the volume automatically. However, measuring bladder volume with a portable bladder ultrasound instrument may not always be accurate. After childbirth, the uterus remains a fluid (lochia)-filled structure for several days and there exists the potential for the bladder scanner to record the intrauterine lochia volume instead of urine. Barrington et al., (2001) found that, although overall this method was accurate in the measurement of postpartum bladder volume, there were several isolated cases where the actual volume differed considerably.

PEDIATRIC UNIT

Voiding patterns and acquisition of bladder control in healthy children are age and maturation dependent. Although the neurophysiological process by which children acquire urinary control is not completely understood, various developmental stages are recognized (Table 9). The bladder is a drop-shaped intra-abdominal organ in small children. Conscious sensation of bladder fullness is expected between the first and second year, and the ability to control voiding commonly develops in the second to third year of life.

Table 9.   Developmental Stages of Bladder Control

Pattern of Bowel & Bladder Control	1. Nocturnal bowel control
	2. Daytime bowel control
	3. Daytime bladder control
	4. Nighttime bladder control
Infants:	Voiding occurs spontaneously as a spinal cord reflex (voids approximately 20 times/day).
1-2 years	Sense bladder fullness and inhibit bladder contractions (decrease in voiding frequency, increase in volume) via micturition center in frontal lobe.
2-3 years	Voluntary voiding via relaxation of pelvic floor and contraction and voluntary inhibition.
4 years	Adult voiding pattern; ability to contract sphincter to inhibit voiding.

During the newborn period, renal and bladder ultrasound is typically performed within 48 hours of birth to assess the urinary tract and PVR residual. If the infant retains a significant amount of urine, or is unable to void spontaneously, scheduled IC is performed, adjusted based on the PVR (Smith et al., 2010). A wet diaper does not imply normal voiding, because it may represent overflow incontinence.

Children cannot express the sensation of bladder fullness or their inability to void, so many define urinary retention (UR) in children as the inability to void for at least 12 hours (Asgari et al., 2005). In normal children, voiding intervals more than 12 hours are rare. Postoperative urinary retention in children is defined as any volume exceeding the age-specific bladder capacity and this formula can be used (30 mL x age in years) + 30 mL (Hjalmas, 1988).

Urine volume in the first 48 hours of the infant's life is low. Bladder capacity can be determined using one of the following formulas:

- Bladder capacity in children (≤2 years) = [2 × age (year) + 2] × 30
- Bladder capacity in children (>2 years) = [age (year) / 2 + 6] × 30

CAUSES OF URINARY RETENTION IN CHILDREN

AUR is rarely seen in childhood, but the main causes include neurological conditions, severe voiding dysfunction, UTI, constipation, local tumors, obstructing lesions and incarcerated inguinal hernia. AUR in children can also be caused by an adverse drug event and can occur after surgical interventions (Gatti et al., 2001).

Multiple neurological disorders in children are associated with neurogenic bladder, and many of these birth defects are screened during pregnancy. Myelomenigocele, as one of the most common causes of NGB, is usually seen in children with spina bifida (SB). Spina bifida is a congenital malformation of the spine with
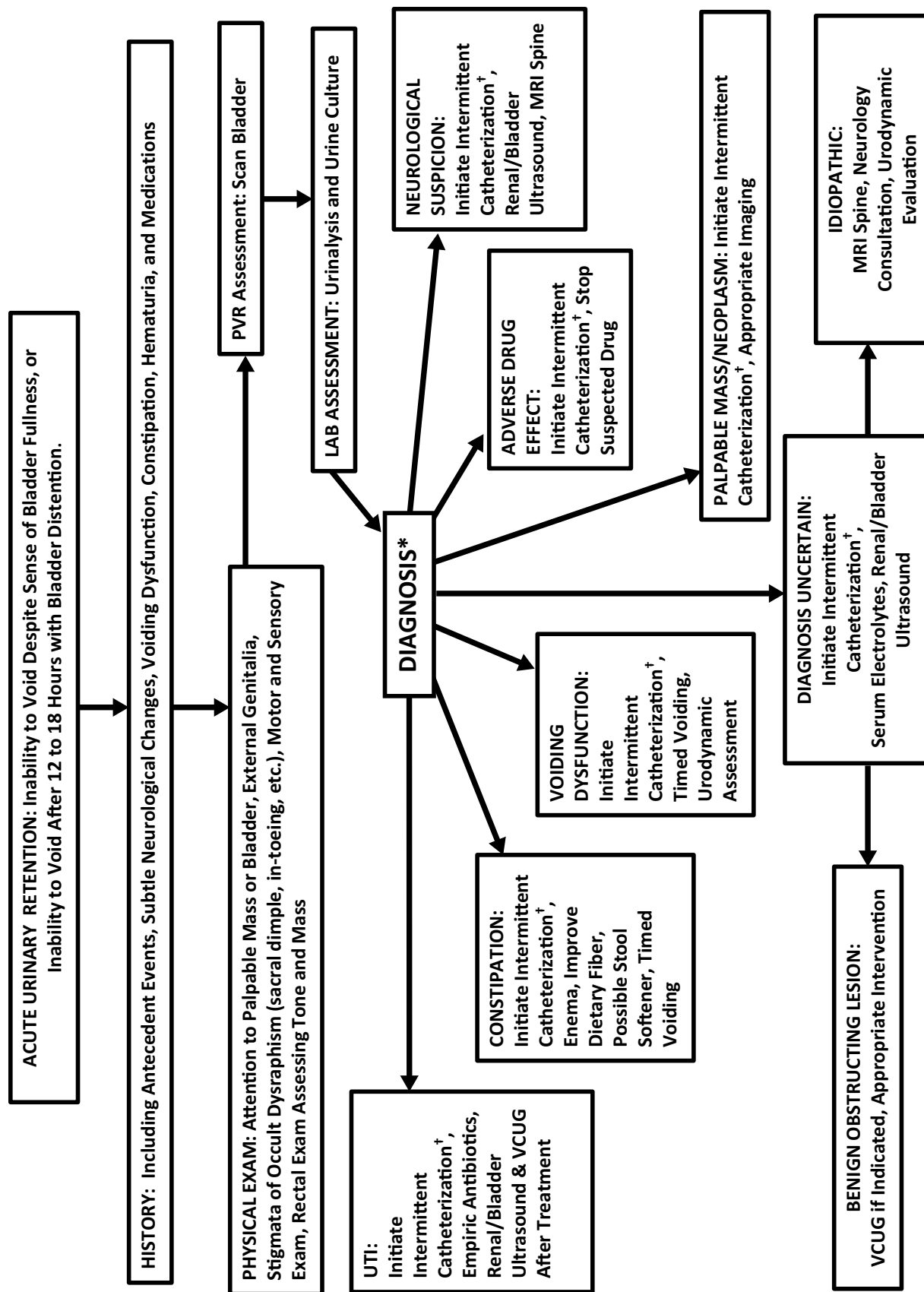
abnormal neural tube closure occurring between the third and fourth weeks of gestation, and most frequently affects the lumbar and sacral regions. There is an opening in the spinal cord through which meninges, cerebrospinal fluid, and neural elements protrude. The opening in the spine is closed surgically shortly after birth, however, some degree of paralysis, bowel and bladder dysfunction remain. According to the Center for Disease Control and Prevention (CDC) and the National Centers for Health Statistics, SB affects approximately 1000 live births each year (Boulet et al., 2009). These children are now in the school system, which presents even more challenges for bladder management (Katrancha, 2008). Thirty percent of the deaths in adult patients with spina bifida can be attributed to the urinary tract (Smith et al., 2010), so bladder monitoring in these children is imperative. According to new CDC guidelines (Gould et al., 2010), clinicians should consider IC in children with myelomeningocele and NGB to reduce the risk of urinary tract deterioration.

Non-neurogenic neurogenic bladder is a potentially severe dysfunctional voiding disorder that is related to contractions of the external urethral sphincter during voiding (Vidal et al., 2009). It is associated with voiding problems and upper GU tract damage. These children present with UR and upper urinary tract damage (vesicoureteric reflux and hydronephrosis), but do not have an anatomical obstruction or neurological problem. It can cause functional bladder outlet obstruction with lower tract symptoms due to inadequate bladder emptying and UR. Another cause of non-neurogenic neurogenic bladder in children is Hinman's syndrome, a rare but severe dysfunctional disorder that is an acquired condition, occurring after the age of toilet training. It was initially diagnosed in school-aged boys. A diagnosis of non-neurogenic neurogenic bladder is made by exclusion when a child has all the clinical, radiographic and urodynamic features of neuropathic bladder but no neurological pathology is detected.

ASSESSMENT OF POST VOID RESIDUAL IN CHILDREN

Because of the grave consequences of a prolonged over-distended bladder, monitoring bladder volume in post-surgical children who do not require an indwelling catheter should be mandatory (Figure 13). When using a portable bladder volume instrument (e.g. BladderScan®) in children, direct the ultrasound probe towards the center of the bladder, which is usually at a right angle to the abdominal wall. Some clinicians suggest scanning the child using the male mode because of the anatomical position and shape of the bladder (Rosseland et al., 2005). Avoid catheterization in children as it can be very stressful and painful.

Figure 13. Clinical Decision Tool for Evaluation of AUR in Children

ACUTE URINARY RETENTION: Inability to Void Despite Sense of Bladder Fullness, or Inability to Void After 12 to 18 Hours with Bladder Distention.

HISTORY: Including Antecedent Events, Subtle Neurological Changes, Voiding Dysfunction, Constipation, Hematuria, and Medications

PHYSICAL EXAM: Attention to Palpable Mass or Bladder, External Genitalia, Stigmata of Occult Dysraphism (sacral dimple, in-toeing, etc.), Motor and Sensory Exam, Rectal Exam Assessing Tone and Mass

PVR Assessment: Scan Bladder

LAB ASSESSMENT: Urinalysis and Urine Culture

DIAGNOSIS*

NEUROLOGICAL SUSPICION: Initiate Intermittent Catheterization[†], Renal/Bladder Ultrasound, MRI Spine

ADVERSE DRUG EFFECT: Initiate Intermittent Catheterization[†], Stop Suspected Drug

PALPABLE MASS/NEOPLASM: Initiate Intermittent Catheterization[†], Appropriate Imaging

IDIOPATHIC: MRI Spine, Neurology Consultation, Urodynamic Evaluation

VOIDING DYSFUNCTION: Initiate Intermittent Catheterization[†], Timed Voiding, Urodynamic Assessment

DIAGNOSIS UNCERTAIN: Initiate Intermittent Catheterization[†], Serum Electrolytes, Renal/Bladder Ultrasound

CONSTIPATION: Initiate Intermittent Catheterization[†], Enema, Improve Dietary Fiber, Possible Stool Softener, Timed Voiding

UTI: Initiate Intermittent Catheterization[†], Empiric Antibiotics, Renal/Bladder Ultrasound & VCUG After Treatment

BENIGN OBSTRUCTING LESION: VCUG if Indicated, Appropriate Intervention

*All etiologies require follow-up after interval of treatment or observation to reassess voiding.

†An IUC catheter may be used if IC is not tolerated.

GASTROINTESTINAL, ABDOMINAL, & ANORECTAL SURGERY

CASE STUDY

> *MK is a 68 year-old woman who underwent abdominal perineal resection for colorectal cancer. She has a history of hypertension, diabetes, with medication treatment of loop diuretic and metformin. Prior to surgery, patient reported some incontinence and uses 2 perineal pads for protection. She denied other lower urinary tract symptoms. Peri-operative course included IUC insertion with bilateral ureteral stents inserted. Post-operatively, a ureteral stent was left in place for 3 days. The IUC was removed at midnight on the 5th day and patient's voiding was monitored throughout the night. In early AM, patient voided 325 mL and a scanned bladder volume indicated 275 mL. Staff prompted patient to void again and voided volume was approximately 180 mL with a scanned bladder volume of < 85 mL.*

AUR is one of the most common complications following gastrointestinal surgery. Incidence following anorectal surgery ranges from 1% to 52% (Kneist et al., 2005). Among various anorectal procedures, hemorrhoidectomy is associated with a significantly higher incidence (15%) of UR when compared with other procedures, such as lateral sphincterotomy or fistulotomy (Lau et al., 2002). Postoperative urinary retention after anorectal procedures is usually of short duration. The cause of UR in these patients is multifactorial with post-operative pain an important contributing factor. Patients who have a stapled hemorrhoidectomy have less post-operative pain and thus, less UR.

Urinary dysfunction is a well-recognized complication of colorectal cancer surgery. Tumor location, instead of the type of operation, is the most important risk factor for postoperative urinary dysfunction. Abdominal perineal resection for the treatment of colorectal cancer is also frequently associated with prolonged UR with reported rates ranging 15% to more than 35% (women) and 41% (men) Darrah, et al., 2009). Abdominal perineal resection is associated with a significantly higher rate of UR compared with anterior resection. Causes include the disruption of innervation from the pudendal nerve associated with the anal dissection.

Abdominal surgery such as cholecystectomy, performed laparoscopically has a POUR rate of only 1.4% with an overall rate for elective cholecystectomy in modern series varies from 0.7% to 6.5%. An open surgical approach will increase the risk of UR.

Lower rectal cancer surgery has the highest prevalence of POUR and is more common in patients undergoing rectal cancer surgery than colon cancer surgery and is a well-known complication after removal of the rectum. Reported incidence ranges widely from 2% to 50%, depending on the criteria used to define POUR, tumor location, type of operation, and degree of nerve preservation during the operation (Toyonaga et al., 2006). Preserving the pelvic autonomic nerves during removal of the rectum lowers the rate of major bladder voiding problems after surgery (Kneist et al., 2005).

The predisposing factors for POUR, such as voiding history, abdominal wound pain, subclinical obstructive urinary dysfunction, overdistention of the bladder during the operation and in the recovery room after the operation, sympathomimetic and anticholinergic medications during or after anesthesia, and an inability to stand or sit after surgery, are similar between patients with colon cancer and patients with rectal cancer. However, the risk of developing POUR increases with the addition of a pelvic procedure, such as partial cystectomy, hysterectomy, and removal of the prostate and/or the seminal vesicle. This may be due to increased chance of nerve injuries and increased duration of the operation.

The exact cause of UR following hemorrhoidectomy is not completely understood but may be due to dysfunction of the detrusor muscle or the trigone in response to pain or distention of the anal canal or perineum. Patients who receive adequate analgesics may have a lower incidence of POUR. Various methods have been used to reduce its incidence, including the use of α-adrenergic blockers, sitz bath, and fluid restriction.

Nerve damage resulting from pelvic dissection during rectal cancer surgery is most likely responsible for the greater incidence of POUR seen after rectal resection. Pelvic dissection leads to transient or permanent injury of the superior hypogastric plexus at the sacral promontory level or of the nervi erigentes at the pelvic side wall level. Nervi erigentes are splanchnic nerves that arise from sacral spinal nerves S2, S3, S4 which provide parasympathetic innervation to the base of the bladder. The reported risk factors for POUR after colorectal carcinoma surgery include patient age, type of anesthesia, type of operation, extension of pelvic dissection and level of the anastomosis, and the presence of pre-existing voiding symptoms.

HERNIA SURGERY

Patients undergoing inguinal hernia repair are particularly susceptible to POUR as reported rates after open inguinal or femoral herniorrhaphy vary from 5% to 26% (Koch et al., 2006). There may be a decreased incidence with laparoscopic techniques as reports range from 4% to 22% (Jensen et al., 2002).

NEUROSURGERY

The majority of patients in neurosurgical units have brain and spinal lesions. Disease and surgical causes may affect the function of the nerves related to micturition or the nerve pathways from the bladder to the brain, resulting in voiding disorders such as UI and UR, which may precipitate UTI. Lee et al., (2007) investigated the causes and urine amount for catheterization in neurosurgical patients. They found that 28% catheterizations were unnecessary and 15% of catheterized patients had UR. For the patients who received single catheterization to determine their PVR after catheter removal, half of the catheterizations were unnecessary.

ORTHOPEDIC SURGERY

CASE STUDY

JO is an 80 year-old man who underwent right hip replacement. He denied a pre-operative history of lower urinary tract symptoms. Medical history includes hypertension and atrial fibrillation. Post-operatively, patient was sent to unit with an IUC which was removed the morning after surgery. After 4 to 6 hours, patient was prompted to void, but voided volume was only 100 mL. A bladder volume instrument (using BladderScan®*) indicated 525 mL and straight catheterization was performed. Patient was started on an alpha- blocker. For 48 hours following surgery, patient continued to have incomplete bladder emptying and staff continued to prompt patient to void. After each void, a bladder volume measurement was taken and if elevated PVRs were noted, IC was performed. By post-op day 3, voided volumes had increased and PVRs had decreased to < 100 mL.*

Orthopedic patients have an elevated risk of POUR. Retention complicates 21% to 55% of knee arthroplasties and 11% to 48% of hip arthroplasties (Kumar et al., 2006; O'Riordan et al., 2000). In addition to prolonging length of stay and impairing rehabilitation, UR in this patient population poses a special concern, as transient bacteremia or UTI resulting from catheterization can cause deep infection in the prosthesis requiring its removal. There is a direct relationship between urinary tract manipulation, bacteremia, and the seeding of organisms in joints. Deep joint sepsis has been reported in 0.5% to 6.2% of patients who develop UR after total hip replacement. One of the most feared complications of joint replacement is deep sepsis and failure of the implant (Johansson, et al., 2010). This is a high risk population as most patients with a hip fracture have

multiple medical problems and an increased risk of developing complications. Half of patients with hip fracture are described as having impaired cognitive ability and/or dementia syndrome in connection with surgery (Gruber-Baldini et al., 2003) and one-third die within one year (Roche et al., 2005).

Bladder catheter removal should be prompted as early as possible, typically on postoperative day 1 when patients begin to mobilize out of bed. If UR is encountered (patients unable to void 8 hours post–catheter removal with bladder scan urine volumes more than 200 mL, or when patient expresses physical discomfort), IC is preferable to reinsertion of an IUC. Benefits of IC compared with IUCs include early resumption of spontaneous voiding, decreased risk for bladder infection, improved patient mobility, and reduced risk for delirium.

THORACIC SURGERY

POUR can occur in patients undergoing thoracic surgery with thoracic PCEA and 10% will require an IUC, which is often left in place until after epidural analgesia is discontinued (Ladak et al., 2009). Epidural analgesia is an integral component of peri-operative pain management for patients undergoing major thoracic surgery. It reduces postoperative cardiac complications and improves pain control and respiratory function. But the most appropriate duration of urinary catheterization after major thoracic surgery in patients receiving continuous epidural analgesia remains uncertain.

TREATMENT OF URINARY RETENTION

The initial management of UR consists of immediate bladder decompression via urethral or suprapubic catheterization. Catheterization can be both diagnostic and therapeutic in the treatment of UR, as by draining the bladder, the volume of bladder contents can be assessed. However, once the bladder has been drained and the patient's condition stabilized, the catheter should be removed. There are several other treatments that can be used to ensure complete bladder emptying and they are reviewed in this section.

VOIDING TRIAL

If a catheter is inserted to relieve UR or inserted for monitoring output during a surgical procedure, once stabilized, the patient's IUC should be removed followed by a voiding trial (sometimes referred to as a trial without catheter [TWOC]). A TWOC is the process in which a catheter is removed, followed by subsequent monitoring to establish whether a patient can void independently. IUCs should be removed in the early AM, since voiding problems can be evaluated frequently with adequate staffing during the day shift. Once the IUC is removed, the patient should be encouraged (prompted) to void to ensure bladder emptying.

If there is suspicion of inadequate voiding, the bladder ultrasound instrument can also be used to evaluate the PVR, since it is useful to monitor bladder volume before it becomes excessively large. If the PVR volume is <100 mL, or the voiding urine volume/scanned urine volume is >2:1, then catheterization is not required. Measurements via ultrasound should be made within 5–10 minutes after voiding. If the patient continues to void adequate amounts and the measurements of PVR urine volumes are low, then the TWOC has been successful. If the PVR volume per scan is >400 to 500 mL, then the patient will be catheterized and scanned 3 to 4 hours later. Patients at high risk of POUR can have a PVR > 600 mL, even though they may be able to void (usually small voided amounts). is a clinical decision tool for nursing staff to follow for completing a TWOC.

Implementing an ultrasound bladder volume measurement program as part of the TWOC can reduce the incidence of catheterization (Stevens 2005). Nicolle et al., (2008) recommends that nurses develop a protocol for the management of the postoperative UR, including nurse-directed use of IC and use of ultrasound bladder volume measurement (e.g. BladderScan®). Bladder volume measurement should be performed every four to six hours during the first 24 hours.

PROMPTED VOIDING

Prompted voiding (PV) is a toileting program that involves regular monitoring of patient's voiding and prompting the patient to void. PV requires active participation of nursing staff in the patient's toileting, should be done as part of a TWOC, and performed prior to catheterizing a bladder that is not adequately emptying. This means that the patient should be provided with privacy during voiding and be allowed to sit on the toilet or toilet substitute (e. g. commode, bedpan) for at least 15 minutes. A shorter time is too rushed. Some patients may also be hindered by stress, anxiety, and lack of privacy.

MEDICATIONS

Medications for urinary retention include: 1) cholinergic medications, such as urecholine, which may be prescribed to increase the efficiency of the weak detrusor contractions (appropriate when DSD is absent), 2) anticholinergic medications, which may be given to relax the spastic bladder and combined with IC to ensure periodic complete bladder emptying, 3) alpha blockers to attempt pharmacological relaxation of the internal sphincter, and 4) antispasmodics, such as baclofen or diazepam, to relax the external urinary sphincter.

Table 6 on page 23 lists the current medications that are used in men for the treatment of BPH. 5α-reductase inhibitors block the conversion of testosterone to dihydrotestosterone, which plays a key role in the development of BPH. These drugs have been shown to reduce prostate volume by up to 20% over 6–10 months (Chung & Sandhu, 2011).

Alpha-adrenoceptor antagonists (referred to as "alpha blockers") can be prescribed in both men and women to improve bladder emptying. Alpha blockers have been shown to increase peak urinary flow rates and improve symptoms in 30–45% of men, but may have little value in patients with complete inability to void (Chung & Sandhu, 2011). They act by relaxing the prostate and bladder neck smooth muscle, reducing outlet obstruction without adversely affecting detrusor contractility.

SURGERY

Surgery, such as a transurethral sphincterotomy, may be performed in cases of severe DSD to alleviate obstruction due to sphincter spasm. This option is generally reserved for male patients who can rely on external collection devices to control any UI that results.

CATHETERIZATION

Bladder emptying for patients who develop UR in the acute care setting is initially managed with an indwelling urinary catheter. However, this should be removed as quickly as possible and based on the patient's voiding status and bladder volume, the patient should be managed using straight (in-and-out) catheterization performed intermittently if UR persists.

Intermittent catheterization has been shown to be one of the most effective and commonly used methods of bladder management in patients with UR and in those diagnosed with a NGB (Newman & Willson, 2011). Regular bladder emptying reduces intravesical bladder pressure and improves blood circulation in the bladder wall, making the bladder mucous membrane more resistant to infectious bacteria (Lapides et al., 1972). By inserting the catheter several times during the day, episodes of bladder overdistention are avoided. In addition, the bladder wall is susceptible to bacteria that circulate in retained urine. When the bladder becomes stretched from retained urine, the capillaries become occluded, preventing the delivery of metabolic and immune substrates to the bladder wall (Heard & Buhrer, 2005).

Catheterization of the bladder is performed several times a day (e.g. intermittently), depending on the severity of UR. The goal is to allow the bladder to store a reasonable volume of urine at low pressure, and empty it at appropriate intervals if the patient is not adequately voiding. Long-term use of IC is preferable to an IUC, as IC has a lower risk of infection and other complications (Newman & Wein, 2009). Sterile (aseptic) technique includes genital disinfection and the use of sterile catheters, gloves, and other equipment. In hospitals, sterile IC is preferred over a non-sterile procedure as fewer cases of bacteriuria and UTI occur (Newman & Willson, 2011). According to industry standards, all disposable catheters are intended for one-time use.

IC is useful in any condition in which bladder emptying is impaired in association with outlet resistance. It is used on a regular basis throughout the day (and night) to ensure bladder emptying in patients with UR. The number of catheterizations required will depend on factors such as fluid intake, ambient temperature, bladder capacity and social factors. Most patients will probably need to be catheterized at least four or five times each day.

For intermittent self catheterization to be successful in patients with long-term or CUR, the bladder must be able to store urine adequately without leaking, a condition that can be facilitated through the use of antimuscarinic medication (Table 7 on page 28). The patient must be physically able and motivated to perform catheterization, or a caregiver must be able to do it for them.

BEST PRACTICES FOR TEACHING INTERMITTENT SELF-CATHETERIZATION

1. Maintain good hygiene, particularly of the hands and perineum.

    *   Hands should be thoroughly washed before attempting catheterization

    *   The genitalia should be washed daily with soap and water and always cleansed from front to back.

    *   It is preferable to perform catheterization before bowel program to minimize E. coli bacteria contamination of the urethra.

    *   Immediate perineal hygiene is recommended after vaginal intercourse as the act of intercourse may push anal bacterial into the urethra. Sexually active females should avoid spermicidal lubricants, because these products may alter normal vaginal and lower urethral flora.

2. Teach male patients the correct positioning of the male urethra during insertion of the catheter to minimize trauma as the catheter passes through curved portions of the urethra (Figure 14).

Figure 14. Correct Position of the Penis for Male Self-Catheterization
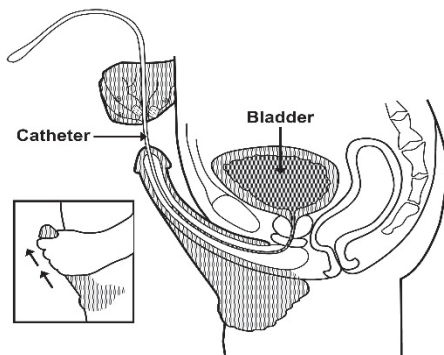
3. Be careful to avoid touching the tip of the catheter and/or letting it touch other surfaces.

4. Use a generous amount of lubricant along the length of the catheter (especially male patients) since dry catheters may cause excoriations in the urethra leading to an entry point for bacterial contamination.

5. Keep bladder as empty as possible by having patients catheterize at least 4 to 6 times a day or to maintain bladder urine volume < 400 mL. Keeping the bladder as empty as possible will prevent over-distension of the bladder and increases in intravesical pressure, all of which will preserve an adequate blood supply to the bladder wall.

6. Use a new catheter each time an IC is performed. Most catheters are manufactured and packaged for single sterile use.

INDWELLING URINARY CATHETERIZATION

OVERVIEW

An indwelling (or Foley) urinary catheter (IUC) is a commonly used medical device that allows for continuous urine drainage in patients with bladder dysfunction (Newman, 2007). Catheters are used in both men and women in all care settings, but the acute care setting uses IUCs more than any other medical device. Each year, urinary catheters are inserted in more than 5 million patients in acute care hospitals. This is estimated to be 18% to 25% of all hospitalized patients (Klevens et al., 2007). Prevalence is greater in high acuity patient units, with critical care and intensive care units having the highest (Weber, et al., 2007).

UTIs are the most prevalent hospital-acquired infection and are directly associated with the use of IUCs. These infections are referred to as catheter-associated urinary tract infections or CAUTIs. Approximately, 20%–30% of patients with catheters will develop symptoms of a CAUTI. A CAUTI can cause substantial morbidity in both male and female patients and is a preventable patient safety issue.

In hospitalized older medical patients without a specific medical indication, urinary catheterization was associated with a greater risk of death: four times as great during hospitalization and two times as great within 90 days after discharge. They are also associated with morbid events such as delirium and with longer lengths of stay and higher costs of medical care (Holroyd-Leduc, et al., 2007).

Other complications associated with the use of IUCs include urethritis, urethral strictures, hematuria, bladder perforation, catheter obstruction, and urosepsis. Urosepsis is a life-threatening infectious complication, and its associated risk increases with prolonged IUC usage. Urosepsis mortality rates are reported as high as 25% to 60% (Holroyd-Leduc et al., 2007; Klevens et al., 2007).

Approximately 560,000 cases of CAUTIs are reported yearly to the CDC (Horan et al., 2008). The complication of a UTI can increase a patient's hospital length of stay by 0.4 days for an asymptomatic UTI and 2.0 days for a symptomatic UTI. The cost of treating a single episode of a CAUTI varies from $980 to $2900 depending on the presence of associated bacteremia (Saint, 2000; Saint, 2009a).

Although the use of an IUC in patients with UR should be the last resort when all other treatments have failed, it may occasionally be indicated for shorter periods (<30 days) (Meddings et al., 2010). Urinary catheters often are placed unnecessarily, remain in without physician awareness, and are not removed when no longer needed (Saint et al., 2008).

USE OF AN INDWELLING URINARY CATHETER

An IUC is a flexible hollow tube that is aseptically inserted in the bladder and held in place with a retention balloon and attached to a drainage bag (Newman & Wein, 2009). Urethral catheters are usually inserted and managed by nurses. Most catheters are inserted via the urethra, but there is increasing use of suprapubic catheters in patients whose bladder dysfunction is managed long-term with a catheter. Indwelling urinary catheters are recommended only for short-term use which is defined as less than 30 days. Long-term use, defined as > 30 days, is discouraged because prolonged use places the patient at increased risk for adverse events and complications (Newman & Wein, 2009).

If the nurse is responsible for inserting and managing these medical devices, he/she needs to understand their characteristics:

Catheter Size

- Measured by the outer circumference and according to a metric scale known as the French (Fr) gauge.
- Range is 6 –18 (Fr)—each French unit equals 0.33 mm in diameter.
- Smallest catheter size is preferred (14 to 16 Fr) as use of large-size catheters (>18 Fr) may cause more erosion of the bladder neck and urethral mucosa, can cause stricture formation, and does not allow adequate drainage of periurethral gland secretions, causing a buildup of secretions that may lead to irritation and infection.

Catheter Tips (Figure 15)

- A coudé-tipped or Tiemann catheter, which is angled upward at the tip, is often used in men with an enlarged prostate or urethral stricture gland, since it allows easier passage.
- A straight-tipped catheter is most commonly used.
- Silicone-coated latex catheters have a chemically-bonded coating of silicone elastomer or Teflon that prevents urethral contact with the latex.
- Teflon-coated catheters are thought to reduce the absorption rate of water.
- 100% silicone catheters are thin-walled, more rigid, catheters with a larger diameter drainage lumen that may prevent blockage from biofilms and encrustations.
- Hydrogel-coated latex catheters absorb water to produce a slippery outside surface.
- Silver alloy may decrease symptomatic UTIs if used short term.

Figure 15. Catheter Tips

Catheter Material

Criteria for catheter material selection include:

- How long the catheter will remain in place
- Comfort
- Presence of latex sensitivity
- Ease of insertion and removal
- Ability to reduce the likelihood of complications, such as:
    ○ Urethral and bladder tissue damage
    ○ Colonization of the catheter system by microorganisms
    ○ Encrustation

CATHETER-ASSOCIATED URINARY TRACT INFECTION

CAUTI is not a new problem, and despite several studies and publications during the past 30 years that have identified risk factors and strategies to reduce CAUTI risk, it remains a common condition. Prolonged catheterization is the single most important risk factor for CAUTI. Urinary catheters are often placed unnecessarily, are in place without physician awareness, and are not removed promptly when no longer needed. Not paying for CAUTI seems to be a strategy to save money, motivate hospitals to develop systems to prevent hospital-acquired CAUTI, avoid unnecessary use of urinary catheters, and implement other preventive strategies for patients who require catheters.

Sources of CAUTIs include: contamination during insertion, migration of bacteria along the external surface of catheter to bladder, junction between the catheter, drainage tube and/or collection bag, migration up the system from the drainage port or tap, and reflux from contaminated drainage tubes or bags to the bladder (Figure 16). Antimicrobial therapy is only transiently effective if the catheter remains in place.

Figure 16. Bacteria Entry Levels

Urethral Meatus – Catheter Junction

Catheter Drainage Tubing Junction

Drainage Bag Outlet Tube
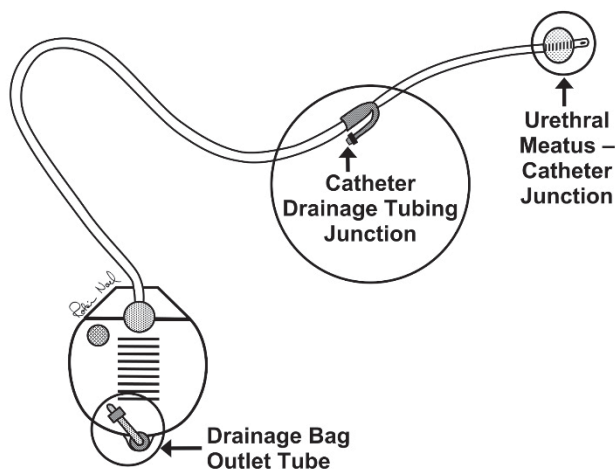
Catheters are detrimental to patients in many ways. Inappropriate IUC has been equated to a "one-point restraint," because like a restraint, they can cause functional impairment, discomfort, pressure ulcers, and death. Patients have reported that IUCs are uncomfortable, painful and restrict activities of daily living.

In addition to the length of the time the IUC is in place, there are other risk factors for development of a CAUTI including improper catheter insertion techniques, female gender, older age, compromised immune system, and co-morbid conditions (e.g. diabetes, renal dysfunction). Other contributing factors to the development of a CAUTI are non-evidence-based nursing care practices for managing catheters. Procedures such as meatal cleansing with antiseptics, leaving catheters unsecured, catheter irrigation, disconnecting the catheter from the drainage tubing, and others, are routinely performed by nurses, are not supported by research and, in many cases, have been shown to contribute to the development of a CAUTI.

The fact that nurses are not following specific practices to prevent UTIs was shown in a survey about practices to prevent hospital-acquired UTI and other device-associated infections distributed to both nonfederal and federal U.S. hospitals. Only 9% of hospitals reported using a IUC stop-order or reminder, only 14% used condom catheters in appropriate men, and only about 30% used a portable bladder ultrasound scanner for determining PVR. Use of a condom catheter and bladder scanning for PVRs are primarily nursing interventions (Saint et al., 2008).

CAUTI MONITORING

Monitoring of all HAIs and comparison of UTI rates is a governmental and state activity with postings available on many websites. The Surgical Care Improvement Process (SCIP) is a national quality partnership of organizations interested in improving surgical care by reducing surgical complications. The new SCIP measures (SCIP-9) will require providers (e.g. hospitals) to submit data on the proportion of the sample of surgical patients captured for whom an IUC (if used) was removed on postoperative day 1 or 2.

The National Healthcare Safety Network (NHSN) of the Center for Disease Control and Prevention is a performance measurement system devoted to tracking HAIs. The NHSN created the National Nosocomial Infection Surveillance (NNIS) system, a national database that benchmarks infection rates of similar hospitals. The NNIS benchmarks are published annually and are determined by calculating the pooled mean infection rates for similar participating critical care units in 300 participating hospitals in their database. According to Pennsylvania state guidelines, NHSN defines "catheter-associated infection" as a UTI that occurs in a patient who had an IUC in place within the 48 hour period before the onset of the UTI (http://www.cdc.gov/hicpac/cauti/005_background.html). The NNIS formula for determining UTI rate is determined by number of CAUTIs divided by the total device days multiplied by 1,000. The NHSN classifies a CAUTI as a patient who demonstrates clinical symptoms, as well as having laboratory evidence of the UTI. As of January 2009, asymptomatic bacteriuria (the presence of bacteria in a urine specimen in the absence of signs and symptoms of infection) is no longer considered to be a CAUTI by NHSN and, since then, this condition has not been included in the CAUTI analysis.

CAUTI PREVENTION

The cornerstone of any CAUTI prevention program is to only use an IUC when indicated and if used, remove the IUC as soon as possible. When to remove the IUC after surgery is controversial and practices vary. Most are advocating removal on post-op day 1 with a nursing staff instituting a comprehensive TWOC as outlined in

The following are examples of appropriate and inappropriate use:

Appropriate indications for an IUC include:

- Acute urinary retention/bladder outlet obstruction.
- Need for accurate inputs and outputs (I&O) if critically ill.
- Assist in healing of open sacral/perineal wound in patients with urinary incontinence.

- To improve comfort in end of life care if needed.
- Peri-operative use in selected surgical procedures.
- Urologic/other surgeries on contiguous structures of GU tract.
- Anticipated prolonged duration of surgery (should be removed in PACU).
- Operative patients with urinary incontinence.
- Need for intra-operative hemodynamic monitoring.

Inappropriate uses of IUCs include:

- As a substitute for nursing care of the patient with incontinence.
- As a means of obtaining urine for culture or other diagnostic tests when the patient can voluntarily void.
- For prolonged post-operative duration without appropriate indications (e.g., structural repair of urethra or contiguous structures, prolonged effect of epidural anesthesia, etc).

Components identified that can decrease IUC use and prevent nosocomial CAUTIs include:

- Instituting hospital-wide administrative interventions.
- Implementing quality improvement programs.
- Educating physician and nursing staff on indications.
- Evidence-based nursing care of the IUC to prevent infection.

Most experts recommend the use of a "bundle," a set of evidence-based practices which are designed to be implemented together to optimize treatment, prevent or reduce complications, and improve outcome (Berwick, et al., 2006). The ABCDE Bundle for prevention of CAUTIs (Saint, et al., 2009b) is as follows:

- Adherence to general infection control principles (e.g., hand hygiene, surveillance and feedback, aseptic insertion, proper maintenance, education) is important.
- Bladder ultrasound may avoid IUC.
- Condom catheters or other alternatives to an IUC such as intermittent catheterization and incontinence products should be considered in appropriate patients.
- Do not use the IUC catheter unless medically appropriate.
- Early removal of the catheter using a reminder or nurse-initiated removal protocol appears warranted.

Developing a clinical nursing decision tool, protocol or algorithm for management of patients following IUC removal is an important step in decreasing the unnecessary use of IUCs. The Clinical Decision Tool and Nursing Algorithm in Figure 17 on page 51 was developed by this author with the staff at the Hospital of the University of Pennsylvania as part of a CAUTI initiative to decrease UTI rates and device days. It outlines the care pathway for IUC removal. A key component of the algorithm is the use of a portable bladder volume instrument (e.g. BladderScan®) at each step. This instrument should also be used to measure urine volume in other situations, including verifying an empty bladder or UR, and identifying obstruction in an IUC that is draining adequately. But the key point is that the ultrasound measurement should be used to decide whether catheterization is needed. This replaces the previously used fixed schedule for catheterization that most hospital clinicians followed in the past.

Figure 17. Example of a Clinical Decision Tool and Nursing Algorithm for IUC Removal
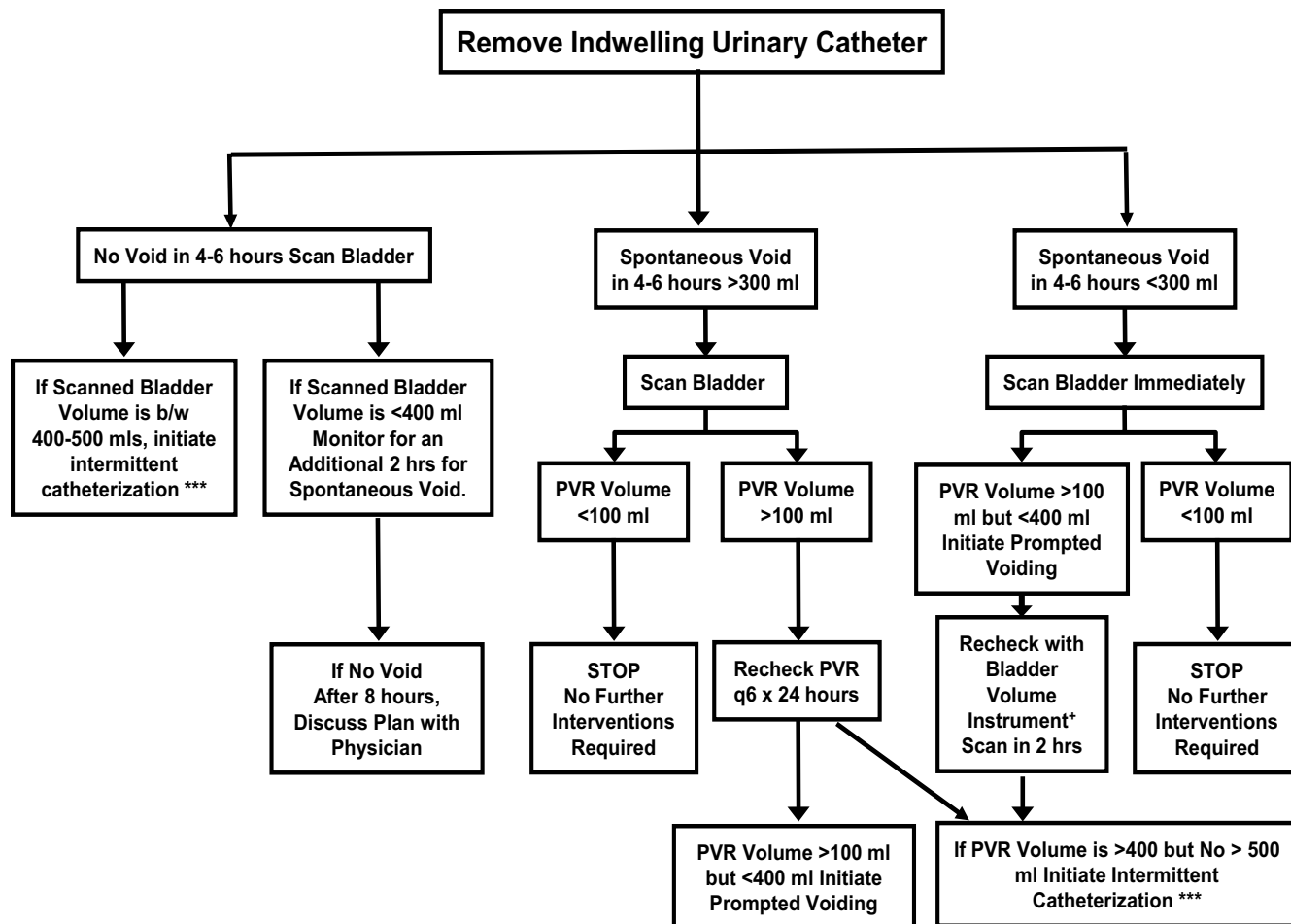
⁺**Bladder Volume Instrument recommended is the BladderScan®**

***For Urine Volume >500 mls Obtain Order for Reinsertion of IUC for 24 hours and Reattempt Algorithm for Removal

SUCCESSFUL CAUTI PREVENTION STRATEGIES

There are several examples in the literature of how acute-care hospitals and nursing teams have implemented CAUTI prevention programs (Wenger, 2010; Fuchs et al., 2011; Miller et al., 2010; Fakih et al., 2008; Loeb et al., 2008; Topal et al., 2005; Huang et al., 2004). Wenger (2010) describes an initiative at Lancaster General Hospital, Lancaster Pennsylvania, where a three-pronged approach—beginning with education, progressing to tests of new and better products, and ending with the nurse-driven protocol for catheter removal—was implemented. Fuchs et al., (2011) instituted an evidence-based, nurse-driven daily checklist for initiation and continuance of IUC in five adult intensive care units. They based the checklist on best practice protocols recommended in the literature. This study measured compliance, provider satisfaction and clinical outcomes which all improved. A study, by Elpern et al., (2009), involved the application of IUC criteria. Over a six month period, IUC use was measured in a medical intensive care unit with discontinuation recommended if the IUC use did not meet the criteria. The unit was able to reduce IUC use and CAUTIs during this period of time. However, neither of these studies looked at the effect of the intervention in sustaining improved outcomes.

IUC BEST PRACTICES

A key component of preventing a CAUTI is identifying best practices for ensuring IUC care. The following is a list of recommendations from the evidence-based 2009, CDC Healthcare Infection Control Practices Advisory Committee (HICPAC) Guideline for Prevention of CAUTIs (Gould et al., 2010). HICPAC has estimated that up to 69% of hospital-acquired CAUTIs may be prevented by implementation of an evidence-based prevention program. Although patients who have IUCs in place long-term will most certainly develop a CAUTI, evidence suggests that certain interventions can reduce the incidence of CAUTI in patients who have IUCs in place for short-term duration.

The following interventions can reduce CAUTIs:

- Conduct daily evaluation of the need for IUCs in all patients and implement quality improvement programs to reduce the risk of CAUTIs.
- Perform catheter insertion using strict aseptic technique and equipment.
- Minimize urethral trauma during insertion by using generous amounts of sterile lubricant.
- Hold the penis in a near vertical insertion position when catheterizing a male patient.
- Perform hand washing before and after handling of the catheter site or apparatus since up to 15% UTIs occur in clusters – as a result of cross-infection.
- Wear gloves when handling any part of the catheter system.
- Ensure an unobstructed urine flow by preventing any kinks or loops from occurring in the catheter and tubing which might restrict the flow of urine.
- Secure the catheter by anchoring it to the upper thigh in women or to the upper thigh or lower abdomen in men, to prevent excessive tension on the catheter, which can lead to urethral trauma and tears.
- Empty the drainage bag at least every 4 to 6 hours or when urine in the drainage bag reaches 400 mL to avoid migration of bacteria up the lumen of the catheter system. Empty the bag prior to transporting the patient.
- Separate graduated containers for each patient and each patient drain. With multiple drainage devices for one patient, keep drainage devices on opposite sides of the bed and keep drainage devices in semi-private rooms on opposite sides of the room.
- Consider changing the catheter before obtaining a specimen for culture, since cultures obtained through the old catheter may be inaccurate.
- Consider changing the entire catheter, and system, if infection or obstruction occurs.
- Encourage adequate fluid intake (approximately 30 mL/kg/day with a 1,500 mL/day minimum or as indicated based on the patient's medical condition).

There have also been practices that can contribute to CAUTIs and most experts recommend the following IUC practices:

- Determine daily the need for a catheter.
- Do not perform rigorous, frequent cleansing of the catheter entry site (meatus or suprapubic) and do not use antiseptics for routine cleansing, rather just wash the catheter entry site daily with soap and water daily or after bowel contamination.
- Do not open the system by disconnecting the catheter from the drainage bag for any reason. The use of pre-connected catheter systems may prevent disconnection.
- Do not clamp the catheter or drainage tube.
- Do not perform routine cultures in the absence of infection, because all chronically catheterized individuals have bacteria and the organisms change frequently (about one to two times per month). Urine cultures should only be obtained if the patient demonstrates clinical symptoms of a UTI.
- Do not give the asymptomatic patient antibiotics and antimicrobials as a UTI prevention strategy.
- Do not perform bladder or catheter irrigation unless medically necessary (e.g. tissue/blood clots obstructing drainage). If catheter patency is questioned or occlusion is suspected, scan the bladder to assess urine volume.

Indwelling Urinary Catheterization

GLOSSARY

ABBREVIATION	DEFINITION
AUR	Acute Urinary Retention
BOO	Bladder Outlet Obstruction
BPH	Benign Prostatic Hyperplasia
CAUTI	Catheter-Associated Urinary Tract Infection
CDC	Center for Disease Control and Prevention
CUR	Chronic Urinary Retention
CMS	Centers for Medicare & Medicaid Services
DRE	Digital Rectal Exam
DSD	Detrusor-Sphincter-Dyssynergia
EBCPG	Evidence-Based Clinical Practice Guideline
EBP	Evidence-Based Practice
GU	Genito-Urinary
HAI	Healthcare-Associated Infection
HICPAC	CDC Healthcare Infection Control Practices Advisory Committee
IC	Intermittent Catheterization
ISC	Intermittent Self-Catheterization
IUC	Indwelling Urinary Catheter (Foley catheter)
LUTS	Lower Urinary Tract Symptoms
MS	Multiple Sclerosis
NGB	Neurogenic Bladder
NHSN	National Healthcare Safety Network
NNIS	National Nosocomial Infection Surveillance
PACU	Post-Anesthesia Care Unit
PCEA	Patient-Controlled Epidural Anesthesia
PFM	Pelvic Floor Muscle
POP	Pelvic Organ Prolapse
POUR	Post Operative Urinary Retention
PV	Prompted Voiding
PVR	Post-Void Residual
PSA	Prostate-Specific Antigen
SCI	Spinal Cord Injury
SCIP	Surgical Care Improvement Process
TWOC	Trial Without Catheter
UI	Urinary Incontinence
UR	Urinary Retention
UTI	Urinary Tract Infection

BladderScan®

ABBREVIATION	DEFINITION
VCUG	Voiding Cystourethrogram
VT	Voiding Trial

Glossary

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To obtain additional information regarding BladderScan® products, including instructions for use, maintenance, and troubleshooting, please contact Verathon® Customer Care or visit verathon.com/product-documentation.

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