

Acute and Chronic Urinary Retention in Men and Women: Epidemiology, Treatment and Future Directions*

Learning Objective: At the conclusion of this continuing medical education activity, the participant will be able to describe the epidemiologic, physiologic, and operative factors that contribute to acute and chronic urinary retention, as well as how to mitigate those factors and treat retention.

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ACUTE URINARY RETENTION

Epidemiology. Acute urinary retention is the inability to adequately and spontaneously empty the bladder of urine. It is commonly understood to be a painful occurrence and can be a common urological emergency.¹ It is described by the International Continence Society as both a symptom and as a diagnosis, with the latter defined as, “A patient is unable to pass any urine despite having full bladder, which on examination is painfully distended and readily palpable or percussible.”² AUR is a problem encountered by all health care providers, not simply urologists. AUR may be either spontaneous or provoked and may occur in those with identifiable risk factors or without. Retention may be secondary to medications, benign prostatic hyperplasia and lower urinary tract symptoms, cerebrovascular accident, immobility, postpartum or postoperative setting.

While it is impossible to estimate a true prevalence due to differing study and clinical definitions of retention, in a recent review of the literature Oelke et al reported AUR requiring catheterization in 2.2% to 8.5% of 1000 man-years in those without previous AUR or known risk factors.³ This rate increased to 18.3–35.9 per 1000 man-years for those with BPH/LUTS participating in pharmacological trials. Approximately 10% and 30% of men in their 70s and 80s, respectively, will suffer from acute urinary retention within 5 years.⁴ Acute urinary retention is much rarer in female patients, with estimates of approximately 1 to 7 in 100,000 per year with a female-to-male ratio of 1:13 commonly cited.⁵ There are differing reports of whether the prevalence of AUR is increasing or decreasing, as noted by Yoon et al who highlighted a difference in rising rates based on emergency room visit data in California and UK data that showed a slight decrease a decade prior.⁴

Acute urinary retention is prevalent among those undergoing surgery, with up to 14%-16% of patients reporting postoperative urinary retention overall.¹ In particular, anorectal surgeries and total joint arthroplasties have increased risk of POUR, with reported rates ranging from 20% to 40% and 0% to 75%, respectively. A large, prospective trial in Switzerland using the enhanced recovery after surgery pathway reported an incidence of 14% POUR requiring catheterization.⁶ The rates of postpartum urinary retention vary as widely, with reports of 0.5%-37%.⁷ An estimated 2% of all admissions to teaching hospitals for acute urinary retention are due to medication side effects.⁸ Many neurological injuries, especially spinal shock and other spinal cord trauma, can result in AUR. Cerebrovascular accidents, especially those involving the brainstem, can have reported incidences of AUR in the early recovery period of up to 19%-47% with some number recovering function over time.

Presentation/sequelae. While the exact cause of urinary retention varies with each individual case, general pathways have

been proposed as the mechanisms resulting in AUR. **The first and most intuitive is mechanical or dynamic obstruction.** As noted, those with BPH/LUTS have a significant increase in the risk of AUR. Traditionally, this has been thought to be caused by BPH with a large, ball-valving median lobe, or intravesical prostatic protrusion.¹ Increased sphincter tone is thought to contribute to dynamic obstruction and may be induced with either medications that temporarily increase alpha-adrenergic tone, or with the alpha-adrenergic activity increase via anorectal stimulation as has been demonstrated in anal cancer surgery.⁹

Yet another common presentation of AUR is acute clot retention. This emergent condition can present as a consequence of spontaneous hematuria or as a postoperative complication from common cystoscopic interventions, such as TURP and transurethral bladder tumor resection.¹⁰⁻¹² With the increasing prevalence of patients on dual antiplatelet or anticoagulant therapy, especially with placement of bare metal and drug eluting cardiac stents, there is an increased rate of clot retention in those who remain on these therapies during transurethral bladder tumor resection.¹¹ Other causes of obstruction that may contribute to episodes of acute urinary retention include urethral stricture, lower urinary tract calculi, and malignancies of the urinary tract or surrounding organs resulting in compression of the lower urinary tract.

Another mechanism is that of disruption of the innervation of the micturition pathways (fig. 1).¹ These can be of either the motor or sensory pathways. Drugs may inhibit detrusor contraction, spinal anesthetics can inhibit the sacral reflex

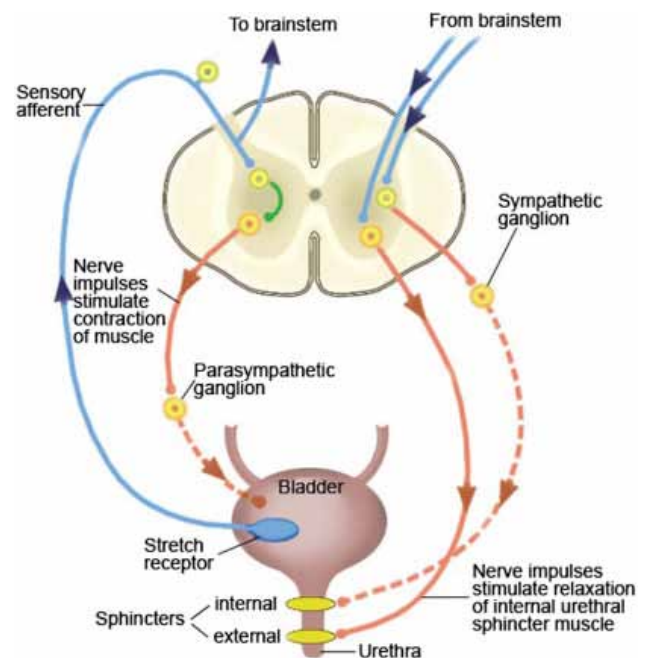


Figure 1. Micturition reflex pathway (reprinted with permission).¹

ABBREVIATIONS: 5ARI (5-alpha reductase inhibitor), AUA (American Urological Association), AUR (acute urinary retention), BOO (bladder outlet obstruction), BPH (benign prostatic hyperplasia), CAUTI (catheter associated urinary tract infection), CIC (clean intermittent catheterization), CUR (chronic urinary retention), eGFR (estimated glomerular filtration rate), ICS (International Continence Society), LUTS (lower urinary tract symptoms), POUR (postoperative urinary retention), PVR (post-void residual), SPT (suprapubic tube), TURP (transurethral resection of the prostate), UR (urinary retention), UTI (urinary tract infection)

micturition loop, and injury to pelvic nerves may contribute. Injury to autonomic nerves during mesorectal excision or lymph node dissection resection can result in POUR.⁹

Another likely cause of AUR is a self-perpetuating cycle that can be secondary to one of the previously mentioned causes or secondary to surgical intervention—myogenic failure from overfilling of the bladder. If the bladder is overfilled, such as during surgery, the smooth muscle fibers of the detrusor can overstretch, become fatigued, and experience ischemia and axonal degeneration. This is directly related to increased intravenous fluid administration and total anesthesia/surgery time, found to be a significant intraoperative factor in extended major colorectal surgery.^{1,6,9,12} There are no data with respect to the exact temporality of myogenic failure acute urinary retention during surgery. More clearly elucidated are aging related changes in underactive bladder conditions that are thought to contribute to myogenic failure in those cases. In histological and animal studies the axonal content of the bladder is reduced, deposition of collagen is increased and there is an attenuation of response to cholinergic signals by the muscarinic receptors in the bladder.¹³ However, one theory that may explain this in acute myogenic failure is that exposure to higher volumes over extended intraoperative periods results in overstretching of the muscle fibers in the bladder, and may result in similar attenuation of response of muscarinic receptors in the bladder to normal cholinergic signaling. This would suggest that that one may reduce the risk of myogenic failure by minimizing the volume-time exposure with respect to bladder filling.

The presentation of what constitutes AUR varies from clinician to clinician, as reflected in the broadness of the ICS definition that includes a number of subjective elements. In particular, what constitutes a full bladder will vary from patient to patient, depending on compliance, age and presence of anatomical abnormalities such as diverticula. Also, the ability to “adequately” void is highly subjective, and a number of measures of voiding ability have been used in an attempt to add a component of objectivity to be used by clinicians and researchers. One of the most common is the use of ultrasonic bladder scans, catheterized outputs and post-void residual measurements. Ultrasonic measurement of PVRs has gained widespread acceptance but there is no standard criteria for cutoff indicating AUR such as that experienced in a trial without catheter post-surgically. The presence of a palpable bladder occurs at as little as 150 ml,⁸ but may not cause discomfort or be palpable until much higher volumes such as in a diabetic patient with decreased sensation or in a patient with a body habitus that limits examination.

What is not in question are the sequelae of acute urinary retention and their associated health care costs. Included among these are the possibility of bladder rupture, gross hematuria, urinary tract infection, catheterization, autonomic dysfunction, hospitalization and invasive interventions up to and including surgery. Even after treatment of retention, there is the possible sequela of postobstructive diuresis. Postobstructive diuresis is a polyuric state in which a copious amount of salt and water is excreted after the relief of urinary obstruction. It occurs in 0.5%-52% of patients with urinary obstruction, and while it can be a normal physiological response to the obstruction, it can also be a pathological response.¹⁴ The mechanism of this change is unclear, but theories include a combination of osmotic diuresis and down-regulation of sodium transport-

ers, loss of juxtamedullary nephrons to ischemia, and reduced response of the collecting duct to antidiuretic hormone leading to nephrogenic diabetes insipidus.^{1,14} Urine outputs of greater than 200 ml per hour for 2 consecutive hours, or greater than 3 L over 24 hours are diagnostic of postobstructive diuresis. If the diuresis persists beyond a euvolemic state, this is pathological and warrants nephrologic consultation and can result in life threatening metabolic derangements.¹

Persistent postobstructive diuresis requires vigilant monitoring of urine osmolality, sodium and potassium as well as serum electrolytes. Electrolyte disturbances and negative fluid balance, especially with symptoms of altered mental status, are indicative of clinically threatening postobstructive diuresis, and require careful replenishment of fluids and electrolytes until a euvolemic state is reached.¹⁴

A significant cause of morbidity and associated health care costs that may be traced to urinary retention involves catheter associated urinary tract infections. This is the most common hospital acquired condition in the United States, and are a cause of a significant degree of patient morbidity and cost in the U.S. and in the United Kingdom.^{15,16} These costs have been estimated in a systematic review as anywhere from \$876 (in 2016 dollars) for the simplest attributable CAUTI costs of additional tests and therapies, to more than \$10,000 in patients with significant complexity such as an intensive care unit patient with secondary bacteremia.¹⁵ Bacteremia is seen in 17% of all urinary tract infections, and the risk of CAUTI increases each day an indwelling catheter is left in place, as with increasing age, diabetes and female sex. However, only 1%-4% of CAUTIs are the attributable cause of secondary bacteremia.^{1,15}

Prevention. It is possible to prevent AUR in certain situations. Avoiding medications such as alpha-adrenergic agonists and anticholinergics can help reduce the incidence of AUR. The Appendix outlines some common medication classes and their accompanying mechanisms that contribute to urinary retention. Delaying Foley catheter removal has been shown to increase success in trial without catheter after surgery. In particular, after anorectal surgery it was demonstrated that removal of a catheter within the first 48 hours postoperatively was an increased risk of urinary retention.¹⁷ Another study showed that removing a catheter on the second postoperative day as opposed to the first reduced the risk of POUR to 7.1% from 21.6% after anorectal surgery.⁹ Other factors that have been shown to reduce AUR include use of an alpha blocker prior to removal of catheter, and recent data suggest that there is no statistical superiority between alpha blockers in this application.^{18,19} **Alpha blockers can be used to reduce the incidence of AUR in both short and long term when combined with 5ARIs, with greater efficacy in the short term (<12 months) and similar efficacy in the long term as 5ARI monotherapy.**³ With adherence to a midterm course of 5ARI therapy, each extra 30 days of 5ARI treatments can reduce the probability of the onset of acute urinary retention and need for surgery by 14% and 11%, respectively.²⁰ Surgical interventions such as those that relieve bladder outlet obstruction can reduce the risk of AUR (and are discussed further in the treatment of chronic urinary retention section).

Treatment. Treatment of AUR focuses on the correction of the underlying anatomical or physiological processes that are inhibiting the emptying of the bladder. This can include using medications to reduce sphincter tone or to reverse the effects

of detrusor inhibition, but most commonly involve some type of mechanical bladder drainage. Most cases of AUR that present to the clinician are time sensitive emergencies and, as previously mentioned, overdistention can worsen retention, so timely drainage is paramount. The most common method of treatment is placement of an indwelling Foley catheter. However, due to the risk of CAUTI with short-term catheterization, which has been described as up to 5% per day,¹ clean intermittent catheterization should be considered to reduce this risk. **While urethral catheterization is the mainstay for AUR, whether it is indwelling or in and out as with CIC, placement of a suprapubic tube is an alternative to urethral catheterization.**

SPT should be the preferred method of bladder drainage if urethral catheterization is impossible or if cystoscopic placement of a catheter cannot be performed. One particular instance where this is preferable is in patients with significant pelvic trauma or other select clinical situations, such as in a patient with a closed bladder neck and an uncatheterizable conduit. For patients who are demented or combative and, thus, are more likely to pull out the catheter themselves, strong consideration must be given prior to SPT placement. It is recommended, but not required, to use ultrasound guidance to place the SPT. An example technique for percutaneous SPT is described in figure 2.

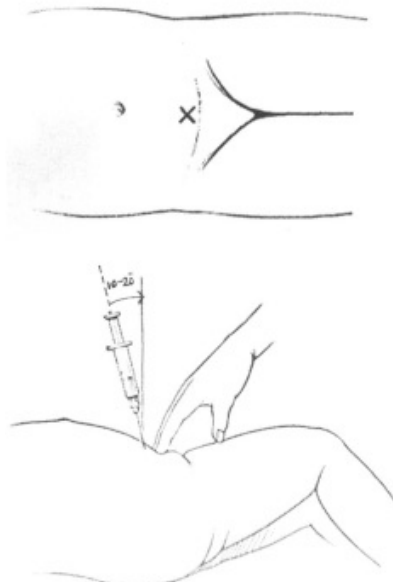
An alternative to suprapubic tube placement in an emergency is cystoscopic placement of a urethral catheter, with or without concurrent use of urethral dilators. At our institution we prefer to use flexible urethral dilators at the bedside over

balloon dilation or urethral sounds (especially for more proximal narrowing). We use the Seldinger technique to dilate to a goal of 2 sizes (4Fr) above the desired catheter size (ie 20Fr when using a 16Fr catheter) and then place a council tip catheter. However, careful consideration of the patient's anatomy, suspected mechanism of stricture or obstruction, and clinical condition must be employed when deciding on a method of bladder decompression and catheter placement.

While bladder decompression via catheter is the mainstay in an emergency situation of AUR, there are less invasive measures that can be successful in carefully selected patients. In a randomized controlled trial Afazel et al demonstrated that POUR was significantly reduced in men with the postoperative application of a hot pack or lukewarm-water-soaked gauze to the suprapubic area over a control group.²¹ The hot pack and gauze relieved POUR in 59.5% and 71.4%, respectively, in patients undergoing select urological, orthopedic and general surgeries, but neither method was significantly superior to the other. As such, this could be a valuable adjunct in the immediate postoperative period when catheterization is undesirable. In female patients whose AUR is thought to be due to mechanical obstruction from pelvic organ prolapse, simply inserting a pessary may relieve the anatomical obstruction and provide relief of the retention.

Surgical procedures such as bladder outlet obstruction procedures are generally reserved for chronic urinary retention and will be discussed in that section.

Percutaneous Suprapubic Tube Placement



1. Palpate the bladder
2. Prep and drape the infra-umbilical region
3. Inject local anesthetic into area 2 cm above pubic symphysis at midline.
4. Advance an 18-gauge hollow needle (spinal needle may be used) under continuous aspiration with a syringe until urine flashback appears at a 10–20 degree angle caudal.
5. Advance the needle 1 cm more, detach the syringe
6. Advance a floppy-tip guidewire (0.035 or 0.038 in Bentson) in Seldinger fashion until it coils in the bladder
7. Withdraw the needle and make a small incision on the anterior abdominal fascia
8. Dilate the tract with sequential graduated dilators to one size above desired catheter size
9. Advanced a Council catheter over the guidewire and into the bladder.
10. Inflate balloon and/or suture tube to skin

Figure 2. Percutaneous SPT placement (reprinted with permission).¹

CHRONIC URINARY RETENTION

Epidemiology. As opposed to AUR, which presents as a painful sensation, **chronic urinary retention is defined by the ICS as “a generally (but not always) painless and palpable or percussible bladder, where there is a chronic high PVR where the patient experiences slow flow and incomplete bladder emptying.”**²² As what constitutes a high PVR and what constitutes “incomplete” emptying are highly variable, the definition of chronic retention is even broader than that of AUR. The AUA white paper on non-neurogenic chronic urinary retention published in 2016 defines CUR as “an elevated PVR of >300 ml that has persisted for at least six months and is documented on 2 or more separate occasions.”²² Regardless, CUR and associated conditions of underactive bladder and bladder outlet obstruction are quite common. In a population based survey of metro Detroit approximately 23% of respondents noted difficulty emptying their bladder.²³ Cohn et al, believing that earlier estimates relying on hospitalization for retention underestimated the true prevalence, looked at a sample of Medicare beneficiaries who had service claims with at least 1 code relating to urinary retention, catheterization and overflow incontinence in 2012.²⁴ From this sample of more than 1 million women they estimated a urinary retention prevalence of 1532 per 100,000 women-years or 1.5%, which was much greater than the traditionally quoted number of AUR in 7 of 100,000 women-years.

Independent risk factors for CUR include increasing age, disease states that cause obstruction such as BPH with LUTS, neurological diseases including Parkinsonism, diabetes, use of antipsychotic and alpha-adrenergic and anticholinergic medications, opioids, and male sex.^{1, 5, 22} Other independent risk factors for CUR include limited mobility status, hypothyroidism and previous POUR.^{20, 25} An association has also been shown between retention and combination therapy with 5ARIs and alpha blockers for BPH with LUTS, but this likely represents conscious decisions of physicians to use combination therapy in those with worse symptoms.²⁶

Presentation/sequelae. Due to the variety in presentations and behaviors of CUR in different populations, including hydronephrosis, recurrent UTIs and decreased renal function, Stoffel et al **recommend stratifying CUR by risk and symptomatology.**²² High risk features of CUR include decreased eGFR to stage 3 chronic kidney disease, pyelonephritis or 3 or more UTIs in 12 months, or development of hydronephrosis or bladder stones. Symptomatic CUR is defined as having subjectively moderate to severe urinary symptoms impacting quality of life on a validated questionnaire or inability of void in the last 6 months requiring catheterization, excluding AUR or that caused by traumatic or neurological event.

Prevention. Prevention of CUR is mainly a mitigation of modifiable risk factors that contribute to urinary retention in general. Optimization of patient health parameters is paramount. Minimizing pharmacological interventions that can contribute to urinary retention, maintaining good bowel function and mobility are key among the elderly. Disease states associated with retention due to neurological dysfunction including Parkinsonism and diabetes should be managed effectively. As POUR is an independent risk factor for persistent episodes of retention, this should be avoided through limiting intraoperative time and intravenous fluids, reducing overdistention of the bladder where possible, and appropriate use of alpha blockade. LUTS should be effectively managed with

medical or surgical therapy where indicated to ensure adequate emptying. The working group for the white paper on CUR recommends urodynamic assessment if the provider suspects low bladder compliance, and consideration of urodynamics prior to intervention for CUR. They also recommend frequent use of PVRs and validated quality of life questionnaires to supplement routine laboratory studies, and history and physical to screen for worsening CUR and identification of high risk features.

One method for reducing retention is to limit pelvic floor dysfunction. Any condition that makes it difficult for the pelvic floor muscles to relax can reduce bladder emptying. This is seen in acquired voiding syndrome and in painful bladder conditions such as interstitial cystitis, in which to reduce pain from urine in the bladder the patient will strain, which can also lead to dysfunctional voiding patterns that may lead to UR.²⁷ As with more classic BOO, this straining to urinate may contribute to myogenic failure. As such, reducing pelvic floor dysfunction via behavioral modification, pelvic floor physiotherapy or pharmacological treatment may help prevent CUR.

Treatment. Management of CUR can be through catheterization in the short term, especially for those meeting the threshold for treatment, such as those with identified high risk variables and those who are symptomatic. There is some weak evidence per a Cochrane review of the literature comparing clean intermittent catheterization, indwelling and suprapubic catheterization that CIC may be preferable to indwelling catheters. The cost of CIC is higher than that of indwelling or suprapubic catheterization, but the generally assumed risk reduction of symptomatic UTIs and subsequent urosepsis using CIC is poorly defined in the literature.²⁸

Surgical treatments are usually reserved for those patients with chronic urinary retention in whom medical therapy and/or 1 or more trial without catheter after an event of AUR has failed. Procedure selection is based on the etiology of the CUR, but the vast majority are due to obstruction, especially in men with CUR caused by BPH, bladder neck obstruction/contracture, or urethral stricture disease. A number of surgical techniques are well-defined with advantages/disadvantages to each in properly selected patients. While the aim in this section is not to discuss these in depth, we will briefly mention some common surgical treatments of CUR.

In particular, transurethral resection of the prostate has long been considered the gold standard for the treatment of lower urinary tract obstruction secondary to BPH.¹ In a recent retrospective propensity matched cohort study, looking specifically at long-term rates of UTI and urinary retention in men diagnosed with BPH treated surgically or only medically with alpha blockers for at least 6 months, TURP was statistically significant in reducing UTIs with a hazard ratio of 0.62 (CI 0.50-0.76) and a HR of UR requiring catheterization of 0.35 (CI 0.25-0.45) up to 3 years.²⁹ Other procedures previously compared against TURP and not found to be as durable or as effective include transurethral needle ablation and transurethral microwave therapy, and ethanol ablation of the prostate.¹

While a younger technology than TURP, laser procedures for reducing BOO in a more minimally invasive fashion have continued to gain widespread acceptance and adoption. These techniques have involved multiple lasers, techniques and wavelengths, in particular green light photovaporization and holmium laser enucleation of the prostate for CUR. Holmium and

photovaporization have been demonstrated to improve urinary parameters, including PVR, and AUA symptom score improvement, with holmium laser enucleation of the prostate significant to photovaporization in offering higher rates of spontaneous voiding postoperatively.^{30,31} Thulium laser enucleation has also been shown to be effective in patients with refractory CUR, also with improvement in International Prostate Symptom Scores.³² However, it should be noted that surgical management of CUR is not without its limitations, and that patients are more likely to experience POUR if they have preoperative UR than those who do not as noted in an examination of thulium laser enucleation for BPH with UR.³³

For urethral stricture disease, urethral dilation, direct visual incision and urethrotomy, or urethroplasty are all potential options for relieving CUR based on length, location and etiology of the stricture causing obstruction.²²

The most common cause of BOO resulting in CUR in women is iatrogenic, associated with prior mid urethral sling placement for urinary incontinence. Either a sling incision or revision is the indicated treatment in this case.²² For those with severe pelvic organ prolapse resulting in BOO, pessary placement as well as surgical repair through a variety of techniques can be effective.^{1,22}

For non-obstructive urinary retention due to detrusor non-contractility or decreased contractility or idiopathic causes, sacral neuromodulation by way of an implantable pacemaker has been approved by the U.S. Food and Drug Administration and shown to be an effective option.^{1,22} While the exact mechanism behind the success of sacral neuromodulation in non-obstructive UR has not been elucidated, the theory is that it acts on bladder sensory afferent nerves by blocking abnormal somatic afferent input processing to and in the spinal cord, and also sends coordinated efferent impulses to the bladder.^{1,34}

FUTURE DIRECTIONS AND RESEARCH NEEDS

While definitions as to what constitutes AUR and CUR have been proposed by the ICS and the AUA working group on CUR,² there is still a great deal of variability in the literature as to the study inclusion criteria and outcome measurement of these conditions, especially AUR. Epidemiological studies,

especially in the female population and in special populations, are lacking. There has been an increased effort in recent years to establish rates of urinary retention in women,^{20,23,24} but there is still a significant amount of work to do in subsets of this population such that the conclusions are useful to clinicians. There is a paucity of evidence and little definitional consensus on the diagnosis and management of postpartum urinary retention³⁵ and how pelvic floor dysfunction from a variety of causes may contribute to this disease.²⁷

Providers across the country seek to reduce opioid use throughout their practices, and epidemiological data to further categorize the effects of opioid use as an independent risk factor for AUR, CUR and POUR for identifying patients at occult risk for these conditions who are otherwise already engaged in the health care system.

As the CUR working group also suggests, and these authors are in agreement, elucidation of better biomarkers and development of better animal markers for UR to help understand the underlying physiology of UR are essential areas to explore, as well as pharmacological or other interventions to rescue decompensated detrusor tissue.²²

DID YOU KNOW?

- Acute and chronic urinary retention are difficult to define, which makes their true prevalence difficult to define, although they are problems commonly encountered by the practicing urologist.
- Etiologies of urinary retention are postulated to include bladder outlet obstruction, disruption of neural pathways of micturition and myogenic failure of the detrusor muscle.
- AUR is generally managed via catheterization, while a combination of medical and surgical treatments are used to manage CUR. Surgical therapy is generally reserved for CUR.
- Further research is required to better elucidate prevalence and treatment in special populations, specifically those that are non-male and those suffering from pelvic floor dysfunction or postpartum urinary retention.

Appendix. Medication classes contributing to acute urinary retention

Category	Mechanism
Alpha adrenergic agonists	↑ urinary sphincter tone
Opioid pain medicines	↓ bladder contractility and urge
Nonsteroidal anti-inflammatory drugs	↓ contractility through downregulation of prostaglandins
Calcium channel blockers, beta adrenergic agonists	↓ detrusor tone
Antidepressants, antipsychotics, antihistamines	Other

Adapted from Kowalik and Plante.¹

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Study Questions Volume 39 Lesson 30

1. According to the International Continence Society (ICS) definition a patient has acute urinary retention if they have a full bladder that is
 - a. painless and they are unable to pass any urine
 - b. painful and they are unable to pass any urine
 - c. painful and they are able to pass some urine
 - d. >600 ml with a bladder scanner after attempting to void
2. A 68-year-old man is postoperative day 1 after a radical nephrectomy. He has a 40 gm prostate and is set to undergo a trial without catheter in the hospital. He has a 6-month history of lower urinary tract symptoms and has been on tamsulosin for the last 4 months and finasteride for 2 weeks. The factor that will most likely contribute to a successful trial without catheter in the perioperative period is
 - a. finasteride
 - b. tamsulosin
 - c. surgery time >4 hours
 - d. removal of catheter on postoperative day 1
3. A 75-year-old man with an elevated creatinine and acute urinary retention is catheterized for 1.5 liters. Over the next 24 hours his urine outputs are monitored for postobstructive diuresis. The rate of urine output above which he would meet the criteria for this condition is
 - a. 2.5 L in 24 hours
 - b. 400 ml over 3 hours
 - c. 200 ml for 2 consecutive hours
 - d. 300 ml in 1 hour
4. A conservative intervention that is demonstrated to reduce postoperative urinary retention in men is
 - a. application of hot packs and/or warm, moist gauze applied to the suprapubic area
 - b. high volumes of intravenous fluid administration
 - c. application of lidocaine gel to the perineum
 - d. bladder massage
5. A 73-year-old woman with hematuria is found to have a bladder stone measuring 4 cm in diameter. She has chronic urinary retention and she has had 2 symptomatic urinary tract infections in the past year. Her eGFR is 68. According to the AUA working group on chronic urinary retention, she has high risk features of CUR based on
 - a. development of a bladder stone
 - b. eGFR of 68 (stage 1 chronic kidney disease)
 - c. 2 UTIs in 1 year
 - d. hematuria