Prevention of Central Venous Catheter - Related Infections

Part I

Clinical Practice Guidelines				
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Part II

Sample Clinical Practice Protocol				
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Clinical Practice Guidelines on Prevention of Central Venous Catheter - Related Infections

Background

The magnitude of the potential for CVCs to cause morbidity and mortality resulting from infectious complications has been estimated in several studies (1). In the United States, 15 million CVC days (i.e., the total number of days of exposure to CVCs by all patients in the selected population during the selected time period) occur in ICUs each year (2). If the average rate of CVC-associated BSIs is 5.3 per 1,000 catheter days in the ICU (4), approximately 80,000 CVC-associated BSIs occur in ICUs each year in the United States. The attributable mortality for these BSIs has ranged from no increase in mortality in studies that controlled for severity of illness (3, 4), to 35% increase in mortality in prospective studies that did not use this control (5,6). Thus, the attributable mortality remains unclear.

Migration of skin organisms at the insertion site into the cutaneous catheter tract with colonization of the catheter tip is the most common route of infection for peripherally inserted, short-term catheters (26,7). Contamination of the catheter hub contributes substantially to intraluminal colonization of long-term catheters (28–30). Occasionally, catheters might become hematogenously seeded from another focus of infection. Rarely, infusate contamination leads to CRBSI (31).

To improve patient outcome and reduce health-care costs, strategies should be implemented to reduce the incidence of these infections.

Strategies for Prevention of Catheter-Related Infections in Adult Patients

1. Site of Catheter Insertion

The density of skin flora at the catheter insertion site is a major risk factor for CRBSI. Authorities recommend that CVCs be placed in a subclavian site instead of a jugular or femoral site to reduce the risk for infection. No randomized trial satisfactorily has compared infection rates for catheters placed in jugular, subclavian, and femoral sites. Catheters inserted into an internal jugular vein have been associated with higher risk for infection than those inserted into a subclavian or femoral vein (7,8,9). Femoral catheters have been demonstrated to have relatively high colonization rates when used in adults (10).

In adult patients, a subclavian site is preferred for infection control purposes, although other factors (e.g., the potential for mechanical complications, risk for subclavian vein stenosis, and catheter-operator skill) should be considered when deciding where to place the catheter. Consideration of comfort, security, and maintenance of asepsis as well as patient-specific factors (e.g., preexisting catheters, anatomic deformity, and bleeding diathesis), relative risk of mechanical complications (e.g., bleeding and pneumothorax), the availability of bedside ultrasound, and the risk for infection should guide site selection.

2. Type of Catheter Material

Teflon® or polyurethane catheters have been associated with fewer infectious complications than catheters made of polyvinyl chloride or polyethylene (11,12,13).

3. Hand Hygiene and Aseptic Technique

Maximal sterile barrier precautions (e.g., cap, mask, sterile gown, sterile gloves, and large sterile drape) during the insertion of CVCs substantially reduces the incidence of CRBSI compared with standard precautions (e.g., sterile gloves and small drapes) (7,14).

4. Skin Antisepsis

In the United States, povidone iodine has been the most widely used antiseptic for cleansing arterial catheter and CVC insertion sites (15). However, in one study, preparation of central venous and arterial sites with a 2% aqueous chlorhexidine gluconate lowered BSI rates compared with site preparation with 10% povidone-iodine or 70% alcohol (16).

5. Catheter Site Dressing Regimens

A meta-analysis has assessed studies that compared the risk for catheter-related BSIs for groups using transparent dressings versus groups using gauze dressing (17). The risk for CRBSIs did not differ between the groups. The choice of dressing can be a matter of preference. If blood is oozing from the catheter insertion site, gauze dressing might be preferred.

6. Catheter Securement Devices

Sutureless securement devices can be advantageous over suture in preventing catheter-related BSIs. One study, which involved only a limited number of patients and was underpowered, compared a sutureless device with suture for the securement of PICCS; in this study, CRBSI was reduced in the group of patients that received the sutureless device (18).

7. In-Line Filters

In-line filters reduce the incidence of infusion-related phlebitis (19, 20). No data support their efficacy in preventing infections associated with intravascular catheters and infusion systems.

8. Antimicrobial / Antiseptic Impregnated Catheters and Cuffs

The decision to use chlorhexidine/silver sulfadiazine or minocycline/ rifampin impregnated catheters should be based on the need to enhance prevention of CRBSI after standard procedures have been implemented (e.g., educating personnel, using maximal sterile barrier precautions, and

using 2% chlorhexidine skin antisepsis) and then balanced against the concern for emergence of resistant pathogens and the cost of implementing this strategy.

9. Systemic Antibiotic Prophylaxis

No studies have demonstrated that oral or parenteral antibacterial or antifungal drugs might reduce the incidence of CRBSI among adults (21–23).

10. Antibiotic / Antiseptic Ointments

Povidone-iodine ointment applied at the insertion site of hemodialysis catheters has been studied as a prophylactic intervention to reduce the incidence of catheter-related infections.
In addition, rates of catheter colonization with Candida spp. might be increased with the use of antibiotic ointments that have no fungicidal activity (24, 25).

Practice Guidelines

1. Hand Hygiene

a. Proper hand-hygiene procedures either by washing hands with conventional antisepticcontaining soap and water or with waterless alcohol-based gels or foams. Observe hand hygiene before and after palpating catheter insertion sites, as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Palpation of the insertion site should not be performed after the application of antiseptic, unless aseptic technique is maintained. **Category IA**
b. Use of gloves does not obviate the need for hand hygiene. **Category IA**

2. Aseptic Technique during Catheter Insertion and Care

a. Maintain aseptic technique for the insertion and care of intravascular catheters. **Category IA**
b. Sterile gloves should be worn for the insertion of arterial and central catheters. **Category IA**
c. Wear clean or sterile gloves when changing the dressing on intravascular catheters. **Category IC**

3. Catheter Insertion

Do not routinely use venous cutdown procedures as a method to insert catheters. Use of Seldinger technique is preferred.

4. Catheter Site Care

a. Disinfect clean skin with an appropriate antiseptic before catheter insertion and during dressing changes. Although a 2% chlorhexidinebased preparation is preferred, tincture iodine, an iodophor, or 70% alcohol can be used. **Category IA**
b. Allow the antiseptic to remain on the insertion site and to air dry before catheter insertion. Allow povidone iodine to remain on the skin for at least 2 minutes, or longer if it is not yet dry before insertion. **Category IB**

5. Catheter-Site Dressing Regimens

a. Use either sterile gauze or sterile, transparent, semipermeable dressing to cover the catheter site. **Category IA**
b. Replace catheter-site dressing if the dressing becomes damp, loosened, or visibly soiled. **Category IB**
c. Change dressings at least weekly for adult and adolescent patients depending on the circumstances of the individual patient. **Category II**
d. Do not use topical antibiotic ointment or creams on insertion sites (except when using dialysis catheters) because of their potential to promote fungal infections and antimicrobial resistance.

6. Selection and Replacement of Intravascular Catheters

a. Select the catheter, insertion technique, and insertion site with the lowest risk for complications (infectious and noninfectious) for the anticipated type and duration of IV therapy. **Category IA**
b. Promptly remove any intravascular catheter that is no longer essential. **Category IA**
c. Do not routinely replace central venous catheters solely for the purposes of reducing the incidence of infection. **Category IB**
d. When adherence to aseptic technique cannot be ensured (i.e., when catheters are inserted during a medical emergency), replace all catheters as soon as possible and after no longer than 48 hours. **Category II**
e. Use clinical judgment to determine when to replace a catheter that could be a source of infection (e.g., do not routinely replace catheters in patients whose only indication of infection is fever). Do not routinely replace venous catheters in patients who are bacteremic or fungemic if the source of infection is unlikely to be the catheter. **Category II**
f. Replace any short-term CVC if purulence is observed at the insertion site, which indicates infection. **Category IB**
g. Replace all CVCs if the patient is hemodynamically unstable and CRBSI is suspected. **Category II**
h. Do not use guidewire techniques to replace catheters in patients suspected of having catheter-related infection. **Category IB**

7. Replacement of Administration Sets*, Needleless Systems, and Parenteral Fluids

a. Administration sets
- Replace administration sets, including secondary sets and add-on devices, no more frequently than at 72-hour intervals, unless catheter-related infection is suspected or documented. **Category IA**
- Replace tubing used to administer blood, blood products, or lipid emulsions (those combined with amino acids and glucose in a 3-in-1 admixture or infused separately) within 24 hours of initiating the infusion. **Category IB** If the solution contains only dextrose and amino acids, the administration set does not need to be replaced more frequently than every 72 hours. **Category II**
- Replace tubing used to administer propofol infusions every 6 or 12 hours, depending on its use, per the manufacturer's recommendation. **Category IA**

b. Needleless intravascular devices
- Change the needleless components at least as frequently as the administration set. **Category II**
- Change caps no more frequently than every 72 hours or according to manufacturers' recommendations. **Category II**
- Ensure that all components of the system are compatible to minimize leaks and breaks in the system. **Category II**
- Minimize contamination risk by wiping the access port with an appropriate antiseptic and accessing the port only with sterile devices. **Category IB**

c. Parenteral fluids
- Complete the infusion of lipid-containing solutions (e.g., 3-in-1 solutions) within 24 hours of hanging the solution. **Category IB**
- Complete the infusion of lipid emulsions alone within 12 hours of hanging the emulsion. If volume considerations require more time, the infusion should be completed within 24 hours. **Category IB**
- Complete infusions of blood or other blood products within 4 hours of hanging the blood. **Category II**
- No recommendation can be made for the hang time of other parenteral fluids. **Unresolved issue**

8. IV-Injection Ports

a. Clean injection ports with 70% alcohol or an iodophor before accessing the system. **Category IA**
b. Cap all stopcocks when not in use. **Category IB**

9. Surveillance

a. Monitor the catheter sites visually or by palpation through the intact dressing on a regular basis. If patients have tenderness at the insertion site, fever without obvious source, or other

manifestations suggesting local or BSI, the dressing should be removed to allow thorough examination of the site. **Category IB**

b. Record the operator, date, and time of catheter insertion and removal, and dressing changes on a standardized form. **Category II**

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Sample Clinical Practice Protocol on Prevention of Central Venous Catheter - Related Infections

1. Objective

Ensure safe and effective utilization of central venous catheters for the intensive care patient.

2. Scope

All intensive care patients whom require central venous access, from insertion to removal of the catheter.

3. Definitions

Central venous catheter	A catheter inserted into the superior vena cava, the inferior vena cava, or any major intra-thoracic or intra-abdominal vein emptying into either of them
Senior	Medical practitioner registered as critical / intensive care specialist or an experienced medical practitioner as assigned by the director of the unit
MO	Registered medical practitioner after ICU orientation Any special skill training
RN	Registered nurse after ICU orientation

4. Responsibilities

4.1 **Senior** shall:
Supervise MO & provide assistance whenever necessary.

4.2 **MO** shall:
Decide on the need, perform the cannulation and assess the correct placement. Decide to remove the catheter, monitor & manage for complications. Seek advice from senior whenever necessary.

4.3 **RN** shall:
Prepare patient & equipment for cannulation. Assist during the process of cannulation. Handle the catheter for administration of fluid or medication, measurement of CVP. Monitor for and inform doctors of complication.

5. Procedures

5.1 Preparation

	Action	*Responsible*
5.1.1	• Decide the need on insertion of central venous catheter • Select of insertion site and the appropriate catheter • Inform RN of the choice	MO / Senior
5.1.2	• Some relative contraindications for central venous cannulation includes ▪ Local sepsis at the site ▪ For subclavian and internal jugular vein cannulation ◆ Contra-lateral haemothorax/pneumothorax ◆ Required high /FiO2 (>0.8) ◆ Significant bleeding tendency (platelet<50, INR>1.5)	MO / Senior
5.1.3	• Standard set up: ▪ Cap ▪ Face mask ▪ Sterile Gown ▪ Sterile Gloves ▪ Sterile Drapes (sterile field should be large enough) • Antiseptic (depends on whatever available in individual hospital) ▪ Providone (wait for air drying before line inserion – approx 2 minutes) ▪ 2% Chlorhexidine ▪ 0.5% Chlorhexidine in 70% alcohol • Dressing ▪ Transparent dressing over insertion site (fixed with other dressing over edge if necessary) • Other equipment ▪ Simple suture set ▪ Catheter of choice ▪ 2/0 or 3/0 silk suture with cutting needle ▪ Scalpel, extra syringes & guide wire ▪ Blood culture bottles if necessary	RN
5.1.4	Position the patient to facilitate cannulation and avoid air embolism	RN / MO

5.2 Cannulation

	Action	*Responsible*
5.2.1	Use full aseptic technique with routine Seldinger Technique	MO / Senior
5.2.2	• Keep the patient head down until the line is secured and all connections are fitted in order to prevent air embolism. (no need for femoral cannulation) • Monitor ECG & SpO2 during the procedure, observe especially for arrhythmias	RN / MO
5.2.3	Consult senior for assistance if cannulation failed after 2 attempts, or otherwise found to be difficult	MO / Senior
5.2.4	• Secure the catheter with sutures • Clean & dry the insertion site before application of transparent dressing	MO
5.2.5	Start the administration of fluid or drugs via the newly inserted line if: ▪ Free aspiration of blood is possible and venous cannulation is certain ▪ If venous cannulation is uncertain, confirm by either pressure transducer, or blood gas	RN / MO
5.2.6	Order a chest X-ray after either successful or failed attempts of jugular or subclavian cannulation. MO should review the X-ray as soon as it becomes available, and document the position of catheter and any complication in case notes	RN / MO

5.3 Central Line Care

	Action	*Responsible*
5.3.1	• No routine change of line • Mark date of application or change on the dressing • Change the dressing: ▪ If visibly soiled, contaminated or grossly detached ▪ At day 4 (96 hours) after insertion	RN
5.3.2	• Change of infusion set ▪ Immediately after blood product transfusion ▪ Every 12 hours for Propofol infusion (even infusion via peripheral vein) ▪ Every 24 hours for TPN solution ▪ Every 96 hours for other IV fluid infusion	RN

Action	*Responsible*
• Routine use of in-line bacterial filter in not recommended	

5.4 Management of Line Sepsis Suspected

Action	*Responsible*
5.4.1 Check clinical evidence of infection over lines ▪ Cellulitis (erythema > 2cm) or purulent discharge over insertion site ▪ Bacteraemia of uncertain soure with central line in situ ▪ Fever of unknown original with central line in situ	RN / MO
5.4.2 Paired blood culture ▪ From peripheral site, or via central vein while inserting another central line under strict aseptic technique, and ▪ Via suspected line ▪ Use bundled blood culture booths (set of 4 bottles with appropriate label) ▪ Mark time of collection in microbiology request form or scan in LRIS	RN / MO
5.4.3 • Remove catheter under aseptic technique. Use separate sterile scissors for cutting anchoring stitiches • Send catheter tip (≈5cm) for culture and sensitivity • If obvious discharge from insertion site of catheter, take swab for culture and sensitivity	RN
5.4.4 Prescribe antimicrobial therapy according to culture result	MO

6. Quality Records

- Patient's medical record
- ICU flow chart

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