

White Paper



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AUA White Paper on Catheter-Associated Urinary Tract Infections: Definitions and Significance in the Urologic Patient

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INTRODUCTION

Catheter-associated urinary tract infections (CAUTIs) are widely recognized as the most common healthcare-associated infection (HAI) in the acute care hospital setting. Microbial colonization occurs within five to seven days of catheter placement and is frequently associated with the development of a bacterial biofilm, presumably the source of the CAUTI. As a result, the focus of CAUTI prevention programs has been on the inappropriate use of catheters, which may not apply to many urologic patients. The word “catheter” in this white paper refers to an indwelling urinary catheter (IUC), commonly referred to as a “Foley.”

It is important for healthcare practitioners to be familiar with existing CAUTI guidelines (Healthcare Infection Control Practices Advisory Committee [HICPAC], the Infectious Diseases Society of America [IDSA], Centers for Disease Control and Prevention [CDC]/National Healthcare Safety Network [NHSN], and the European Association of Urology [EAU]), and particularly important for practitioners to understand the CAUTI definitions used by their hospital system. However, urology patients represent a unique patient group with regard to catheter usage. As a result, broad CAUTI definitions can be challenging to apply to specific urologic clinical presentations.

This paper will address limitations surrounding how and when current definitions can be used to detect a CAUTI in a urologic patient, and propose alternative methods for CAUTI diagnosis in specific populations including geriatric, neurogenic bladder, and lower urinary tract reconstruction. Additionally, techniques will be described on how CAUTI can be avoided through proper urethral catheterization and alternatives to indwelling catheters for urologic patients will be highlighted. Where literature was lacking, expert opinion was used to build recommendations, which may be useful to the urologic community.

BACKGROUND

Definitions and Reporting

Changes in definitions and CAUTI criteria over time, and differences between organizations, make understanding the true prevalence of CAUTI challenging. Thus, urologists should be familiar with the definitions relating to CAUTI.

The Healthcare Infection Control Practices Advisory Committee (HICPAC), first created in 1991, is a federal advisory committee made up of 14 external infection control and public health experts who provide guidance to the CDC and the Secretary of the Department of Health and Human Services (HHS) regarding the practice of healthcare infection prevention and control, as well as strategies for surveillance, prevention, and control of HAIs in the United States, including CAUTI.¹

A multicenter, 10-year study was undertaken from 1991-2001 that ultimately led to the development of the National Surgical Quality Improvement Program (NSQIP).² Since that time, NSQIP has become the largest national program in surgery and is used to predict outcomes and identify at-risk populations.³ NSQIP has very specific criteria to define a post-operative UTI, although it does not specify from where urine is collected (Table 1).

Table 1. National Surgical Quality Improvement Program (NSQIP) Definition⁴

Postoperative symptomatic urinary tract infection must meet one of the following two criteria:		
<i>One</i> of the following: fever (>38°C), urgency, frequency, dysuria, or suprapubic tenderness	AND	Urine culture of >10 ⁵ colonies/mL urine with no more than two species of organisms
<i>Two</i> of the following: fever (>38°C), urgency, frequency, dysuria, or suprapubic tenderness	AND	Any of the following: <ul style="list-style-type: none"> • Dipstick test positive for leukocyte esterase and/or nitrite • Pyuria (>10 WBCs/mL or >3 WBC/hpf of unspun urine) • Organisms seen on Gram stain of unspun urine • Two urine cultures with repeated isolation of the same uropathogen with >10² colonies/mL urine in non-voided specimen • Urine culture with <10⁵ colonies/mL urine of single uropathogen in patient being treated with appropriate antimicrobial therapy • Physician's diagnosis • Physician institutes appropriate antimicrobial therapy

Outside of NSQIP, urinary tract infection (UTI) criteria vary by organization, medical specialty, and even within hospitals. In every hospital, several different criteria may be used by various reporting services (e.g., the surgery department may use the NSQIP definition, while the infectious disease department and hospital labs use the Infectious Disease Society of America [IDSA] criteria), which further compounds the problem with reporting and determining accurate incidence.

When considering CAUTI data, it is also important to recognize that patients treated for urinary symptoms but who are subsequently proven to have negative cultures are often not excluded from reporting, despite the lack of evidence for UTI. For example, patients treated for dysuria, urinary urgency or frequency from an IUC may be included in CAUTI reporting despite no positive

urinary cultures. CAUTI definitions do not consider that urinary symptoms can be secondary to bladder/urethral irritation from the perioperative IUC, postoperative urinary retention, or from baseline voiding dysfunction related to underlying benign prostatic hyperplasia/overactive bladder.⁵ In short, many CAUTI definitions do not consider that IUCs may exacerbate baseline voiding symptoms.⁶

Obtaining urine from patients with long-term IUCs presents a particular challenge for CAUTI reporting. No consistent guidelines are available on how to obtain urine for culture from chronically catheterized patients, or what constitutes true urinary tract infection versus asymptomatic bacteriuria (ASB). The 2009 UTI guidelines published by the IDSA reflect some of this difficulty and suggest the need to use clinical judgment, something for which NSQIP does not allow.⁷ The IDSA requires “no other identified source of infection” and acknowledges that pyuria in catheterized patients is not diagnostic of UTI and should not be the deciding factor in treating a patient. The IDSA also clearly states that urine should not be obtained from asymptomatic patients, and that low-grade fever and pyuria in the absence of any other UTI symptoms does not necessarily indicate infection.⁷

The European Association of Urology (EAU) has recently revised their definitions to help address over reporting of post-operative UTIs. Currently, EAU definitions state postoperative UTI is considered a “complicated UTI” and note, “It also has to be recognized that symptoms, especially lower urinary tract symptoms, are not only caused by UTIs but also by other urological disorders, such as benign prostatic hyperplasia, etc.” The EAU guidelines provide specific laboratory testing recommendations (microscopy) and colony count criteria based on the method of urine collection. Interestingly, the EAU requires two consecutive positive urine cultures at least 24 hours apart in

asymptomatic patients, while NSQIP and others do not. Lastly, the EAU clearly states that they do not recommend treatment for ASB in any patient due to the widespread problem of resistant bacterial strains.⁸

Similar to the EAU, the CDC and the NHSN have published guidelines that attempt to identify symptomatic hospital acquired infections, including UTIs.⁹ While very similar to the NSQIP classification, several important differences exist. The CDC/NHSN guidelines specifically state that there must be “no other recognized cause” of UTI symptoms, including fever.⁹ The CDC/NHSN guidelines also include a separate section for ASB, similar to the EAU guidelines, and they make recommendations regarding acceptable and unacceptable specimen collection. In comparison, NSQIP does not differentiate between various categories of UTI/bacteriuria, nor do they require specific methods of urine collection.⁴ The CDC algorithm is too exhaustive for this paper but should be reviewed when examining CAUTI strategies.¹⁰

Given new regulations regarding reimbursement, and the variance in CAUTI criteria depending on organization, it is incumbent upon physicians and quality review teams of any hospital to accurately diagnose UTIs related to surgery and/or hospitalization according to their organization’s definition. How we identify and document UTIs is paramount and needs to be explored, recognizing that it could lead to an increase in overall healthcare costs. With decreased reimbursement for nosocomial UTIs and new monitoring methods regarding catheter duration (referred to as Device Days), it is crucial that a multidisciplinary approach is used to develop validated and standardized criteria. In addition, uniform methods of specimen collection will need to be clearly established by all organizations to ensure fair compensation for comparable services.

Epidemiology

Definitions that differ between organizations make true diagnosis challenging, leading to the application of principles and guidelines that may not accurately identify the cause of the problem or result in meaningful changes in perceived outcomes. In addition, studies using different definitions, or definitions that have since changed, make accurate comparisons of reported rates difficult. While the true incidence of CAUTI is difficult to discern due to potential over-diagnosis from current definitions; all organizations agree that the impact incidence of CAUTI is on the rise in healthcare and prevention is important.

Numerous studies have examined the epidemiology of CAUTI in various clinical settings. In one such study, national data over a 10-year period from 2001 to 2010 found that 3.8 million of 70.4 million catheterized adults developed a CAUTI.¹¹ Incidence rates have decreased with time from 9.4 cases per 100 catheterizations in 2001 to 5.3 cases per 100 catheterizations in 2010. Mortality from CAUTIs also declined from 5.4 percent in 2001 to 3.7 percent in 2010. However, as mentioned previously, the true incidence of CAUTI is difficult to ascertain due to changing CAUTI definitions over time. The median length of hospital stay associated with CAUTI has decreased from nine days in 2001 to seven days in 2010. In this study, several variables were found to be independent predictors for risk of developing CAUTI, including female sex, emergency hospital admission, transfer from another facility, and Medicaid payment ($P < .001$).

A hospital-based study examined whether clinicians' actions in daily practice matched the NHSN definition for CAUTI and found that clinicians initiated antibiotics in 216 of 387 cases (55.8 percent), although only 30.7 percent of cases actually met the NHSN definition of CAUTI.¹²

Infectious disease consultants tended to diagnose CAUTI in substantially more cases than those

strictly considered under the definition. These findings highlight the variation that is present in clinical practice with regard to diagnosis and treatment of this condition.

Differentiating between symptomatic CAUTI and ASB in patients with an IUC is important both for treatment considerations and reporting rates for patient safety, epidemiological research and payment. In 2000, Tambyah and Maki examined 1,498 newly catheterized patients in an acute care hospital setting and found that 235 (14.9 percent) patients developed positive urine cultures, with 85 percent having more than 10^5 CFU/mL in one or more cultures.¹³ However, more than 90 percent of these patients were asymptomatic. In a parallel study, they also reported that pyuria was a poor marker for CAUTI in catheterized patients and that it should not be used to determine the need for antibiotic treatment.¹⁴ More recently, Jayakumar et al. prospectively studied 100 newly catheterized patients and found that 32 percent had bacterial growth on serial cultures by the fifth day, but 68 percent remained culture-negative up to the seventh day.¹⁵ They emphasized the need for careful surveillance because of the potential risk of multidrug-resistant organisms, even in asymptomatic patients. However, this is somewhat controversial because most experts agree that ASB, including cases associated with catheter use, does not usually require antibiotic treatment.¹⁶ Despite this, rates of inappropriate antibiotic administration for ASB remain as high as 32 percent.¹⁷

Changes and differences in the CAUTI defining criteria as reviewed above have impacted its reporting. Press and Metlay examined whether the change in definition by the CDC over time influenced reported rates of infection by reviewing data from a 760-bed academic hospital between July 1, 2007 and December 31, 2009.¹⁸ They found a CAUTI rate of 12.5 ± 0.4 per 1,000 catheter-days using the old definition, which included ASB cases, compared to 5.3 ± 0.5 per 1,000 catheter-

days using the new definition. Press and Metlay cautioned that comparison of contemporary data to historical information should be done within the clear context of the definition that was being used to generate data. In a separate study, Wright *et al.* examined different methods of surveillance and data reporting and found that the traditional method of reporting CAUTI rates per 1,000 device-days might not accurately capture improvements from quality-of-care programs compared to CAUTI rates per 10,000 patient-days before and after an intervention.¹⁹ This discrepancy is due to changes in rates of device utilization, which could artificially increase or decrease the denominator for comparison.

The method of data collection is also important to consider. Many studies use insurance claims data to identify CAUTI for epidemiological research. Zhan et al. examined the positive predictive value and sensitivity of using Medicare claims data to identify CAUTIs in a random sample of hospital discharges from 2005 to 2006.²⁰ In patients undergoing major surgery, the positive predictive value for identifying CAUTIs was only 30 percent, and sensitivity was only 65 percent. Additionally, they noted that the use of procedure codes for urinary catheterization was low (1.4 percent). They concluded that there was limited validity of identifying both catheter use and CAUTI based on this type of administrative claims data.

CAUTI Nonpayment Policy

As reporting of UTIs became more prevalent through programs such as NSQIP, HICPAC began to more intensely evaluate CAUTI incidence and prevention. Naturally, the increasing use of antibiotics and IUCs brought the issue of CAUTI to the forefront, leading to widespread attempts to reduce CAUTI incidence. This need to reduce the incidence was underscored in October 2008, when the Centers for Medicare and Medicaid Services (CMS) announced that it would no

longer provide reimbursement over and above the typical Inpatient Prospective Payment System rate for care required to treat several types of HAIs. CAUTI not only fell into this category, but it has quickly become one of the most prominent targets for prevention and intervention.

CAUTI has been designated as one of the ‘never events’ for patients in a hospital setting. This is based on the concept that CAUTIs are preventable and should not occur following hospital admission. In a critical analysis, Umscheid et al. noted that 65-70 percent of CAUTIs should have been preventable using current evidence-based strategies.¹ They also noted that a 100 percent eradication rate was most likely not attainable under the current healthcare system.

Several studies have examined the financial and epidemiological effects of the nonpayment policy for CAUTIs that develop in the hospital setting and found that the economic impact has been negligible. A nationally representative sample of 398 hospitals examined trends between January 2006 and March 2011 by determining the longitudinal rates of infection for two nonpayment-targeted conditions (CAUTI and central venous catheter bloodstream infections) and one non-targeted condition (ventilator-associated pneumonia).²¹ Between 14,817 and 28,339 infections were examined depending on type. Overall, there was a strong trend toward decreased infections across time, including the years prior to the nonpayment policy. For CAUTI, the overall incidence-rate ratio, which reflects the change with time, was 1.03 ($P = .08$). No hospital demographic variables appeared to affect the observed results. The authors concluded that in this study, the nonpayment policy did not influence CAUTI outcomes. Meddings et al. examined 96 nonfederal acute care hospitals in Michigan and found that the nonpayment policy affected only 25 out of 781,343 hospitalizations (0.003 percent) in 2009. Part of this was attributed to the use of claims data to identify CAUTI rather than clinical diagnosis.²²

UROLOGIC CONCERNS

Catheter Insertion and Removal

Prevention of CAUTI relies on appropriate selection for placement of an IUC, timely removal of IUCs postoperatively, and proper technique with IUC insertion. Catheterization with long-term IUCs must be performed in a sterile fashion with aseptic technique. There is conflicting evidence on the common practice of using topical anesthetic jelly prior to placement of a catheter.²³ It is possible that the main benefit of intraurethral anesthetic gel may be from the lubrication it provides rather than the anesthetic effect, but this is difficult to establish based on the literature. Regardless, ample lubrication is important in the placement of any catheter and one should use clinical judgment when deciding whether or not to use anesthetic lubricant or plain lubricant.

In males, the genital skin is draped to leave the penis exposed and prepped with sterile antiseptic solution. If a man is uncircumcised, the prepuce is retracted such that the glans and meatus is exposed and can be directly prepped. The penis is held securely in the nondominant hand at a 90° angle toward the ceiling. Adequate lubrication is placed onto the catheter for insertion. Alternatively, when additional lubrication is desired, special applicators are available to deliver the lubricant directly into the meatus in order to distend the urethra. The IUC is inserted into the penis with the sterile, dominant hand and advanced to its hub to ensure that it is completely inserted into the bladder. Care must be taken when navigating through the bulbospongiosus, membranous, and prostatic urethra. The spontaneous return of urine confirms that the IUC is within the bladder proper. Only then, the balloon may be inflated with sterile water or saline depending on availability.²⁴ The prepuce is then reduced to avoid creating a paraphimosis. Several commercially available kits exist that allow placement of an IUC with minimal preparation. These come with antiseptic prep, drapes, lubricant, catheter, sterile water in 10-mL syringe, and often a urine

collection bag with tubing. The catheter balloon should be filled with fluid based on specifications printed on the balloon port, although 5-10 cc is usually considered a standard volume for a 10-cc catheter balloon. There is no data demonstrating a reduction of CAUTI by placing antibiotic ointment at the male urethral meatus after catheter placement. However, some practitioners feel that antibiotic ointment may reduce urethral meatus trauma if an erection occurs while a catheter remains in place.

Placement of an IUC in the female is significantly different because the urethra is shorter and the meatus is located in a much less accessible position. Proper aseptic technique is essential. The nondominant hand is used to expose the meatus by separating the labia with the patient ideally in a frog-leg position or in stirrups. The perineum and urethral meatus are prepped using a sterile technique and ample lubrication is used to coat the catheter prior to insertion. Anesthetics jelly may be used at the clinician's discretion. The catheter is inserted and correct placement is verified by the return of clear urine, in addition to ensuring that the IUC is inserted well beyond the bladder neck. Assistance from additional personnel and other aids may be required in morbidly obese patients in order to expose the difficult-to-access meatus.

The CDC/NHSN guidelines currently recommend rapid removal of any IUCs when clinically indicated. However, specific urological situations and patient populations may require longer-term catheterization (Table 2).⁹ The recent guidelines pertain to most patients without complex lower urinary tract pathology and specifically indicate IUC for patients with acute urinary retention or bladder outlet obstruction and for patients undergoing certain surgical procedures, such as urologic surgery or other surgery on contiguous structures of the genitourinary tract.⁹ Specific conditions that may result in the need for prolonged or repeated catheterizations include recent lower

genitourinary tract reconstruction to allow healing in the postoperative period; trauma to the lower urinary tract; urethral stricture disease; neurologic bladder dysfunction; and conditions requiring drainage in patients who are unfit for surgical reconstruction.

Table 2. Conditions and Surgeries Requiring Urologic Consultation before Removing Urinary Catheter*

Condition	Potential Risks Associated with Early Catheter Removal	Common Length of Time Indwelling Catheter Is Used
Bladder Injury/Perforation Partial Nephrectomy	Peritonitis, urinoma, abscess, trauma	7 – 21 days from injury
Bladder Surgery Partial Cystectomy Cystotomy Repair Enterocystoplasty Ureteral Reimplant Vesicovaginal Fistula Repair Enterovesical Fistula Repair	Peritonitis, urinoma, abscess, failure of repair, ureteral stricture, fistula	3 – 21 day after surgery
Urinary Diversions	Stoma stricture, stoma disruption, urine leak	3 – 21 days from surgery
Suprapubic Tube	Loss of stoma track	Indefinite
Radical Prostatectomy	Urethral disruption, urethral stricture, urinoma	5 – 21 days after surgery
Prostatectomy	Hematuria, urethral stricture, urinoma	3 – 21 days after surgery
Transurethral Prostate Surgery	Hematuria	1 – 7 days after procedure
Urethral Injury	Urethral disruption, urethral stricture, hematoma, urinoma	3 – 21 days from injury
Urethral Surgery Primary Repair Onlay Grafts	Hematoma, urethral disruption, urethral stricture, urethrocutaneous fistula	3 – 21 after surgery
Perineal Urethrostomy	Urethral stricture, urinary retention	3 – 14 days after surgery
Urethral Diverticulum Repair	Urethral stricture, urethrovaginal fistula	3 – 21 days after surgery
Female Urogynecological Reconstructive Procedures: Pubovaginal Sling Procedures, Urethrolisis, Prolapse Repairs, Mesh Removal	Retention, bleeding	1 – 7 days after procedure

* Refers to acute events/conditions and new post-operative patients.

Urinary diversion by IUC is used to allow healing after lower urinary tract surgery or trauma in specific situations, including patients who have recently undergone reconstruction for urethral stricture disease, reconstruction after radical prostatectomy or other bladder or urethral surgery, patients who have suffered blunt trauma to the lower genitourinary tract resulting in bladder perforation/rupture, and patients who have experienced penetrating trauma to the prostate, urethra, or bladder. In addition, patients with refractory bleeding of the bladder or prostate may require prolonged indwelling catheterization for continuous irrigation of the lower genitourinary tract. The catheter size (ranging from 12 to 30 French) and type used for these conditions depends on the specific indication with respect to prior surgery and ultimate goal of the bladder drainage.

IUCs are constructed with various types of tips, including blunt straight tips, curved tips (Coudé), and tips with lumens designed specifically for the placement of guidewires (Council tip catheters), that are chosen for use depending on the specific situation. Council catheters are an excellent option in patients who have recently undergone dilations or incisions for urethral stricture disease, as they allow placement over a guidewire. Coudé catheters increase the ease of placement through a large prostate or when specific angulation is encountered between the urethra and the bladder, as is seen after prostate surgery.

Most IUCs have two lumens: one to allow drainage of the fluid from the bladder and the other to fill the retaining balloon. Other IUCs that are currently rarely used in the urethra have no self-retaining balloon but rather flanges on the end in order to hold it in position (Malecot). When encountered, they are usually placed intraoperatively to facilitate maximum bladder drainage.

Three-way catheters have an additional port to allow inflow and are used for continuous bladder

irrigation (CBI) in cases where hematuria is persistent. In these patients, CBI reduces the risk of blood clots forming in the bladder and obstructing the catheter.

Most IUCs are constructed of latex, rubber, silicone, or polyvinylchloride (PVC) and may be coated with silver alloys. When drainage is required after urinary reconstruction or trauma, a silicone catheter may also be used. Although controversial, there are some data to suggest that silicone is non-reactive and possibly associated with less bacterial adherence than other catheter materials.²⁵ Silicone catheters are also indicated in patients with latex allergies (the major risk factor being significant previous exposure to latex). Many health systems have attempted to completely dispose of any latex-containing products, substituting all IUCs with those constructed of silicone or PVC. However, some specialty catheter types are not available in a material other than latex, and are still in use in clinical practice.

In uncommon, very specific situations, an IUC may need to remain in place for long periods of time. Such situations include when the lower urinary tract anatomy is altered, such as after trauma while awaiting definitive repair (pelvic fracture with urethral distraction defect) or in instances of difficulty with catheterization (patients with prior multiple false passages in which the blind placement of an IUC is impossible). In such cases, the use of a Council catheter as described above is appropriate. Catheter changes are performed with this special device in the clinic setting under local anesthesia with ample lubricating jelly. A guidewire is placed through the pre-existing Council tip catheter. The existing catheter balloon is drained and removed. A new sterile Council tip catheter then is placed over the guidewire, verifying the correct position with irrigation of the bladder. This technique may require urologic assistance from an experienced care provider.

Alternatives to Indwelling Catheters: Intermittent Catheterization

Intermittent catheterization (IC) is the insertion of a catheter several times daily to empty the bladder and it is immediately removed after bladder drainage is complete. This type of catheterization is used to drain urine per urethra from a bladder that is not emptying adequately or can be performed via a surgically created channel that connects the bladder with the abdominal surface (e.g., Mitrofanoff continent urinary diversion). It is widely advocated as an effective bladder management strategy for acute care patients with incomplete bladder emptying and/or urinary retention due to idiopathic or neurogenic bladder dysfunction.

Theoretically, 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.²⁶ In addition, when the bladder becomes stretched from retained urine, the capillaries become occluded, preventing the delivery of metabolic and immune substrates to the bladder wall; thus, the bladder wall becomes susceptible to bacteria that circulate in retained urine.²⁷ One measure to avoid UTIs in patients with incomplete bladder emptying is regular drainage of the bladder, which ensures the avoidance of high intravesical pressure and overdistention of the bladder, thus preserving an adequate blood supply to the bladder wall.²⁶

According to evidence-based guidelines, IC is preferable to IUCs or suprapubic catheters in patients with bladder emptying dysfunction.^{7,9} A recent Cochrane review noted low-quality evidence of benefit for using IC over IUCs in selected populations, as there is a decreased risk of symptomatic UTI.²⁸ Hakvoort and colleagues noted that IC results in shorter catheterization duration and reduced risk of UTIs. Also, many patients prefer IC to an IUC.²⁹

The use of IC is common in the acute care setting, especially in surgical patients who are at risk for develop post-operative urinary retention.³⁰⁻³² In addition, IC usage is preferred in spinal cord injury patients and in children with myelomeningocele and neurogenic bladder because IC may reduce the risk of urinary tract deterioration and urethral trauma in these patients over the long term.⁹

Although IC is a preferred catheterization method for many bladder conditions causing urinary retention, complications and adverse events can arise from IC over the long term. Complications include bleeding, urethritis, stricture, creation of a false passage, and epididymitis, as well as UTIs and stones. However, no definitive data exists for universal recommendations regarding catheter technique, type, or strategy.³³

Like an IUC, the tip of a catheter used for IC can be either straight or curved (referred to as Coude-tipped or Tiemann). Coude-tipped catheters are preferred in male patients with an enlarged prostate or in those who are at risk for difficult catheterization. Hydrophilic-coated catheters may be preferable to standard non-coated catheters⁹ because of their low friction, and such catheters are associated with a lesser degree of urethral inflammatory response when compared to standard non-coated catheters.³⁴⁻⁴³ Because the hydrophilic catheter theoretically causes less trauma upon insertion, performing IC with these catheters may also decrease the incidence of UTIs,^{39,41,43} microscopic hematuria/urethral trauma,^{34,37,39,44} and urethral strictures.^{35,45,46}

No evidence supports recommendations for the frequency of IC. Gould and colleagues recommend IC be performed at regular intervals to prevent bladder overdistension.⁹ Standard practice is for nursing staff to use a portable ultrasound device (e.g., bladder scanner) to assess urine volume in patients prior to performing IC to verify the need to drain the bladder.^{47,48} The

catheterization schedule or frequency should be based on intake and output records, functional bladder capacity based on urodynamic findings, ultrasound bladder scans for post-void residual (PVR) urine, and the impact of catheterization on the patient. As a general rule, bladder volume should not exceed 500 mL.⁴⁹ PVR values should be individualized for patients with known vesicoureteral reflux, bladder diverticulum, or high bladder storage pressures, and indirect evidence from patients undergoing urologic and gynecologic surgical procedures suggest using lower threshold volumes for re-catheterization in the acute care setting.

IDENTIFYING CAUTI IN SPECIALIZED UROLOGIC PATIENTS

Patients with Delirium

One of the major questions in the diagnosis of CAUTI is what constitutes its symptoms. In many cases, symptoms include fever, chills, pain, and changes in urine consistency (color, odor, opacity, and increased sediment). However, in older adults, and particularly those with underlying cognitive impairment, symptoms may be more subtle due to changes in the immune response with aging or other factors. In the more vulnerable geriatric population, cognitive changes, lethargy, anorexia, and more generalized symptoms can be associated with UTI, while in younger patients, these may be considered ‘atypical’ symptoms.⁵⁰

IUC use has been reported to be associated with an increased risk of delirium, particularly in the intensive care unit (ICU) and acute care hospital setting. In a study of 523 ICU patients in four hospitals, the overall incidence of delirium was 30 percent.⁵¹ Of multiple risk factors examined, the presence of an IUC was strongly associated with delirium in univariate analysis (odds ratio [OR] 5.37, 95 percent confidence interval [CI] 2.09-13.80). The only factors that were more strongly correlated with the development of delirium in this study were use of physical restraints (OR

33.84, 95 percent CI 11.19-102.36); pharmacological sedation (OR 13.66, 95 percent CI 7.15-26.10); and length of ICU stay > 2 days (OR 5.77, 95 percent CI 3.71-8.97). Another study identified IUCs, history of heavy alcohol use, and polypharmacy (defined as seven or more medications) as independent risk factors for the development of delirium in a cohort of 401 older adults admitted to a sub-ICU.⁵²

Early catheter removal has been considered an interventional target to potentially reduce rates of delirium in hospitalized patients; however additional research on this topic is needed. Several studies have examined the utility of building prompts in electronic medical record (EMR) systems to help with this process. A study of a clinical practice with 60 older adults with cognitive impairment in an ICU setting showed high rates of catheter discontinuation both with (72 percent) and without (76 percent) the EMR prompt ($P = .99$).⁵³

There are no clear indications of when to obtain urine cultures in geriatric patients with delirium or dementia. A study on the use of urine dipstick analysis to screen asymptomatic ICU patients for CAUTI suggested that this practice might be cost-effective.⁵⁴ However, as previously discussed, screening of asymptomatic patients may not be warranted, and treatment is usually not recommended in these cases.

Neurogenic Bladder Patients

Although symptoms can signal CAUTI in neurologically intact patients, neurogenic bladder patients may not experience some symptoms of UTI due to an altered afferent nervous system. Common spinal cord pathologies that are associated with an insensate bladder include spinal cord injuries, cauda equina syndrome, transverse myelitis, and central cord syndrome. However, even

within these diagnoses, there is considerable variation in bladder sensation depending on the severity of disease and location of neurologic injury.⁵⁵ Peripheral nervous system conditions that can similarly affect bladder sensation include diabetes mellitus, radical pelvic surgery, and pelvic fractures. When evaluating neurogenic bladder patients for CAUTI, understanding the baseline bladder sensation for the individual patient is critically important to accurately interpreting the clinical scenario.

Urinary incontinence is cited as a possible symptom and sign of CAUTI in the neurologically intact population. However, many neurogenic bladder patients have more baseline overactive bladder symptoms and worse quality-of-life symptom scores compared to non-neurogenic bladder patients.⁵⁶ In some neurogenic bladder patients, such as those with spinal cord injury or spina bifida, increased incontinence is related to progressive loss of bladder compliance rather than an acute event such as CAUTI.

Although CAUTI is prevalent in the neurogenic bladder population, practitioners need to consider poor bladder compliance as an alternative cause of increased urinary incontinence. Low compliance is prevalent in some neurogenic bladder conditions, such as cervical and thoracic spinal cord injuries, and is a risk factor for renal deterioration.⁵⁷ However, differentiating low bladder compliance urinary symptoms from catheter-associated cystitis is challenging and usually requires urodynamic evaluation after a suspected CAUTI is treated.

Given the difficulty of using urinary signs and symptoms for CAUTI diagnosis in neurogenic bladder patients, the National Institute on Disability and Rehabilitation Research (NIDRR) and IDSA listed additional signs and symptoms that can also be associated with UTI in neurogenic

bladder patients with spinal cord injury. These signs and symptoms include findings of “discomfort or pain over the kidney or bladder or during urination, onset of urinary incontinence, fever, increased spasticity, autonomic hyperreflexia, malaise, lethargy, and sense of unease”.⁷ However, many of these constitutional symptoms in neurogenic bladder patients can be caused by pathologies other than CAUTI, such as constipation, neurogenic bowel, or chronic neurologic abdominal pain.⁵⁸ As with using urinary symptoms to screen for CAUTI in neurogenic bladder patients, practitioners should consider alternative etiologies to explain observed constitutional symptoms.

The testing of urine for the presence of pyuria and obtaining cultures to assess bacterial colony count are utilized for the diagnosis of CAUTI in non-neurogenic patients.⁷ These findings can also suggest CAUTI in the neurogenic bladder population. However, the positive predictive value of using pyuria and colony count to diagnose a CAUTI is likely lower in the neurogenic bladder population due to low correlation with lower urinary tract symptoms.⁵⁹ Confounding the data further, many neurogenic bladder patients are colonized with multiple bacterial species, many of which may be multi-drug resistant. These variables make interpretation of urine cultures challenging.^{60,61} More information is needed to validate and standardize urine characteristics from different neurogenic bladder groups managed with urinary catheters. Until more data become available, the most prudent practice may be to address the need for urine cultures on an individual basis, based on the clinical suspicion of a progressively symptomatic urinary tract infection.

Patients with a Reconstructed Urinary Tract

CAUTI can also be difficult to diagnose in patients after reconstructive bladder surgery, such as enterocystoplasty/bladder augmentation. After small bowel or colon is used to surgically enlarge

the bladder in these patients, urine samples are frequently contaminated with bacteria and mucous and chronic pyuria is often present. In a representative study of asymptomatic colcystoplasty patients, 95 percent had positive urine cultures.⁶² Stones also frequently occur in an augmented bladder, which can also be a source of persistent bacteriuria.⁶³ It has been difficult to standardize urine findings after bladder augmentation because many patients use bladder irrigation such as saline solutions⁶⁴ and antibiotic instillations,⁶⁵ which can confound urine analysis. Consequently, practitioners should understand baseline urine characteristics in augmented patients when evaluating for CAUTI.

Special Circumstances for Maintaining a Catheter

IUCs are required in specific situations. Patients who have recently undergone lower urinary tract reconstruction such as prostatectomy, urethroplasty, or bladder reconstruction require catheter drainage for a period of time in order to promote healing. Significant harm can result from unplanned or early removal of these catheters, as may be dictated by various hospital algorithms for patients with signs and symptoms of CAUTI. Therefore, extreme caution must be exercised when considering CAUTI in a catheterized patient who has undergone recent surgery. Consultation with the operative surgeon is paramount in these situations in order to prevent disruption of recently reconstructed tissues.

UROLOGY-SPECIFIC ALTERNATIVES TO INDWELLING CATHETERS

A number of alternatives to IUCs are available to either collect urine, stent/support the urinary tract while healing post-operatively, or prevent leakage if other medical or surgical treatment methods have been unsuccessful.

Male External Catheters (MECs), aka “Condom Catheters” or “Texas Catheters”

Patients with reflex voiding, bothersome urinary incontinence, or free flow of urine (total incontinence) are candidates for an external drainage device. These are typically patients with a neurologic condition such as a spinal cord injury with coordinated involuntary contractions or those with a damaged external sphincter – either intentionally in a patient who has undergone a sphincterotomy for detrusor external sphincter dyssynergia (DESD) or unintentionally in a patient after prostate surgery with urinary incontinence.

A condom-like device is placed over the penis and is connected to tubing that drains urine into a collection device. Patients with a retracted penis (common in the spinal cord injury and obese populations) have been shown to benefit from placement of a semirigid penile prosthesis, which provides length and stability for appropriate attachment of the device in situations where chronic drainage is anticipated.⁶⁶

The biggest challenge with MECs is preventing unintentional dislodgement. Most MECs used in the acute care setting have an internal adhesive that adheres to the penile shaft to stay in place, and studies have demonstrated that patients prefer a stronger adhesive to a weaker one.⁶⁷ Complications are generally irritative, allergic, or compressive in nature. Many of the more serious complications have been due to ring devices that are used to keep the MECs in place; however, these are now rarely used. As some of these patients lack sensation in the genitalia due to spinal cord injury, it is important to visually inspect the area regularly.

External Pouches

External pouches, which are modeled on ostomy pouches, are available for both men and women with urinary incontinence. The pouch is secured to the perineum using a synthetic adhesive and can be connected to a drainage bag.

Incontinence Products

Incontinence products that absorb urine are an alternative to the use of an IUC in patients with urinary incontinence.

Penile Clamps

For men with incontinence related to poor sphincter function but with normal bladder compliance, sensation of fullness, and reasonable bladder capacity, a mechanical device that compresses the urethra and prevents unwanted leakage is an alternative to an IUC or diapers. The Cunningham Clamp is the classic device used for this purpose.⁶⁸ It features a hinged frame with two foam pads and a locking device. The penis is placed between the foam pads, and the hinged clamp is closed. While the device is effective, it can be uncomfortable and bulky and is not tolerated by all men. Other alternatives rely on similar principles but are less bulky. Some newer devices gently wrap around the penis and have a small elevation at the site of the urethra so that they obstruct the urethra, but do not put undue compression on the rest of the penis. Potential complications are related to penile constriction but should be uncommon in patients with reasonable cognition and normal sensation.

Temporary Urethral Stents

Urethral stenting with the “Spanner” device, a temporary stent, has been reported to be effective in ameliorating voiding symptoms after minimally invasive prostate procedures.⁶⁹ The stent extends from the bladder neck to the proximal side of the external sphincter, with anchors on both ends to keep in place. Temporary urethral stenting is not yet widely adopted, but is an alternative to an indwelling catheter in situations where prostatic obstruction might otherwise require Foley catheter drainage.

Suprapubic Tubes

In some instances in which there is no alternative to an IUC, a suprapubic catheter (SPT) may be preferable to a transurethral catheter. Patients who need a catheter for an extended period of time may avoid urethral complications (such as meatal erosion) and find catheter changes easier when the catheter is placed in a suprapubic location. Women with long-term urethral catheters can have destruction of the urethra secondary to long-term pressure by the balloon at the bladder neck, which often necessitates some form of bladder neck closure and urinary diversion or SPT.

Women, particularly those with limited mobility or spasticity of the lower extremities, often find SPT changes easier because exposure of the urethra is not necessary and changes can be completed when supine.

Men with long-term urethral catheters may develop iatrogenic hypospadias (urethral erosion) if the catheter is not cared for appropriately by securing it to the abdominal wall to prevent pressure necrosis of the ventral urethra. Those with prostatic obstruction may also find SPT changes easier. In addition, sexually active patients, those with urethral abnormalities, and those with recurrent prostatitis or epididymo-orchitis may have less difficulty with a SPT.

CONCLUSIONS

Patients with urologic disorders have specific concerns as described above relating to CAUTI.

Reviewing the available literature as well as common clinical practice provides directives for the treatment of these patients in a specific and distinctive fashion so as to reduce the risk of infection.

By understanding the needs and technical modifications necessary in these patients, hospital systems and practitioners can limit their patients' exposure to CAUTI.

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