

Guideline for Prevention of Catheter-associated Urinary Tract Infections

INTRODUCTION

The urinary tract is the most common site of nosocomial infection, accounting for more than 40% of the total number reported by acute-care hospitals and affecting an estimated 600,000 patients per year. Most of these infections -- 66% to 86% -- follow instrumentation of the urinary tract, mainly urinary catheterization. Although not all catheter-associated urinary tract infections can be prevented, it is believed that a large number could be avoided by the proper management of the indwelling catheter. The following recommendations were developed for the care of patients with temporary indwelling urethral catheters. Patients who require chronic indwelling catheters or individuals who can be managed with intermittent catheterization may have different needs. Determination of the optimal catheter care for these and other patients with different drainage systems requires separate evaluation.

EPIDEMIOLOGY

The risk of acquiring a urinary tract infection depends on the method and duration of catheterization, the quality of catheter care, and host susceptibility. Reported infection rates vary widely, ranging from 1%-5%, after a single brief catheterization to virtually 100% for patients with indwelling urethral catheters draining into an open system for longer than 4 days. Adoption of the closed method of urinary drainage has markedly reduced the risk of acquiring a catheter-associated infection, but the risk is still substantial. As recent studies have shown, over 20% of patients catheterized and maintained on closed drainage on busy hospital wards may be expected to become infected. In these studies, errors in maintaining sterile closed drainage were common and predisposed patients to infection. Host factors which appear to increase the risk of acquiring catheter-associated urinary tract infections include advanced age, debilitation, and the postpartum state.

Catheter-associated urinary tract infections are generally assumed to be benign. Such infection in otherwise healthy patients is often asymptomatic and is likely to resolve spontaneously with the removal of the catheter. Occasionally, infection persists and leads to such complications as prostatitis, epididymitis, cystitis, pyelonephritis, and gram-negative bacteremia, particularly in high-risk patients. The last complication is serious since it is associated with a significant mortality, but fortunately occurs in fewer than 1% of catheterized patients.

Catheter-associated urinary tract infections are caused by a variety of pathogens, including *Escherichia coli*, *Klebsiella*, *Proteus*, enterococcus, *Pseudomonas*, *Enterobacter*, *Serratia*, and *Candida*. Many of these microorganisms are part of the patient's endogenous bowel flora, but they can also be acquired by cross-contamination from other patients or hospital personnel or by exposure to contaminated solutions or non-sterile equipment. Urinary tract pathogens such as *Serratia marcescens* and *Pseudomonas cepacia* have special epidemiologic significance. Since these microorganisms do not commonly reside in the gastrointestinal tract, their isolation from catheterized patients suggests acquisition from an exogenous source.

Whether from endogenous or exogenous sources, infecting microorganisms gain access to the urinary tract by several routes. Microorganisms that inhabit the meatus or distal urethra can be introduced directly into the bladder when the catheter is inserted. Generally, however, low rates of infection have been reported after single brief catheterization, suggesting that microorganisms introduced by this method are usually removed from healthy individuals by voiding or by antibacterial mechanisms of the bladder mucosa. With indwelling catheters, infecting microorganisms can migrate to the bladder along the outside of the catheter in the periurethral mucous sheath or along the internal lumen of the catheter after the collection bag or catheter-drainage tube junction has been contaminated. The importance of intraluminal ascension is suggested by the substantial reduction in infections that has been achieved through the use of the closed urinary drainage system. However, if sterile closed drainage can be maintained, extraluminal migration of microorganisms in the periurethral space becomes a relatively more important pathway of entry into the bladder.

CONTROL MEASURES

An estimated 4 million patients are subjected yearly to urinary catheterization and, therefore, are at risk for catheter-associated infection and its related sequelae. One of the most important infection control measures is to limit the use of urinary catheters to carefully selected patients, thereby reducing the size of the population at risk. Generally, urinary catheterization is indicated 1) to relieve urinary tract obstruction, 2) to permit urinary drainage in patients with neurogenic bladder dysfunction and urinary retention, 3) to aid in urologic surgery or other surgery on contiguous structures, and 4) to obtain accurate measurements of urinary output in critically ill patients. Specifically, urinary catheterization should be discouraged as a means of obtaining urine for culture or certain diagnostic tests such as urinary electrolytes when the patient can voluntarily void or as a substitute for nursing care in the incontinent patient.

In selected populations, other methods of urinary drainage exist as possible alternatives to the use of the indwelling urethral catheter. Suprapubic catheter drainage is most frequently used in patients on urologic or gynecologic services. Although preliminary data on the risk of infection are encouraging, the benefit of the suprapubic catheter with regard to infection control has not been proven by controlled clinical studies. For certain types of patients with bladder-emptying dysfunction, such as those with spinal cord injuries or children with meningomyelocele, intermittent catheterization, is commonly employed. The "no-touch" method of intermittent catheterization advocated by Guttman is generally reserved for patients hospitalized during the acute phase of their spinal cord injury, while the clean, nonsterile method of Lapides is frequently used by ambulatory patients for whom the practice of aseptic catheter insertion is difficult to maintain. As with suprapubic catheterization, however, well-designed clinical trials comparing the efficacy of intermittent catheterization by either method to indwelling catheterization in minimizing the risk of infection are lacking.

For patients who require indwelling urethral catheterization, adherence to the sterile continuously closed system of urinary drainage is the cornerstone of infection control. For short-term catheterization, this measure alone can reduce the rate of infection from an inevitable 100% when open drainage is employed to less than 25%. All other interventions can be viewed as adjunctive measures since none have proven to be as effective in reducing the frequency of catheter-associated urinary tract infections.

Efforts have been made to improve the design of the closed urinary drainage system by modifying or adding to the basic unit introduced and widely adopted in the 1960s. Two modifications, the addition of urine sampling port in the drainage tubing and the preconnected catheter/collecting tube system seem to have been logical advances since they discourage or prevent opening the closed system which has been well-documented to predispose patients to infection. Other alterations have included the insertion of air vents, drip chambers, and one-way valves that were designed to prevent the reflux of contaminated urine. Although these modifications have some theoretical basis, none have been shown to be effective in reducing the frequency of catheter-associated infections. Additionally, overly complex drainage systems can affect the ease of operation or more easily malfunction. These latter factors can influence the acceptance of different systems by hospital personnel and ultimately affect infection control.

Other efforts to reduce the incidence of catheter associated infections have been directed toward 1) preventing microorganisms at the meatus from entering the bladder and 2) eradicating microorganisms that gain entry into the urinary tract before they can proliferate. Measures directed toward the first objective include aseptic catheter insertion, daily meatal cleansing, and daily application of antimicrobial ointments or solutions. On the basis of recent studies that have shown that catheterized patients colonized at the meatus with gram-negative bacilli or enterococci are at increased risk for subsequent infection, these measures have some theoretical value and can be expected to delay or prevent the onset of infection. Generally, clinical trials that have attempted to demonstrate their efficacy have not been well designed or did not include the use of the closed system of urinary

drainage. However, 2 recent prospective, controlled studies conducted by the same research group have shown that meatal care as it is currently commonly practiced (either twice-a-day cleansing with povidone-iodine solution followed by povidone-iodine ointment or daily cleansing with soap and water) was ineffective in reducing the frequency of catheter-associated infections in patients on closed urinary drainage. The value of different regimens (e.g., more frequent application, other concentrations, or other antimicrobial agents) is not known and requires further evaluation.

Infection control measures for purposes of eradicating microorganisms in the urinary tract before they can proliferate and cause infection include irrigation of the bladder and the use of prophylactic systemic antibiotics. In one controlled study, continuous irrigation of the bladder with nonabsorbable antibiotics was associated with frequent interruption of the closed drainage system and did not bring about a reduction in the frequency of catheter associated infections. It is not known, however, whether such irrigation would be effective if the integrity of the closed drainage system could be maintained. Several recent studies have shown that prophylactic systemic antibiotics delay the emergence of catheter-related infection, but this protective effect was transient and was associated with the selection of antibiotic-resistant microorganisms. Thus, controversy regarding the value of prophylactic systemic antibiotics remains.

When cross-infection is likely to be responsible for the spread of catheter-associated infections, additional measures have been proposed. In several outbreaks of nosocomial urinary tract infections, catheterized patients with asymptomatic infections served as unrecognized reservoirs of infecting organisms, and the mechanism of transmission appeared to be carriage on the hands of patient-care personnel. In these outbreaks, the implementation of control measures to prevent cross infection, including renewed emphasis on hand washing and spatial separation of catheterized patients, particularly infected from uninfected ones, effectively ended the outbreak. In the absence of epidemic spread or frequent cross-infection, spatial separation of catheterized patients is probably less effective in controlling catheter-associated infections.

Regular bacteriologic monitoring of catheterized patients has been advocated to ensure early diagnosis and treatment of urinary tract infections. Its possible value as an infection measure lies in its potential usefulness in detecting and initiating treatment of clinically inapparent infections, which may serve as reservoirs of hospital pathogens, and thus, reducing the likelihood of cross-infection.