PURPOSE

Procedure for managing central venous line occlusions caused by thrombosis or precipitates.

Signs of central venous line (CVL) occlusion include: (Gorski, 2003)
- Inability to aspirate blood
- Resistance to flushing
- Sluggish infusion
- Complete inability to flush/infuse
- Increasing occlusion alarm activation with use of electronic infusion devices

STANDARDS

Instillation of medications and/or solutions used to dissolve thrombotic deposits or precipitates in a CVL requires a prescriber’s order. The order must specify the medication/solution to instill, concentration and volume to be instilled, dwell time, and instructions if unable to aspirate following dwell time.

Volume of catheter clearing solution ordered should be 110% of the internal lumen volume of the CVL.

<table>
<thead>
<tr>
<th>Solution</th>
<th>Concentration</th>
<th>Dwell time</th>
</tr>
</thead>
<tbody>
<tr>
<td>alteplase (cathflo®):</td>
<td>1 milligram/millilitre solution</td>
<td>Assess after 30 minutes. If not functional, allow to dwell another 90 minutes.</td>
</tr>
<tr>
<td>maximum dose 2 mg/2 mL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ethanol</td>
<td>70% solution</td>
<td>1 hour</td>
</tr>
<tr>
<td>hydrochloric acid:</td>
<td>0.1% solution</td>
<td>1 hour</td>
</tr>
<tr>
<td>maximum dose 3 mL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sodium bicarbonate</td>
<td>1 mEq/mL solution</td>
<td>1 hour</td>
</tr>
</tbody>
</table>

A chest x-ray is required to confirm catheter tip placement before instillation of catheter clearing solutions. A venogram may also be ordered.

Implanted ports are to be re-accessed to confirm occlusion prior to instillation of catheter clearing solution.

If cause of occlusion is unknown, catheter clearance is attempted first with alteplase. If unsuccessful after 2 instillations, further attempts can be made with other agents as appropriate or further investigations should be performed to rule out mechanical occlusion.

Aseptic technique is an essential component of all central venous line access procedures to reduce the risk of catheter related blood stream infection.

Instillation of ethanol may damage catheters made of some types of polyurethane; manufacturers’ directions for use should be reviewed and followed. **NOTE:** BARD PowerLines and PowerPorts may not be instilled with ethanol.

Emergency equipment and emergency reversal medications must be readily available prior to instilling catheter clearing solutions into the central line. **Emergency reversal medications for the following solutions:**

- **Alteplase:** Epinephrine, diphenhydramine, and hydrocortisone for treatment of possible anaphylaxis.

- **70% Ethanol:** 50% glucose IV solution. 70% ethanol can cause hypoglycemia if administered systemically. Every attempt should be made to remove the contents of the CVL device after instillation of the ethanol.

- **Hydrochloric Acid:** 50 mL sodium bicarbonate 8.4% injection. Since N HCl can lower the pH of the blood if administered systemically, every attempt should be made to remove the contents of the CVC device after instillation of the N HCl. A volume of 9 mL of 0.1 N HCl is needed to lower the blood pH of a 3 kg child by one unit. Therefore a small volume (0.21-1 mL) of 0.1 N HCl is quite safe to administer locally in a blocked catheter, especially if the contents are aspirated afterwards.
MANAGEMENT OF NON-FUNCTIONING CENTRAL VENOUS LINES
WITH THE INSTILLATION OF ALTEPLASE (T-PA), ETHANOL,
HYDROCHLORIC ACID (N HCL) OR SODIUM BICARBONATE (NHCO3)

SITE APPLICABILITY
Applicable in all areas where patients with central venous lines are cared for.

PRACTICE LEVEL/COMPETENCIES
Competencies for management of non-functioning central line:
- Knowledgeable of medication and/or solution dosage, contraindications, side effects, potential complications and procedure for instillation/withdrawal of each catheter clearing solution.
- Competent in central venous line heparin locking and blood sampling procedures.

DEFINITIONS
Alteplase works by acting on fibrin bound plasminogen (clot), producing plasmin at the site, breaking down the thrombus and restoring CVL function.

70% Ethanol has been shown to dissolve lipid build-up caused by TPN infusions.

1.1 1 N Hydrochloric Acid can be instilled into the CVL to dissolve calcium-phosphorus precipitates or precipitates of low pH drugs such as vancomycin.

Sodium Bicarbonate is used to neutralize precipitates caused by drugs with high pH such as phenytoin.

Complete Occlusion: inability to withdraw blood or infuse/flush catheter.

Partial Occlusion: sluggish blood withdrawal and/or difficulty infusing/flushing catheter.

Withdrawal Occlusion: inability to withdraw blood but able to infuse/flush catheter.

EQUIPMENT
- Surface disinfectant wipe
- Personal Protective Equipment (PPE): gloves, mask, eye protection and gown if splash risk
- Sterile dead-end cap
- 2% chlorhexidine in 70% alcohol wipes
- Reconstituted syringe of catheter clearing agent*
  - alteplase (Cathflo®): reconstitute solution as per parenteral monograph using aseptic technique. **DO NOT SHAKE VIAL AFTER RECONSTITUTION.**
  - other solutions: consult with pharmacist for appropriate reconstitution instructions

NOTE: keep the alteplase vial refrigerated until ready to reconstitute. Vials are available on 3B/2B, Oncology Clinic, PICU and 3F. All other areas can obtain vials as required from the pharmacy or PICU night cupboard after-hours.

- 10 mL syringe(s) of normal saline*
- Sterile 3 way stopcock if line completely occluded*
- 5 mL sterile syringes* for aspirating
- pre-filled 10 mL syringe with 3 mL heparin 10 Units/mL* if heparin locking
- Needleless connector *
- Swabcap™*

*Double the above supplies when both lumens/ports of a double-lumen CVC or double implanted port are occluded.

PROCEDURE

1. **IDENTIFY** patient and **EXPLAIN** procedure. **Rationale**
   - Failure to correctly identify patients prior to procedures may result in errors.
   - Evaluates and reinforces understanding of previously taught information and confirms consent for procedure.

2. **ASSESS** for potential cause of occlusion and **Rationale**
   - For determination of appropriate catheter
**MANAGEMENT OF NON-FUNCTIONING CENTRAL VENOUS LINES WITH THE INSTILLATION OF ALTEPLASE (T-PA), ETHANOL, HYDROCHLORIC ACID (N HCL) OR SODIUM BICARBONATE (NHCO3)**

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Notify prescriber. <strong>Obtain</strong> order for appropriate catheter clearing agent. clearance solution.</td>
</tr>
<tr>
<td>2.</td>
<td><strong>MEASURE</strong> and <strong>RECORD</strong> baseline vital signs (Temperature, Pulse, Respiratory Rate and Blood Pressure). Establishes baseline.</td>
</tr>
<tr>
<td>3.</td>
<td><strong>CLEAN</strong> working surface using disinfectant wipe. Routine infection control practices; reduces transmission of microorganisms.</td>
</tr>
<tr>
<td>4.</td>
<td><strong>PERFORM</strong> hand hygiene and <strong>DON</strong> PPE.</td>
</tr>
<tr>
<td>5.</td>
<td><strong>PREPARE</strong> equipment using aseptic technique.</td>
</tr>
<tr>
<td>6.</td>
<td><strong>REMOVE</strong> IV tubing if present and <strong>ATTACH</strong> sterile dead-end cap to open end to maintain sterility. Maintains sterility of administration set for reconnection after catheter clearance.</td>
</tr>
<tr>
<td>7.</td>
<td><strong>CLEAN</strong> working surface using disinfectant wipe. Routine infection control practices; reduces transmission of microorganisms.</td>
</tr>
<tr>
<td>8.</td>
<td><strong>SCRUB</strong> the cap for 30 seconds using a chlorhexidine/alcohol wipe. With second wipe, <strong>CLEAN</strong> up the line including clamp. <strong>DISCARD</strong> wipes and <strong>ALLOW</strong> cap to dry for 1 minute.</td>
</tr>
<tr>
<td>9.</td>
<td><strong>ATTACH</strong> 10 mL prefilled normal saline syringe to catheter/extension tubing. <strong>UNCLAMP</strong> and <strong>ATTEMPT</strong> to aspirate and flush. <strong>To confirm occlusion.</strong></td>
</tr>
<tr>
<td>10.</td>
<td>If occlusion confirmed, <strong>CLAMP</strong> and <strong>REMOVE</strong> the syringe. <strong>Confirms occlusion.</strong></td>
</tr>
<tr>
<td>11.</td>
<td><strong>ATTACH</strong> syringe with ordered catheter clearing agent to catheter. <strong>UNCLAMP</strong> and <strong>INJECT</strong> solution slowly and gently into the catheter using a gentle &quot;pull/push&quot; technique to create turbulence. <strong>NEVER</strong> force clearing solution as it could cause catheter to rupture or dislodge a thrombus/precipitate. <strong>Aids in solution reaching occlusion.</strong></td>
</tr>
<tr>
<td>12.</td>
<td>For complete occlusion, the 3-way stopcock method is the preferred method for catheter clearance (contact the IV team if unfamiliar with this technique): <strong>Instillation of solution for catheter clearance is best performed using a negative pressure approach. In order to establish negative pressure within the catheter, a vacuum must be created by aspirating air or dead space from within the catheter.</strong></td>
</tr>
<tr>
<td></td>
<td>• <strong>ATTACH</strong> a 3-way stopcock (OFF to patient) directly to catheter hub</td>
</tr>
<tr>
<td></td>
<td>• <strong>ATTACH</strong> the solution filled syringe to the stopcock at the vertical opening</td>
</tr>
<tr>
<td></td>
<td>• <strong>ATTACH</strong> an empty 5 mL syringe to the stopcock at the horizontal opening</td>
</tr>
<tr>
<td></td>
<td>• <strong>TURN</strong> stopcock off to the solution filled syringe and open to the empty syringe</td>
</tr>
<tr>
<td></td>
<td>• <strong>UNCLAMP</strong> catheter and gently aspirate using the empty syringe until the plunger reaches the 8-9 mL mark and hold it to create negative pressure in the catheter</td>
</tr>
<tr>
<td></td>
<td><strong>A 5-mL syringe minimizes the risk of catheter collapse during aspiration.</strong></td>
</tr>
</tbody>
</table>
**MANAGEMENT OF NON-FUNCTIONING CENTRAL VENOUS LINES WITH THE INSTILLATION OF ALTEPLASE (T-PA), ETHANOL, HYDROCHLORIC ACID (HCL) OR SODIUM BICARBONATE (HCO3)**

- **TURN** stopcock off to the empty syringe and open to the solution filled syringe. The solution will be drawn into the catheter by the negative pressure created within the catheter to the exact amount required to come in contact with the clot formation.
- **CLAMP** the catheter and **turn stopcock off to patient**.
- **REMOVE** stopcock from catheter hub and **ATTACH** a new cap.
- **ATTACH** Swabcap™ to cap.

**13. ATTACH** label to each lumen indicating solution instilled, amount instilled and time of instillation. **Alerts other members of the health care team that solution other than standard solution is instilled in line.**

**14. ALLOW** solution to dwell as per protocol/orders. **Minimum length of time required for dissolving occlusion.**

**15. Following dwell time, REMOVE** Swabcap™ from cap and **DISCARD**. If Swabcap™ not used, disinfect needleless connector with chlorhexidine/alcohol wipes. **SCRUB** needleless connector for 30 seconds and allow to dry for 1 minute.

**16. ATTACH** 5 mL syringe and **UNCLAMP** catheter. Gently **ASPIRATE** and **REMOVE** 3 mL of solution/blood. **CLAMP** and **REMOVE** syringe. **Removes solution and verifies functional line.**

**NOTE:** If catheter remains occluded after 30 minute alteplase dwell, allow to dwell another 90 minutes and then attempt to aspirate. For other solutions, notify physician at end of prescribed dwell time. If a second instillation is necessary, another order is required.

**17. ATTACH** normal saline syringe to catheter, **UNCLAMP**, and **FLUSH** using turbulent positive pressure technique with recommended amount based on type of line. **CLAMP**. **Confirms clearance of occlusion.**

**NOTE:** If using a positive displacement cap, do not clamp until after removal of syringe.

**18. PROCEED** with heparin locking procedure or **CONNECT** to infusion. **Continues with prescribed therapy.**

**19. REPEAT** procedure if opposite lumen of double lumen catheter is occluded.

**20. REMOVE** equipment, **DISPOSE** appropriately and **PERFORM** hand hygiene. **Routine infection control practices.**

**DOCUMENTATION**

**DOCUMENT** on appropriate records:
- assessment of line occlusion
- catheter clearing agent used and time instilled
- dwell time and time solution removed
- number of times repeated and results
- outcome of procedure
REFERENCES


