Prevention of Intravascular Device-Associated Infections

Chapter 17
Prevention of Intravascular Device-Associated Infections

Key points

- Thorough hand disinfection by operator before insertion of catheter and during maintenance procedures.
- Thorough disinfection of skin at insertion site.
- No touch technique or gloved hands during insertion, maintenance, and removal of catheter.
- Secure the IV line to prevent movement of the catheter.
- Maintain a closed system.
- Protect the insertion site with a sterile dressing.
- Inspect insertion site daily.
- Remove the catheter as early as possible and immediately if any signs of infection are present.
- Do not reuse catheters which are intended for single use.
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Introduction

Intravenous (IV) infusions are among the commonest invasive procedures performed in health care; and are administered either by peripheral or central routes. Infections are common; IV catheters are the main source of central line-associated bloodstream infection (CLABSI). Infections associated with peripheral catheters may occur, however with a much lower incidence. The principles used for preventing infection are similar for both central and peripheral catheters.

An IV catheter is a foreign body that produces a reaction in the host resulting in a biofilm or layer of fibrinous material on the catheter’s inner and outer surfaces. This biofilm may become colonised by microorganisms which are then protected from host defence mechanisms and the effect of antimicrobials. Both local and systemic infection may result from contamination or colonisation of intravascular devices. Cellulitis, abscess formation, septic thrombophlebitis, bacteraemia, or endocarditis may occur as complications of intravascular therapy and monitoring.¹

Infection prevention and control measures are designed to prevent contamination of intravascular devices from microorganisms entering equipment, catheter insertion sites, or the bloodstream (See Figure 17.1). Because of the risk of bloodborne pathogen transmission to patients and staff, do not reuse intravascular devices; they are intended for single use only.

Healthcare personnel should be educated about insertion, care, and maintenance of intravascular devices.²³ Their knowledge of and adherence to preventive measures should be assessed periodically.

Because of the high risk of infection, IV catheters should not be inserted unnecessarily and used only for strict medical indications (e.g., severe dehydration, blood transfusion, parenteral feeding). Whenever possible, use alternative routes for hydration or parenteral therapy. Once catheters have been inserted, the need for them should be assessed daily. Catheters not required for patient care should be removed as soon as possible.⁴

Strict asepsis is required for insertion of the catheter and maintenance of the insertion site. The site should be kept dry, free from contamination,
secured, and dressed in a position which is as comfortable as possible for the patient.

**Sources and Routes of Transmission**

Sources of contamination of the device as well as the infusate are either intrinsic (contamination before use) or extrinsic (contamination introduced during therapy). Most of the microorganisms that cause intravascular device-related infections are from the patient’s own skin flora, however, contamination of a device hub is also a major source of infection.5-6 Gram-
positive bacteria (methicillin-resistant and sensitive \textit{S. aureus}, coagulase-negative staphylococci) account for 60 to 90% of infections.\textsuperscript{7,8} Less frequently, Gram-negative bacilli (including multiresistant \textit{Acinetobacter baumannii}) or \textit{Candida albicans} may cause infection.\textsuperscript{9}

Skin microorganisms may enter the catheter insertion site along the outside of the catheter. Microorganisms from the hands of staff or the patient’s skin may enter through the hub when the catheter is disconnected or through injection ports. In particular, coagulase-negative staphylococci can adhere to polymer device surfaces more effectively than other microorganisms. The microbes grow in the biofilm created, usually on the catheter’s outer surface, and may be released into the bloodstream.

Less frequently, CLABSIs have been caused by microorganisms growing in inadequately sterilised, commercially prepared infusions or medications.\textsuperscript{10} Infections originating from contaminated infusates may appear as clusters of bloodstream infections. Finally, colonisation of the catheter tip may occur, seeded from a distant site of infection (e.g., wound, lung, or kidney).

**Source of Infection and Prevention**

Table 17.1 outlines the major sources of contamination related to intravascular catheters.

**General Comments**

Unless signs of infection or irritation occur, peripheral IV catheters do not require routine changes,\textsuperscript{11} although some guidelines recommend changing peripheral venous catheters every 72-96 hours in adults to reduce the risk of phlebitis.\textsuperscript{12} Peripheral catheters should not be replaced routinely in children, unless phlebitis or infiltration occurs.\textsuperscript{11-12}

Routine replacement of central catheters is not necessary and exposes the patient to additional infectious and mechanical complications. Central catheters should be used only when medically indicated.\textsuperscript{12}

For peripheral and central IV catheters, the risk of infection increases with length of time of catheterisation. Non-essential catheters should be removed promptly.\textsuperscript{13}
Table 17.1. Major sources of contamination related to intravascular catheters

<table>
<thead>
<tr>
<th>Main source of infection</th>
<th>Prevention</th>
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| Infusion fluid           | If produced in house:  
  • Monitor sterilisation process.  
  • Ensure fluid is pyrogen free.  
  Avoid damage to container during storage.  
  Inspect container for cracks, leaks, cloudiness, and particulate matter. |
|                          | Addition of medications  
  Use aseptic technique (hand disinfection, no touch technique).  
  Use sterile medications only.  
  Carry out procedure preferably in the pharmacy.  
  Use a sterile device for accessing the system.  
  Use single-dose vials whenever possible.  
  If multidose vials have to be used:  
  • Refrigerate after opening (if not otherwise recommended by manufacturer).  
  • Wipe diaphragm with 70% isopropanol before inserting a cannula/needle. |
|                          | Warming-container  
  Ensure no contamination from warming fluid.  
  Dry warming systems are preferred. |
|                          | Insertion of catheter  
  Thorough hand disinfection and use of sterile gloves by operator.  
  Thoroughly disinfect the skin insertion site. |
|                          | Catheter site  
  Cover with sterile dressing as soon as possible.  
  Remove catheter if signs of infection occur.  
  Inspect site every 24 hours.  
  Change dressing only when soiled, loosened or wet/damp, using good aseptic technique.  
  Do not use antimicrobial ointments. |
|                          | Injection ports  
  Clean with 70% isopropanol and allow to dry before use.  
  Close ports that are not needed with sterile stopcocks. |
|                          | Changing of infusion set  
  Replace no more frequently than 72 hours (blood and lipids every 24 hours*).  
  Thorough hand disinfection by operator.  
  Use good aseptic technique. |

* In some countries, national guidelines or recommendations exist for infusion of blood or blood products, including infusion times of <24 hours. Certain lipid products may also require more frequent replacement.5
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Teflon® or polyurethane catheters have been associated with fewer infectious complications than catheters made of polyvinyl chloride or polyethylene. Steel needles used as an alternative to catheters for peripheral venous access have the same rate of infectious complications as Teflon® catheters. However, the use of steel needles frequently is complicated by infiltration of IV fluids into the subcutaneous tissues.14

Well-trained staff should set up and maintain infusions. Masks, caps, and gowns are not necessary for insertion of peripheral IV lines. The use of non-sterile gloves and an apron or gown will protect the operator if blood exposure is likely (e.g., profuse bleeding).

**Protocol for peripheral infusions**

- Place arm on a clean sheet or towel.
- Operator should use an alcohol-based hand rub or antiseptic soap to disinfect hands. If these are not available, wash hands thoroughly with plain soap for at least 20 seconds.
- Dry hands thoroughly on a paper or freshly washed, unused linen towel, unless alcohol-based hand rub is used.
- The use of gloves does not make hand hygiene redundant.
- If it is necessary to remove hair from the insertion site, clip the hair; avoid shaving.
- Disinfect skin site with 0.5% chlorhexidine-alcohol, 2% tincture of iodine, 10% alcoholic povidone-iodine, or 70% alcohol (isopropanol). Apply with rubbing for 30 seconds and allow drying before inserting the cannula. Chlorhexidine products should not be used in children younger than 2 months.¹
- Insert cannula into vein, preferably in an upper limb, using a no touch technique.
- Apply sterile dressing (gauze or equivalent or clear semi-permeable) and secure. Semi-permeable adhesive dressings are more expensive; however they allow inspection of the site without removal of the dressing.
- Secure cannula to avoid movement and label with insertion date.
- Assess the need for continuing catheterisation every 24 hours.
- Inspect catheter daily and remove at first sign of infection.
- Avoid cut downs, especially in the leg.
- Cannulae and administration sets must be sterilised before use. It is preferable to use single-use, disposable products.
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- If reuse is necessary, clean thoroughly and autoclave if possible.
- If autoclaving is not possible, use boiling water for 15 minutes.
- Chemical disinfection is undesirable. However, if reusable items are heat-labile, clean thoroughly then immerse in 0.5% sodium hypochlorite or other chlorine-releasing solution for 15 minutes (hypochlorites are neutralised by proteins such as blood). Flush the cannulae/catheter with a syringe and needle to clean the internal surface of the device. Ensure the disinfectant remains in contact with all surfaces of tubes and catheters. Hypochlorites are corrosive to metals and some plastics; thoroughly rinse the device with sterile water after disinfection.

**Additional guidelines for central catheters**

- Site selection may be an important risk factor for infection: higher infection rates have been observed for jugular and femoral than for subclavian catheters.\(^{12}\)
- Use maximum barrier precautions: sterile gloves, gowns, cap, and mask for operator and a large sterile drape to cover the patient.\(^{15-16}\)
- Preferably disinfect skin site with 2% chlorhexidine-alcohol. Allow drying before inserting the catheter.
- Change transparent dressings regularly, at least once a week or more frequently if the dressing is soiled, loose, or damp. Gauze dressings should be changed every two days. When changing the dressing, disinfect the site with chlorhexidine-alcohol.
- Replace administration sets not used for blood, blood products, or lipids at intervals no more frequently than 72 hours.\(^{12}\)

Measures that should **not** be considered as part of a general prevention policy:\(^{1}\)

- Systemic antibiotic prophylaxis while the catheter is in situ.
- Topical use of antimicrobial ointments or creams at the insertion site.
- Routine replacement of central venous catheters.
- Routine use of antibiotic locks for central venous catheters.
- Routine use of in-line filters.
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References


