Chapter 14
Prevention of Urinary Tract Infections

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Key points

- Urinary catheterisation should be avoided if possible. Do not use urinary catheters for incontinence of urine.
- The catheter should be removed as soon as clinically possible, preferably within 5 days.
- Urinary catheterisation should be performed with sterile equipment. If not possible, high-level disinfection using heat should be performed.
- Aseptic technique should always be maintained during insertion and aftercare procedures.
- Catheters should not be changed routinely as this exposes the patient to increased risk of bladder and urethral trauma.
- Maintain the closed drainage system; open systems should be avoided if at all possible.
- Bladder irrigation or washout and instillation of antiseptics or antimicrobial agents do not prevent catheter-associated urinary tract infection and should not be used.
- The drainage bag should be emptied once per nursing session into a clean receptacle used only on one patient.

Introduction

Urinary tract infections (UTIs) are the commonest healthcare-associated infections, accounting for up to 30% of all. Most are associated with the use of urinary drainage devices, such as bladder catheters. The risk of acquiring bacteriuria in a catheterised patient increases with the duration of catheterisation, rising from approximately 5% per day during the first week to almost 100% at 4 weeks. 1-4% of patients with bacteriuria will ultimately develop clinically significant infection, e.g., cystitis, pyelonephritis and septicaemia. Therefore urinary catheters must only be inserted when there are clear medical indications, such as problems with emptying the bladder or measurement of urine production, and should be removed as soon as no longer needed. In suitable patients, clean intermittent urinary catheterization should be considered, as it has a much lower risk of infection. Urinary incontinence is not an indication for urinary catheterisation; use napkins or absorbent pads instead.

Pathogenesis

Under normal circumstances urethral flora, which tends to migrate into the bladder, is constantly flushed out during urination. When a catheter is inserted this flushing mechanism is circumvented and perineal and urethral flora can pass up into the bladder in the fluid layer between the outside of the catheter and the urethral mucosa. Because of this, bladder colonisation is almost inevitable if catheters are left in place for prolonged periods. In addition, bladder infection can be caused by bacterial reflux from contaminated urine in the drainage bag, therefore closed drainage systems should be used to reduce infection, when possible. Hands of personnel may also contaminate the urinary catheter system during insertion or management. (See Figure 14.1)

Microbiology

A UTI is usually endogenous, caused by microorganisms from the patient's own bowel. In community-acquired infection, the commonest microorganisms are *E. coli* and *Proteus spp.* which are usually sensitive to most antibiotics and are relatively easy to treat. However healthcare-associated UTIs are more resistant to antibiotics. This is because

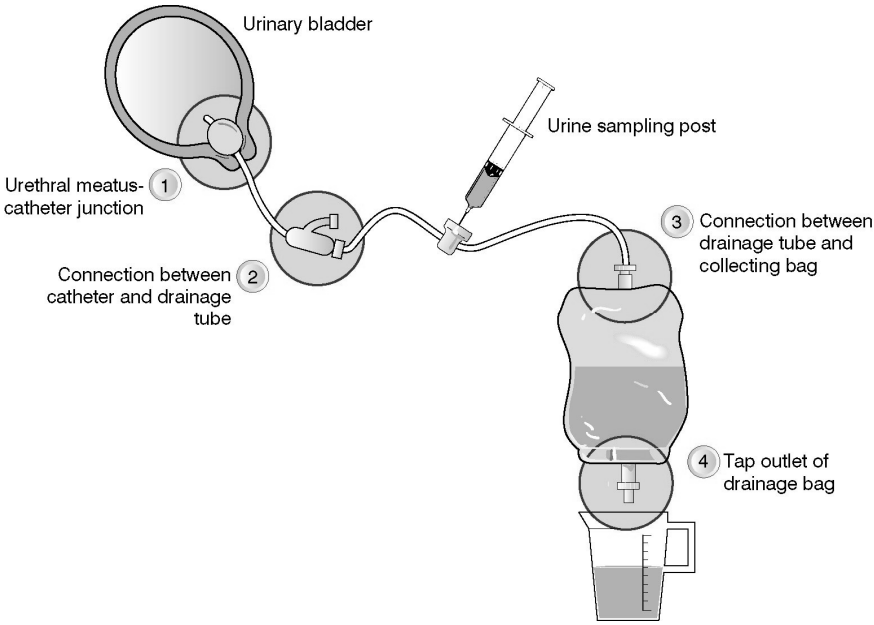

Figure 14.1 The four main sites through which bacteria may reach the bladder of a patient with an indwelling urethral catheter. The recommended measures for prevention are listed in Table 14.1.
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hospitalised patients become colonised with resistant organisms, a process encouraged by increasing length of hospital stay and exposure to antibiotics. In communities where indiscriminate antimicrobial use is common, multiresistant Gram-negative bacteria are also prevalent in the human bowel outside the hospital.

E. coli is the commonest cause of healthcare-associated UTI, however, these infections are increasingly caused by more resistant Gram-negative species, such as *Klebsiella* and *Pseudomonas.* Similarly, ampicillin-sensitive *Enterococcus faecalis* is gradually being replaced by the resistant *E. faecium.* Then, with additional antibiotic exposure, infections occur with multiply drug resistant versions of these and other species.

In addition, resistant organisms may be acquired by transfer from other patients, most commonly via contaminated staff hands, but sometimes from environmental sources. Infected urine is a potent source of staff hand contamination. Urine and urinary catheter systems should be

carefully disposed of, bottles and jugs cleaned and disinfected, and hands properly washed and decontaminated during insertion and management.

Diagnosis

The diagnosis of UTI in hospitals depends on laboratory support. Where this is good and a careful, midstream specimen is collected: finding $\geq 10^5$ bacterial colony forming units (CFU)/ml in a patient without an indwelling catheter is diagnostic of UTI. Bacterial concentrations $>10^2$ CFU/ml suggest infection if the specimen is obtained aseptically by needle aspiration from the proximal drainage tubing port in a patient with an indwelling catheter. Although UTIs in non-catheterised patients are usually caused by a single microorganism, in catheterised patients infections are frequently polymicrobial.

The presence of multiple microorganisms does not necessarily indicate contamination. Urine must be processed promptly, since even with good technique urine samples may contain small numbers of contaminants. These microbes can multiply at room temperature (especially in hot climates) and give falsely high colony counts. If delay is expected, the specimen should be transported in an ice box and refrigerated on arrival. Alternatively, boric acid (1% W/V or 1 g/10 ml of urine) should be added to the urine. Specimens containing boric acid need not be refrigerated.

Where microbiological support is poor or unavailable, clinical symptoms (e.g., fever, supra-pubic tenderness, frequency, and dysuria) may be useful in diagnosis, principally in non-catheterised patients. The presence of pyuria on either microscopic examination or by dip stick (leukocyte esterase) is highly suggestive of UTI. If dip sticks are available, a positive nitrite reaction in combination with a positive leukocyte esterase reaction is virtually diagnostic. In catheterised patients, as stated above, a positive urinary culture or dip-stick is not sufficient for diagnosis of infection. In such patients, fever and leukocytosis or leucopenia are additional diagnostic criteria.

Strategies to prevent infection (See Table 14.1)

Staff training

Healthcare personnel performing urinary catheterisation should receive training on correct procedures for insertion and maintenance of urinary catheters based on local written protocols.

Catheter size

Catheters are available in different sizes. The smallest diameter catheter that allows free flow of urine should be used. Larger diameter catheters are more likely to cause unnecessary pressure on the urethral mucosa, which may result in trauma and ischaemic necrosis. Urological patients and some other patient groups may require larger sized catheters; these should only be used on the advice of specialists.

Catheter insertion

Urinary catheterisation should always be performed using sterile or high level disinfected equipment and aseptic technique. To minimize trauma to the urethra and discomfort to the patient, a sterile lubricant or local anaesthetic gel should be used.

Meatal cleansing

Meatal cleansing should be performed regularly to ensure that the meatus is free from encrustations. Cleansing with soap and water is sufficient; application of antimicrobial ointment or disinfectant to the urethral meatus is harmful and should be avoided.

Drainage bag

To help prevent trauma to the urethra, the urinary drainage tubing should be secured to the patient's thigh and straps adjusted to a comfortable fit. The catheter drainage bag must always be placed below the level of the bladder to promote good drainage. If a ¾ catheter stand is used, the drainage bag and drainage tap must not come in contact with the floor. During patient movement, the drainage tube should be temporarily clamped to prevent back-flow or reflux of urine. Do not disconnect the drainage bag unnecessarily as this causes interruption to the closed drainage system.

Emptying the drainage bag

The drainage bag should be emptied regularly (i.e., when ¾ full or

sooner if it fills rapidly) via the drainage tap at the bottom of the bag. If the bag does not have a tap, it must be replaced when ¾ full using aseptic technique.

Extreme care must be taken when emptying a drainage bag to prevent cross-infection between patients. Hands must be washed or disinfected with an alcohol hand rub and non-sterile disposable gloves should be worn when emptying the bag. Alcohol impregnated swabs should be used to decontaminate the outlet of the drainage tap (inside and outside). After emptying the bag, gloves must be removed and hands must be washed.

When emptying the drainage bag, use a separate container for each patient's urine and avoid contact between the urinary drainage tap and the container. The urine container should be rinsed and heat disinfected (preferably in a washer-disinfector unit), dried and stored in a clean place before further use.

Bladder irrigation

Bladder irrigation or washout and instillation of antiseptics or antimicrobial agents do not prevent catheter-associated UTI and therefore should not be used for this purpose. The use of these agents may damage the bladder mucosa or catheter and promote the development of resistant bacteria which are difficult to treat.

Specimen collection

Samples of urine for bacteriological examination should be obtained from the sampling port or sleeve using aseptic technique. The sampling port should be disinfected by wiping with a 70% isopropyl alcohol impregnated swab. The sample may then be aspirated using a sterile needle and syringe and transferred into a sterile universal container. Never obtain a sample from the drainage bag. In asymptomatic patients, routine bacteriological testing is of no clinical benefit.

Use of antimicrobial agents

The routine administration of systemic antibiotics at the time of catheter insertion/removal is not recommended. The administration of a prophylactic antibiotic as a single dose at catheter change may be used in selected patients who either have clinical infection or have a higher risk of developing UTIs. Use of prophylactic antibiotics should be assessed on an individual basis.

The antibiotic treatment of catheter associated UTIs in the presence of long-term indwelling catheters may breed resistant bacteria and may not be successful because the causative bacteria are often embedded in biofilm on the surface of the catheter and are therefore protected from the action of antibiotics.

Table 14.1. Prevention of bacterial colonization/infection of the bladder in patients with indwelling urethral catheters

Entry points for bacteria	Preventive measures
1. External urethral meatus and urethra	
Bacteria carried into bladder during insertion of catheter	Pass catheter when bladder is full for washout effect Before catheterisation, clean urethral meatus using sterile water or saline. Instil 2% lidocaine, 0.25% chlorhexidine gluconate into urethra and hold there for at least 3 minutes before inserting catheter Use sterile or adequately decontaminated catheter Use no-touch technique for insertion
Ascending colonization or infection of urethra around outside of catheter	Keep peri-urethral area clean and dry Secure catheter to prevent movement in urethra
2. Junction between catheter and drainage tube	Do not disconnect catheter unless absolutely necessary Always use aseptic technique Collect urine specimen from sampling port Apply alcohol impregnated wipe and allow it to dry completely then aspirate urine with a sterile needle and syringe and transfer specimen into sterile container
3. Junction between drainage tube and collection bag	
Reflux from bag into tube	Keep bag below level of bladder Empty bag regularly Do not hold bag upside down when emptying
4. Tap at bottom of collection bag -emptying of bag	Collection bag must never touch floor Always wash or disinfect hands before and after opening tap Use a separate jug to collect urine from each bag

There may be a place for the use of condom catheters for short-term drainage in cooperative patients. Frequent changes, e.g., daily, may avoid complications together with penile care. They should be removed at the first sign of penile irritation or skin breakdown. Condom use for 24 hour periods should also be avoided and other methods, such as napkins or absorbent pads, used at night.

References and Further Reading

1. Department of Health. Epic Guidelines. Guidelines for preventing infections associated with the insertion and maintenance of short-term indwelling urethral catheters in acute care. J Hosp Infect 2001;47 Suppl:S39–46.
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3. Huang W-C, Wann S-R, Lin S-L, **et al.** Catheter-associated urinary tract infections in intensive care units can be reduced by prompting physicians to remove unnecessary catheters. Infect Control Hosp Epidemiol 2004;25:974-8.