Chapter 18

Prevention of Catheter-Associated 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 using sterile equipment.
- 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 a closed drainage system; open systems should be avoided if at all possible.
- Bladder irrigation or washout and instillation of antiseptics or antimicrobial agents does 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.
Urinary tract infections (UTI) are the commonest healthcare-associated infections (HAI), accounting for up to 40% of all HAIs. Most involve urinary drainage devices, such as bladder catheters. The risk of a catheterised patient acquiring bacteriuria increases with the duration of catheterisation, rising from approximately 5% per day during the first week to almost 100% at 4 weeks. One to four percent 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. They should be removed as soon as no longer needed. In suitable patients, clean intermittent urinary catheterisation 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 18.1]
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Microbiology

A UTI is usually caused by endogenous microorganisms from the patient’s own bowel. In community-acquired infections, 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 hospitalised patients become colonised with resistant microorganisms, a process encouraged by an increased length of stay and exposure to antibiotics. In communities where indiscriminate antimicrobial use is common, multiresistant Gram-negative bacteria (e.g., extended spectrum beta-lactamase producers - ESBL) are also prevalent in the human bowel.

*E. coli* is the commonest cause of catheter-associated UTI (CA-UTI). However, increasingly, CA-UTIs are caused by more resistant Gram-negative species, such as *Klebsiella* and *Pseudomonas*. Similarly, ampicillin-sensitive *Enterococcus faecalis* is gradually being replaced by vancomycin-
resistant *E. faecium* (VRE). Then, with additional antibiotic exposure, infections occur with multiply drug resistant versions of these and other species (e.g., ESBL, VRE).

In addition, resistant microorganisms may be acquired by transfer from other patients, most commonly via contaminated staff hands, but sometimes from environmental sources. 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.

**Definitions and Surveillance**

Surveillance of CA-UTI can be performed in certain groups of patients, e.g., patients in intensive care units or specific types of surgical patients. The definition for CA-UTI may be obtained from the U.S. CDC/NHSN (Centers for Disease Control and Prevention/ National Healthcare Safety Network) or HELICS (Hospital in Europe for Link Infection Control through Surveillance).

**Diagnosis**

The diagnosis of UTI depends on laboratory support. Where a carefully collected midstream specimen is obtained, finding $\geq 10^5$ bacterial colony forming units (CFU)/ml in a patient without an indwelling catheter is diagnostic of UTI. Bacterial concentrations $>10^5$ CFU/ml suggest infection if the specimen is obtained aseptically by needle aspiration of the proximal drainage tubing in a patient with an indwelling catheter.

Although UTIs in non-catheterised patients are usually caused by a single microorganism, in catheterised patients infections can be 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 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 usually diagnostic. In catheterised patients, a positive urine 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**

Also see Table 18.1.

**Care bundle approach**

A care bundle is a package of evidence-based interventions that, when implemented together for all patients with urinary catheters, has resulted in substantial and sustained reductions in CA-UTIs. Care bundle intervention plans for CA-UTIs have been developed by the US Institute for Healthcare Improvement and the UK Department of Health.

**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.

**Antimicrobial coated catheters**

Several studies support the use of antimicrobial coated urinary catheters (latex-coated silver alloy) as an adjunct for the prevention of CA-UTI. These catheters significantly reduce the incidence of asymptomatic bacteriuria, however only for placement less than 1 week. There is no evidence that they decrease symptomatic infections and therefore they should not be
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used routinely. However, their use should be considered in selected high-risk catheterised patients.

Catheter insertion
Urinary catheterisation should always be performed using sterile or high-level disinfected equipment and aseptic technique. To minimise 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 with straps and 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 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 of urine. Do not disconnect the drainage bag unnecessarily to interrupt the closed drainage system.

Emptying the drainage bag
The drainage bag should be emptied regularly via the drainage tap at the bottom of the bag (i.e., when ¾ full or sooner if it fills rapidly). 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-based hand rub and non-sterile/clean 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 must be rinsed and heat disinfected after each use (preferably in a washer-disinfector unit), dried, and stored inverted in a clean place before further use.

**Bladder irrigation**
Bladder irrigation or washout and instillation of antiseptics or antimicrobial agents does not prevent CA-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 a higher risk of developing UTIs. Routine use of prophylactic antibiotics while the catheter is in situ must not be used to prevent CA-UTI as it breeds resistant bacteria. For the same reason, the antibiotic treatment of CA-UTIs in the presence of long-term indwelling catheters may not be successful because the causative bacteria are often embedded in biofilm on the surface of the catheter and protected from the action of antibiotics.

**Condom catheters**
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.
Table 18.1. Prevention of bacterial colonisation/infection of the bladder in patients with indwelling urethral catheters

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<thead>
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<th>Summary of Prevention Strategies</th>
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<td><strong>Entry points for bacteria</strong></td>
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<tr>
<td>1. External urethral meatus and urethra</td>
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<td>Bacteria carried into bladder during insertion of catheter</td>
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<td>Ascending colonisation/infection up urethra around outside of catheter</td>
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<td>2. Junction between catheter and drainage tube</td>
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### Summary of Prevention Strategies

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<th>Entry points for bacteria</th>
<th>Preventive measures</th>
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<td>3. Junction between drainage tube and collection bag</td>
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<tr>
<td><strong>Disconnection</strong></td>
<td>- Drainage tube should be welded to inlet of bag during manufacture.</td>
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| **Reflux from bag into catheter** | - Drip chamber or non-return valve at inlet to bag.  
- Keep bag below level of bladder. If it is necessary to raise collection bag above bladder level for a short period, drainage tube must be clamped temporarily.  
- Empty bag every 8 hours or earlier if full.  
- 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 (e.g., with 70% alcohol) before and after opening tap.  
- Use a separate disinfected jug to collect urine from each bag.  
- Routine instillation of disinfectant into bag after each emptying is of no value. |
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Guidelines

Catheter Care: RCN Guidance for nurses. Royal College of Nursing (RCN).

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References


