

868 as the initial therapy in emphysematous pyelonephritis and can be followed by elective nephrectomy as needed. Papillary necrosis with obstruction requires intervention to relieve the obstruction and to preserve renal function.

ASYMPTOMATIC BACTERIURIA

Treatment of ASB does not decrease the frequency of symptomatic infections or complications except in pregnant women, persons undergoing urologic surgery, and perhaps neutropenic patients and renal transplant recipients. Treatment of ASB in pregnant women and patients undergoing urologic procedures should be directed by urine culture results. In all other populations, screening for and treatment of ASB are discouraged. The majority of cases of catheter-associated bacteriuria are asymptomatic and do not warrant antimicrobial therapy.

CATHETER-ASSOCIATED UTI

Multiple institutions have released guidelines for the treatment of CAUTI, which is defined by bacteriuria and symptoms in a catheterized patient. The signs and symptoms either are localized to the urinary tract or can include otherwise unexplained systemic manifestations, such as fever. The accepted threshold for bacteriuria to meet the definition of CAUTI is $\geq 10^3$ CFU/mL, while the threshold for bacteriuria to meet the definition of ASB is $\geq 10^5$ CFU/mL.

The formation of biofilm—a living layer of uropathogens—on the urinary catheter is central to the pathogenesis of CAUTI and affects both therapeutic and preventive strategies. Organisms in a biofilm are relatively resistant to killing by antibiotics, and eradication of a catheter-associated biofilm is difficult without removal of the device itself. Furthermore, because catheters provide a conduit for bacteria to enter the bladder, bacteriuria is inevitable with long-term catheter use.

The typical signs and symptoms of UTI, including pain, urgency, dysuria, fever, peripheral leukocytosis, and pyuria, have less predictive value for the diagnosis of infection in catheterized patients. Furthermore, the presence of bacteria in the urine of a patient who is febrile and catheterized does not necessarily predict CAUTI, and other explanations for the fever should be considered.

The etiology of CAUTI is diverse, and urine culture results are essential to guide treatment. Fairly good evidence supports the practice of catheter change during treatment for CAUTI. The goal is to remove biofilm-associated organisms that could serve as a nidus for reinfection. Pathology studies reveal that many patients with long-term catheters have occult pyelonephritis. A randomized trial in persons with spinal cord injury who were undergoing intermittent catheterization found that relapse was more common after 3 days of therapy than after 14 days. In general, a 7- to 14-day course of antibiotics is recommended, but further studies on the optimal duration of therapy are needed.

In the setting of long-term catheter use, systemic antibiotics, bladder-acidifying agents, antimicrobial bladder washes, topical disinfectants, and antimicrobial drainage-bag solutions have all been ineffective at preventing the onset of bacteriuria and have been associated with the emergence of resistant organisms. The best strategy for prevention of CAUTI is to avoid insertion of unnecessary catheters and to remove catheters once they are no longer necessary. Evidence is insufficient to recommend suprapubic catheters and condom catheters as alternatives to indwelling urinary catheters as a means to prevent CAUTI. However, intermittent catheterization may be preferable to long-term indwelling urethral catheterization in certain populations (e.g., spinal cord-injured persons) to prevent both infectious and anatomic complications. Antimicrobial catheters impregnated with silver or nitrofurazone have not been shown to provide significant clinical benefit in terms of reducing rates of symptomatic UTI.

CANDIDURIA

The appearance of *Candida* in the urine is an increasingly common complication of indwelling catheterization, particularly for

patients in the intensive care unit, those taking broad-spectrum antimicrobial drugs, and those with underlying diabetes mellitus. In many studies, >50% of urinary *Candida* isolates have been found to be non-*albicans* species. The clinical presentation varies from an asymptomatic laboratory finding to pyelonephritis and even sepsis. Removal of the urethral catheter results in resolution of candiduria in more than one-third of asymptomatic cases. Treatment of asymptomatic patients does not appear to decrease the frequency of recurrence of candiduria. Treatment is recommended for patients who have symptomatic cystitis or pyelonephritis and for those who are at high risk for disseminated disease. High-risk patients include those with neutropenia, those who are undergoing urologic manipulation, those who are clinically unstable, and low-birth-weight infants. Fluconazole (200–400 mg/d for 14 days) reaches high levels in urine and is the first-line regimen for *Candida* infections of the urinary tract. Although instances of successful eradication of candiduria by some of the newer azoles and echinocandins have been reported, these agents are characterized by only low-level urinary excretion and thus are not recommended. For *Candida* isolates with high levels of resistance to fluconazole, oral flucytosine and/or parenteral amphotericin B are options. Bladder irrigation with amphotericin B generally is not recommended.

PREVENTION OF RECURRENT UTI IN WOMEN

Recurrence of uncomplicated cystitis in reproductive-age women is common, and a preventive strategy is indicated if recurrent UTIs are interfering with a patient's lifestyle. The threshold of two or more symptomatic episodes per year is not absolute; decisions about interventions should take the patient's preferences into account.

Three prophylactic strategies are available: continuous, postcoital, and patient-initiated therapy. Continuous prophylaxis and postcoital prophylaxis usually entail low doses of TMP-SMX, a fluoroquinolone, or nitrofurantoin. These regimens are all highly effective during the period of active antibiotic intake. Typically, a prophylactic regimen is prescribed for 6 months and then discontinued, at which point the rate of recurrent UTI often returns to baseline. If bothersome infections recur, the prophylactic program can be reinstated for a longer period. Selection of resistant strains in the fecal flora has been documented in studies of women taking prophylactic antibiotics for 12 months.

Patient-initiated therapy involves supplying the patient with materials for urine culture and with a course of antibiotics for self-medication at the first symptoms of infection. The urine culture is refrigerated and delivered to the physician's office for confirmation of the diagnosis. When an established and reliable patient-provider relationship exists, the urine culture can be omitted as long as the symptomatic episodes respond completely to short-course therapy and are not followed by relapse.

PROGNOSIS

Cystitis is a risk factor for recurrent cystitis and pyelonephritis. ASB is common among elderly and catheterized patients but does not in itself increase the risk of death. The relationships among recurrent UTI, chronic pyelonephritis, and renal insufficiency have been widely studied. In the absence of anatomic abnormalities, recurrent infection in children and adults does not lead to chronic pyelonephritis or to renal failure. Moreover, infection does not play a primary role in chronic interstitial nephritis; the primary etiologic factors in this condition are analgesic abuse, obstruction, reflux, and toxin exposure. In the presence of underlying renal abnormalities (particularly obstructing stones), infection as a secondary factor can accelerate renal parenchymal damage. In spinal cord-injured patients, use of a long-term indwelling bladder catheter is a well-documented risk factor for bladder cancer. Chronic bacteriuria resulting in chronic inflammation is one possible explanation for this observation.