

Catheter-associated urinary tract infection in adults

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- **Lab Exam:**
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- U/C: klebsiella: 103 cfu



- After treatment (10 days later) U/A and U/C were repeated.
- Patient had no symptom
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yeast: many
- U/C: > 10⁵ cfu candida A



Catheter placement

Diagnostic

Therapeutic

Convenience

- Management of urinary retention with or without bladder outlet obstruction
- Hourly urine output measurement in critically ill patients.
- Daily urine output measurement for fluid management or diagnostic test.
- During surgery to assess fluid status and prevent bladder overdistention (ie, prolonged procedures, large-volume fluid infusion).
- During and following specific surgeries of the genitourinary tract or adjacent structures (ie, urologic, gynecologic, colorectal surgery).
- Management of hematuria associated with clots.
- Management of immobilized patients
- Management of patients with neurogenic bladder.
- Management of open wounds located in the sacral or perineal regions in patients who are incontinent.
- Intravesical pharmacologic therapy (eg, bladder cancer)
- Improved patient comfort for end-of-life care

EPIDEMIOLOGY

- Bacteriuria in patients with indwelling bladder catheters occurs at a rate of approximately 3 to 10 percent per day of catheterization
- Of those with bacteriuria, 10 to 25 percent develop symptoms of urinary tract infection (UTI)
- Inappropriate use of indwelling catheters has been associated with increased mortality
- Unwarranted urinary catheters are placed in 21 to 50 percent of hospitalized patients
- The most common inappropriate indication for placing an indwelling urethral catheter is the management of urinary incontinence

Prevention

The most important aspects of prevention of catheter-associated UTI:

- Avoidance of unnecessary catheterization (most important)
- Use of sterile technique when placing the catheter
- Maintenance of a sterile, continuously closed drainage system
- Continued assessment of the necessity of catheterization
- Removal of the catheter as soon as possible, Following surgery not in the urinary tract, catheters should be removed as soon as possible (ideally in the recovery room)

No clear benefit

- Either antibiotic-coated urinary catheters (eg, nitrofurazone, minocycline, or rifampin) or silver
- Prophylactic antibiotic
- Changing an indwelling catheter at routine, fixed intervals is not recommended
- Antimicrobial irrigation of the bladder
- Bacterial interference (purposeful inoculation of the bladder with nonpathogenic bacteria).

Catheter-associated bacteriuria defined by IDSA guidelines

Symptomatic bacteriuria (urinary tract infection [UTI]) – Culture growth of $\geq 10^3$ colony forming units (cfu)/mL of uropathogenic bacteria in the presence of symptoms or signs compatible with UTI without other identifiable source in a patient with indwelling urethral, indwelling suprapubic, or intermittent catheterization.

- Compatible symptoms include fever, suprapubic or costovertebral angle tenderness, and otherwise unexplained systemic symptoms such as altered mental status, hypotension, or evidence of a systemic inflammatory response syndrome.

Asymptomatic bacteriuria – Culture growth of $\geq 10^5$ cfu/mL of uropathogenic bacteria in the absence of symptoms compatible with UTI in a patient with indwelling urethral, indwelling suprapubic, or intermittent catheterization.

A UTI diagnosed in a patient who had a catheter removed within the past 48 hours is also considered a catheter-associated UTI.

Risk factors

- The duration of catheterization is an important risk factor
- Female sex
- Older age
- Diabetes mellitus
- Bacterial colonization of the drainage bag
- Errors in catheter care (eg, errors in sterile technique, not maintaining a closed drainage system, etc.)

PATHOGENESIS

- **Extraluminal infection:** entry of bacteria into the bladder along the biofilm that forms around the catheter in the urethra
- **Intraluminal infection:** due to urinary stasis because of drainage failure, or contamination of the urine collection bag with subsequent ascending infection.
- Extraluminal is more common than intraluminal infection (66 versus 34 percent in one study)



LOGY

- The causative pathogens are similar to those that are associated with complicated UTI in general.
- Specifically, *Escherichia coli* and other Enterobacteriaceae are common, but *Pseudomonas aeruginosa*, enterococci, staphylococci, and fungi are also significant causes
- Prolonged catheterization can be associated with **polymicrobial bacteriuria** or changing urinary flora.
- Some of these organisms **lack some of the virulence factors** that allow the usual uropathogens to adhere to uroepithelium, easy access to the bladder via the catheter.

Antimicrobial resistance

- Organisms that cause catheter-associated UTI and asymptomatic bacteriuria are increasingly resistant to antimicrobial agents.
- Of the 10,800 E. coli catheter-associated isolates, 35 percent were resistant to [fluoroquinolones](#), and 16 percent to advanced generation antipseudomonal cephalosporins (ie, cefepime and ceftazidime)
- Of 4700 Klebsiella isolates, 9.5 percent were resistant to [carbapenems](#)

CLINICAL FEATURES

- Fever is the most common symptom
- Localizing symptoms may include flank or suprapubic discomfort, costovertebral angle tenderness, and catheter obstruction
- Older or debilitated patients often present with nonspecific signs or symptoms, such as falls, change in functional status, and change in mental status
- The cloudy appearance or foul smell of the urine has not been demonstrated to be clearly associated with either bacteriuria or a UTI

Laboratory findings and Diagnosis

- **Pyuria** is a common finding in catheterized patients with bacteriuria, whether they are symptomatic (ie, have UTI) or not.
- The diagnosis of a catheter-associated UTI is made by the finding of **bacteriuria** in a catheterized patient who has signs and symptoms that are consistent with UTI or systemic infection that are otherwise unexplained.

Specimen collection

- Ideally removing the indwelling catheter and obtaining a **midstream specimen**.
- If ongoing catheterization is needed, the **catheter should be replaced** prior to collecting a urine sample for culture.
- If a sample is being collected without catheter removal, urine should be obtained from the **port in the drainage system**
- For circumstances in which the above approaches are not possible, the culture should be obtained by **separating the catheter from the drainage system**.

TREATMENT

The approach to treatment of catheter-associated urinary tract infection (UTI) includes antimicrobial therapy and catheter management.

Antimicrobial therapy

- Antibiotic selection for both acute complicated UTI and acute simple cystitis takes into account risk factors for **resistant infection**, regimen should be tailored to the specific organism isolated.
- Depending on the clinical response, the infecting organism, and the agent used for treatment, **7 to 10 days of therapy** is generally appropriate (with longer therapy for patients who respond slowly)
- **Oral therapy** can be used for some or all of the treatment courses if the organism is susceptible and the patient is well enough to take oral medication with adequate absorption.
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Catheter management

- Minimization of the use of indwelling catheters
- Patients who no longer require catheterization should have the catheter removed and receive appropriate antimicrobial therapy
- Patients who require extended catheterization should be managed with intermittent catheterization, if possible.
- If long-term catheterization is needed the catheter should be replaced at the initiation of antimicrobial therapy (fewer and later relapses)

COMPLICATIONS

- Important complications: sepsis, bacteremia, and involvement of the upper urinary tract.
- Approximately 20 percent of healthcare-associated bacteremias arise from the urinary tract, and the mortality associated with this condition is about 10 percent.

ASYMPTOMATIC BACTERIURIA

- Treatment of asymptomatic bacteriuria does not affect patient outcomes, including the risk of complications and or the subsequent development of UTI symptoms
- Increases the likelihood of emergence of resistant bacteria
- With few exceptions, screening and treatment for asymptomatic bacteriuria in catheterized patients is not indicated (only in the setting of pregnancy or prior to urologic procedures for which mucosal bleeding is anticipated)

Candida infection of the bladder and kidney

- **Funguria** is common in hospitalized patients and is generally benign.
- The vast majority of fungal infections of the kidney and bladder result from **Candida albicans** and other Candida species.
- Other fungi: **Aspergillus species**, **Cryptococcus neoformans**.
- Two mechanisms by which Candida spp infect the urinary tract: infections can **begin in the lower urinary tract** and ascend to the upper urinary tract, and infection can also occur via **hematogenous dissemination to the kidneys**

- Presence of an **indwelling bladder catheter** is associated with biofilm formation, and this allows persistent colonization by *Candida* species
- **Candida was the third most common organism** isolated from urine in hospitalized patients
- The following risk factors were noted: **indwelling bladder catheters, prior antibiotic therapy, DM**, older age, length of stay, ventilator support, and parenteral nutrition and malignancy.
- Urinary tract infections associated with **drainage devices, diabetes, or urinary tract abnormalities** are considered complicated.

INFECTION VERSUS COLONIZATION

- Most patients with candiduria are asymptomatic, and the yeasts merely represent **colonization** (1.3 percent in one series).
- Infected patients may have **dysuria, frequency, and suprapubic discomfort**
- **Pyuria** is so common in patients with a chronic indwelling bladder catheter that it **cannot be used to indicate infection**.
- **Neither the presence of pseudohyphae in the urine nor the number of colonies growing in culture** (unlike bacterial urine cultures) help to distinguish colonization from infection.
- The identification of **fungal casts** in urine cytology specimens stained with periodic acid-Schiff or silver stains is diagnostic of kidney involvement

NATURAL HISTORY

- There are several concerns in patients with asymptomatic candiduria: the development of ascending infection of the kidney, the development of candidemia, and the possibility that candiduria is a manifestation of disseminated candidiasis.
- Ascending involvement of the kidneys usually occurs in the setting of urinary tract obstruction, which may be caused by formation of fungus balls
- Complications of upper tract infection, such as emphysematous pyelonephritis and papillary necrosis, are rare
- Persistent candiduria, especially in diabetics, should prompt radiologic imaging of the kidneys with ultrasound or computed tomography (CT) to evaluate for renal involvement

CLINICAL CHARACTERISTICS

- Candidemia-associated infection: usually bilateral, consisting of multiple microabscesses in the cortex and medulla
- Ascending infection: subacute to chronic course, tends to involve the renal pelvis and medulla with sparing of the cortex, unilateral

TREATMENT

- Asymptomatic candiduria: rarely requires antifungal therapy unless it occurs in the setting of a condition that confers high risk of dissemination (neutropenia, very low birthweight infants (<1500 mg), or urinary tract manipulation)
- Neutropenic patients and very low birthweight infants (<1500 g): should be treated with an antifungal regimen recommended for candidemia.
- Patients with asymptomatic candiduria who will be undergoing a urologic procedure: oral fluconazole 400 mg (6 mg/kg) or amphotericin B deoxycholate 0.3 to 0.6 mg/kg intravenously (IV) daily for several days before and after the procedure.

- Renal transplantation is no longer an absolute indication for treatment of asymptomatic candiduria
- Candiduria is most often treated in renal transplant recipients: high risk for graft or device involvement, such as early after transplant when ureteral stents are in place.
- Lack of efficacy of antifungal therapy for asymptomatic candiduria
- Reducing risk factors for acquisition of candiduria, such as removal of bladder catheters or urologic stents and discontinuation of antibiotics
- Placement of new devices or intermittent bladder catheterization may decrease colonization

Symptomatic candiduria

- Symptomatic candiduria should be treated
- For patients who are not at risk for fluconazole-resistant Candida infection, we give fluconazole.
- For patients at risk for fluconazole-resistant Candida infection, amphotericin B deoxycholate

fluconazole-susceptible *Candida* spp

- Cystitis due to fluconazole-susceptible *Candida* spp: fluconazole (200 mg [3 mg/kg] orally daily).
- Pyelonephritis due to fluconazole-susceptible *Candida*: fluconazole (200 to 400 mg [3 to 6 mg/kg] orally daily)
- Therapy should be continued for 14 days for both cystitis and pyelonephritis.
- Dosing of fluconazole should be reduced in patients with renal insufficiency.

Fluconazole-resistant Candida

- Cystitis or pyelonephritis caused by fluconazole-resistant Candida spp: intravenous amphotericin B deoxycholate (0.3 to 0.6 mg/kg per day) for one to seven days
- For patients with pyelonephritis: flucytosine may be added to amphotericin B deoxycholate.
- Lipid formulations of amphotericin B should not be used to treat urinary tract infections because they do not penetrate the kidney or achieve adequate concentrations in the urine
- Bladder irrigation with amphotericin B will clear funguria, is not recommended for cystitis and pyelonephritis

- Echinocandins, caspofungin or micafungin, might be effective in treating Candida urinary tract infections (evidence not firm)
- There is little clinical experience in treating Candida infections of the kidney or bladder with voriconazole, posaconazole, or isavuconazole (should only be considered in the absence of alternative therapies)

COMPLICATIONS

Perinephric abscess:

- **Drainage** is preferred and can often be performed with percutaneous catheters. Patients with multiple loculations or fistulae may require open drainage for complete evacuation.
- **Systemic antifungal drugs** should be given to all patients with perinephric abscesses

Fungus balls (sometimes called fungal bezoars):

- Combination of surgical and medical therapy
- Fluconazole (200 to 400 mg [3 to 6 mg/kg] orally once daily
- Amphotericin B deoxycholate (0.3 to 0.6 mg/kg intravenously daily) with or without flucytosine (100 mg orally per day divided into four doses) as an alternative regimen.
- Therapy should be continued until a surgical or endoscopic procedure to remove the fungus ball has been accomplished, symptoms have resolved, and urine cultures are negative.

Renal arteritis with aneurysm formation:

- In renal transplant recipients who have acquired Candida infections at

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