Chapter 18

Prevention of Catheter-Associated Urinary Tract Infections

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Key Points
• Urinary catheterisation should be avoided if possible. If needed, then catheter should be reviewed on a daily basis and removed as soon as clinically possible, preferably within 5 days. • Urinary catheterisation should be performed using sterile equipment and aseptic technique should always be maintained during insertion and aftercare procedures. • Hands must be properly washed before and after procedure and during daily management. • 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 at least once per nursing session into a clean receptacle used only on one patient.

Introduction[1-4]

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, the daily rate is 5% so that by 4 weeks almost 100% of patients are bacteriuric. 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 (See Table 18.1). They should be removed as soon as no longer needed. In suitable patients, clean intermittent urinary catheterisation or external condom catheters should be considered, as these have a lower risk of infection. Urinary incontinence is not an indication for urinary catheterisation; use napkins or absorbent pads instead.

Table 18.1. Indications for the use of indwelling urinary catheters

Examples of *appropriate* uses of indwelling catheters
Patient with acute and/or chronic urinary retention or bladder outlet obstruction
Maintain a continuous outflow of urine for patients with voiding difficulties (as a result of neurological disorders that cause paralysis or loss of sensation affecting urination)
Need for accurate measurements of urinary output in critically ill patients
Perioperative use for selected surgical procedures, e.g., patients undergoing urological surgery or other surgery on contiguous structures of the genitourinary tract
Anticipated prolonged duration of surgery − catheters inserted for this reason should be removed in theatre recovery unit
Patients anticipated to receive large-volume infusions or diuretics during surgery or need for intraoperative monitoring of urinary output
To assist in healing of open sacral or perineal wounds in selected incontinent patients
Patient requiring prolonged immobilisation, e.g., potentially unstable thoracic or lumbar spine or multiple traumatic injuries such as pelvic fractures
To improve comfort for end of life care if needed
Examples of *inappropriate* uses
Don't use indwelling catheters as a substitute for nursing care of the patient or resident with incontinence
Don't use as a means of obtaining urine for culture or other diagnostic tests when the patient can voluntarily void
Don't use for prolonged postoperative duration without appropriate indications

Pathogenesis

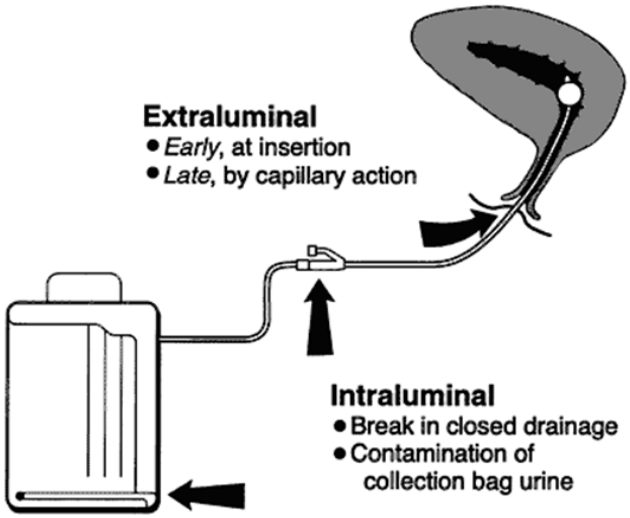
Under normal circumstances urethral flora, which tends to migrate into the bladder, is constantly flushed out during urination. When a catheter is inserted, this flushing mechanism is circumvented and perineal and urethral flora can pass up into the bladder in the fluid layer between the outside of the catheter and the urethral mucosa or in the urine in the catheter lumen (i.e., endogenous). Because of this, bladder colonisation is 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. Closed drainage systems reduce onset of infection by limiting access of bacteria to the urine. Hands of personnel may also contaminate the urinary catheter system during insertion or management (i.e., exogenous). See Figure 18.1.

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.

Fig 18.1. Main sites through which bacteria may reach the bladder of a patient with an indwelling urethral catheter.



Source: Maki DG, Tambyah PA. *Emerg Infect Dis* 2001;7:1-6.

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, multi-resistant Gram-negative bacteria (e.g., extended spectrum beta-lactamase producers [ESBL] and *carbapenem-resistant Enterobacteriaceae [CRE])* are also common colonisers of the human bowel.

E. coli is the most frequent cause of catheter-associated UTI (CAUTI). However, increasingly, CAUTIs are caused by more resistant Gram-negative species, including *Klebsiella* and *Pseudomonas*, as well as resistant *E. coli.* Similarly, ampicillin-resistant *Enterococcus* and vancomycin-resistant *E. faecium* (VRE) are becoming common. With additional antibiotic exposure, infections occur with multiply drug resistant bacteria (e.g., ESBL, CRE, VRE).

Resistant microorganisms may also 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 CAUTI can be performed in selected groups of patients, e.g., patients in intensive care units or specific types of surgical patients. A definition for CAUTI may be obtained from the USA Centers for Disease Control and Prevention/National Healthcare Safety Network web site (http://www.cdc.gov/nhsn/) or European Centre for Disease Prevention and Control(http://ecdc.europa.eu/).

Strategies to Prevent Infection

Care bundle approach

Current strategies to prevent CAUTIs are based on the implementation of a 'care bundle'. A care bundle is a package of interventions that, when implemented together for all patients with urinary catheters, has resulted in substantial and sustained reductions in CAUTIs. The catheter care bundle for the prevention of CAUTIs developed by the USA Institute of Healthcare Improvement and the United Kingdom Department of Health are summarised in Table 18.3 with further strategies to prevent CAUTIs outlined in Table 18.2.

Table 18.2: Prevention of bacterial colonisation/infection of the bladder in patients with indwelling urethral catheters

1. EXTERNAL URETHRA MEATUS AND URETHRA	
Bacteria carried into bladder during insertion of catheter	• Use aseptic non-touch technique (ANTT) for insertion. • Pass catheter when bladder is full (preferably) for wash-out effect. • Use bladder ultrasound, if available
	• Before catheterisation, clean the urinary meatus using single-use sterile water/saline or antiseptic solution.
	• Use single-use sterile gel. If 2% lignocaine anaesthetic (single-use sterile) gel is used, then inject gel into urethra and hold it for 3-5 min before inserting catheter.
	• Use sterile items /equipment (sterile catheter, sterile gloves, single-use sterile solution etc.). • Use Urinary Catheter Pack (contains sterile items required for insertion of catheter in a
Ascending colonisa-tion up urethra	• Keep peri-urethral area clean and dry. • *Don't use* catheter maintenance solution or ointments.
	• Secure catheter appropriately to prevent movement in urethra.
	• After faecal incontinence, clean perineum as soon as possible.
	• Maintain unobstructed urine flow; ensure that the catheter and drainage bag tubing are free of kinks.
2. JUNCTION BETWEEN CATHETER AND DRAINAGE TUBE	
	• Break in the closed drainage must be avoided unless absolutely necessary.
	• Closed drainage bag should *not* be disconnected. If a sample of urine is required for bacteriological examination, it should be obtained from a sampling port using aseptic
3. TAP AT BOTTOM OF COLLECTION BAG	
Reflux from bag into catheter	• Ensure the drainage bag is *never* raised above the height of the bladder. • Keep the catheter and collecting tube free from kinking.
	• *Do not* hold the bag upside down when emptying. • The drainage bag *must never* touch the floor.
Emptying of bag	• Empty the bag every 8 hours or when 2/3 full. • Use a separate disinfected jug to collect urine from each bag; prevent contact of the drainage spigot with the non-sterile collecting jug/container.
	• *Don't* instil antiseptic into urinary bag after emptying.
	• Always wash or disinfect physically clean hands with an alcoholic hand rub before and after opening tap.

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, leading to 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.

Table 18.3. Care bundle to prevent catheter-associated urinary tract infections*

Insertion Care Bundle
Avoid unnecessary catheterisation Chose catheters of appropriate size Use sterile items/equipment Insert catheter using strict aseptic non-touch technique Use closed drainage system

Maintenance Care Bundle
Review the need for the catheter on a daily basis and remove catheter promptly when no longer necessary Use aseptic technique for daily catheter care (e.g., hand hygiene, sterile items/equipment) Don't break the closed drainage system. If urine specimen required, take specimen aseptically via the sampling port (see Fig. 18.1)

*Adapted with modification from references 6 and 7. Note: The Care Bundle can be adapted or expanded to cover more issues according to local needs.

Antimicrobial coated catheters

Silver alloy catheters may reduce the incidence of asymptomatic bacteriuria in patients on short-term catheterization (2–10 days). There is no evidence that they decrease symptomatic infections and therefore they should not be used routinely. They should not be used for patients with chronic catheters.

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; maintain 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 3/4 full or sooner if it fills rapidly). If the bag does not have a tap, it must be replaced when 3/4 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 disinfected (preferably in a washer disinfector) after each use, 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 CAUTI 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 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 container.

If the urinary catheter has no sampling port, then the sample can be obtained from the urinary catheter by wiping the tube with 70% isopropyl alcohol. Allow to dry and then aspirate the urine sample using a sterile small bore needle and syringe. Transfer into a sterile urine container and send it to the microbiology laboratory as soon as possible. Never obtain a sample from the drainage bag. In asymptomatic patients, routine bacteriological testing is of no clinical benefit and not recommended.

Use of antimicrobial agents

The routine administration of systemic antibiotics at the time of catheter insertion/removal is not recommended. Routine prophylactic antibiotics while the catheter is in situ must not be used as this does not prevent CAUTI; it leads to resistant bacteria. The antibiotic treatment of CAUTIs 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 male patients. Frequent changes, e.g., daily, may avoid complications, together with penile care. It 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.

Diagnosing UTI

The diagnosis of a UTI depends on laboratory support. When either 1) a carefully collected midstream specimen is obtained or, 2) the specimen is obtained aseptically by needle aspirate of the proximal drainage tube in a patient with an indwelling catheter, finding $\geq 10^5$ bacterial colony forming units (CFU)/ml is diagnostic of UTI. Bacterial concentrations $>10^2$ CFU/ml suggest infection if the specimen is obtained aseptically or in women with acute, uncomplicated cystitis.

Although UTIs in non-catheterised patients are usually caused by a single microorganism, in patients with chronic catheters, 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 bacteria can multiply at room temperature (especially in hot climates) and result in falsely high colony counts. If delay is expected, the specimen should be transported to the laboratory 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 limited, 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 consistent with UTI, however it is not specific. If dip-sticks are available, a positive nitrite reaction in combination with a positive leu-

kocyte esterase reaction is supportive in a symptomatic patient. 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.

Diagnosis of symptomatic infection can be difficult; you cannot rely on a positive culture result or dipstick as these are usually positive in most patients with a urinary catheter after a few days of insertion. Diagnosing CAUTI is based on clinical assessment as most patients are elderly and may not able to communicate properly. A thorough examination of the patient is required; ruling out other sources of infection is essential before a diagnosis of CAUTI is made. As a guide, most patients with CAUTI may have bladder spasm, suprapubic tenderness, fever (>37.5–38.3 °C), and/or renal angle tenderness. Renal angle tenderness in the absence of any other underlying pathology suggests pyelonephritis.

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