Capital Health

Learning Module for
Care of an Occluded
Central Venous Access Device

Post-Entry Level Competency
CC 80-022
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PURPOSE
The Registered Nurse (RN) will demonstrate knowledge of the theory and skill related to the nursing care of an occluded central venous access device.

LEARNING OBJECTIVES
Following completion of the learning activities, the RN will be able to:
1. Describe both the external and internal causes of an occluded central venous access device (CVAD).
2. Describe interventions to prevent an occlusion.
3. Define a total and partial occlusion.
4. Identify the signs and symptoms of a catheter related thrombus, drug precipitate and waxy lipid residue.
5. Describe the nursing interventions related to a suspected CVAD occlusion.
6. Describe the management of an occluded CVAD.
7. Identify the action, contraindications, and adverse effects of alteplase.
8. Describe the theory and procedure related to instillation of alteplase.

REQUIREMENTS FOR COMPETENCY
Nursing care of an occluded central venous access device (CVAD) is a Post-Entry Level Competency (PELC) for a Registered Nurse (RN) which requires the RN to:
1. Be deemed competent in the PELC of caring for CVADs
2. Review the policy, learning module and complete the self-test for the Care of an Occluded CVAD.
4. Maintain a record of competence and conduct a yearly self-assessment of competency level.

THEORY
Catheter occlusions are a common complication of CVADs. Loss of catheter patency occurs for many reasons and may include kinking, malpositioning, fibrin sheath buildup, lipid deposition, device breakage and drug precipitates. The most common reasons for occlusions are fibrin sheaths or clots. Early identification and prompt intervention is critical. The longer the catheter remains occluded the lower the success rate of catheter clearance.
PREVENTING OCCLUSIONS

The primary approach to managing a CVAD occlusion is through prevention, based on following proper care and maintenance procedures, use of positive pressure adaptors on all lines and use of normal saline flush before and after blood withdrawal, or blood/medication administration.

NURSING IMPLICATIONS

1. Maintain regular flushing schedules for venous access devices when not in use.
2. Use turbulent flushing technique. The turbulent flush technique, best described as a stop/start motion, allows the solution to clear the walls of the catheter to help prevent buildup of fibrin or medication precipitate. Turbulent flushing must be done with hands on technique, using a syringe. Flushing using normal saline via the pump does not provide an adequate flush.
3. Follow the principles of positive pressure flushing and ensure a positive pressure device is used on all CVADs. Positive pressure technique using the CLC 2000™ positive pressure adaptors includes the following steps:
   o Scrub the white valve of the CLC 2000™ with an alcohol swab for 15 seconds.
   o Attach 10 mL normal saline syringe, confirm blood return, and flush through the adaptor using turbulent flushing technique.
   o Remove syringe and ensure the white valve is not depressed
   o Clamp the lumen.
   NOTE: If the white valve is depressed, there is no positive pressure applied and the CLC 2000™ should be replaced and the lumen re-flushed.

DEFINITIONS

Patent Catheter No resistance to flushing and unimpeded blood return on aspiration.

Partial Occlusion Able to infuse fluid but blood return is sluggish or absent on aspiration. OPTIMAL TIME FOR INTERVENTION

Total Occlusion No solution can be infused and no blood can be aspirated.

CAUSES OF OCCLUSION:

Catheter occlusions may be thrombotic, non-thrombotic or mechanical.

1. Mechanical Obstruction
   a) Empty IV bag
b) Closed clamp  

c) Kinked or twisted tubing  

d) Pressure on line due to dressing  

e) Patient position may be such that catheter tip is occluded in the vessel  

f) Catheter malposition: Tip of catheter no longer located in the superior vena cava at right atrial juncture.  

g) Pinch-off syndrome: Pinch-off syndrome is the anatomic mechanical compression of a catheter as it passes between the clavicle and first rib at the costoclavicular space. The catheter lies in the costoclavicular space next to the subclavian vein instead of in the vein. This complication results in intermittent occlusion that is temporarily relieved by specific position changes such as raising the arm or rolling the shoulder on the CVAD side. This syndrome can lead to fracture of the catheter and embolism. **A line that is being pinched must be removed.**  

h) Catheter kinkage: Occurs when the catheter migrates and becomes twisted or bends inside the vein or in the subcutaneous tunnel tract.

2. **Non-thrombotic Occlusions**  

a) Caused by infusion of incompatible solutions or inadequate flushing. Results in drug crystallization in the catheter or distal tip. Lipid accumulation may be another cause of CVAD occlusion.

3. **Thrombotic Occlusions**  

a) Occur when fibrin or thrombi accumulate within, surrounding, or at the tip of catheters.  

b) There are 4 main types of thrombotic occlusions:

i. **Intraluminal**: develops when fibrin accumulates in the lumen, causes sluggish flow and complete obstruction is possible. Contributing factors may be insufficient flushing, frequent blood withdrawal and reflux of blood into the catheter perhaps secondary to improper use of positive pressure adaptors.

ii. **Mural (Vein wall)**: Thrombus forms when catheter tip irritates the vessel wall to the extent of injury. Fibrin from the injured area binds to fibrin that has formed on the catheter surface, causing the catheter to anchor to the wall and cause obstruction of tip.

iii. **Fibrin tail**: Fibrin adheres to the end of the catheter. This tail or flap often acts as a one way valve, allowing infused solution to push the tail away from the catheter tip but preventing withdrawal as the suction causes the tail to be sucked against the tip.

iv. **Fibrin sleeve/sheath**: Develops when fibrin adheres to surface of catheter forming a sock-like adhesive sleeve around the distal end of catheter. Infused solutions get blocked by the sheath. This may cause retrograde flow back up length of catheter internally and/or

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back along the sheath on the outside of the catheter causing tissue irritation and necrosis.

PATHOPHYSIOLOGY OF CLOT (THROMBUS) FORMATION

A clot develops when thrombin, an enzyme made from prothrombin, converts fibrinogen to fibrin, a collagen. This fibrin is what actually forms the clot. Normally when this happens, activated plasminogen forms plasmin, an enzyme that dissolves the clot and keeps fibrinogen from forming more fibrin. This is called fibrinolysis. The natural response of fibrinolysis may not occur inside a Central Venous Access Device (CVAD), so when a clot or fibrin sheath occludes the catheter, a thrombolytic agent must be instilled to restore patency.

PARTIAL / TOTAL OCCLUSIONS
Catheter occlusions may be partial or complete (total). A complete or total occlusion is easily recognized because neither infusion of fluid nor aspiration of blood can be accomplished. With a partial occlusion, fluid can still be infused but blood return cannot be accomplished.

SIGNS AND SYMPTOMS OF CATHETER OCCLUSION
a) inability to infuse / flush
b) resistance with flushing
c) lack of blood return
d) edema – catheter site, hands, arms, face, and shoulder
e) vein distention (i.e. neck and chest wall veins)
f) pain (aching, burning, tenderness, or severe pain at the sites and/or along the tunnel tract)
g) numbness/tingling of fingers, hands, arms
h) skin temperature changes and/or skin discoloration (esp. hands/arms)
i) leakage of infusate at exit site.

ASSESSMENT / TROUBLE SHOOTING
The assessment of a partially or totally occluded CVAD should include the following:
   a) Review line and medication history.
   b) Exclude external causes of catheter obstruction:
      o Check entire tubing and delivery system for kinks or malfunctions. Be certain the dressing is not occluding the catheter. Check to see if line is clamped. For an implanted infusion port, ensure needle is in proper position.
      o Check for blood return with patient sitting and leaning forward or lying on right or left side, have patient deep breathe and cough (Rationale: line may be resting against a vessel wall).

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o Assess for catheter migration, pinch off syndrome, neck vein distention, ear popping, back pain, burning or stinging with infusion. If present catheter placement must be confirmed.

c) Key assessment questions:
   i. How has the CVAD been functioning?
   ii. When was the line last flushed?
   iii. What was infusing when the occlusion occurred?
   iv. Did the occlusion occur during blood specimen collection?
   v. Was the onset of the occlusion sudden or gradual?

d) Based on type of infusion and line history, determine which is more likely:
   i. Fibrin sheath or thrombus formation
   ii. Chemical/drug precipitation (examples of causative agents are: etoposide, phosphorous, calcium salts, TPN or phenytoin)
   iii. Build up of waxy lipid residue from recent lipid infusion.

e) Vigorous attempts to get blood return must NEVER be done due to the risk of damage to the catheter or vessel wall.

COMPLICATIONS OF OCCLUSIONS:

a) Interruption of therapy
b) Infiltration or extravasation
c) Infection. There is a direct association between catheter-related thrombus and catheter-related infections. Fibrin and thrombus provide a focus for microbial adherence and growth.
d) Increased cost

Management of an occluded CVAD is dependent upon the cause of the occlusion. Early identification and intervention is recommended. Do not wait until the line is completely occluded. The longer a catheter remains occluded, the lower the success rate of restoring patency to the CVAD and an increased risk of additional complications.

Chemical precipitates may occur when a change in the pH causes a solution to change its solubility state. Instilling a solution which may return the pH of the crystallized medication back into the normal range may dissolve the precipitate. If drug precipitate is suspected, pharmacy may be able to identify if the occlusion is acid or alkaline.

For medications with a high pH, such as phenytoin, sodium bicarbonate may be infused to raise the pH and dissolve the precipitate. For medications with a low
pH, 0.1N Hydrochloric acid may be instilled to lower the pH and dissolve the precipitate. 70% ethanol may be used to dissolve lipid occlusions.

In the absence of any visual precipitate, the sudden development of an occlusion is suggestive of a fibrin deposit and should be managed as such. Treatment with a thrombolytic agent is recommended for restoring patency of a central venous access device which is occluded by fibrin.

Once an occlusion is identified, early intervention to troubleshoot and resolve the occlusion is recommended. The optimal time to intervene is when the CVAD is first noted to be partially occluded (able to infuse/flush but unable to withdraw blood). The standard instillation method can be used to instill the alteplase. If a central line is completely occluded, the stopcock method is used to create negative pressure to allow the instillation of the alteplase.

THROMBOLYTIC AGENT – Alteplase (Cathflo®)

Refer to package insert

1. Indication: Alteplase, a tissue-type plasminogen activator (t-PA), is indicated for restoring patency to CVAD partially or completely occluded by blood clots or fibrin.
2. Action: Alteplase is a fibrinolytic agent, which binds directly to fibrin in a thrombus and starts the conversion of plasminogen to plasmin, thereby initiating local fibrinolysis.
3. Precautions:
   - When alteplase is administered locally to restore the patency of an occluded CVAD, it should not have an effect on systemic coagulation. Any alteplase released into the circulation is metabolized rapidly by the liver (plasma half-life less than 5 minutes). Therefore, systemic complications such as bleeding are rare.
   - Allergic reactions are unlikely.
   - Cathflo® is contraindicated in patients with known hypersensitivity to Alteplase or any of its components (L-arginine, phosphoric acid and polysorbate 80).
   - Cathflo® should not be used in the presence of known or suspected catheter infections. Instillation may release localized infection into systemic circulation causing sepsis.
   - Alteplase (Cathflo®) has not been studied in patients known to be at risk of bleeding. Therefore it should be used with caution in patients with thrombocytopenia, any underlying bleeding tendency, or conditions associated with potential bleeding.
   - Caution should be exercised in patients who have active internal bleeding, or who have had any of the following within 48 hours: coronary artery bypass surgery, obstetrical delivery, organ biopsy, or puncture of a non-compressible vessel.
4. Pharmacokinetics: plasma half-life less than 5 minutes.

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5. Adverse Effects (Roche 2003)
   - Bleeding: rare
   - Sepsis: less than 0.5%
   - GI bleeding: less than 0.5%

6. Dose
   - For patients weighing greater than 30 kg, the dose of alteplase is 2 mg (2mL).
   - The recommended dose for patients weighing less than 30 kg is 110% of the internal volume of the CVAD, not to exceed 2 mg (2mL).

REFERENCES


SELF TEST QUESTION SHEET
CARE OF AN OCCLUDED CENTRAL VENOUS ACCESS DEVICE

1. List four causes of non-thrombotic occlusions.
   (1)   (2)   (3)   (4)

2. List two types of thrombotic occlusions.
   (1)    (2)

3. List two ways to prevent a Central Venous Access Device occlusion.
   (1)
   (2)

4. Define a:
   Total Occlusion
   Partial Occlusion

5. When is the optimal time to intervene with a suspected CVAD occlusion?

   (1)   (2)   (3)   (4)

7. State the actions you would take with a suspected CVAD occlusion.

8. What do you require from a physician in order to instil Alteplase to clear an occluded CVAD?

9. What is the recommended concentration and dose of Alteplase?

10. What is the maximum time allowed for Alteplase to dwell in an occluded CVAD?

11. How many times can you repeat an attempt to clear an occluded CVAD in 24 hrs?

12. Where should you document the Alteplase instillation?

13. What should your documentation include?

14. What should you do to the lumen(s) once you have instilled Alteplase?

Name: ____________________________________________
Self-Directed learning completion date: ________________
1. Empty I.V. bag, closed clamp, kinked or twisted tubing/catheter, pressure due to dressing, patient position, break or malposition of catheter.

2. Fibrin sheath, fibrin tail, mural or intraluminal

3. (1) Proper use of positive pressure adaptors on all lumens
(2) Maintain flushing schedules as per policy

4. Total occlusion = No solution can be infused and no blood can be aspirated.
Partial occlusion = Able to infuse fluid but blood return is sluggish or absent on aspiration.

5. During a partial occlusion.

Neck and vein distention
Pain, aching, burning, tenderness along the tunnel tract.
Numbness, tingling of fingers, hands, arms.
Skin temperature changes of hands and arms.
Leakage of infusate at exit site.
Alterations in ability to infuse solutions and/or withdraw blood.

7. Check for blood return using 10mL syringe. Exclude external causes by checking clamps, changing patients' position, etc. Attempt to instil small amount of saline without using excessive force. Determine if more likely a fibrin sheath, chemical precipitate or lipid build-up. Contact physician.

8. A written order specifying the concentration, volume of drug/solution, frequency and dosing interval.

9. Alteplase = 1mg/mL concentration. Recommended dose per occluded lumen = 2 mg (2mL).

10. The maximum dwell time of Alteplase is 2 hours. Blood return may be assessed every 30 minutes x 4 during one instillation.

11. No more than 2 doses in a 24 hour period (may only repeat once).

12. Progress Notes, MAR and Patient Kardex.

13. Date and time of procedure, type of occlusion, dose of Alteplase given and dwell time, response to Alteplase

14. Label the lumen(s).
Instillation of Alteplase for Partial Occlusions – Standard Procedure

**Name:** ______________________________  **Unit:** ____________

**Evaluator:** ______________________________  **Date:** ____________

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<tr>
<th>Critical Behaviours Performed</th>
<th>Yes</th>
<th>No</th>
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<tr>
<td>1. Obtains order for alteplase. Check baseline vitals.</td>
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<tr>
<td>2. Explains procedure to patient / family.</td>
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<tr>
<td>3. Washes hands and assembles equipment.</td>
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<tr>
<td>4. Reconstitutes alteplase (Cathflo®). Withdraws 2mg (2mL) of solution into a 10mL syringe.</td>
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<tr>
<td>5. Washes hands, mask and glove.</td>
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<tr>
<td>6. Scrubs connection with an alcohol swab for 15 seconds. Ensure catheter clamp is closed, remove positive pressure adaptor and attach 10mL normal saline syringe.</td>
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<tr>
<td>7. Opens catheter clamp, attempts to flush / aspirate blood.</td>
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<td>8. If able to flush but unable to aspirate blood, flushes lumen with 20mL of normal saline.</td>
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<td>9. Removes normal saline syringe and attaches syringe containing alteplase.</td>
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<tr>
<td>10. Opens catheter clamp and slowly instils alteplase.</td>
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<td>11. Reclamps catheter and allows alteplase to dwell for 30 minutes. Labels the lumens that have alteplase dwelling.</td>
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<tr>
<td>12. At 30 minutes intervals attempts to aspirate blood. If blood return is unsuccessful, allow alteplase to dwell for a maximum dwell time of 2 hours.</td>
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<tr>
<td>13. If aspiration is successful for blood return, withdraws and discards 10mL blood / alteplase.</td>
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<tr>
<td>14. Clamps catheter, replaces positive pressure adaptor and flushes line with 20mL normal saline using turbulent technique.</td>
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<td>15. Documents accordingly.</td>
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### PROFICIENCY SKILLS CHECKLIST

**Instillation of Alteplase for Complete Occlusions – Stopcock Procedure**

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<td>5. Washes hands, mask and glove.</td>
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<tr>
<td>Ensures catheter clamp is closed, removes positive pressure adaptor and attaches 10mL normal saline syringe.</td>
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<tr>
<td>7. Opens catheter clamp, attempts to flush / aspirate blood. If unable to flush or aspirate blood, clamps catheter and removes normal saline syringe. Attaches a 3-way stopcock directly to the catheter with the key pointed 'off' towards the catheter.</td>
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<td>8. Attaches an empty 10mL syringe at the 6 o’clock position. Attaches the 10mL syringe containing 2 mL alteplase to the 3 o’clock position.</td>
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<td>9. Turns the key to ‘off’ position towards the alteplase syringe. Opens catheter clamp and gently aspirates the empty syringe creating negative pressure in the lumen.</td>
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<td>10. While maintaining negative pressure on the syringe, turns the key ‘off’ towards the empty syringe opening the valve towards the alteplase syringe allowing the release of alteplase into the catheter.</td>
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<td>11. Reclamps catheter and allows alteplase to dwell for 30 minutes. Labels lumens which have alteplase dwelling.</td>
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<td>12. At 30 minutes intervals attempts to aspirate blood. If blood return is unsuccessful, allow alteplase to dwell for a maximum dwell time of 2 hours.</td>
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