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KINGSTON GENERAL HOSPITAL

Central Venous Access Catheters

INTRODUCTION LEARNING PACKAGE

FOR
REGISTERED NURSES &
REGISTERED PRACTICAL NURSES

Original Issue: **May 2011**

INTRODUCTION

Only authorized nurses (RN and RPN) may provide care and procedures for a patient with a central venous access catheter.

1.1 Authorization Program

In order to care for a central venous catheter the Nurse must complete the following authorization program:

1.2.1 review the learning package and complete the authorization test with a score of 80% or greater;

1.2.2 attend an education session; and

1.2.3 successfully perform a return demonstration of the following steps to the Clinical Educator or designated delegate:

i] initiation of an infusion;
ii] discontinuation of an infusion;
iii] withdrawal of a blood specimen;
iv] flushing with heparin and saline solutions; and
v] changing the injection cap.

2.0 CENTRAL VENOUS ACCESS CATHETERS

A central venous access catheter is a catheter inserted through the subclavian, internal jugular or femoral veins; or peripherally through the brachial or cephalic veins (peripherally inserted catheter, or PICC). The distal end of the catheter is located in the superior or inferior vena cava.

These catheters provide reliable short or long term access for patients requiring chemotherapy, antibiotics, parenteral nutrition, fluids, blood products, pain management, and frequent blood sampling.

A central venous access catheter may also be inserted for hemodynamically unstable patients requiring central venous pressure monitoring.

2.1 Long Term Central Venous Catheters

Long term central venous catheters are implanted silastic catheters with external access. They are approximately 90cm in length. They are usually inserted through the upper chest and tunneled subcutaneously 5-10cm, ending in the superior vena cava. One or two dacron cuffs may be located within the tunnel. Fibrous tissue forms within 3-4 weeks around the cuff(s) stabilizing the catheter and preventing retrograde microorganism migration. Some exit site cuffs emit silver ions to combat microorganisms normally found on the skin surface.

A peripherally inserted central line (PICC) is inserted in the brachial or cephalic veins. These catheters are not cuffed or tunneled. They may be sutured in place to stabilize their position.

All long term central venous catheters are inserted by a physician or an interventional radiologist.

Note: As of Dec 2010, the advanced practice nurse for critical care has been authorized to insert peripherally inserted central lines (PICC).

2.2 Short Term Central Venous Catheters

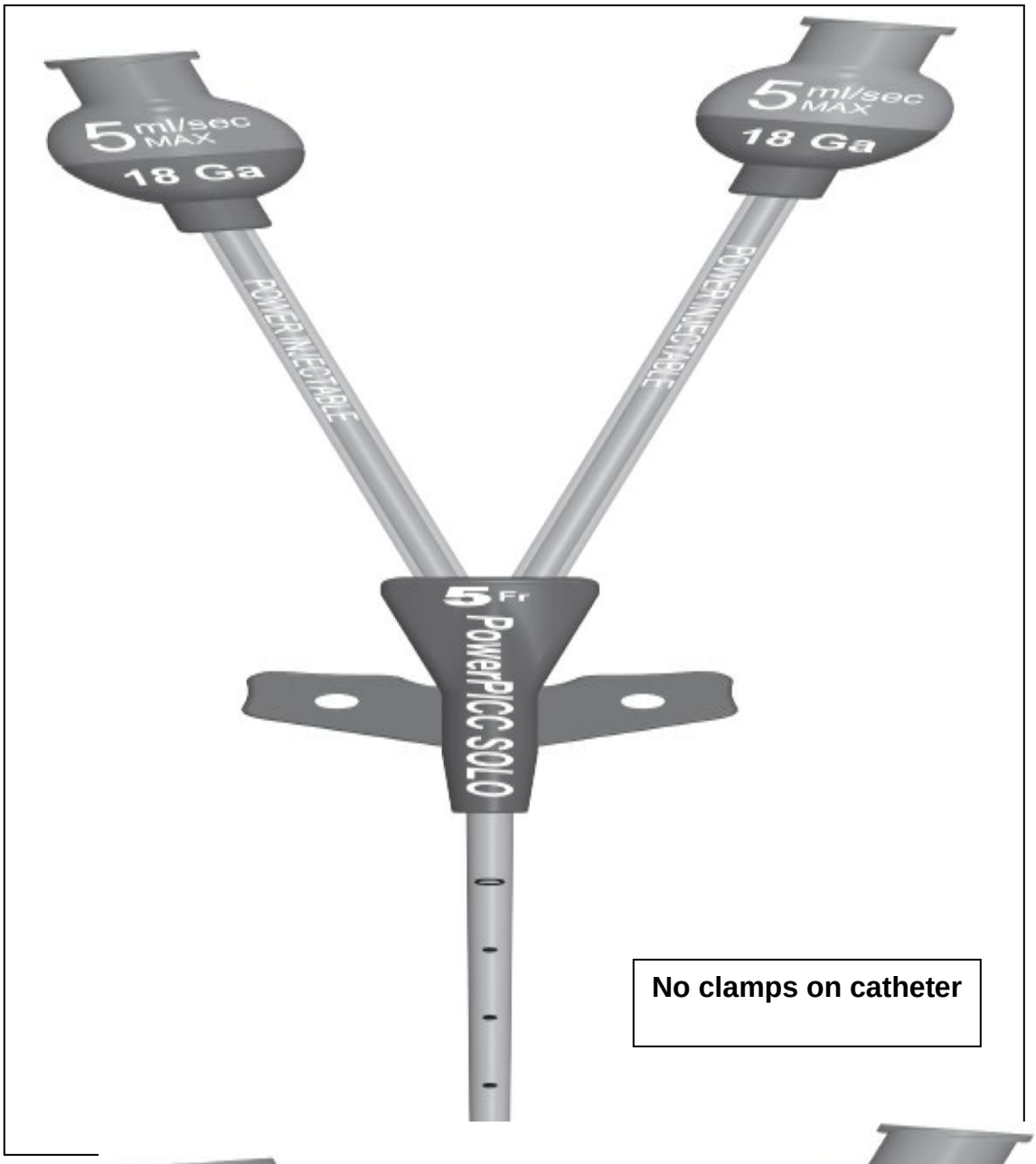
The short term central venous catheter is generally inserted in Imaging Services by an interventional radiologist. In an emergency situation, short term catheters may be inserted at the bedside by a physician.

The subclavian vein is the vein of choice for central venous catheter insertion, as it has a greater volume of blood than most veins. This allows hypertonic solutions such as PN to be diluted more rapidly. The tip of the catheter may rest in the superior vena cava or the right atrium of the heart. Short term central venous catheters may also be inserted in the internal jugular vein.

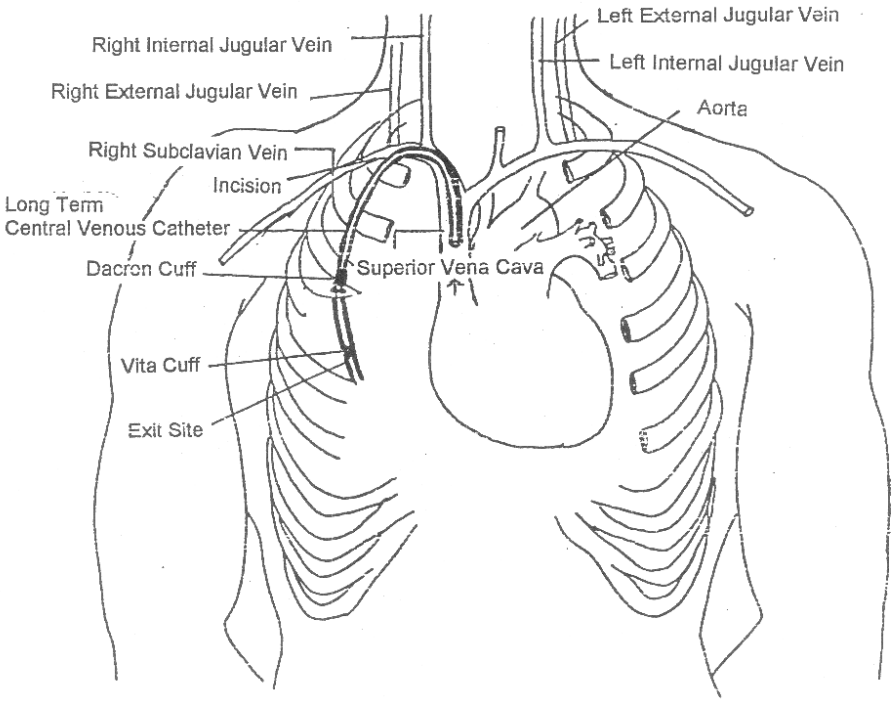
2.3 Valved Peripherally Inserted Central Catheter (PICC)

A central venous catheter with a valve that is present at the distal or proximal tip. Clamping is not necessary. Valved PICCs require application of positive pressure (flushing or infusion) or negative pressure (aspiration) for fluid to move within the catheter. Valved PICCs do not allow blood to back up into the lumen of the catheter and do not require heparin.

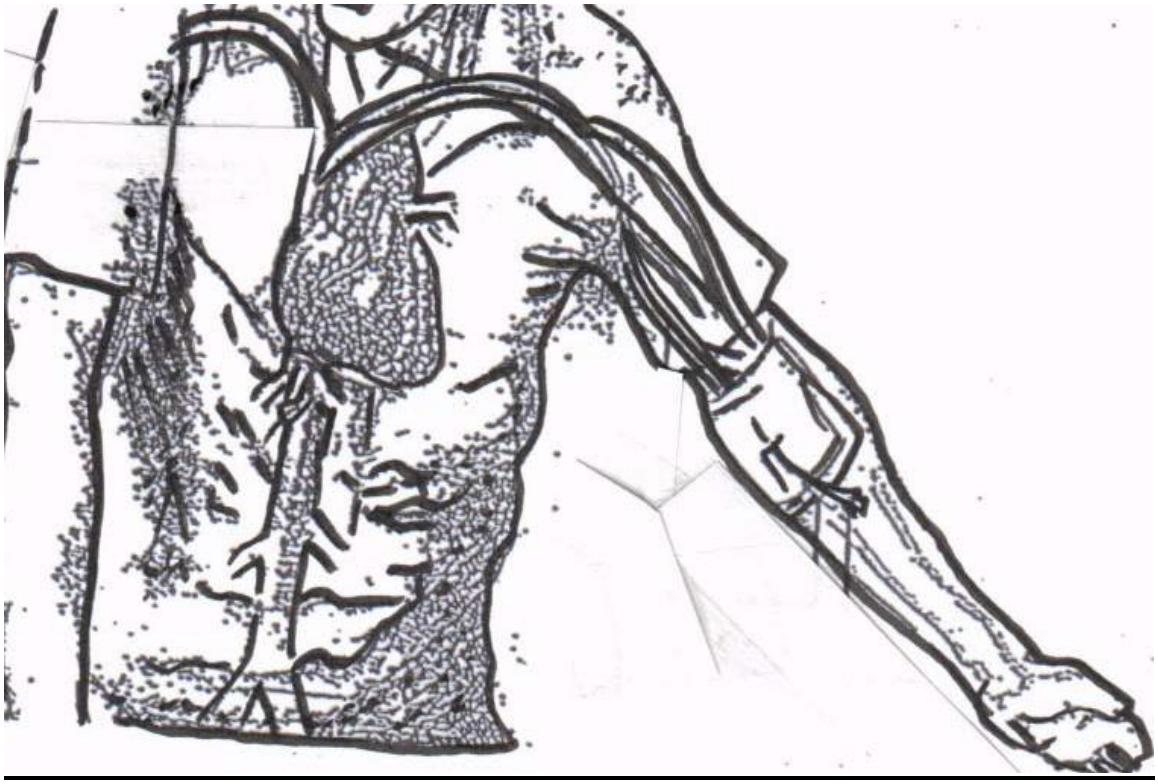
2.4 Picture of Valved PICC



2.5 Anatomical Location of Short and Long Term Central Venous Catheters



2.6 Anatomical Location of a Peripherally Inserted Central Catheter(PICC)



3.0 CATHETER CARE & MAINTENANCE

General Principles

1. All Pediatric patients will have their lines heparnized regardless if the catheter is valved or not.

2. Intravenous administration and extension sets must have luer lock connections.

3. Use a needleless system when gaining access to a central venous catheter for the administration of intravenous fluids, antibiotic therapy, parenteral nutrition and blood and blood products. This significantly reduces the risk of air embolus. All efforts must be made to maintain a closed system.

4. Assess central line insertion sites a minimum of once per 12 hour shift for evidence of cannula-related complications.

5. Change dressings with site changes; when the dressing is removed to inspect the site; or if the dressing is damp, loose or soiled. **NOTE:** nurses are advised to assess and change the dressing with tubing changes (every 72 hours.)

6. In the circumstance of a peripherally inserted central catheter (PICC) change the dressing according to the pre-printed order (24 hours after insertion, then weekly and prn).

7. The initial dressing on a long term central venous catheter, e.g., Hickman is left intact for 7 days to ensure healing and avoid dislodgment. The catheter may be secured with a device such as a 'Cath-secure' device to prevent tugging or twisting at the exit site.

8. When disconnecting intravenous tubing from a central venous catheter:
   Capped systems: Single clamp with one of the following:
   - forceps; or
   - clamp on the line.

   Systems that are not capped : Double clamp with any two (2) of the following:
   - forceps (with line cushioned between gauze);
   - clamp on the line;
   - closed stopcock; or
   - single clamp while the patient performs a Valsalva maneuver.

   Valved catheter systems: Do not require clamping when disconnecting IV tubing

9. Establish patency of the central venous catheter prior to each use by withdrawing 2.5 ml waste (if heparin used in line) otherwise 0.5 mL.

Note: if unable to withdraw blood attempt to flush…STOP if any resistance

10. If a central venous catheter should break or develop a hole in it, the nurse will:
    - Immediately clamp the catheter as close to the skin insertion site as possible with forceps or attach the 10mL syringe;
    - Position the patient in Trendelenburg position (on left side)
    - Notify the physician.

11. If a valved catheter develops a break or hole the nurse will clamp as close as possible to the patient as the valve will be lost. Notify physician.

12. Do not use a syringe smaller than 10mL for flushing. With a syringe smaller than 10mL the pressure created is too high and may damage the catheter.
    Note: Syringes smaller than 10mL may be used when administering medications to neonatal and pediatric patients.

13. When the central line is external and does not have a cap or valve, ensure that the patient has with him/her at all times:
    - forceps or a clamp on the line; or
    - a sterile 10mL syringe (adults); or
    - a sterile 10mL syringe with 0.9% sodium chloride (pediatrics).

14. Explain care of the central venous catheter to the patient:
    - Instruct the patient to clamp the line and call for assistance if the line becomes disconnected. If the patient has a valved catheter instruct the patient to call for assistance…no need to clamp

Intermittent Use of a Central Venous Catheter

Refer to policy

3.1 Post-Insertion Care

Nursing management after central venous catheter placement involves assessment of the insertion site. Observe the site for bleeding, drainage, hematoma, or seroma. Assess for local or systemic infection. Local infection may be manifested as pain, discharge, redness, and warmth around the site. The involved muscles may be stiff and sore. Symptoms of systemic infection may include chills, fever, general malaise, progressing to a weak, rapid heart rate, shallow respirations and hypotension.
A chest X-ray is taken post-insertion, to ensure correct placement and to confirm that the patient has not developed a pneumothorax. It is important to monitor the patient for signs and symptoms of a pneumothorax, such as:

- chest pain;
- shortness of breath;
- decreased breath sounds on the side of the central line; and
- increased heart rate.

3.2 Initiation of an Infusion

Refer to nursing policy and procedure.

3.3 Usual Flush Solutions for Central Lines

Refer to nursing policy and procedure.

3.4 Discontinuation of an Infusion

Discontinuation **does not** involve removal of the central line itself.

Refer to nursing policy and procedure.

3.5 Central Line Dressing

There is no consistent evidence to suggest best practice surrounding the frequency of central line dressing changes **however;** nurses are advised to examine the dressing at the time of tubing changes and to consider changing the dressing at that time. In the case of a PICC dressing it is indicated on the preprinted orders to change the dressing within the first 24 hours then weekly and prn.

Nursing Actions

1. Adhere to strict aseptic technique to prevent infection.
   - The nurse will wear a mask if he/she has a cold or if the patient is neutropenic.

2. Remove old dressing and assess catheter site and surrounding skin.
   - If redness, swelling, tenderness or discharge is noted, notify the physician. Request a physician's order for culture and sensitivity.

3. Assessment of Hickman catheter placement varies in the pediatric patient. Please consult with educator.

4. Remove the dressing for unsutured lines, e.g., Hickman, as follows:
   - Loosen the transparent dressing at the distal end
   - Anchor the catheter hub with one hand.
   - Peel the dressing carefully toward the insertion site and parallel to the skin.
   - Support the line in place as the dressing is removed.

5. Cleanse catheter site with chlorhexidine 2% aqueous solution or prepared swab. Using a continuous circular motion, gently clean outward from the catheter exit site for about 10cm (adult) or 5cm (pediatric). Continue cleaning for about 30 seconds and let dry. Cleanse proximal catheter

(10cm adult or 5cm neonate or pediatric) for about 30 seconds and let dry.

6. Cover with sterile transparent dressing or a gauze dressing, as applicable.
   - Patients who perspire, especially during the summer months, may experience a 'greenhouse effect' under the dressing. Signs of this may include redness, blistering and/or serous discharge. Patients with these signs should have their dressings changed to dry dressings, and may need to leave a well-healed catheter open to air.
   - A dressing may not be required on a long term, well-healed central venous catheter.

3.6 Obtaining a Blood Specimen

Refer to nursing policy and procedure.

Important Points to Remember

- **Coagulation studies** such as PT/PTT may be drawn from a central venous catheter when other access is not possible
- Always follow order of draw when obtaining samples as outlined on the blood requisition
- **Blood Cultures:** Label specimen and requisition precisely with bottle number, e.g., bottle 1 of 2, sample site, e.g., bottle 1 = proximal lumen of right subclavian line, date and time of sample draw, and patient's current prescribed antibiotics.
- **Note: no waste is required prior to obtaining blood cultures from the central line**
- When obtaining blood work from a Power PICC Solo (valved catheter) aspirate gently-pull back I mL and pause for 1-2 seconds as there are two valves to open.

3.7 Changing the Injection Cap

Refer to nursing policy and procedure.

3.8 Changing Intravenous Tubing

Nursing Actions

1. Apply mask to self and patient if patient is immunocompromised.

2. Assess the catheter site and the surrounding skin.

3. Prime the intravenous tubing with prescribed solution.

4. Scrub the catheter and intravenous tubing for a minimum of 30 seconds with povidone-iodine or alcohol swab. Let dry for two minutes. Place the cleansed line on sterile gauze 4x4.

5. Wash hands.

6. Capped system: Single clamp with either forceps or a clamp on the line;
   Systems that are not capped: Double clamp with any two of the following: forceps (with line cushioned between gauze); clamp on the line; or closed stopcock; or single clamp the catheter while the patient performs a Valsalva maneuver.
   Valved System: no clamping required but hold catheter below level of the heart

7. Glove. Remove the old intravenous tubing and insert the new intravenous tubing. Ensure luer lock is secured tightly.

8. Unclamp as required and initiate intravenous infusion. If patency not clearly established, consult physician.

3.9 Documentation

Documentation is required in the following areas, as indicated:

1. Continuous Parenteral Therapy Record (CPTR)
   - site and site checks
   - tubing/dressing change
   - solution
   - prescribed rate
   - volume hung and TBA (to be absorbed).
   - if continuous fluid is discontinued

2. Fluid Balance Record
   - fluid volumes infused and cumulate amounts.

3. Medication Administration Record
   - heparin and sodium chloride 0.9% and/or just sodium chloride 0.9% flushes.

4. Interprofessional progress Notes
   - any complications in relation to initiation or discontinuation of infusion;
   - any problems or potential problems related to assessment of site and dressing change;
   - nursing observations and interventions related to obtaining a blood sample;
   - any problems in relation to IV tubing change;
   - patient's response to interventions.

5. Patient Profile (Kardex)
   - next scheduled tubing change
   - next scheduled dressing change
   - next cap change

4.0 POTENTIAL COMPLICATIONS & MANAGEMENT

Central venous access catheters provide safe and reliable access to the venous or arterial system. However, as with any invasive device, there are certain risks and the potential for complications.

4.1 Infection

Infection may occur at the exit site, inside the catheter or along the track through which it is tunneled. The main causes include contamination of the hub or injection site cap, contamination from percutaneous entry, or systemic sepsis.

Nursing Assessment

1. Assess the patient at least every 12 hours for signs and symptoms of local or systemic infection. Inspect the site and palpate the tunnel track of a long term central venous catheter for tenderness or induration, and observe for erythema, drainage and swelling. The patient may also complain of a sore, stiff shoulder.

2. Assess the patient for systemic signs of infection. Monitor for an elevated leukocyte count, tachycardia, glucose intolerance, hypotension, fever, chills or general malaise.

Nursing Interventions

1. Use aseptic technique when accessing the central venous catheter.

2. Adhere to dressing change technique.

3. Apply a transparent dressing over the exit site.

4. Apply injection caps to each lumen. This closes the system, thus decreasing the risk of infection.

5. If signs/symptoms of exit site infection are present:
   - Request a physician's order and collect an exit site swab for culture and sensitivity.
   - Collect urine, sputum and blood cultures, as ordered. (Blood cultures are drawn from each lumen of the central venous catheter, as well as peripherally.)
   - Infuse antibiotics and/or anti-fungal agents via the catheter, as ordered.

4.2 Occlusion

Occlusion may be due to a variety of reasons. These include:

- catheter thrombosis (prevents both fluid flow into the catheter and blood return);
- medication precipitate;
- fibrin sheath formation;
- catheter tip resting against the wall of the vein (prevents blood return and infusion of fluids may or may not be impeded); and
- failure to use positive pressure.

Nursing Interventions

To prevent occlusion

1. Check for incompatible medications prior to simultaneous or sequential infusion of two or more medications.

2. Always use stop start technique and positive pressure technique when flushing the catheter to prevent reflux of blood into the catheter tip.

3. Assess catheter patency prior to administering any medication or fluid.

4. Flush the central venous catheter a minimum of once weekly and following each use.

If occlusion occurs

1. If blood does not return:
   - Ask the patient to change positions, raise his/her arms, and/or cough repeatedly in order to shift the position of the catheter from the vein wall.
   - Attach a 10mL syringe with 3mL sodium chloride 0.9% to the catheter. Attempt to withdraw a possible blood clot by pulling and then releasing on the plunger. **Never** inject any solution into the catheter when patency is not clearly established. Continue with the previous interventions.
   - If the infusion continues to be impeded after these measures, notify the physician. A fluoroscopy needs to be performed in Imaging Services to determine the presence of a fibrin sheath, or a thrombus. A fibrin sheath on the end of the catheter acts as a valve that closes against the tip of the catheter when a vacuum is created during blood withdrawal.
     Fibrin or blood clots may be dissolved using Urokinase, which converts plasminogen to plasma and acts directly on the clot. Urokinase (concentration 5000IU/mL) is instilled into the catheter **by a physician.**

The amount is calculated according to the internal diameter or the total volume of the catheter. After instillation, the drug is allowed to act for 5 minutes. After 5 minutes, an attempt to aspirate is made every 5 minutes for 30 minutes. After 30 minutes, the catheter is clamped and another attempt may be made in 30 minutes. If this is unsuccessful, a second instillation is performed.

4.3 Air Embolism

Air may enter an unvalved catheter if it becomes disconnected while unclamped. Air may enter a valved catheter if there is a hole in the catheter or the injection cap is not prefilled with normal saline. During inspiration, thoracic pressure decreases compared to atmospheric pressure. Air travels from an area of high pressure (atmosphere) to an area of low pressure (intra-thoracic), thus causing an air embolism.

Nursing Interventions
Prevention is the best intervention.

1. Ensure an injection cap is attached to each lumen of the central venous catheter.

2. Ensure that all connections are securely luer-locked.

3. When accessing a closed system (the injection cap is on), single clamp the catheter. When opening the system (the injection site cap is off), double clamp the catheter or single clamp the catheter while the patient performs a Valsalva maneuver.

4. **Remember** a valved catheter does not require clamping but still maintain a closed system as much as possible. If the cap is removed from the valved catheter ensure that the catheter is held below the level of the heart.

5. After the injection cap has been changed, always ensure that any air within the injection site cap/catheter has been withdrawn prior to injecting any fluid.

6. If the line is severed or disconnected, teach the patient to place his/her thumb over the end of the catheter, clamp the line with forceps or a clamp and call for immediate assistance. If concern of an air embolus position patient on left side in Trendelenburg position to trap air in the right side of the heart so that it will not travel to the pulmonary system.

7. If the valved catheter is damaged below the valve clamp the line.
Note the valve is in the hub of the catheter.

8. **Never** use scissors to remove the dressing.

4.4 Dislodgment of Line

Newly inserted long term central venous catheters are rarely sutured in place and rely on the dressing to hold them securely until healing has occurred. When healed, the cuffs secure the line within the tunnel. Short term central venous catheters are usually sutured in place. Dislodgment can occur if the catheter is accidentally pulled.

Nursing Interventions

1. Assess the length of the catheter daily.
2. Use a Cath-Secure device to prevent pulling on the catheter.
3. Assess the exit site for edema.
4. Palpate the exit site and tunnel of a long term catheter for coiling.
5. Assess the patient for distended neck veins.
6. Do not change the dressing on a long term catheter for the first seven days following insertion.
7. Verify the position of the catheter by X-ray prior to its initial use. An X-ray should also be taken if dislodgment is suspected.

4.5 Migration

Since the subclavian is a low-pressure vein, the catheter may migrate into other closely associated veins or into the right atrium. Catheter migration can cause life-threatening complications such as:

- perforation of the pleura, heart or great vessels;
- infiltration;
- myocardial irritations;
- pneumothorax or hemothorax.

Nursing Interventions

1. Assess for edema of the arm and/or hand on the side of the catheter.
2. Assess for distended neck veins.
3. Assess the length of the catheter daily.
4. If migration is suspected, notify a physician.
5. Confirm that a placement X-ray has been performed prior to initial use.

Some less frequently used nursing interventions to assess catheter migration include:

6. Assess the patient for migration of the catheter to the internal jugular vein by monitoring for ear or neck pain on the side of placement and by asking the patient if he/she hears swishing or gurgling sounds.

7. Assess for migration of the catheter to the right atrium by assessing for palpitations and/or cardiac arrhythmias.

8. Assess for backflow of blood into the catheter. This may be due to the migration of the catheter into the right atrium.

4.6 Pneumothorax

Insertion of a central venous catheter can be difficult. The subclavian vein lies in close proximity to the lung. During insertion, the catheter may inadvertently be threaded through both the visceral and parietal linings of the lung and directly into the lung. This results in a pneumothorax.

Nursing Interventions

1. Assess the patient for chest pain, shortness of breath, decreased breath sounds on the side of the insertion, decreased blood pressure, tracheal deviation to the unaffected side, and increased heart rate.

2. Prepare to administer oxygen, as indicated.

3. Obtain chest X-ray to rule out a pneumothorax.

4. Prepare for the insertion of a chest tube.

4.7 Damaged Catheter

A central venous access catheter can become damaged when:
- the catheter is not clamped on the reinforced portion;
- if too much positive pressure is exerted; or
- if the catheter becomes cut/develops a hole.

Fluid will leak at the damaged portion of the catheter. There is a risk of air emboli with a damaged catheter.

Nursing Interventions

1. Assess for holes, leaks and cuts during each shift.

2. Use the needleless system to decrease the risk of accidental punctures.

3. Clamp only on the reinforced section of the catheter with forceps (padded with 2x2 gauze).

4. Never use scissors on a central venous catheter.

5. Do not use a syringe smaller than 10mL.

6. If the catheter is damaged, clamp the catheter as close to the exit site as possible. Do not remove catheter.

4.8 Phlebitis

Phlebitis at the insertion site may occur as a result of a mechanical irritation or a break in aseptic technique. Signs and symptoms include: fever, pain, erythema, swelling, and induration at the site or along the venous tract.

Nursing Interventions

1. Assess the patient for signs and symptoms of phlebitis.

2. Apply warm, moist compresses to the insertion site and upper arm every 4 hours for fifteen minutes until the phlebitis clears.

3. Elevate the extremity.

4. Encourage range of motion (ROM) exercises.

5. Assess the insertion site for drainage or discharge. Notify the physician and send a culture and sensitivity swab as ordered.

6. The physician may order antibiotic therapy to treat the phlebitis. If the phlebitis progresses, the physician will remove the catheter.

Policies to Consider:

- C-1800
- C-1805
- C-1806
- C-1810
- C-1812
- C-1813

CENTRAL VENOUS CATHETER AUTHORIZATION TEST

Name: _____

Date: _____

1. A central venous catheter is a catheter that can be inserted centrally or peripherally via which routes:

    a) subclavian, jugular or femoral
    b) brachial, saphenous or cephalic
    c) both a & b
    d) only a

2. A valved peripherally inserted central catheter is a central line that has a valve at the proximal or distal tip and does not require clamping.

    a) True
    b) False

3. The stop/start technique for flushing requires the practitioner to:

    a) Use heparin with positive pressure technique
    b) Use heparin and 0.9% sodium chloride intermittently when flushing
    c) Clamp the catheter and withdraw while injecting the last 0.5 mL of 0.9% sodium chloride
    d) Flush 2-3 mL at a time pausing between each mL to create a turbulent effect to remove blood from the inside of the catheter

4. Verification of blood return is necessary prior to flushing or establishing an infusion in any central line:

    a) True
    b) False

5. A peripherally inserted central line without a valve should be clamped any time the system is open

    a) True
    b) False

6. Prior to blood sampling from a central line a total waste of _____ mL (Adult) and ____ mL (pediatrics) must be withdrawn and discarded. **Note**: pediatric answer will vary based on weight i.e. 5 kg or less

7. Post blood sampling a flush of ____mL (adult) and ____mL (pediatric) 0.9% sodium chloride is necessary to clear the line.

8. A central venous catheter should **never** be flushed with a syringe smaller than 10 mL

    a) True
    b) False

9. Catheter cap(s) must be changed on a central line:

    a) Every 7 days for a PICC
    b) Anytime the cap is damaged, leaking or filled with blood
    c) Every 72 hours for a short-term central line i.e. in the jugular
    d) With the intravenous tubing every 72 hours in the case of a continuous infusion
    e) All if the above

10. If a central venous catheter should break or develop a hole the nurse should:

    a) immediately clamp the catheter as close to the skin insertion site as possible and notify the physician
    b) raise the head of the bed
    c) place the patient in trendelenburg position
    d) a & c
    e) a & b

11. The valved PICC not in use requires a 20 mL 0.9 sodium chloride flush using the stop/start technique weekly.

    a) True
    b) False

12. Central lines without a valve require flushing with 0.9% sodium chloride and heparin using the:

    a) positive pressure technique
    b) stop/start technique
    c) a & b
    d) only a

13. All pediatric patients will have their lines heparnized if the catheter is valved or not;

a) True
b) False

14. State three (3) other potential complications associated with management of central venous access catheters and the nursing management of each.

Complication	Nursing Management

15. Describe two (2) circumstances when the catheter cap should be changed.

5.0 AUTHORIZATION RECORD – CENTRAL VENOUS ACCESS CATHETERS

Name: _____

SKILL	DATE	SIGNATURE OF CLINICAL INSTRUCTOR OR DELEGATE
1. Initiation of an infusion		
2. Discontinuation of an infusion		
3. Obtaining a blood specimen		
4. Changing an injection cap		
5. Flushing with heparin and saline solutions		
6. Quiz		

6.0 EVALUATION OF LEARNING GUIDE

Your feedback and comments are most appreciated. Thank you for your time in completing this questionnaire. It will help us in planning and revising learning materials.

Please circle appropriate response	Strongly agree				Strongly disagree
1. The content was clear and easy to understand. Comments:	5	4	3	2	1
2. The content was relevant. Comments:	5	4	3	2	1
3. I feel that my learning needs were met. Comments:	5	4	3	2	1
4. This guide will help me to meet the knowledge/skill requirements of caring for patients with central venous access catheters. Comments:	5	4	3	2	1

Additional comments/suggestions:

Please return completed evaluation to your Clinical Educator. Thank you.