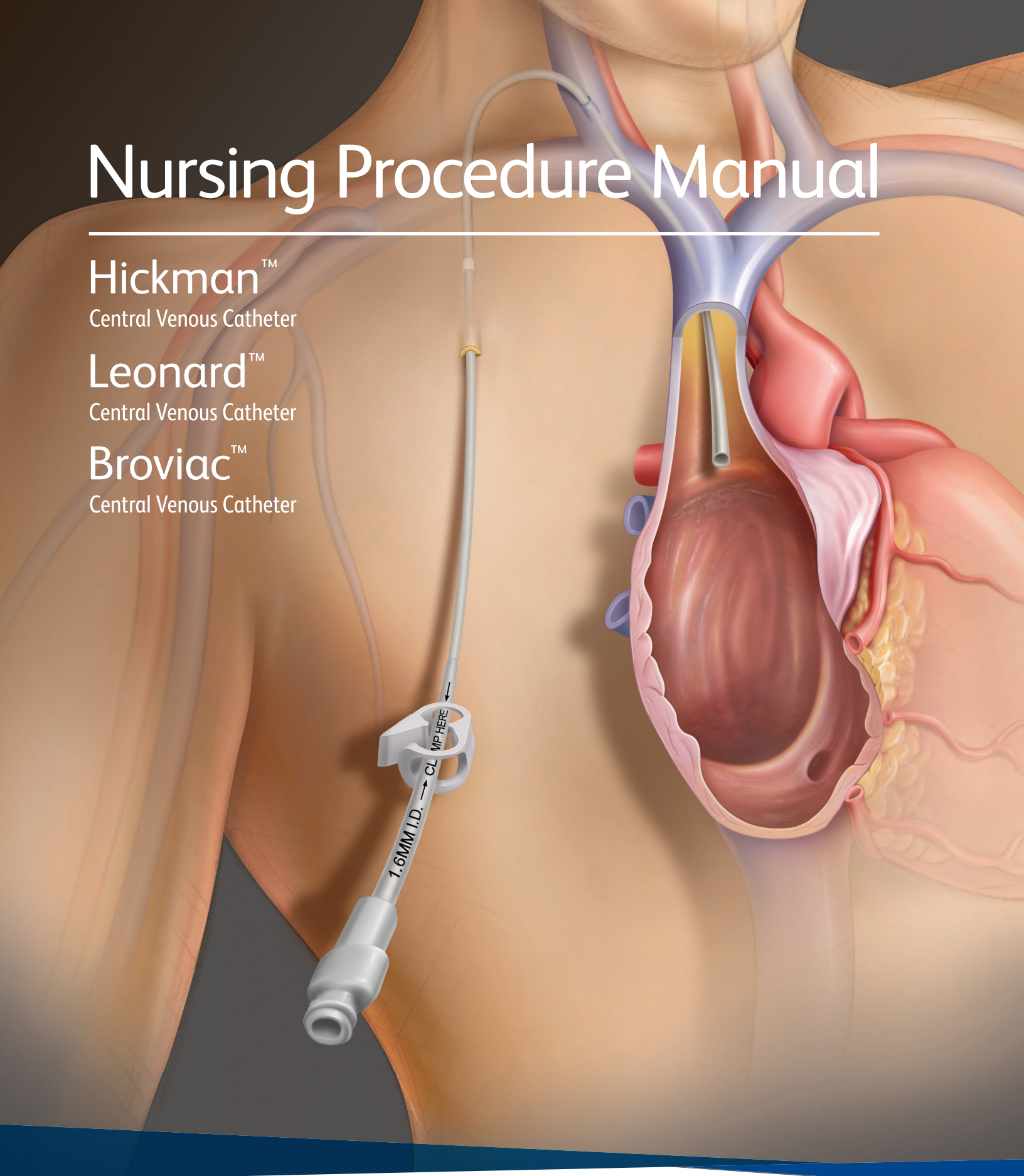
Nursing Procedure Manual

Hickman™
Central Venous Catheter

Leonard™
Central Venous Catheter

Broviac™
Central Venous Catheter



BD

Table of Contents

Introduction

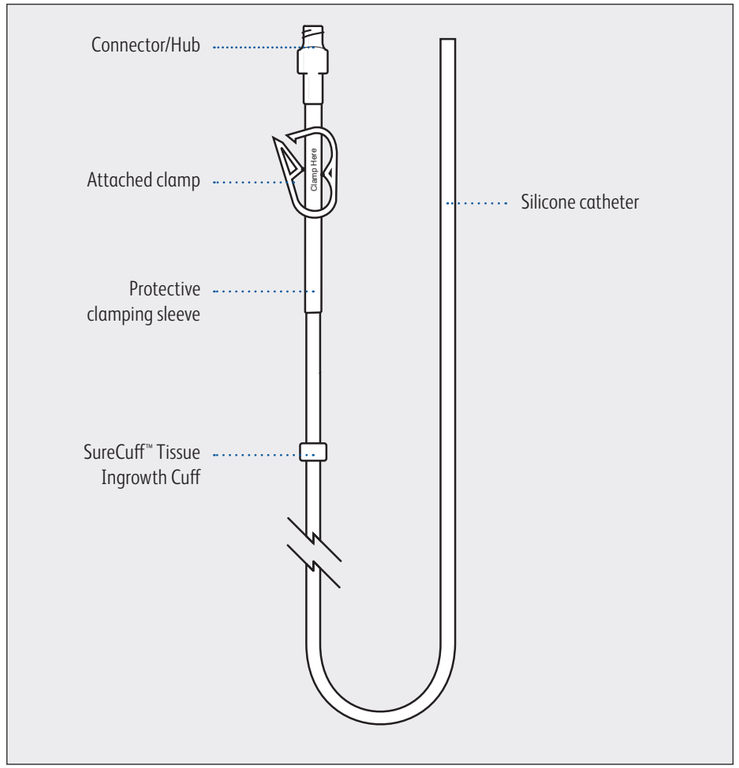
Description of Catheters

The Hickman™, Leonard™ and Broviac™ Central Venous Catheters are made of radiopaque medical grade silicone. Each has female luer locking adapter(s) and SureCuff™ Tissue Ingrowth Cuff for fixation of the catheters in the subcutaneous tunnel.

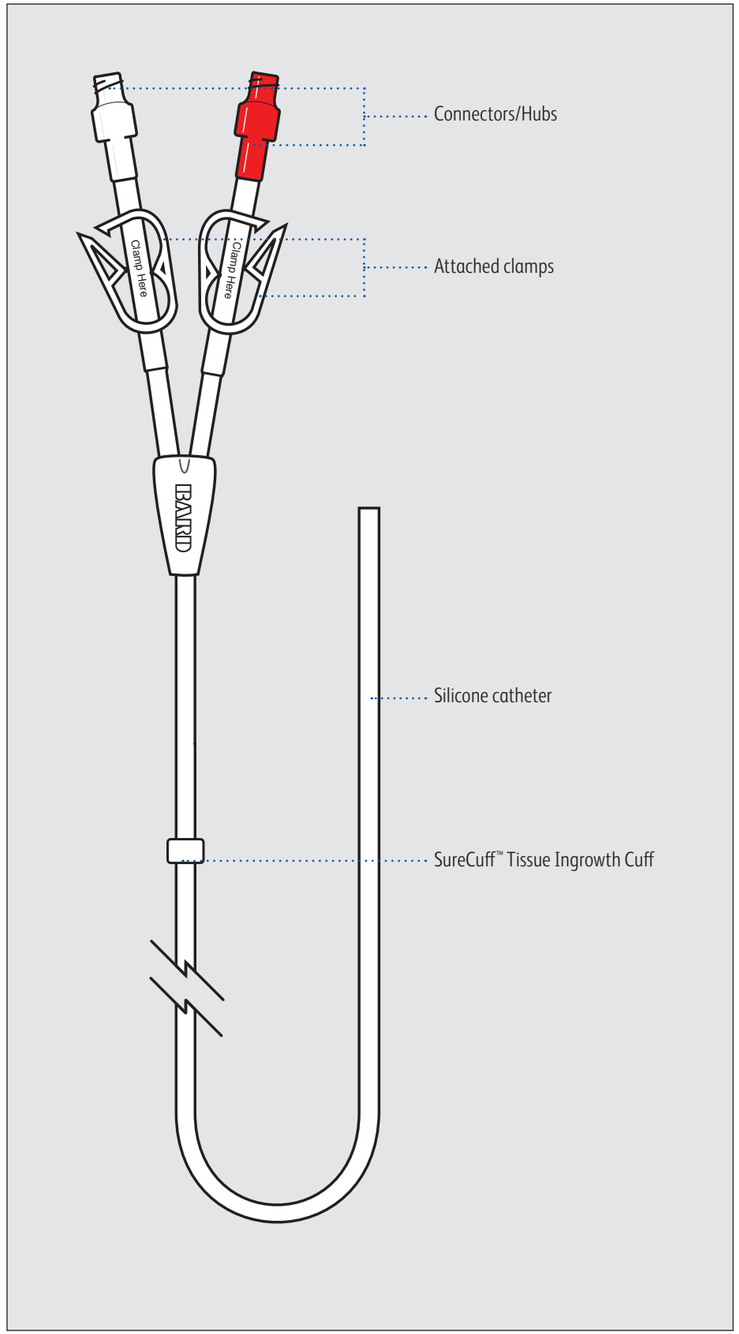
Catheter repair kits for Hickman™, Leonard™ and Broviac™ Central Venous Catheters are available.

WARNING: Hickman™, Leonard™ and Broviac™ Central Venous Catheters are not indicated for power-injection.

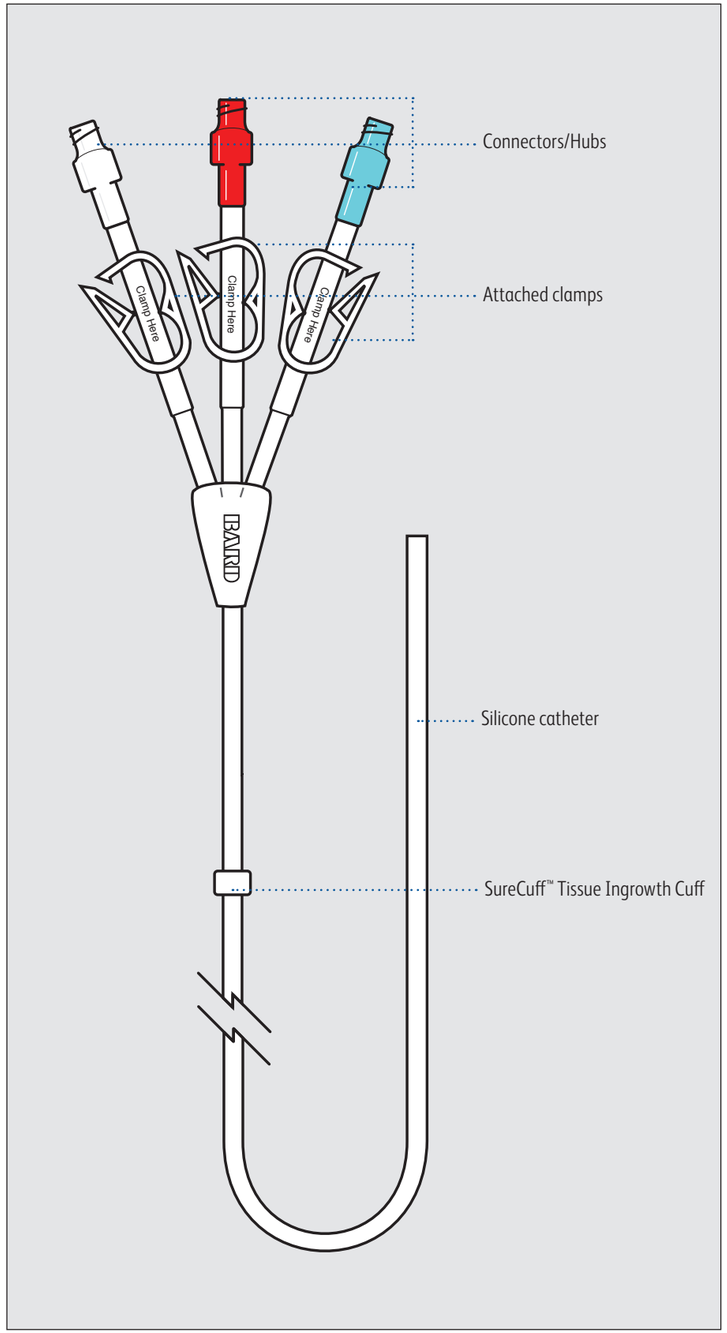
Single-Lumen Catheter Features



Dual-Lumen Catheter Features

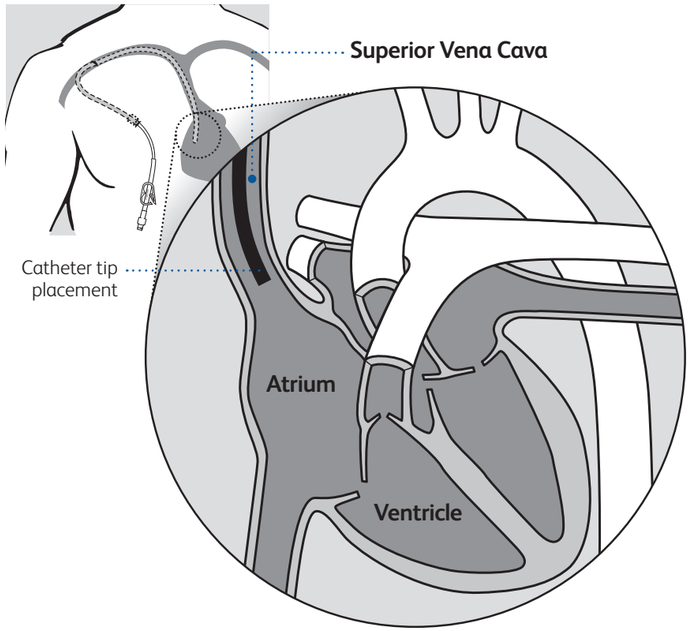


Triple-Lumen Catheter Features

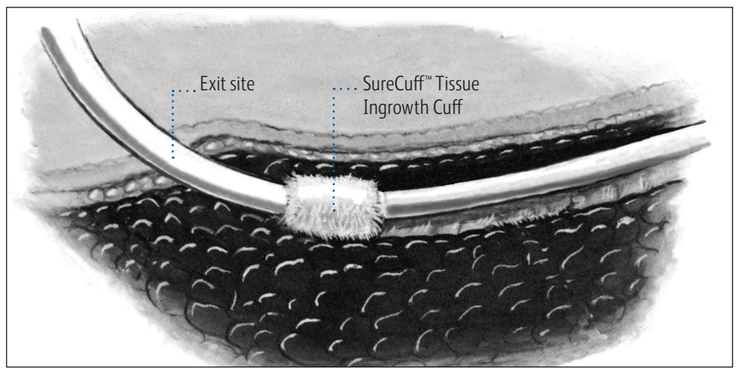


Placement

The catheter tip is placed via one of the large central veins into the superior vena cava above the right atrium. The proximal end of the catheter is tunneled subcutaneously for several inches to the desired exit site.



The SureCuff™ Tissue Ingrowth Cuff, attached to the catheter, is positioned in the tunnel. The cuff helps secure the catheter through fibrous tissue ingrowth and creates a physical barrier to help reduce the potential for infection caused by the migration of bacteria through the subcutaneous tunnel.



Indications for Use

Hickman™, Leonard™, and Broviac™ Central Venous Catheters are indicated for the administration of I.V. fluids, blood products, drugs and parenteral nutrition solutions, as well as blood withdrawal.

NOTE: While smaller lumen Broviac™ catheters have been used successfully for blood withdrawal, their small lumen sizes increase the chance of clotting.

Warnings

CAUTION: DO NOT USE A SYRINGE SMALLER THAN 10 ML TO FLUSH OR CONFIRM PATENCY

Patency should be assessed with a 10 mL or larger syringe with sterile saline. Upon confirmation of patency, administration of medication should be given in a syringe appropriately sized for the dose. Do not infuse against resistance.

Infusion pressures should never exceed 25 psi. Smaller syringes generate more pressure than larger syringes.

When catheter damage or connector separation occurs, the catheter should be immediately clamped or kinked closed to prevent any possibility of air embolism or loss of blood.

Universal precautions should be observed by all health care professionals when performing the procedures included in this manual.

Chlorhexidine gluconate 2% is the suggested antiseptic to use. Alternatively, 70% isopropyl alcohol swab-sticks followed by povidone-iodine may also be used as an antiseptic. Acetone and tincture of iodine should not be used because they could adversely affect the performance of the catheter and connectors.

CAUTION: Chlorhexidine gluconate solutions should not be used by persons who are known to be hypersensitive to chlorhexidine gluconate.

Follow chlorhexidine gluconate manufacturer's prescribing information for indications, contraindications, warnings, and precautions.

WARNING: Hickman™, Leonard™, and Broviac™ Central Venous Catheters are not indicated for power-injection.

CAUTION: Some patients may be hypersensitive to heparin or suffer from heparin induced thrombocytopenia (HIT) and these patients must not have their catheter locked with heparin flush solution.

Care and Maintenance

Catheter Flushing Protocol/ Medication Administration

Purpose

- To maintain catheter patency.
- To prevent mixing of incompatible medications.

Routine Maintenance

Flushing frequencies from once daily to once weekly have been found to be effective when the catheter is not in use. Flush with heparin after IV administration of total parenteral nutrition, IV fluids, or after medications. For frequently accessed catheters (accessed at least every 8 hours), flushing with 10 mL of sterile saline without heparin between infusions has been found to be effective.

NOTE: Preservative-free 0.9% Sodium Chloride USP is recommended by the Infusion Nurses Society. Single-use flushing systems (sterile saline and heparin solution) such as pre-filled syringes or single-dose vials, are the preferred choices for flushing and locking. If multiple-dose containers must be used, each container should be dedicated to a single patient.

NOTE: Flush the catheter using a “pulse” or “stop/start” technique.

NOTE: The catheter should be clamped between each use. Catheter clamping sequence is determined by needleless connector/injection cap directions for use.

CAUTION: DO NOT USE A SYRINGE SMALLER THAN 10 ML TO FLUSH OR CONFIRM PATENCY.

Patency should be assessed with a 10 mL or larger syringe with sterile saline. Upon confirmation of patency, administration of medication should be given in a syringe appropriately sized for the dose. Do not infuse against resistance.

Supplies

- Gloves
- Antiseptic wipes/device containing alcohol, chlorhexidine, or povidone-iodine
- Pre-filled sterile saline syringe
- Pre-filled syringe with at least 2.5 mL heparin solution (10 -100 units/mL or per facility protocol)

NOTE: The appropriate heparin concentration, volume, and flushing frequency should be based on the patient's medical condition, laboratory tests, and prior clinical experience.

Procedure

NOTE: For Broviac™ Catheters, follow the procedure below except use 2 mL sterile saline or 1.5 mL heparin solution.

1. Gather supplies, perform hand hygiene and don gloves per facility protocol.
2. Scrub the hub of the needleless connector/injection cap with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
3. Insert the sterile tip of the saline syringe directly into the needleless connector/injection cap and open clamp.
4. Aspirate slowly until a blood return is visualized.
5. Flush the catheter with at least 10 mL of sterile saline. Remove syringe.
6. Scrub the hub of the needleless connector/injection cap with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
7. Flush the catheter with at least 2.5 mL (or per facility protocol) of heparin solution. Do not allow the tip of the syringe plunger to bottom out against the base of the syringe. This helps prevent a vacuum which can pull a small amount of blood into tip of catheter.
8. Clamp the catheter.

Medication Administration

Complete steps 1-6 from the Routine Maintenance section above prior to medication administration.

1. Administer medication per facility policy, scrubbing between each medication syringe or before attaching the IV tubing.
2. Flush catheter with 10 mL of sterile saline between and after each medication.
3. Flush the catheter with at least 2.5 mL (or per facility protocol) of heparin solution. Alternatively, may use saline without heparin for frequently accessed catheters (accessed at least every 8 hours). Do not allow the tip of the syringe plunger to bottom out against the base of the syringe. This helps prevent a vacuum which can pull a small amount of blood into tip of catheter.
4. Clamp the catheter.

Blood Draw Procedure

Purpose

- To obtain blood samples for laboratory evaluation, without peripheral venipunctures.
- To verify venous placement prior to administration of I.V. fluids, blood products, medications and parenteral nutrition solutions.

NOTE: While smaller lumen Broviac catheters have been used successfully for blood withdrawal, their small lumen sizes increase the chance of clotting. The larger Hickman™ and Leonard™ Catheters are intended for both infusion of I.V. fluids, medications and nutritional solutions and for withdrawal of blood samples.

Supplies

- Gloves
- 3 - 10 mL pre-filled sterile saline syringes
- Empty sterile syringes (if drawing into syringes)
- Pre-filled syringe with at least 2.5 mL heparin solution (10 -100 units/mL or per facility protocol)
- Antiseptic wipes/devices containing alcohol, chlorhexidine, or povidone-iodine
- Vacuum blood collection system and specimen tubes
- 1 vacuum tube with at least a 5 mL volume for discard

Procedure

NOTE: Prior to blood sampling, all infusions should be stopped

1. Gather supplies, perform hand hygiene and don gloves per facility protocol.
2. Scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
3. Attach a 10 mL pre-filled sterile saline syringe to the needleless connector/injection cap, open clamp. Verify blood return and flush the catheter.
4. Pull back syringe plunger and aspirate 5 mL of blood (3 mL for pediatric) to discard. (This removes fluid from the catheter that can dilute the specimen.)

NOTE: A vacuum collection specimen tube may be used to withdraw the discard sample, but be sure to use one with at least a 5 mL capacity.

5. Remove syringe from needleless connector/injection cap and discard the blood filled syringe per facility protocol.
6. Scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.

7.

Blood Draw Through Needleless Connector or Hub to Hub	Blood Draw Through Vacuum Collection System
Attach empty syringe/syringes and draw volume needed for tests. Between each syringe, scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry. **NOTE:** Alternatively you may remove the needleless connector and attach the syringe directly to the catheter hub. Scrub the hub and clamp catheter between syringes.	Attach vacuum blood collection system to the needleless connector/injection cap per manufacturer's directions. Push blood specimen tube into vacuum collection device sleeve so that needle pierces rubber stopper. Blood needed for specimen will flow into specimen tube. Change tubes as needed for required tests. Remove vacuum blood collection system and sleeve from needleless connector/injection cap.

8. Scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
9. Flush catheter with 20 mL sterile saline to remove blood from the line, lock with heparin solution and clamp the catheter. Do not allow the tip of the syringe plunger to bottom out against the base of the syringe. This helps prevent a vacuum which can pull a small amount of blood into tip of catheter.
10. Change needleless connector/injection cap per facility protocol or if blood is seen in the connector and is not cleared by flushing.

Needleless Connector/Injection Cap Change Procedure

Purpose

- To minimize potential for infection.

Frequency

- Every seven days, per manufacturer's directions or per facility policy.
- When the needleless connector/injection cap has been removed for any reason.
- Anytime the needleless connector/injection cap appears damaged, is leaking, blood is seen in the catheter without explanation, or blood residue is observed in the needleless connector/injection cap.
- After blood withdrawal through the needleless connector/injection cap (per facility protocol).

Supplies

- Gloves
- New sterile needleless connector/injection cap
- Pre-filled sterile saline syringes (one for each lumen)
- Antiseptic wipes/devices containing alcohol, chlorhexidine, or povidone-iodine

Procedure

NOTE: Catheter should always be clamped before needleless connector/injection cap removal.

1. Gather supplies, perform hand hygiene and don gloves per facility protocol.
2. Using aseptic technique, open needleless connector/injection cap package and attach sterile saline syringe to connector, maintaining sterility of syringe tip. Prime the needleless connector/injection cap with saline.
3. Clamp catheter.
4. Remove the old needleless connector/injection cap.
5. Scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
6. Attach new needleless connector/injection cap per manufacturer's directions and twist clockwise onto the catheter hub. Avoid over-tightening.
7. Unclamp the catheter and flush, per flushing protocol.
8. Reclamp the catheter.

Dressing Change Procedure

Purpose

To prevent external infection of the central venous catheter.

Frequency

Assess the dressing in the first 24 hours after catheter placement and change if there is an accumulation of blood, fluid or moisture beneath the dressing.

Dressing change frequency after the first 24 hours:

- Transparent membrane dressing: change every seven days and as needed if dressing is loose, damp or visibly soiled.
- Gauze and tape dressing: change at least every 48 hours and as needed if dressing is loose, damp or soiled.

NOTE: With a well-healed tunneled central venous access device, consideration may be given to no dressing.

NOTE: When a transparent semipermeable membrane is applied over gauze, it is considered a gauze dressing and must be changed every 48 hours.

NOTE: Chlorhexidine gluconate 2% is the suggested antiseptic to use by the Infusion Nurses Society. Alternatively, 70% isopropyl alcohol swab-sticks followed by povidone-iodine may also be used.

Supplies

- Sterile dressing change kit is preferred or sterile supplies
- 1 pair sterile gloves
- 1 pair clean gloves
- Chlorhexidine gluconate 2% or other antiseptic solution per facility policy
- Transparent dressing large enough to cover the entire insertion site
- Sterile gauze (optional if insertion site is bleeding or oozing after placement)
- Masks (have patient turn head away from insertion site or wear a mask if they can tolerate)
- Securement device, tape or surgical strips
- Sterile needleless connector/injection cap
- Chlorhexidine antimicrobial patch (optional)
- Skin prep pad
- Label

Procedure

1. Gather supplies, perform hand hygiene and don clean gloves and mask per facility protocol.
2. Open dressing kit or supplies maintaining asepsis.
3. Carefully remove the old dressing and discard in accordance with blood and body fluids universal precautions. Avoid tugging on the catheter, use of scissors, or other sharp objects near the catheter.
4. Inspect the exit site for swelling, redness, exudate. During all dressing changes assess the external length of the catheter to determine if migration of the catheter has occurred. The SureCuff™ Tissue Ingrowth Cuff should be located inside the tunnel track. Notify physician if the cuff is seen outside the insertion site or if any problems are observed.
5. Remove gloves and perform hand hygiene.
6. Don sterile gloves.
7. Cleanse skin with chlorhexidine gluconate 2% antiseptic solution using a back and forth scrubbing motion for 30 seconds. Allow to completely air dry. Alternatively, 70% isopropyl alcohol followed by povidone-iodine may can be used.
8. Apply skin protectant per facility policy and allow to dry to the touch.
9. Place antimicrobial patch (e.g. GuardIVa™ chlorhexidine patch) around the catheter at the insertion site per facility protocol (optional).
10. Apply securement device per institutional policy avoiding the placement of tape directly on the silicone catheter material.
11. Position sterile transparent dressing over insertion site and gently smooth from center toward edge; do not apply excessive tension to skin; shearing may result. Gauze may be placed around the catheter if needed to absorb exudate from insertion site (gauze dressing will need to be changed at least every 48 hours).

Broviac™ Catheters

Secure catheter out of sight for infants and children by:

- Tunneling catheter to lateral back exit site.
- Using vests and other clothing to completely cover tubing and exit site.

Do not allow child to chew or pull on tubing at any time to avoid catheter damage or breakage.

Clearing Occlusions

Purpose

To restore patency to a catheter with a partial or total occlusion.

Supplies –Thrombotic Occlusions

- Gloves
- Sterile needleless connector/injection cap
- Thrombolytic solution mixed per manufacturer's directions
- Appropriately sized syringe
- Pre-filled sterile saline syringe
- Antiseptic wipes/devices containing alcohol, chlorhexidine, or povidone-iodine

Procedure –Thrombotic Occlusions

NOTE: Always clamp catheter before removal of needleless connector/injection cap.

1. Gather supplies, perform hand hygiene and don gloves per facility protocol.
2. Clamp catheter and remove needleless connector/injection cap.

3. Scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
4. Attach an empty 10 mL syringe to the catheter hub, unclamp catheter and attempt to aspirate. If aspiration is successful, withdraw clots and flush catheter with 10 mL sterile saline and clamp.
5. Scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
6. Attach new sterile needleless connector/injection cap (see Needleless Connector/ Injection Cap Change procedure). If aspiration is unsuccessful, proceed to step 7.
7. Obtain physician's order for the use of thrombolytic solution to declot the catheter.

NOTE: Cautions and dosing recommendations contained in medication package insert should be observed. Solution volume is determined by the drug manufacturer's prescribing instructions and internal volume of the catheter (volume may be reduced if catheter length has been cut).

8. Scrub the hub of needleless connector/injection cap with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
9. Aseptically attach the thrombolytic solution filled syringe to the needleless connector/injection cap. Unclamp catheter and administer thrombolytic solution per manufacturer's directions. To avoid catheter rupture, do not force entire amount into catheter if strong resistance is felt.
10. Allow thrombolytic solution to dwell per drug manufacturer's directions or per facility protocol.
11. When patency is restored, aspirate 5 mL of blood to assure removal of all drug and clots.
12. Discard blood-filled syringe. Scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to dry.
13. Flush catheter per flushing protocol and clamp. Remove and discard syringe.

Procedure – Non-Thrombotic Occlusions

For suspected lipid deposition occlusion when a thrombolytic solution does not clear the blockage, a sterile ethanol 70% solution may be instilled and left in place for two hours. Aspirate and flush with 10 mL of sterile saline. Repeat if occlusion is unresolved.

For suspected calcium/phosphate precipitation when thrombolytic solution does not clear blockage, a sterile 0.1% N hydrochloric acid solution (use exact priming volume) may be instilled in the catheter and left in place for one hour. The solution is then aspirated and the catheter flushed with sterile saline solution. Sodium bicarbonate may also be used for precipitates that are soluble in a basic solution.

Repair Procedure

Repair Kit / Specifications Table

Catheter Description	Repair Kit Product Code	Temporary Repair (G)	Total Length (cm)	O.D./I.D. (mm)
Single-Lumen				
Broviac™ Catheter 2.7F	0601600	24	71	0.9/0.5
Broviac™ Catheter 4.2 F	0601610	22	71	1.4/0.7
Broviac™ Catheter 6.6F	0601620	20	90	2.2/1.0
Hickman™ Catheter 9.6F	0601630	16	90	3.2/1.6
Dual-Lumen				
Hickman™ Catheter 7.0F	0601680 - white ext. 0601690 - red ext. 0601760 - body	16 (Legs)	65	2.3/0.8 - white 1.0 - red
Hickman™ Catheter 9.0F	0601680 - white ext. 0601690 - red ext. 0601700 - body	16 (Legs)	90	3.0/0.7 - white 1.3 - red
Leonard™ Catheter 10.0F	0601680 - white ext. 0601690 - red ext. 0601750 - body	16 (Legs)	90	3.3/1.3 - white 1.3 - red
Hickman™ Catheter 12.0F	0601680 - white ext. 0601690 - red ext. 0601710 - body	16 (Legs)	90	4.0/1.6 - white 1.6 - red
Triple-Lumen				
Hickman™ Catheter 10.0F	0601680 - white ext. 0601690 - red ext. 0601730 - blue ext. 0601790 - body	18 (Legs)	97	3.3/0.8 - white 0.8 - blue 1.5 - red
Hickman™ Catheter 12.5F	0601680 - white ext. 0601690 - red ext. 0601730 - blue ext. 0601740 - body	18 (Legs)	90	4.2/1.0 - white 1.0 - blue 1.5 - red
Adhesive				
Adhesive Repair Kit	0601720	Silicone Adhesive for Catheter repair (Does not contain catheter components)		

Catheter Repair Procedure

Purpose

To repair the damaged external portion of Hickman™, Leonard™, and Broviac™ Central Venous Catheters.

NOTE: Repair of the catheter body segment requires at least

5 cm of undamaged catheter remaining external to the skin exit site. Repair of the adapter leg of multi-lumen catheters requires at least 2.5 cm of undamaged adapter leg remaining proximal to the bifurcation or trifurcation.

CAUTION: The catheter should be clamped with an atraumatic clamp between the catheter exit site and the damaged area when damage occurs and must remain clamped during repair.

Supplies

NOTE: Chlorhexidine gluconate 2% is the suggested antiseptic to use. Alternatively, you may defer to facility policy.

- Sterile repair kit
- Antiseptic solution
- Atraumatic clamp
- Gauze sponges, 4 in. x 4 in. (10 cm x 10 cm)
- Heparin (volume and concentration per facility policy)
- Antiseptic wipes/devices containing alcohol, chlorhexidine, or povidone-iodine
- Scalpel or sterile scissors
- Sterile drapes
- Sterile gloves
- Surgical mask
- Syringe
- Tape
- Tongue blade or application sticks
- Sterile needleless connector/injection cap pre-filled with sterile saline

Warnings

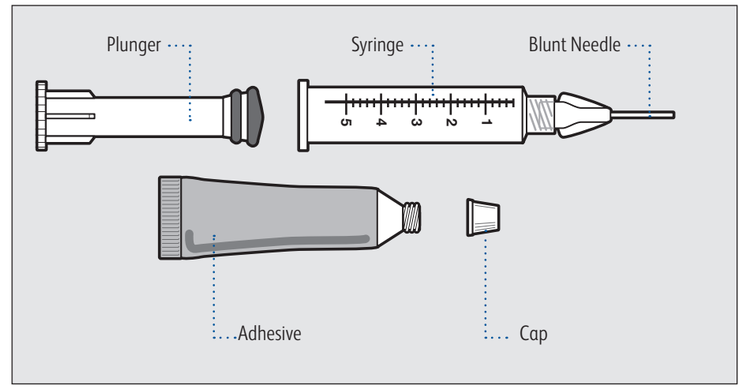
- The replacement segment, splicing sleeve, and stents will repair only the catheter and size for which the repair kit is indicated.
- Avoid accidental device contact with sharp instruments and mechanical damage to the catheter material. Use only smooth-edged atraumatic clamps or forceps.
- When cutting the damaged external catheter segment, a sufficient length of the external catheter segment must remain to permit repair and prevent catheter retraction under the skin line.

DO NOT USE A SYRINGE SMALLER THAN 10 ML TO FLUSH AFTER REPAIR.

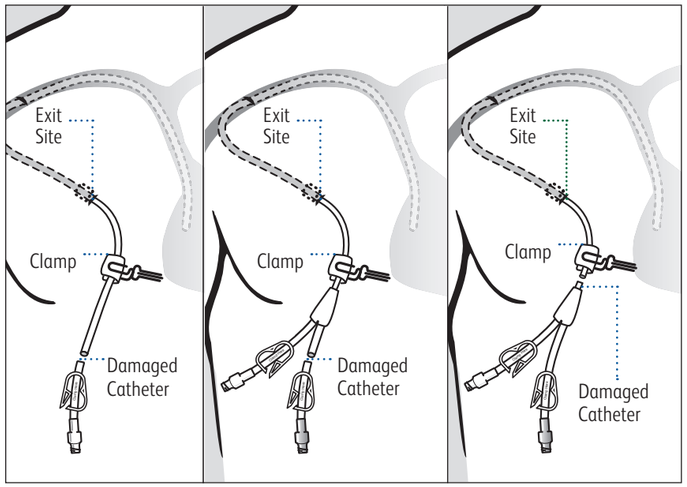
Procedure

CAUTION: Clamp catheter with an atraumatic clamp prior to preforming repair procedure.

1. Obtain a new sterile replacement kit of the correct size.
2. Perform hand hygiene, and don mask and clean gloves.
3. Using aseptic technique, open needed supplies and place on sterile field.
4. Scrub the external segment of the catheter with preferred antiseptic solution and gauze and allow to dry. Sterile 4 in. x 4 in. gauze pads may be used to grasp catheter for scrubbing.
5. Place the cleaned catheter onto a sterile drape.
6. Remove gloves, perform hand hygiene, and don new sterile gloves.
7. Drape catheter and create a sterile field per facility policy.
8. Remove plunger from syringe barrel, inject medical adhesive into syringe barrel, insert plunger, and attach blunt needle.

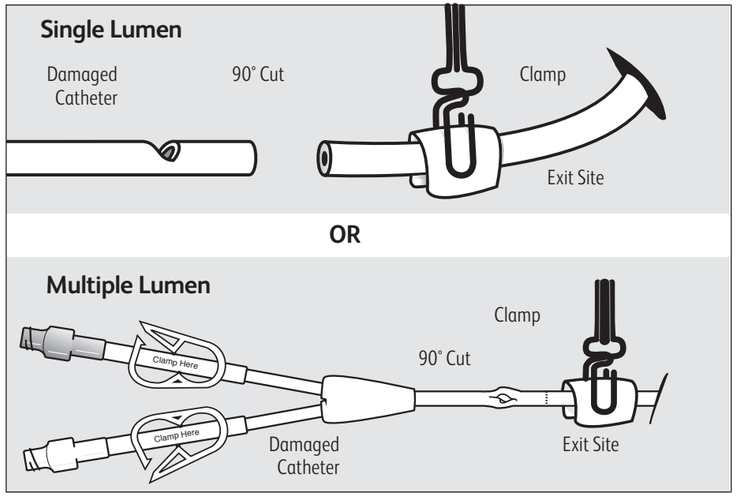


9. Reposition atraumatic clamp near the skin exit site.



Single Lumen Repair | **Multi-Lumen Adapter Leg Repair** | **Multi-Lumen External Segment Repair**

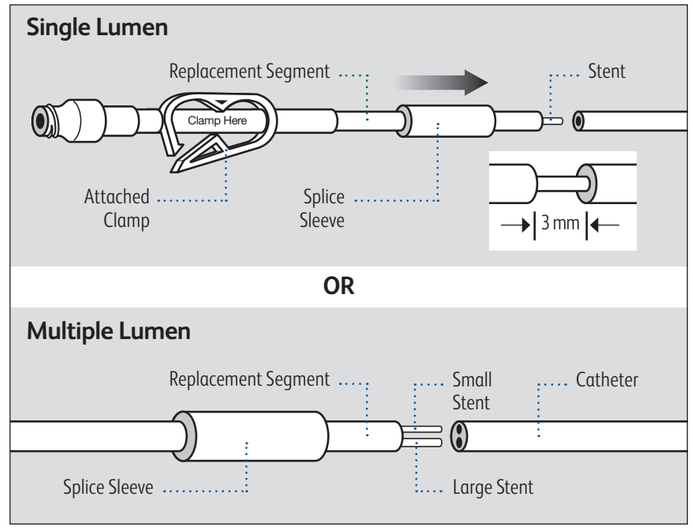
10. Cut the external portion of the damaged catheter at a 90° angle just distal to the damaged area.



WARNING: The length of the remaining external segment must be sufficient to permit catheter repair and prevent catheter retraction under the skin line.

Hickman™ and Leonard™ Adaptor Leg and Segment Attachment

1. Insert the stent attached to the replacement catheter segment into the catheter lumen until the end of the replacement catheter tubing is 3 mm from the cut end of the catheter.



NOTE: For all catheters, do not remove the splice sleeve that is loose-mounted on the replacement catheter segment.

NOTE: If the replacement segment is to be cut to desired length, the splice connector stent can be removed and reinserted.

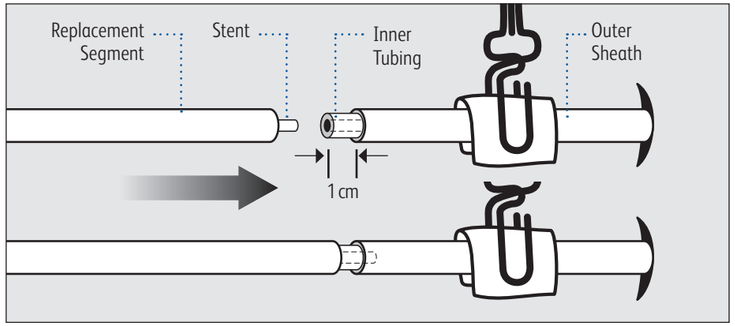
2. Dry space between catheter ends with a sterile 4 in. x 4 in. (10 cm x 10 cm) gauze pad. Fill the 3 mm space with adhesive and push the catheter ends together.

Broviac™ Catheter External Segment Attachment

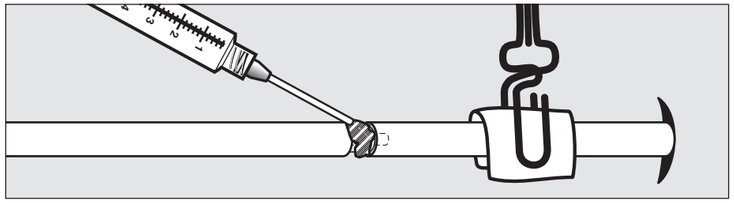
WARNING: The length of the remaining external segment must be sufficient to permit catheter repair and prevent catheter retraction under the skin line.

NOTE: If the inner lumen of the catheter retracts inside the outer sheath, the outer sheath should be cut off flush with the inner lumen.

1. Pull inner tubing from outer sheath 1 cm with atraumatic forceps. Insert the splice connector stent into the inner lumen until catheter segments are together. Lubricate with Isopropyl 70% alcohol if necessary, but be sure the alcohol is removed or evaporated before proceeding.

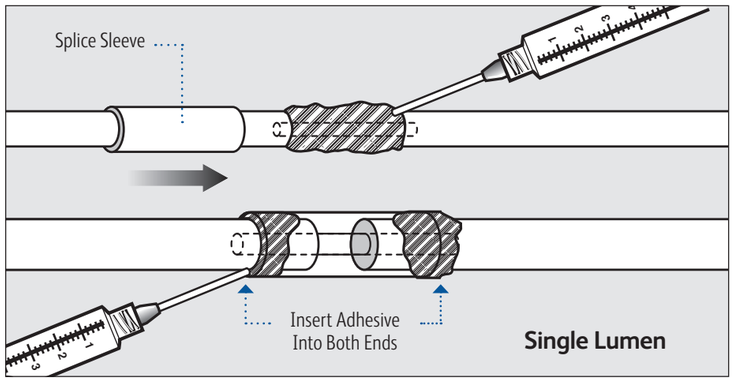


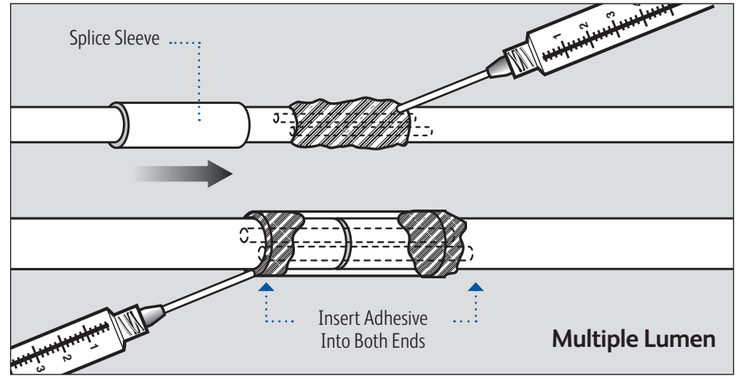
2. Use syringe to apply adhesive onto the exposed inner lumen and ease outer sheath over it. Roll between fingers to evenly distribute the adhesive and wipe away excessive adhesive.



Splice Sleeve Securement (For all catheter repairs)

1. Use syringe to apply adhesive onto the outside of the catheter around the spliced joint, covering an area about 2.5 cm overall length. Slide the splice sleeve down and center it over the joint. Inject adhesive underneath each end of the splice sleeve. Roll the splice sleeve between fingers to distribute and extrude excess adhesive. Wipe away excess adhesive.



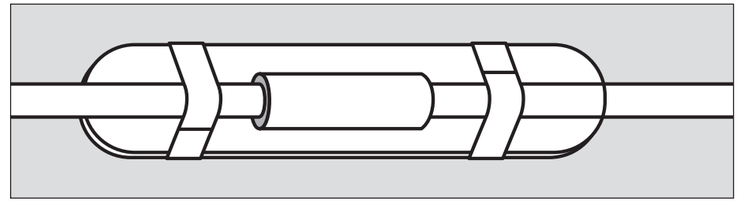


Sterile Field Is No Longer Required

2. Attach sterile needleless connector/injection cap to catheter hub. Remove clamp. Aspirate the air from the replacement segment. Scrub the hub with alcohol, chlorhexidine or povidone-iodine using friction and a twisting motion for no less than 5 seconds and allow to completely air dry. Gently fill the catheter with heparin and reclamp the catheter.

CAUTION: Excessive pressure may rupture joint.

3. Fasten catheter repair joint to splint (application sticks or tongue blade) with tape. Avoid contact of the adhesive with the patient's skin for 48 hours.



NOTE: If necessary, the catheter may be used for infusion after four hours. The joint will not achieve full mechanical strength for 48 hours. The splint may be removed at that time.

Troubleshooting Guide

Aspiration Difficulties

Possible Causes

- Failure to flush according to Catheter Flushing Recommendations, resulting in lumen obstruction.
- Catheter opening may suck up against vein wall with aspiration.
- Blood clot, fibrin sheath, or particulate matter obstructing valve when catheter is aspirated.
  - A clot or other obstruction in the catheter lumen can produce a one-way valve effect. During infusion, the catheter wall expands slightly and allows fluid to flow around the obstruction. During aspiration, the catheter wall contracts slightly, tightening down around the obstruction and preventing aspiration.
  - Fibrin sheaths can form quickly after insertion of a central venous catheter. Advancement of the fibrin sheath can lead to valve obstruction. Fibrin may be pulled into and obstruct the catheter valve when aspiration is attempted, but offer no resistance to infusion.
- Kinked catheter outside or inside the body.
  - Suture constriction at the catheter skin exit site, cuff, or vessel insertion site.
  - Catheter may be pulled too tight through skin tunnel, causing kink at vessel insertion site, or where it curves into the subcutaneous tunnel.
  - Catheter may be curled or kinked within the vessel, or under the dressing.
- Malposition of catheter tip (i.e., jugular vein, outside of vein).
- Compression or transection of the catheter between the clavicle and the first rib. See Pinch Off Troubleshooting.

Possible Solutions

1. Visually check catheter for any exterior kinks, or constricting sutures. If sutures are present, their removal may release the constriction and allow aspiration. A removable suture wing is supplied with the insertion tray to prevent suture constriction at the exit site.
2. If no resistance to infusion is noted, attempt to flush with 10 mL sterile saline. Then pull back gently on syringe plunger 2-3 mL, pause and proceed with aspiration.

NOTE: If resistance to infusion is noted, check for signs of extravasation. If present, notify healthcare provider of possibility of catheter leakage or transection and embolization.

3. Attempt to aspirate with a 20 mL syringe (creates a greater vacuum). If resistance is still present, follow facility protocol for the use of thrombolytic or other solution to clear catheter.
4. If occlusion remains, notify healthcare provider. Obtain an order for a catheter dye study and X-ray to determine catheter position and status.

Catheter Pinch Off

Pinch off: Compression or transection of a **subclavian placed catheter** between the clavicle and first rib.

Signs and Symptoms: Pinch off can cause intermittent inability to infuse or aspirate from the catheter. Sometimes lifting the shoulder or arm releases the compressed catheter and the catheter works as intended.

1. Obtain clinician order for a chest X-ray to determine the position of the catheter. X-ray must be taken with the patient's arms at their sides with normal posture. Raising the arms/shoulders upward can release catheter compression and give inaccurate results.
2. If the catheter has been placed through the pinch-off area, and is being compressed enough to interfere with infusion or aspiration, it is at risk for catheter transection and embolization. The physician should evaluate the patient for catheter replacement. Refer to the Hickman™, Leonard™, and Broviac™ Central Venous Catheter Instructions for Use, Pinch Off section for information and warnings.

Catheter Occlusion

Possible Causes

- Blood clot or fibrin completely obstructing lumen.
- Drug precipitate or lipid deposition completely obstructing lumen.
- Catheter may be kinked, coiled, damaged, or pinched between the clavicle and first rib.
- If sutures were used during the placement of the catheter, they can tighten and restrict flow.
- Catheter may be partially or completely transected. Transection can occur from the repeated pressure of the clavicle and the first rib on the catheter during normal movement if it is placed through the pinch off area.

Possible Solutions

1. Attempt to aspirate blood clot.
2. Move patient's arm, shoulder, and head to see if position change affects ability to infuse. If so, see Step 5 in this section (could be pinch-off).
3. Inspect patient and operative report for presence of sutures around the catheter. If sutures are present, they should be removed. Removable suture wings are available in the insertion tray for holding long-term catheters in place until the SureCuff™ Tissue Ingrowth Cuff heals in enough to anchor the catheter.
4. Follow facility protocol for the use of thrombolytic or other solution to clear catheter.
5. If occlusion remains, notify healthcare provider. Obtain an order for a catheter dye study and X-ray to determine catheter position and function.

Catheter Damage

Possible Causes

- Repeated clamping.
- Contact with a sharp object.
- Rupture from attempt to irrigate an occluded catheter with a small syringe.
  - Small syringes can generate very high internal pressures with very little force. The back pressure from an occlusion may not be felt when using a small syringe until damage to the catheter has occurred.

Possible Solutions

1. When repairing, always fold the catheter between the patient and the damaged area and tape it together, or clamp the catheter between the patient and the damaged area with a smooth-edged, atraumatic clamp.
2. Determine the site of damage and the size and type of catheter.
3. Refer to the appropriate Catheter Repair Procedure to repair the damage. Repair of the catheter body segment requires at least 5 cm of undamaged catheter remening external to the skin exit site. Repair of the adapter leg of multi lumen catheters requires at least 2.5 cm of undamaged adapter leg remaining proximal to the bifurcation or trifurcation.
4. Always use a 10 mL syringe or larger for flushing or checking patency. **Do not flush against resistance.**

Air in Line

Possible Causes

- Hole in catheter.
- Needleless connector/injection cap not pre-filled with sterile saline.
- Loose connections (needleless connector/injection cap, I.V. tubing).

- Diffusion and evaporation of water through the external catheter segment due to silicone permeability. Silicone has an open matrix which allows water vapor and gases to diffuse through the membrane.
  - The amount of diffusion that takes place is dependent on many factors. Therefore, not all patients with silicone catheters will demonstrate this phenomenon.

Possible Solutions

1. Check catheter for leakage by flushing well with sterile saline.
2. Pre-fill needleless connector/injection cap with sterile saline before attaching it to the catheter.
3. Check for loose connections (needless connector/injection cap, I.V. tubing).
4. If the catheter is not damaged, aspirate the air and then irrigate the catheter with 10 mL normal saline to flush out any aspirated blood. Heparin lock and clamp the catheter.

Fluid Leakage from Catheter Exit Site

Possible Causes

- Catheter punctured by sharp object (i.e., scalpel, suture needle, trocar) just prior to placement.
- Catheter ruptured from attempt to irrigate an occluded catheter with a small syringe (i.e., 1 mL or 3 mL syringe).
- Small syringes can generate very high internal pressures with very little manual force. The back pressure from an occlusion may not be felt when using a small syringe until the damage to the catheter has occurred.
- Catheter may have become encapsulated by a fibrin sheath which is preventing infused fluid from entering the venous system. The fluid will then take the path of least resistance, flowing back along the outside of the catheter to the skin exit site.
- Central vein thrombosis or tumor growth occluding the vein can cause infused fluid to flow back along the outside of the catheter to the skin exit site.
- Catheter may have been transected by the clavicle and the first rib due to placement through the "pinch-off" area, allowing fluid infused to flow back along the outside of the catheter to the skin exit site.

Possible Solutions

1. Infuse 10 mL of sterile saline and observe for signs of fluid extravasation under the skin.
2. Obtain order for a catheter dye study through the catheter to determine path of fluid flow.
3. Remove the catheter if a leak or transection is discovered inside the body.
4. If a leak is discovered in the catheter outside the body, repair it following the Catheter Repair Procedure.

References

"Tip Location of Peripherally-Inserted Central Catheters", Journal of the Association for Vascular Access, Vol. 3, No. 2, 1998, pp. 8-10.

Aitken, D.R., and Minton, J.P., "The Pinch-Off Sign": A Warning of Impending Problems with Permanent Subclavian Catheters", American Journal of Surgery, Vol. 148, Nov. 1984, pp. 633-636.

Alexander, M., Corrigan, A., Gorski, L., Hankins, J. and Perucca, R. "Central Venous Access Devices Care and Maintenance and Potential Complications", Infusion Nursing: An Evidence-Based Approach. 3rd ed. St. Louis: Saunders Elsevier, 2010. Print.

Ast, D., and Ast, T. "Nonthrombotic Complications Related to Central Vascular Access Devices", The Art and Science of Infusion Nursing, Vol. 37, No. 5, Sept/Oct. 2014, pp. 349-358.

Baskin J.L., Pui C.H., Reiss U., Wilimas J.A., Metzger M.L., Ribeiro R.C., Howard S.C., "Management of Occlusion and Thrombosis Associated With Long-Term Indwelling Central Venous Catheters", Lancet, Vol. 374, No. 9684, 2009 Jul, pp. 159-69.

Cleves, S., Earhart, A., Meaux, N., "New Standards for Catheter Occlusion Management", Nursing Practice Management, Vol. 1, No. 2, Mar. 2008.

Dennis, W.E., and Larson, W.D., "Permeation and Silicone Elastomers", Dow Corning Corporation, Medical Products Business, Technical Service & Development, Midland, MI.

Hadaway, L.C., "Reopen the Pipeline for IV Therapy", Nursing, Vol. 35, No. 8, 2005, pp. 54-61.

Herbst, S.L., Kaplan, L.K., McKinnon, B.T., "Non Thrombotic Catheter Occlusions and Their Treatment", Infusion, Vol. 4, No. 8, 1998, pp. 12-17.

Hinke, D.H. et al. "Pinch-Off Syndrome: A Complication of Implantable Subclavian Venous Access Devices", Radiology, Vol. 177, No. 2, Nov. 1990, pp. 353-356.

Infusion Nursing Standards of Practice. Journal of Infusion Nursing. 4th ed. 2011

Ingle, R.J., Nace, C.S. "Venous Access Devices: Catheter Pinch-Off and Fracture", 1993.

Kaler, W. et al. "Successful Disinfection of Needleless Access Ports: A Matter of Time and Friction", The Journal of the Association for Vascular Access, Vol. 12, Dec. 2012, pp. 140 –142.

Marschall, J., et al. "Strategies to Prevent Central Line – Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update", Infection Control and Hospital Epidemiology. Vol. 35, No. 7, July 2014.

Mayo, D.J. "Catheter-Related Thrombosis", Journal of Intravenous Nursing, Vol. 24, No. 3S, May/June 2001, pp. 13-22.

McGee, W., et al. "Accurate Placement of Central Venous Catheters: A Prospective, Randomized, Multi-Center Trial', Critical Care Medicine", Vol. 21, Aug. 1993, pp. 1118-1123.

O'Grady, N.P., Alexander, M., Burns, L.A., et al. "Guidelines for the Prevention of Intravascular Catheter-Related Infections, 2011", Centers for Disease Control and Prevention, 2011.

Peterson, J., et al. "Silicone Venous Access Devices Positioned with Their Tips High in the Superior Vena Cava Are More Likely to Malfunction", The American Journal of Surgery, Vol. 178, 1999, pp. 38-41.

crbard.com/peripheral-vascular | bd.com

BD, Tempe, AZ, USA, 1 800 321 4254