Guideline for Prevention of Catheter-associated Urinary Tract Infections

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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 *(1)*.

Most of these infections--66% to 86%--follow instrumentation of the urinary tract, mainly urinary catheterization *(2)*. 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 *(3)* to virtually 100% for patients with indwelling urethral catheters draining into an open system for longer than 4 days *(4)*. 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 *(5, 6)*. 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 *(7,8)*.

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 *(8)*. The last complication is serious since it is associated with a significant mortality, but fortunately occurs in fewer than 1% of catheterized patients *(9,10)*. The natural history of catheter-associated urinary tract infections has been largely unstudied.

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 *(11,12)*. 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 *(13,14)*.

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 *(4)*, suggesting that microorganisms introduced by this method are usually removed from healthy individuals by voiding or by antibacterial mechanisms of the bladder mucosa *(15)*. With indwelling catheters, infecting microorganisms can migrate to the bladder along the outside of the catheter in the periurethral mucous sheath *(16,17)* or along the internal lumen of the catheter after the collection bag or catheter-drainage tube junction has been contaminated *(5, 6)*. 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 *(17)*.

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. Condom catheter drainage may be useful for incontinent male patients without outlet obstruction and with an intact voiding reflex. Its use, however, requires meticulous nursing

care if local complications such as skin maceration or phimosis are to be avoided. In addition, frequent manipulation of the condom catheter drainage system (e.g., by agitated patients) has been associated with an increased risk of urinary tract infection *(18)*. Another alternative, suprapubic catheter drainage, is most frequently used in patients on urologic or gynecologic services. Although preliminary data on the risk of infection are encouraging *(19,20)*, 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, a third alternative, intermittent catheterization, is commonly employed. The "no-touch" method of intermittent catheterization advocated by Guttmann *(21)* is generally reserved for patients hospitalized during the acute phase of their spinal cord injury, while the clean, nonsterile method of Lapides *(22)* 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% *(5)*. 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 a 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 *(6)*. 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 *(5)*. 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 *(23)*. 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 *(17,24)*, 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 *(25, 26)*. 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 *(27)*. 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 *(6,28)*, 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 *(29)*. 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 *(13,14)*. In these outbreaks, the implementation of control measures to prevent cross-infection, including renewed emphasis on handwashing 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 *(8)*. 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. However, the potential benefit of bacteriologic monitoring for such a purpose has not been adequately investigated.

RECOMMENDATIONS

1. Personnel

a. Only persons (e.g., hospital personnel, family members, or patients themselves) who know the correct technique of aseptic insertion and maintenance of the catheter should handle catheters *(5, 6, 8)*. *Category I*

b. Hospital personnel and others who take care of catheters should be given periodic in-service training stressing the correct techniques and potential complications of urinary catheterization. *Category II*

2. Catheter Use

a. Urinary catheters should be inserted only when necessary and left in place only for as long as necessary. They should not be used solely for the convenience of patient-care personnel. *Category I*

b. For selected patients, other methods of urinary drainage such as condom catheter drainage, suprapubic catheterization, and intermittent urethral catheterization can be useful alternatives to indwelling urethral catheterization *(8,19, 21, 22). Category III*

3. Handwashing

Handwashing should be done immediately before and after any manipulation of the catheter site or apparatus *(14,30)*. *Category I*

4. Catheter Insertion

a. Catheters should be inserted using aseptic technique and sterile equipment *(8,16,31)*. *Category I*

b. Gloves, drape, sponges, an appropriate antiseptic solution for periurethral cleaning, and a single-use packet of lubricant jelly should be used for insertion. *Category II*

c. As small a catheter as possible, consistent with good drainage, should be used to minimize urethral trauma *(8)*. *Category II*

d. Indwelling catheters should be properly secured after insertion to prevent movement and urethral traction *(31)*. *Category I*

5. Closed Sterile Drainage

a. A sterile, continuously closed drainage system should be maintained *(5,6,27)*. *Category I*

b. The catheter and drainage tube should not be disconnected unless the catheter must be irrigated (see Irrigation Recommendation 6). *Category I*

c. If breaks in aseptic technique, disconnection, or leakage occur, the collecting system should be replaced using aseptic technique after disinfecting the catheter-tubing junction. *Category III*

6. Irrigation

a. Irrigation should be avoided unless obstruction is anticipated (e.g., as might occur with bleeding after prostatic or bladder surgery); closed continuous irrigation may be used to prevent obstruction. To relieve obstruction due to clots, mucus, or other causes, an intermittent method of irrigation may be used. Continuous irrigation of the bladder with antimicrobials has not proven to be useful *(28)* and should not be performed as a routine infection prevention measure. *Category II*

b. The catheter-tubing junction should be disinfected before disconnection. *Category II*

c. A large-volume sterile syringe and sterile irrigant should be used and then discarded. The person performing irrigation should use aseptic technique. *Category I*

d. If the catheter becomes obstructed and can be kept open only by frequent irrigation, the catheter should be changed if it is likely that the catheter itself is contributing to the obstruction (e.g., formation of concretions). *Category II*

7. Specimen Collection

a. If small volumes of fresh urine are needed for examination, the distal end of the catheter, or preferably the sampling port if present, should be cleansed with a disinfectant, and urine

then aspirated with a sterile needle and syringe *(5,8)*. *Category I*

b. Larger volumes of urine for special analyses should be obtained aseptically from the drainage bag. *Category I*

8. Urinary Flow

a. Unobstructed flow should be maintained *(6,8)*. *Category I* (Occasionally, it is necessary to temporarily obstruct the catheter for specimen collection or other medical purposes.)

b. To achieve free flow of urine 1) the catheter and collecting tube should be kept from kinking; 2) the collecting bag should be emptied regularly using a separate collecting container for each patient (the draining spigot and nonsterile collecting container should never come in contact) *(33)*; 3) poorly functioning or obstructed catheters should be irrigated (see Irrigation Recommendation 6) or if necessary, replaced; and 4) collecting bags should always be kept below the level of the bladder. *Category I*

9. Meatal Care

Twice daily cleansing with povidone-iodine solution and daily cleansing with soap and water have been shown in 2 recent studies not to reduce catheter-associated urinary tract infection *(25,26)*. Thus, at this time, daily meatal care with either of these 2 regimens cannot be endorsed. *Category II*

10. Catheter Change Interval

Indwelling catheters should not be changed at arbitrary fixed intervals *(34)*. *Category II*

11. Spatial Separation of Catheterized Patients

To minimize the chances of cross-infection, infected and uninfected patients with indwelling catheters should not share the same room or adjacent beds *(29)*. *Category III*

12. Bacteriologic Monitoring

The value of regular bacteriologic monitoring of catheterized patients as an infection control measure has not been established and is not recommended *(35)*. *Category III*

Summary of Major Recommendations

Category I. Strongly Recommended for Adoption*

- Educate personnel in correct techniques of catheter insertion and care.
- Catheterize only when necessary.
- Emphasize handwashing.
- Insert catheter using aseptic technique and sterile equipment.
- Secure catheter properly.
- Maintain closed sterile drainage.
- Obtain urine samples aseptically.

- Maintain unobstructed urine flow.

Category II. Moderately Recommended for Adoption

- Periodically re-educate personnel in catheter care.
- Use smallest suitable bore catheter.
- Avoid irrigation unless needed to prevent or relieve obstruction.
- Refrain from daily meatal care with either of the regimens discussed in text.
- Do not change catheters at arbitrary fixed intervals.

Category III. Weakly Recommended for Adoption

- Consider alternative techniques of urinary drainage before using an indwelling urethral catheter.
- Replace the collecting system when sterile closed drainage has been violated.
- Spatially separate infected and uninfected patients with indwelling catheters.
- Avoid routine bacteriologic monitoring.

*Refer to Introduction of manual for full explanation of the ranking scheme for recommendations.

REFERENCES

1. Center for Disease Control. National Nosocomial Infections Study Report, Atlanta: Center for Disease Control, November 1979: 2-14.
2. Martin CM, Bookrajian EN. Bacteriuria prevention after indwelling urinary catheterization. Arch Intern Med 1962;110:703-11.
3. Turck M, Goffe B, Petersdorf RG. The urethral catheters and urinary tract infection. J Urol 1962;88:834-7.
4. Kass EH. Asymptomatic infections of the urinary tract. Trans Assoc Am Physicians 1956;69:56-63.
5. Kunin CM, McCormack RC. Prevention of catheter-induced urinary tract infections by sterile closed drainage. N Engl J Med 1966;274:1155-62.
6. Garibaldi RA, Burke JP, Dickman ML, Smith CB. Factors predisposing to bacteriuria during indwelling urethral catheterization. N Engl J Med 1974;291:215-8.
7. Brumfitt W, Davies BL, Rosser E. The urethral catheter as a cause of urinary tract infection in pregnancy and puerperium. Lancet 1961;2:1059-61.
8. Kunin CM. Detection, prevention, and management of urinary tract infections. 3rd ed. Philadelphia: Lea and Febiger, 1979.
9. Steere AC, Stamm WE, Martin SM, Bennett JV. Gram-negative rod bacteremia. In: Bennett JV, Brachman PS, eds. Hospital infections. Boston: Little, Brown and Company. 1979:507-18.
10. Kreger BE, Craven DE. McCabe WR. Gram-negative bacteremia IV. Re-evaluation of clinical features and treatment in 612 patients. Am J Med 1980,68:344-55.
11. Selden R, Lee S, Wang WLL, et al. Nosocomial *Klebsiella* infections: intestinal colonization as a reservoir. Ann Intern Med 1971;74:657-64.
12. McLeod JW. The hospital urine bottle and bedpan as reservoirs of infection by *Pseudomonas*. Lancet 1958;1:394-5.
13. Maki DG, Hennekens CH, Bennett JV, et al. Nosocomial urinary tract infection with *Serratia*

marcesens: an epidemiologic study. 1973; J Infect Dis 128:579-87.
14. Kaslow RA, Lindsey JO, Bisno AL, Price A. Nosocomial infection with highly resistant *Proteus rettgeri*. Report of an epidemic. Am J Epidemiol 1976; 104:278-86.
15. Norden CW, Green GM, Kass EH. Antibacterial mechanisms of the urinary bladder. J Clin Invest 1968;47:2689-700.
16. Kass EH, Schneiderman LJ. Entry of bacteria into the urinary tract of patients with inlying catheters. N Engl J Med 1957;256:556-7.
17. Garibaldi RA, Burke JP, Britt MR, Miller WA, Smith CB. Meatal colonization and catheter-associated bacteriuria. N Engl J Med 1980;303:316-8.
18. Hirsh DD, Fainstein V, Musher DM. Do condom catheter collecting systems cause urinary tract infection? JAMA 1979;242:340-1.
19. Hodgkinson CP, Hodari AA. Trocar suprapubic cystostomy for postoperative bladder drainage in the female. J Obstet Gynecol 1966;96:773-83.
20. Marcus RT. Narrow-bore suprapubic bladder drainage in Uganda. Lancet 1967;1:748-50.
21. Guttman L, Frankel H. The value of intermittent catheterization in the early management of traumatic paraplegia and tetraplegia. Paraplegia 1966;4:63-83.
22. Lapides J, Diokno AC, Gould FR, Lowe. BS. Further observations on self-catheterization. J Urol 1976; 116:169-71.
23. Sanford JP. Hospital-acquired urinary tract infections. Ann Intern Med 1964;60:903-14.
24. Garibaldi RA, Britt MR, Miller WA, Steinmuller P, Burke JP. Evaluation of periurethral colonization as a risk factor for catheter-associated bacteriuria. In: Proceedings of the 16th Interscience Conference on Antimicrobial Agents and Chemotherapy, 1976;142.
25. Britt MR, Burke JP, Miller WA, Steinmiller P, Garibaldi RA. The non-effectiveness of daily meatal care in the prevention of catheter-associated bacteriuria. In: Proceedings of the 16th Interscience Conference on Antimicrobial Agents and Chemotherapy, 1976; 141.
26. Burke JP, Garibaldi RA, Britt MR, Jacobson JA, Conti M, Alling DW. Prevention of catheter-associated urinary tract infections. Efficacy of daily meatal care regimens. In: Proceedings of the 2nd International Conference on Nosocomial Infections. Atlanta, August 4-8, 1980. Am J Med 1981;70:655-8.
27. Warren JW, Platt R, Thomas KJ, Rosner B, Kass EH. Antibiotic irrigation and catheter-associated urinary tract infections. N Engl J Med 1978;299:570-73.
28. Britt MR, Garibaldi RA, Miller WA, Hebertson RM, Burke JP. Antimicrobial prophylaxis for catheter-associated bacteriuria . Antimicrob Agents Chemother 1977;11:240- 3.
29. Maki DG, Hennekens CH, Bennett JV. Prevention of catheter-associated urinary tract infection: an additional measure. JAMA 1972;221:1270-1.
30. Steere AC, Mallison GF. Handwashing practices for the prevention of nosocomial infections. Ann Intern Med 1975; 83:683-90.
31. Desautels RF, Walter CW, Graves RC. et al. Technical advances in the prevention of urinary tract infection. J Urol 1962;87:487-90.
32. Viant AC, Linton KB, Gillespie WA. Improved method for preventing movement of indwelling catheters in female patients. Lancet 1971;1:736-7.
33. Marrie TJ, Major H, Gurwith M, et al. Prolonged outbreak of nosocomial urinary tract infection with a single strain of *Pseudomonas aeruginosa*. Can Med J 1978;119:593-6.
34. Stamm WE. Guidelines for the prevention of catheter-associated urinary tract infections. Ann Intern Med 1975;82:386-90.

35. Mooney BS, Garibaldi RA, Britt MR. Natural history of catheter-associated bacteriuria (colonization, infection, bacteremia): implication for protection. In: Proceedings of the 11th International Congress of Chemotherapy and the 19th Interscience Conference on Antimicrobial Agents and Chemotherapy. Boston. October 8-12, 1979. Washington, D.C.; American Society of Microbiology 1980:1083-5.
