Infection Prevention and Control Guidelines for Anesthesia Care

Chapter XX: Invasive Procedure Technique

Introduction

Invasive procedures, such as catheter insertion, often expose patients and healthcare providers to heightened risk of infection transmission.[1] Ensuring that proper measures are taken prior to performing invasive procedures helps prevent adverse events such as surgical site infections, central line-associated bloodstream infections, and catheter-associated urinary tract infections. Healthcare providers should perform hand hygiene immediately before patient contact, after contact with the patient or their surroundings, and before assembling equipment. All invasive procedures should be performed using appropriate aseptic or sterile technique, with proper personal protective equipment, and in accordance with facility policy. Patient education is a key component in care delivery, including providing information on the need for the device, the procedure, insertion, management, signs and symptoms of complications, risk of infection, and removal.[2-4]

Purpose

To outline evidence-based best practices in infection prevention and control, maintenance of sterility, and proper handling of invasive devices. By adhering to these recommendations, clinicians can minimize the risk of catheter-related bloodstream infections and ultimately improve patient outcomes and patient safety in acute and critical care settings.

Audience

This resource is intended for Certified Registered Nurse Anesthetists (CRNAs), also known as nurse anesthesiologists or nurse anesthetists, other anesthesia providers, members of the interdisciplinary team, administrators involved in policy development, and other interested stakeholders.

Considerations for Ultrasound-Guided Procedures

Ultrasound guidance for procedures such as vascular access and catheter placement has been shown to reduce infection rates and improve patient satisfaction.[5]

- Site selection should consider factors such as vessel size, depth, course, surrounding structures, and adjacent pathology prior to access.[5]
- Prepare patient skin with an appropriate antiseptic agent.[5-7]
    - Use single-use containers or sachets, as multi-use bottles can result in bacterial contamination.[8]
- Use a sterile sheath, sterile probe covers, and sterile ultrasound gel to mitigate the risk of contamination.[6,7]
- Disinfect ultrasound probes between each procedure and patient according to manufacturer directions.[5-7,9-12]
    - Direct application of non-manufacturer-approved cleaning solutions to the transducer may result in damage.

Considerations for Epidural Catheters and Continuous Peripheral Nerve Block Catheters

- Perform thorough hand hygiene immediately before the procedure and prior to any catheter manipulation.[13,14]
- Adhere to strict aseptic technique and use single-use sterile ultrasound probe gel to prevent contamination during catheter placement.[13-15]
- Don appropriate personal protective equipment, including surgical masks, and consider sterile gowning, gloves, and caps during the procedure.[13,14,16,17]
- Prepare patient skin with an appropriate agent.[14,18-24]
- Dress the insertion site with a sterile transparent, occlusive dressing.[14,15,21]
    - Use chlorhexidine-impregnated dressings at insertion sites to reduce epidural skin entry-point colonization.[25-34]
- Check the insertion site and overall patient status at least daily for:[15,35,36]
    - Early signs of superficial infection (e.g., erythema, tenderness, itching at the site).
    - Symptoms of deep infection (e.g., fever, back pain, lower limb weakness, headache).
    - Changes in sensory or motor status.
- Maintain a closed system and minimize disconnections to reduce contamination risk.
- Change dressings according to facility policy or immediately if the dressing becomes damp, loosened, or visibly soiled.

- Remove the catheter once no longer clinically indicated according to institutional protocol.

Disconnected Catheters

Prolonged use of epidural catheters increases the risk of disconnection from the insertion site, significantly elevating the risk of infection.[37-39] When a disconnected catheter is discovered, it is crucial to assess the situation immediately by considering the duration of disconnection, if known, the extent of fluid movement along the catheter, potential contamination, and the potential risk to the patient.[39-41] The decision to reconnect or remove the catheter should be made by the anesthesia professional, or as addressed in facility policy.

If reconnection is considered, strict aseptic technique must be used so both the catheter and surrounding area remain sterile.[17,41] Remove the catheter if there is any doubt about maintained sterility, visible contamination is present, or if static fluid has moved more than 5 inches from the disconnected end, or a distance defined in facility policy.[40,42]

Considerations for Central Venous Catheter Maintenance and Procedures

Central venous catheters (CVCs), also known as central lines, are used for rapid administration of fluids, blood products, and vasoactive medications.[43,44] They also allow for hemodynamic monitoring and can be crucial for perioperative management.[43,44] Strict adherence to evidence-based insertion techniques, maintenance protocols, and infection prevention strategies is crucial when inserting CVCs. This includes following manufacturer recommendations and facility policies for CVC care, encompassing sterile insertion techniques, proper site care, regular assessment for complications, and prompt removal when no longer clinically necessary.[43,44] Table 8 describes the different types of CVCs.

Table 8. Examples and descriptions of Central Venous Catheters (CVCs).[14,43-46]

Catheter Type	Duration	Description
Tunneled catheter (e.g., Hickman, Groshong®)	Months to years	• Surgically inserted, tunneled under skin • Catheter and attachments emerge from underneath the skin. • Lower infection risk than non-tunneled CVCs.

		• Suitable for long-term therapy.
Non-tunneled catheter (e.g., Quinton)	Days to weeks, longer if needed	• Percutaneously inserted directly into central vein. • Catheter attachments protrude directly. • Common in critical care settings. • Higher infection risk than tunneled CVCs.
Peripherally-Inserted Central Catheter (PICC)	Weeks to months	• Inserted into peripheral vein in arm, threaded to central vein. • Lower risk of insertion complications. • Suitable for intermediate to long-term therapy.
Implanted Port	Years	• Surgically implanted entirely under the skin. • Inserted entirely under the skin. • Medications administered through blunt needle (e.g., Huber needle) placed through the skin to the catheter.

Central Venous Catheter Insertion

In order to reduce the incidence of infections such as central line-associated bloodstream infections, the following is recommended for the proper insertion of a central line:

- Consider the risks and benefits of different insertion sites (e.g., subclavian, internal jugular, or femoral veins). Whenever possible, avoid using the femoral vein for central venous access in adult patients due to the higher risk of infection and other complications associated with this site.[14,47,48]
- Use a subclavian site, rather than a jugular or femoral site, in adult patients to minimize infection risk for non-tunneled CVC placement.[14]
- Perform hand hygiene. Use full barrier precautions, and don sterile gloves, sterile gown, surgical cap, and surgical mask.[14,49-51] Cover the patient's entire body with a large sterile drape prior to insertion.[14,49-51]
- Prepare patient skin using appropriate agent.[14,47,49-51]
- Use ultrasound guidance for catheter insertion, following appropriate infection control technique with sterile sheathe and ultrasound gel.[47,52-55]
- Use antibiotic-impregnated catheters in patients whose catheter is expected to remain in place for more than five days.[14]

- Replace catheter promptly when safe to do so, when adherence to aseptic technique cannot be ensured (e.g., catheters inserted during a medical emergency). Do not routinely replace CVCs.[14]
- Remove any intravascular catheter promptly, according to institutional protocol, once it is no longer clinically indicated.[14,51,55-58]
- Perform surveillance for central line-associated bloodstream infection (CLABSI).[49,55,59-61]
- For complete guidance, refer to the CDC *Guidelines for the Prevention of Intravascular Catheter-Related Infections*.[14]

Central Venous Catheter Access

When accessing CVCs, closed access systems are preferred in addition to the following recommendations:

- Perform hand hygiene before accessing the catheter.
- Scrub the injection cap (e.g., needleless connector) with an appropriate antiseptic agent and allow to dry according to manufacturer recommendation.[18,51,62]
  - For patients ≥2 months old, use 70% alcohol, povidone iodine, or >0.5% chlorhexidine with alcohol.[28,30-32,34,47,63-65]
  - For patients <2 months old, povidone-iodine remains a recommended option.[28,30-32,34,47,63,64]
- Access the injection port with a sterile syringe or intravenous tubing.[62]
  - If necessary, open the clamp.[62]
- Maintain aseptic technique throughout the procedure.

Flushing Technique

Refer to the manufacturer instructions for the catheter and the needleless connector for the appropriate technique to use. Unless otherwise specified, perform the following:

- Perform hand hygiene before accessing the catheter and maintain aseptic technique throughout the flushing procedure.
- The type of flush (e.g., saline, heparin, dilute heparin), concentration, volume, and frequency of flushing should be determined in accordance with manufacturer indications for use and facility policy and per the treating clinician's orders. Individualized patient needs should also be considered.[62,66-70]

- Use a single-use flushing system (e.g., single-dose vials, prefilled syringes) to reduce the risk of contamination.[62,70]
    - Use a minimum of a 10 mL syringe to prevent excessive pressure that could damage the catheter.[71,72]
- Flush the catheter using a pulsatile or "push-pause" technique to create turbulence within the catheter lumen, which helps dislodge any adherent particles.[62,70,71]
- Maintain positive pressure at the end of the flush to prevent reflux of blood into the catheter tip.[62,70,71]

Positive Pressure Technique

The positive pressure technique is crucial for maintaining catheter patency and preventing blood reflux.[62,70,71] However, its application may vary depending on the type of needleless connector used.[73]

For catheters with clamps:

- Flush the catheter using a pulsatile or "push-pause" technique to create turbulence within the catheter lumen, which helps dislodge any adherent particles.[62,71]
- Continue to hold the plunger of the syringe while closing the clamp on the catheter.
- Disconnect the syringe while maintaining positive pressure.[62]

For catheters without clamps:

- Withdraw the syringe as the last 0.5-1 mL of fluid is flushed to create a positive pressure effect.[62]
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For neutral or positive displacement needleless connectors:

- Follow manufacturer-specific instructions, as these devices may have built-in mechanisms to prevent reflux.

Heparin Flushes

- Flushing CVCs with heparin solutions is a recommended practice despite the lack of conclusive evidence of efficacy and safety compared with 0.9% normal saline.[62,66-69,74,75]
- The choice between heparin and normal saline should be based on catheter type, patient factors, and institutional protocols.
- Heparin flushes are appropriate for maintaining patency of CVCs for dialysis.[74]

- For dialysis CVCs, heparin flushes are still commonly used, with higher concentrations sometimes employed for patients with evidence of occlusion or thrombosis.[62,74]
- The injected volume of the heparin flush should not exceed the internal volume of the catheter.[74]

Assessing Placement and Patency

- Aspirate catheter for blood return to initially assess correct placement within the vein, indicated by blood return in syringe.[72,76,77]
- After aspiration, immediately flush the catheter with saline using a pulsatile technique to:[72,76,77]
  - Clear the catheter of blood to prevent clotting
  - Assess patency
  - Detect any resistance that might indicate catheter malposition or thrombosis
- Chest x-ray is recommended following any central line placement. For central venous catheters inserted in the internal jugular or subclavian veins, obtain a chest x-ray to confirm proper tip placement and rule out complications such as pneumothorax.[43,44,78]

Specimen Collection

- Access the catheter as outlined above, maintaining aseptic technique.
- Draw the first 3-5 mL of blood, dispose in an appropriate biohazardous waste receptacle, or return to the patient in accordance with the procedure or as indicated by patient's medical status and institutional protocol.[62]
- Before specimen is collected, flush catheter in accordance with facility policy and per the treating clinician's orders.
- Discard 1.5-2 times the volume of the internal catheter lumen before drawing the specimen.
- Collect the specimen using appropriate specimen tubes, blood culture bottles or syringes.[62]
- After specimen collection, flush the catheter as directed by facility policy and the treating clinician's orders.
- Assure the line ports and injection caps are tightly fastened and any clamps secured as flushing is completed and promptly dispose of used syringes.

Changing the Injection Cap (e.g., needleless connector)

- Change the injection cap immediately when there are signs of contamination (e.g., blood, precipitate) or damage (e.g., leaks, septum destruction). Otherwise, change the cap at least every 7 days or according to manufacturer recommendations and facility policy.[62,79]
- Scrub the injection cap and catheter hub with an appropriate antiseptic agent (e.g., 2% chlorhexidine in 70% isopropyl alcohol) and allow it to dry completely before accessing.[62,72,79,80]
- If necessary, clamp the catheter, or lower the patient to supine position, as the cap is removed to prevent air embolism or blood reflux.[62,80]
- Attach a new sterile cap to the catheter hub using aseptic technique.[79,80]

Site Dressing

- Use single-use, sterile supplies for site cleansing and dressing.[62,79,80]
    - Refer to manufacturer recommendations to ensure compatibility with catheter material.
- Perform hand hygiene and wear sterile gloves for dressing changes.[62,79]
- Prepare patient skin with appropriate agent.
    - When replacing the dressing, remove the existing dressing, visually inspect the site, and document findings before skin preparation.[62,80]
- Do not apply topical antibiotic ointment or cream to the catheter site, except for hemodialysis catheters, where povidone-iodine or bacitracin/gramicidin/polymyxin B ointment may be used.[62,79,81]
- Cover the site with either sterile gauze or a sterile, transparent, semipermeable dressing.[62,79,80]
- Replace or change dressing when indicated.[62,79,80]

Considerations for Implanted Ports

The following considerations outline high-level steps for managing implanted ports, located below the intact skin surface, emphasizing proper access, de-access, and maintenance procedures to minimize infection risks and maximize device longevity.

Additionally, patient education is an important step in implanted port management, as it significantly improves patients' knowledge, confidence, and ability to participate in their care, ultimately leading to better outcomes and reduced complications.[2,82]

Port Access Procedure

- Pre-Procedure Assessment[62,83-87]
  - Perform hand hygiene and don clean gloves.
  - Consider using local anesthetic for patient comfort.
  - Examine the port site for complications such as swelling, erythema, drainage, leakage, pain, or tenderness.
  - Palpate the outline of the port to identify the insertion diaphragm.
    - Mark location on patient skin for blunt needle insertion.
- Preparation[62,83-87]
  - Remove gloves, perform hand hygiene, and don new sterile gloves.
  - Prepare a sterile field with necessary supplies.
  - Clean the port site with an appropriate antiseptic solution (e.g., chlorhexidine-alcohol) and allow it to dry.
- Port Access[62,83-87]
  - Stabilize port with one hand and insert a non-coring needle (e.g., sterile Huber needle) until the needle contacts the back of the port. Gently push the needle through the diaphragm.
  - Aspirate blood to confirm proper placement and patency.
- Post-Access Care[62,83-87]
  - Flush the port with 10-20 mL of normal saline using a pulsatile technique.
  - Secure the needle with a sterile transparent dressing or tape.
  - Stabilize needle/port with tape, securement device, or stabilization device.
  - For short-term use (e.g., outpatient treatment), apply gauze and tape.

Port De-access Procedure[62,83-88]

- Perform hand hygiene and don clean gloves.
- Flush the port catheter in accordance with facility policy and per the treating clinician's orders.
- Remove the dressing.
- Stabilize port with one hand and remove needle with the other hand.

- Maintain positive pressure while de-accessing by flushing the catheter while withdrawing the needle from the septum.
- Apply dressing.

Port Maintenance and Care[62,82-87]

- For short-term use in outpatient settings, a sterile transparent dressing or gauze may be used in place of an occlusive dressing during the infusion.
- Ensure the needle is secure in the portal septum as described above.
- When not in use, implanted ports should be flushed every four to eight weeks to maintain patency.

Considerations for Arterial Catheters and Pressure Monitoring Devices

- Catheters that need to be in place for > five days should not be routinely changed if no evidence of infection is observed.[14]
- Maintain sterility of stopcocks: cap when not in use: apply 70 percent alcohol prior to access.[14]
- Maintain the sterility of the entire monitoring system, including pressure transducers and flush solution
- Minimize the number of manipulations and entries into the pressure monitoring system.
- When the pressure monitoring system is accessed through a diaphragm rather than a stopcock, scrub the diaphragm with an appropriate antiseptic agent before accessing the system.
    - Use sterile devices to access the pressure monitoring system through a diaphragm.
- Sterilize reusable transducers according to the manufacturers' instructions if used.

The *Infection Control Guide for Certified Registered Nurse Anesthetists* was adopted by the AANA Board of Directors in 1992 and revised in 1993, 1997, November 2012. In February 2015, the AANA Board of Directors archived the guide and adopted the *Infection Prevention and Control Guidelines for Anesthesia Care*.

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