Central Venous Catheter (CVC): Occlusion Management by Instillation of Alteplase (CATHFLO)

This DST does not include CVCs used for Hemodialysis or Apheresis.

Site Applicability

All VCH and PHC sites – Acute and Community

Practice Level

RN: Advanced Skill

- RN must receive specialized education and training, and be competency checked by an IV/Infusion/Vascular Access Nurse Educator or Clinical Nurse Educator who has the advanced skill of occlusion management.
- Successful completion of the CVC Care and Maintenance learning module and formalized CVC Care and Maintenance instruction.

Requirements

- Ensure a dysfunctional catheter lumen is promptly investigated to identify type of occlusion for appropriate management.
- Alteplase is used for the management of PICC, Tunneled CVC, IVAD and Non-Tunneled CVC with complete, partial, and/or withdrawal occlusion.
- An order is required from Most Responsible Provider (MRP) for alteplase and must indicate it is to treat CVC occlusion.
- The MRP must be notified immediately in case of adverse reaction to alteplase.
- For occlusion management concerns, contact your IV/Infusion/Vascular Access Nurse Educator or Clinical Nurse Educator. For Powell River General Hospital (PRGH) contact PICC insertion certified nurse.
- If signs and symptoms indicate CVC is malpositioned, kinked or fractured perform chest x-ray (CXR) to verify tip position prior to instilling alteplase. Refer to relevant CVC DST under “complications” for signs and symptoms.
- Treat any lumens that have withdrawal, partial or total occlusions. Do not leave an occluded lumen untreated even when another lumen is functional. Best practice is to treat all lumens in a multi-lumen catheter even if only one lumen is identified with an occlusion. Consult IV/Infusion/Vascular Access Nurse Educator or Clinical Nurse Educator to determine best course of action on an individual basis as needed. Consider stopping infusions if possible.
- Ensure alteplase vial is refrigerated until use. In community settings, use cold chain transportation procedures.

Need to Know

1. Catheter salvage is preferred over catheter removal for management of thrombotic occlusion.

2. There are three types of CVC occlusion and any episode of CVC occlusion can involve more than one type:
   a. Mechanical
   b. Chemical
   c. Thrombotic

3. **Mechanical** occlusion must be ruled out prior to instilling alteplase. For IVADs, rule out non-coring needle issue such as inappropriate size and/or length or malpositioned needle.

4. If **chemical** occlusion suspected, instill alteplase as first intervention. If unsuccessful, consult IV/Infusion/Vascular Access Team Nurse Educator or Clinical Nurse Educator.

5. Alteplase is a **thrombolytic** agent that works specifically by binding to fibrin in a thrombus, then converting the entrapped plasminogen to plasmin resulting in local fibrinolysis (i.e. digests fibrin and dissolves blood clots). In other words, alteplase is highly "clot-sensitive". This dose of alteplase does not cause systemic thrombolysis

6. Contraindications:
   a. Known hypersensitivity to alteplase or any component of the formulation (i.e. L-arginine, phosphoric acid and polysorbate 80).
   b. Discuss with MRP if:
      - Known or suspected infection in the catheter.
      - Patients who have active internal bleeding or
      - Patients who have had any of the following within 48 hours: CABG surgery, organ biopsy, obstetrical delivery or puncture of non-compressible vessels (i.e. arteries).

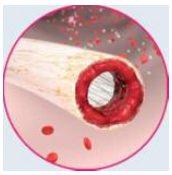
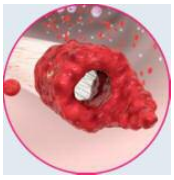
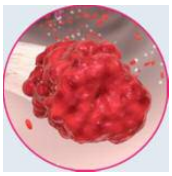
5. Alteplase and heparin are not to be mixed or given concurrently through the same CVC lumen – the mixing of the two agents results in inactivation of alteplase. If heparin present in occluded lumen:
   a. Attempt to flush through with NS prior to instilling alteplase.
   b. If unable to flush to clear heparin (i.e. Total occlusion of lumen) proceed to instill alteplase.

6. A suspected blocked CVC lumen may have a withdrawal, partial, or total occlusion due to thrombus formation
   a. **Withdrawal:** inability to aspirate blood but ability to infuse without any resistance. Lack of free flowing blood return. May be able to flush.
   b. Partial: decreased ability to infuse fluids into the CVC lumen: resistance with flushing and aspiration. Increased pressure during infusion as displayed on the infusion device. Sluggish flow through the catheter. May also have sluggish blood return on aspiration.
   c. Complete: Inability to infuse or withdraw blood or fluid through CVC lumen.

7. The instillation of alteplase into a completely occluded CVC lumen may be done using a single syringe or a 3-way stopcock add-on device. The single syringe method is preferred and is safe and effective for the immediate restoration of CVC lumen patency affected by a thrombotic occlusion.

8. Common sites of thrombus formation: within the CVC lumen, the site where catheter enters the vein, the catheter tip and along the external surface of the catheter.

9. Types of thrombotic occlusions include:

Intraluminal 	Intraluminal thrombus: may cause sluggish flow that is apparent upon flushing or infusing solutions
Fibrin Tail 	Fibrin tail (fibrin flap): inability to aspirate blood is frequently caused by a fibrin tail (acts as a one-way valve allowing catheter flush but not aspiration).
Fibrin Sheath 	Fibrin sheath (fibrin sleeve): extraluminal, occurring when fibrin adheres to the external surface of the catheter – may resemble a sock covering the terminal tip of the catheter or extend from the catheter to the point where the catheter enters the vein.
Mural 	Mural thrombus: if the catheter tip causes a vessel wall injury, a mural thrombus may form as fibrin from the vessel wall injury attaches to the fibrin building on the catheter surface.

CVAA Occlusion Management Guidelines (2013). Used with permission.

10. The standard **concentration** of alteplase after reconstitution is 1 mg/mL.

CVC Type	Standard Dose
PICC, non-tunneled CVC, and tunneled CVC	2 mg May repeat x 1
IVAD	4 mg May repeat x 1

11. Recommended maximum dose of alteplase is 4 mg total per instance of occlusion (except for IVADs.)
    a. For multi-lumen catheters, perform a risk and benefit analysis when more than one lumen is occluded. Instillation of alteplase may exceed the recommended maximum dose of 4 mg. Understand that risks may be mitigated by the safety profile of the thrombolytic.
    b. Consideration of type of catheter and duration of treatment may influence planning and dividing of alteplase instillation.
        - ***Example 1***: Triple lumen catheter with all lumens fully occluded - use 4 mg and divide per 3 lumens (i.e. 2 mg in largest lumen and 1 mg in each smaller lumen).
        - ***Example 2***: Partial occlusion of dual lumen, and unable to stop a continuous infusion – instill alteplase into first lumen to resolve, then switch continuous infusion to working lumen and treat second lumen.

12. Recommended dwell time is 30 to 120 minutes.
    a. Best outcomes are reported following at least 60 minutes dwell time
    b. A longer dwell time may be required for:
        - A complete occlusion
        - Second instillation of alteplase (when patency not fully restored with first dose)
    c. There are no maximum recommendations for dwell time from the manufacturer; however, once alteplase has resolved the occlusion within the catheter, action ceases, therefore it is safe to leave alteplase to dwell in a catheter for longer periods of time.
    d. Consider extending dwell time to 24-72 hours to permit longer contact time of alteplase with the fibrin in the clot.

13. Although rare, the following potential adverse reactions may occur with alteplase instillation.
    a. **Allergic reactions**: can include laryngeal edema, rash and urticaria.
    b. **Bleeding**: especially from recent puncture sites, gums, urine or GI tract.
    c. **Pulmonary embolus**: may result from a portion of the thrombus/fibrin sheath dislodging and floating into the pulmonary circulation.
    d. **Sepsis**: occurs from unblocking an infected CVC.

14. The MRP must be notified immediately in case of adverse reaction.

Procedure: Alteplase Instillation

Equipment and Supplies:

Note: Use aseptic no-touch technique for alteplase instillation.

- To prepare alteplase:
  - Alteplase 2 mg vial (or syringe with prepared alteplase from VGH pharmacy for leukemia/BMT inpatient program)
  - Sterile water for injection
  - Empty, sterile 10 mL syringe
  - Blunt needle
  - Alcohol swabs, large
- Surface disinfectant
- Non-sterile gloves
- Alcohol swabs, large
- Sterile dead end cap(s), one per treated lumen
- NS 10 mL in pre-filled 10 mL syringe – four to five syringes
- 3-way stopcock (if required for complete occlusion) and 10 mL empty syringe
- Label (required so can write: alteplase dose instilled; date/time; Do Not Use; and attach to lumen)

Alteplase Instillation Procedure:

1. Check chart for alteplase order, allergy status and contraindications to alteplase instillation. Confirm patient identification and explain the procedure to the patient.

2. Re-assess catheter patency according to CVC DST to confirm occlusion. See Appendix A

3. Clean work surface with surface disinfectant and let dry.

4. Perform hand hygiene.

5. Prepare alteplase if not obtained from on-site pharmacy.

   To reconstitute alteplase:
   - Alteplase 2 mg vial
   - Sterile water for injection
   - alcohol swabs
   - empty 10 mL syringe with blunt needle
     - Using 10 mL syringe and aseptic technique, withdraw 2.2 mL of sterile water.
     - Inject 2.2 mL of sterile water into alteplase vial; direct water towards powder. If foaming occurs, allow vial to stand undisturbed to allow large bubbles to dissipate.
     - Mix by gently swirling until the contents are completely dissolved. **DO NOT SHAKE.** The reconstituted solution is colourless or pale yellow, with a concentration of 1 mg/mL.
     - Use 10 mL syringe to draw up 2 mL reconstituted alteplase.
     - Label syringe's contents appropriately.

6. Perform hand hygiene.
7. Don non-sterile gloves.
8. Scrub connection of CVC hub and needleless connector with an alcohol swab for 15 seconds. Allow to dry completely.
9. Clamp if non-valved CVC.
10. Remove needleless connector from CVC hub.
11. If contaminants visible (dried blood/crystallization), use new alcohol wipe to scrub hub for 15 seconds, being careful to prevent alcohol solution/contaminants from entering catheter. Allow to dry completely.
12. For partial or withdrawal occlusion:
    a. Attach alteplase filled syringe to catheter hub
    b. Unclamp if non-valved CVC
    c. Instill alteplase slowly so alteplase comes into contact with thrombus.
    d. Go to step 14.
13. For complete occlusion, instill with negative pressure using syringe or stop-cock method:

Direct Syringe Access using Push-Pull Method (single syringe)	**3-way Stopcock Method**
1. Attach alteplase syringe to CVC. 2. Unclamp if non-valved CVC. 3. Pull back on syringe by about 1 mL. 4. Position syringe upright so air moves to top of syringe. 5. Let go of plunger, allowing a small amount alteplase to instill. 6. Repeat as needed until desired dose is instilled. 7. Do not use excessive force on plunger to inject alteplase.	1. Attach alteplase to side connection of stopcock. 2. Attach empty 10 mL syringe to other connection of stopcock. 3. Attach stopcock to CVC hub. 4. Close stopcock to alteplase syringe. 5. Unclamp if non-valved CVC. 6. Pull back on empty 10 mL syringe to create “negative pressure” within CVC. 7. Close stopcock to 10 mL syringe. 8. Allow alteplase to be pulled into catheter. 9. Repeat steps until desired dose of alteplase is instilled into lumen.
Note: Both techniques will require additional time to instill. For both methods, ensure alteplase syringe is upright to prevent air entering the CVC.	

14. Clamp if CVC non-valved.

15. Remove syringe or stopcock if used, and attach new sterile dead-end cap.
16. Label lumen with date/time and amount of alteplase; include “do not use” on label.
17. Allow to dwell for a minimum of 30 minutes to 2 hours. May be left to dwell for longer if required.

Procedure: Alteplase Removal

Equipment and Supplies:

- NS 10 mL in pre-filled 10 mL syringe – four to five syringes per lumen
- Alcohol swabs
- Non-sterile gloves
- Needleless connector cap – 1 per lumen
- For non-valved CVC, flushing solution as per CVC DST

Alteplase Removal Procedure:

1. Clean work surface with surface disinfectant and let dry.
2. Perform hand hygiene.
3. Don non-sterile gloves.
4. Attach 10 mL pre filled NS syringe to needleless connector using no touch technique, prime cap, leave attached in package.
5. Clamp if non-valved CVC.
6. Scrub connection of CVC hub and dead-end cap with an alcohol swab for 15 seconds. Allow to dry completely.
7. Remove 5 mL saline from one pre-filled NS syringe, keep tip sterile.
8. Remove dead-end cap, and attach.
9. Unclamp if non-valved CVC.
10. Attempt to aspirate.
    a. If successful, aspirate 5 mL blood and discard.
    b. If unsuccessful, gently instill NS from attached syringe, leaving about 1 mL in syringe, then re-attempt aspiration. If successful, follow step a.
    c. If still unsuccessful, go to step 16.
11. Clamp if non-valved CVC.
12. Attach 10 mL pre-filled NS syringe to lumen, unclamp if non-valved CVC, and flush.

13. Remove syringe.

14. If contaminants visible (dried blood), use new alcohol wipe to scrub hub for 15 seconds, being careful to prevent alcohol solution/contaminants from entering catheter. Allow to dry completely.

15. Attach new prepared needleless connector, unclamp if non-valved CVC and flush as per CVC DST.

16. If unsuccessful after first dose of alteplase, instill a **second dose** as above.

17. If unable to aspirate after the second dose, flush CVC with NS (if possible), attach sterile dead end cap.

18. If two (2) attempts with alteplase does not clear the occlusion, contact IV/Infusion/Vascular Access Nurse Educator or MRP to determine course of action for catheter salvage (e.g. CXR or linogram, chemical occlusion clearance, different method of thrombolytic instillation). Inform patient and/or family of unsuccessful attempt to clear occlusion and further treatment plan

Expected Patient/Client/Resident Outcomes

Patency restored to CVC and infusion therapy is resumed.

Documentation

Medication Administration Record

- Alteplase is a medication, and must be recorded in your site specific medication record as administered.
- In CERNER: use MAW and eMAR
- The date and time of administration when the alteplase was instilled into the catheter.
- Which lumen was treated and the dose per lumen.

Site specific Flow sheets and/or Interdisciplinary Notes

- Assessment and rationale for each instillation
- Type and location of CVC
- Number of lumens present, assessed and treated.
- Time of procedure and expected dwell time
- Outcome of procedure and patient status

Clinical Care Plan/Kardex

- Amend to reflect any occlusion prevention strategies to ensure catheter patency

CERNER:

For instillation:

- Ensure correct Dynamic Group for CVAD in I-View
- Activity: Choose: "Assessed" and "Other" – Free text: Occlusion
- LUMEN COLOUR TYPE and choose "Occlusion management"
- Unexpected Events – OTHER: Free text "Alteplase instilled"

For removal of Alteplase:

- Ensure correct Dynamic Group for CVAD in I-View
- Activity: Choose: "Assessed" and "Other" – Free text: Alteplase withdrawn
- LUMEN COLOUR TYPE and choose "Aspirated and flushed"
- Unexpected Events – OTHER: Free text "Alteplase effective, patency restored"

Related Documents

- Non-Tunneled Central Venous Catheter (NT-CVC)
- Tunneled Central Venous Catheter (T-CVC)
- Implantable Venous Access Device (IVAD)
- Peripherally Inserted Central Catheter (PICC)
- Parenteral Drug Therapy Manual (PDTM)

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Owners: *(optional)*	PHC/VCH	
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- Clarification and update of some instructions
- Alignment between VCH and PHC regarding procedure (Aseptic no-touch technique)
- Including documentation instructions for Cerner system

Appendix A: Signs and Symptoms of CVAD Occlusions

Upon Flushing or Infusion
• Decreased ability to infuse fluids into the CVC
• Sluggish flow through the CVC
• Increased pressure during infusion or frequent “downstream occlusion” alarms (as displayed on the infusion device)
• Resistance when flushing or unable to flush
Upon Aspiration of Blood
• Inability to withdraw blood
• Sluggish blood return

Appendix B:

Skills Performance Checklist

Central Venous Catheter (CVC): Occlusion Management by Instillation of Alteplase

Name:_____ Unit: _____

Assessor: _____ Date: _____

RN requirements:

- Advanced Skill, received specialized education and training
- Competency checked by IV/Infusion/Vascular Access Nurse Educator or Clinical Nurse Educator

TASK	YES	NO	RELATED QUESTIONS
1. Check prescriber's order, confirm patient identification and explain the procedure to the patient.			• When would you need to get a Chest x-ray prior to instilling alteplase? • Name three types of CVC occlusion and what would you do for each.
2. Re-assess catheter patency according to CVC DST to identify type of catheter occlusion present (i.e. partial or complete).			• Name four contraindications to alteplase instillation. • Describe four types of thrombotic occlusions.
3. Clean work surface with surface disinfectant and let dry. Perform hand hygiene.			
4. Prepare alteplase if not premixed by pharmacy.			• What is the size of syringe to be used for alteplase instillation?
5. Perform hand hygiene and don non-sterile gloves.			• What is the standard dose of alteplase used for CVC occlusion management?
6. Clamp if non-valved CVC.			• Why is clamping required if the CVC is non-valved?
7. Follow CVC DST to cleanse and remove needleless connector.			
8. Instill alteplase, ensuring alteplase syringe is upright to prevent air entering the CVC. a. For complete occlusion, instill with negative pressure using direct syringe or stop-cock method.			• What would you do if you had a triple lumen CVC with occlusions of all three lumens? • Why instill alteplase slowly for a partial occlusion?
9. Clamp if CVC non-valved.			
10. Remove syringe or stopcock if used, and attach new sterile dead-end cap.			

11. Label lumen with date/time and amount of alteplase; include “do not use” on label			
12. Allow to dwell for 30 minutes to 2 hours. May be left to dwell for longer if required.			• What are considerations for shorter or longer dwell times?
REMOVAL:			
13. Prepare work surface, gather equipment, perform hand hygiene and don non-sterile gloves.			
14. Prepare new needleless connector.			
15. Ensure non-valved CVC is clamped.			
16. Remove 5 mL NS from additional prefilled NS syringe, keeping tip sterile.			
17. Follow CVC DST to cleanse and remove dead-end cap.			
18. Remove dead end cap, and attach partially filled NS syringe			
19. Unclamp if non-valved CVC.			
20. Attempt to aspirate.			• What is the volume of blood to withdraw during alteplase aspiration? • What are the steps to take if aspiration is unsuccessful?
21. Clamp if non-valved CVC.			
22. Remove discard syringe, attach 10 mL NS syringe, unclamp			
23. Remove syringe. If contaminants visible (dried blood), use new alcohol wipe to scrub hub for 15 seconds, being careful to prevent alcohol solution/contaminants from entering catheter. Allow to dry completely.			
24. Attach new needleless connector, unclamp if non-valved CVC and flush as per CVC DST.			
25. If unable to aspirate after the second dose, flush CVC with NS (if possible), attach sterile dead end cap.			• What additional actions would you take if the second dose of alteplase was unsuccessful?

EVALUATION

1. Certified competent for CVC Occlusion Management by Instillation of Alteplase. ( )
2. Needs further education. ( )

   Reschedule: _____

Skills Performance Checklist – Answer Key

Central Venous Catheter (CVC): Occlusion Management by Instillation of Alteplase

Questions	Answers
1. When would you need to get a CXR prior to instilling alteplase?	• For patients with CVCs admitted to your facility/program without insertion documentation. • If signs and symptoms suggest CVC is malpositioned, kinked or broken. • If two attempts with the alteplase does not clear the occlusion.
2. Name three types of occlusion and what would you do for each.	• Mechanical-check for catheter kinking, tight sutures (if present), change needleless connector • Chemical – attempt alteplase instillation, if unsuccessful consult IV/Infusion/Vascular Access Educator or Clinical Nurse Educator. • Thrombotic – instill alteplase

3. Name four contraindications to alteplase instillation.	• Known hypersensitivity to alteplase.
	• Discuss with MRP if:
	  ○ Known or suspected infections in the catheter
	  ○ Active internal bleeding or
	  ○ Patients who have had any of the following within 48 hours: CABG surgery, organ biopsy, obstetrical delivery or puncture of non-compressible vessels (i.e. artery).

4. Describe four types of thrombotic occlusions.	• Intraluminal thrombus (blockage in catheter lumen) – may cause sluggish flow that is apparent upon flushing or infusing solutions. • Fibrin tail (fibrin flap) – inability to aspirate blood, fibrin tail acts as a one-way valve allowing catheter flush but not aspiration. • Fibrin sheath (fibrin sleeve) – extraluminal, occurring when fibrin adheres to the external surface of the catheter-may resemble a sock covering the terminal tip of the catheter or extend from the catheter to the point where the catheter enters the vein. • Mural thrombus – if the catheter tip causes a vessel wall injury, a mural thrombus may form as fibrin from the vessel wall injury attaches to the fibrin building on the catheter surface.

5. What is the size of syringe to be used for alteplase instillation?	10 mL syringe
6. What is the standard dose of alteplase used for CVC occlusion management?	2 mg (exception IVAD –4 mg)
7. Why is clamping required if the CVC is non-valved?	To prevent air embolus or bleeding in non-valved CVC
8. What would you do if you had a triple lumen CVC with occlusions of all three lumens?	Perform risk benefit analysis to determine if will give 2 mg per lumen or divide 4 mg between three lumens.
9. Why instill alteplase slowly for a partial occlusion?	To ensure thrombolytic comes into contact with thrombus.
10. What are considerations for shorter or longer dwell times?	Type of occlusion, partial or complete. First dose was not successful.
11. What is the volume of blood to withdraw during alteplase removal?	5 mL
12. What are the steps to take if aspiration is unsuccessful?	• Gently instill NS (if possible), then re-attempt aspiration. • If first dose of alteplase unsuccessful instill a second dose.
13. What additional actions would you take if the second dose of alteplase was unsuccessful?	• If unable to aspirate after the second dose of alteplase, flush CVC with NS (if possible), then attempt to aspirate. • If two attempts of alteplase did not clear the occlusion, contact IV/Infusion/Vascular Access Nurse Educator or MRP to determine course of action for catheter salvage (e.g. CXR or linogram, chemical occlusion clearance, different method of thrombolytic instillation).