

Management of Catheter Occlusion: Clot, Drug Precipitate, Lipid Deposit

PURPOSE

To restore patency to an occluded catheter. To promptly identify and treat catheter occlusions for patient safety and to prevent loss of access.

These guidelines are grouped according to the type of occlusion, including:

- Thrombosis/fibrin
- Drug, calcium or phosphorus precipitate
- Lipid deposit

Risk Factors for Thombotic Occlusions

Insertion Related:

- Traumatic insertion with injury to the blood vessel
- Left-sided insertion

Device Related or Therapy Related Factors:

- Large bore or rigid catheters, particularly in relation to size of blood vessel
- Catheter material, stiffness, and surface roughness
- Length of dwell time
- Location of catheter tip (proximal to lower third of vena cava)
- Catheter malposition
- Administration of sclerosing agents and irritants
- Inadequate catheter maintenance

Health Status Factors

- Malignancy, especially lung cancer or lymphoma
- Venous compression due to tumor or metastasis
- Hypercoagulability
- Dehydration
- Previous history of thrombosis
- Previous vascular access device (VAD)
- Sedentary or bedrest activity status
- Inflammatory bowel syndrome
- Sepsis

Reducing the Risk of Catheter Related Thrombosis

- Follow flushing protocols; educate patients and caregivers on importance of following protocol
- Periodically evaluate adherence to flushing procedures
- Prophylactic therapy with an anticoagulant (i.e. warfarin) with a physician's order

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Signs of Occlusion or Obstruction in Vascular Access Devices

Signs of a Partially Occluded Catheter:

- Resistance to flush or medication/fluid administration
- Difficulty infusing solution
- Bubbles in tubing (blood is foamy)
- Leaking of fluid from the insertion site as fluid tracks back along the fibrin sheath formation

Signs of Thrombotic Occlusion:

- Inability to aspirate, but ability to infuse
- Inability to infuse, but ability to aspirate
- Discomfort associated with flushing or infusion
- Discomfort, pain, edema in shoulder, neck, arm, or insertion site
- Visible clots within external portion of catheter
- Edema of the neck, shoulder, arm and/or collateral circulation on the chest wall
- Increase in number of pump alarms

Signs of Drug Precipitate:

- Inability to administer fluids
- Inability to draw blood
- Discomfort associated with flushing
- Obstruction or resistance following infusion of potential or known incompatible drugs
- Inability to clear the catheter with alteplase or other currently used thrombolytic agents

A catheter is completely occluded when blood cannot be aspirated and complete resistance is met when infusion is attempted. Catheters that remain occluded predispose the patient to infection and thrombus.

Pediatric Considerations

- Children tend to have higher rates of occlusion than adults
- More frequent replacement of catheters is necessary due to growth
- Number of usable sites is limited and frequent replacement may make it necessary to use less desirable sites (e.g. femoral)
- More critical to use pharmacological interventions to salvage occluded devices
- May be attributed to smaller lumen and higher doses of calcium and phosphate in parenteral solutions

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POLICY

1. The RN experienced in central line catheter care may perform the clearing of an occluded catheter with a physician's order.
2. A thorough assessment of the infusion system must be done prior to instillation of medications into the catheter to clear an occlusion. These may include but are not limited to:
 - a. clamped or crimped tubing
 - b. restrictive sutures
 - c. signs of venous thrombosis, fibrin sleeve or flap, intraluminal clot
 - d. malpositioned or kinked catheter
 - e. malfunctioning tubing, extensions, clogged needleless device, or filter
 - f. damaged catheter
 - g. non-coring needle improperly placed in the port
 - h. occlusions caused by drug or solution precipitate (e.g. calcium gluconate, phenytoin, diazepam, 3-in-1 TPN solutions) which will not be solved with the use of a thrombolytic agent
3. Prompt recognition of occlusion and treatment is critical. Treatment should be initiated when catheters become "sluggish" or there is difficulty in withdrawing blood.
4. Thoroughly assess the types of infusates given through the catheter, recent uses of the catheter (i.e. blood draws) and duration of catheter placement. Assess for compatibility of infusates and the most likely composition of the deposit occluding the catheter. Always attempt to withdraw the occluded material prior to initiating a chemical clearing procedure.
5. The most frequently occurring obstruction is the formation of a thrombus within or around the catheter.
 - a. intraluminal thrombus may be caused by:
 - inadequate flushing
 - increased intrathoracic pressure and blood back-up into the catheter
 - frequent blood sampling
 - use of smaller size catheters (more commonly occurring)
 - b. fibrin sleeve (or sheath) or flap-platelet aggregation and fibrin around the catheter
 - may form from point of insertion and completely surround the catheter.
This may cause a retrograde flow of infusate back up the catheter

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- fibrin tail (or flap) on end of catheter can permit infusion but fall back during aspiration and occlude the catheter
 - more likely to form on catheters in place for extended periods of time
- c. venous thrombosis (mural thrombus)
- damage to the lining of the vessel may cause clot to form
 - can be initiated by damage on insertion
 - can be caused by the catheter tip and infusate on wall of vessel
- d. accumulation of precipitates and blood products can form a “sludge” which has been observed in ports causing an occlusion.
6. Precipitates caused by incompatible infusates may also cause occlusion. Instillation of acidic or basic solutions can affect the solubility of the precipitate returning it to solution and clearing it from the catheter.
7. **Do not use hydrochloric acid after using sodium bicarbonate, or vice versa. The chemical reaction that results from this combination may generate enough heat to damage the catheter.**
8. Lipid aggregation has been reported infrequently to occlude catheters.
- a. thought to be caused by accumulation of lipids in TPN solutions (particularly 3-in-1 solutions)
 - b. dissolved with 70% ethanol solution.
9. Indications for a dye study or interventional radiology may include:
- a. Swelling at the catheter entrance
 - b. Swelling in the neck area or limb on side of catheter placement
 - c. Symptoms of superior vena cava syndrome
 - d. Sensations of pain or burning in the area of the catheter
10. Aseptic technique shall be used and consideration given to the use of a mask during this procedure.
11. Only agents specifically indicated to dissolve clots or drug precipitate shall be used.
12. Anti-air embolism precautions must be taken when entering the system.
13. Forceful or rapid injection of the agent should be avoided as this could rupture the catheter or expel a clot or precipitate into the circulation.

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14. Monitor the patient for signs and symptoms of adverse drug reactions during and immediately after the procedure. Report any suspected reaction to the physician.

A. PROCEDURE FOR THROMBOTIC CENTRAL CATHETER OCCLUSION

EQUIPMENT

Liquid soap and sanitizing gel

Gloves

Unit dose (2ml) of thrombolytic agent alteplase (tPA, Cath-Flo[®]); dose may be repeated, total dose of 4ml in a 24-hour period. Pediatric catheters may be filled with alteplase equal to 110% of the catheter volume.

5ml syringe

10ml syringe

30ml vial of 0.9% sodium chloride (USP) or pre-filled sodium chloride syringes

Stop-cock, 3-way with luer-lock ports (optional)

10ml syringe filled with 3-5ml of heparin flush (1-100 unit/ml or as prescribed by physician)

Alcohol or povidone-iodine swabs or other disinfectant product

Needleless connector

Swab Cap

1" tape

Optional: Low tension occlusion clamp

Goggles

Mask

PROCEDURE

1. Obtain order for alteplase solution. Explain procedure to patient.
2. Wash hands thoroughly with soap and water and dry with clean paper towel.
3. Put on mask and goggles, if appropriate.

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4. Assemble supplies on a clean surface. Fill 10ml syringe with sodium chloride (or use a pre-filled syringe).
5. Put on gloves.

Stop-cock Method (For completely occluded catheters)

6. Clamp catheter, remove needleless connector. Luer-lock the stop-cock onto the catheter, with the valve turned off to patient
7. Attach the 2ml alteplase (in a 10ml syringe) and an empty 10ml syringe onto the stop-cock.
8. Turn the stop-cock valve “open” to the empty 10ml syringe. Aspirate (pull back) on the empty syringe. While keeping the plunger pulled back, turn the valve “open” to the alteplase syringe. Allow the alteplase to be pulled into the catheter by the vacuum created. Allow solution to remain in the catheter for 30 minutes.
9. Turn the stop-cock valve “open” to the empty syringe, and aspirate for blood return.
 - a. If blood return noted, draw off waste (4-5ml volume may be modified for infants, patients with anemia, etc.); discard waste syringe and attach sodium chloride flush.
 - b. If no blood return noted, hold negative pressure and open stop-cock to alteplase syringe. Allow solution to flow in; wait another 30 minutes.
 - c. Repeat above procedure every 30 minutes up to 2 hours. Alteplase dose may be repeated if no blood return after 2 hours.

Syringe Method (For partially occluded catheters)

1. Attach the alteplase syringe directly to the catheter. Slowly insert the contents of the alteplase syringe.
2. Wait 30 minutes and attempt to aspirate. If there is adequate blood return, discard and flush catheter with 10-20ml of 0.9% sodium chloride (USP), followed by appropriate amount of heparin solution, if applicable. Volume of flush may be modified for infants or small children.
3. Attach a primed sterile needleless connector.
4. If there is no blood return, repeat steps 1 and 2 above every 30 minutes for 2 hours.

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5. The dose of alteplase may be repeated after 2 hours.
6. Alteplase may be left in the catheter up to 24 hours; however, most occlusions are cleared within an hour.
7. If unable to obtain a blood return, notify the physician.
8. Document procedure in patient's medical record, including dose administered.

B. OCCLUDED CATHETER: PROCEDURE FOR DRUG, CALCIUM OR PHOSPHORUS PRECIPITATE OCCLUSION

EQUIPMENT

5ml syringe filled with 0.1 normal hydrochloric acid (0.1 N HCl), volume equal to catheter
(Note: 0.1 N HCl is a caustic agent. Do not allow direct contact with skin, eyes or mucous membranes)

10ml syringe filled with 3ml of heparin (100 unit/ml or as prescribed by physician)

3-4 10ml syringes

30ml vial of 0.9% sodium chloride (USP) – not needed if using pre-filled syringes

Alcohol or povidone-iodine swabs or other disinfectant product

Sterile needleless connector

Swab Cap

Sharps container

2 masks

Goggles

OPTIONAL: Low tension occlusion clamp

1"tape

Gown

PROCEDURE

1. Obtain order for hydrochloric acid. Explain procedure to patient.
2. Put on mask and goggles (gown, if appropriate).
3. Wash hands thoroughly with soap and water and dry with a clean paper towel.

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4. Assemble supplies on a clean, dry surface.
5. Put on gloves.
6. Clamp catheter, if appropriate.
7. Cleanse catheter / needleless connector junction with 3 alcohol swabs, using friction for one full minute. Remove the needleless connector.
8. Have patient turn his/her head away from the catheter to prevent accidental splashing of the hydrochloric acid on the skin or eyes.
9. Attach a 3ml syringe with 0.1 normal hydrochloric acid to the catheter.
10. Unclamp the catheter and slowly inject the hydrochloric acid equal to the filling volume of the catheter, NOT to exceed 1ml.
11. Clamp the catheter (if appropriate), remove the syringe and attach 10ml syringe and wait 20 minutes.
12. Unclamp the catheter and withdraw the hydrochloric acid. If patency is not restored, repeat the procedure 1-2 more times.
13. When successful, aspirate the instilled drug and at least 4-5ml of blood into the syringe.
14. Clamp the catheter (if applicable) and remove the syringe.
15. Flush the catheter with 10ml of 0.9% sodium chloride, using the push-pause method, and following manufacturer's instructions for maintaining positive or neutral pressure in the catheter. The volume of the flush may be modified for infants or small children. Only preservative-free 0.9% sodium chloride shall be used for pediatric and neonate patients.
16. Remove the syringe and attach a sterile needleless device.
17. Flush the catheter with heparin (if appropriate). Attach new Swab Cap when flushing completed. Document the procedure in the patient's medical record.

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D. HIGH Ph DRUG PRECIPITATE (e.g., Phenytoin)

EQUIPMENT

5ml syringe filled with sodium bicarbonate 8.4% (1mEq/ml), volume to equal catheter volume

Pre-filled heparin syringe (100 unit/ml or as prescribed by physician)

Pre-filled 10ml 0.9% sodium chloride (USP) syringe

3-4 10ml syringes

30ml vial of 0.9% sodium chloride (USP) – unless using pre-filled syringe

Alcohol or povidone-iodine swabs or other disinfectant product

Sterile needleless connector Swab Cap

Sharps container

OPTIONAL: Low tension occlusion clamp

1" tape

Goggles

Mask

PROCEDURE

1. Obtain physician order. Explain procedure to the patient.
2. Put on mask and goggles, if appropriate.
3. Wash hands thoroughly with soap and water and dry with a clean paper towel.
4. Assemble supplies on a clean surface.
5. Put on gloves.
6. Clamp catheter if appropriate.
7. Cleanse catheter/needleless connector junction with 3 alcohol swabs, applying friction for one minute.
8. Remove the needleless connector from the catheter and attach the 3ml syringe with the sodium bicarbonate 8.4% (1mEq/ml).

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9. Unclamp the catheter (if appropriate), and slowly inject the sodium bicarbonate equal to the catheter volume (not to exceed 1ml).
10. Clamp the catheter (if appropriate), remove the sodium bicarbonate syringe and attach an empty 10ml syringe to the catheter. Wait 20 minutes.
11. Unclamp the catheter and withdraw the sodium bicarbonate. If successful, withdraw at least 4-5ml of blood into the syringe. If patency is not restored, repeat the procedure 1-2 more times.
12. Clamp the catheter (if appropriate) and remove the syringe.
13. Flush the catheter with 10ml of 0.9% sodium chloride (USP), following manufacturer's instructions for maintaining positive or neutral pressure in the catheter. Volume of the flush may be modified for infants or small children. Only preservative-free 0.9% sodium chloride shall be used for pediatric and neonate patients.
14. Remove the syringe and attach a needleless connector.
15. Flush the catheter with heparin (if appropriate). Attach new Swab Cap when flushing completed. Document the procedure in the patient's medical record.

E. LIPID DEPOSIT (from 3-in-1 formulation)

EQUIPMENT

5ml syringe with sterilized 70% ethanol, volume equal to the catheter volume

10ml pre-filled 0.9% sodium chloride (USP) syringe

Pre-filled heparin syringe (100 unit/ml or as prescribed by the physician)

30ml vial of 0.9% sodium chloride (USP) – unless using pre-filled syringe

3 – 10ml syringes

Alcohol or povidone-iodine swabs or other disinfectant product

Sterile needleless connector

Swab Cap

Sharps container

OPTIONAL: Goggles

1"tape

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Mask

PROCEDURE

1. Obtain physician order. Explain the procedure to the patient.
2. Put on mask and goggles, if appropriate.
3. Wash hands thoroughly with soap and water and dry with a clean paper towel.
4. Assemble supplies on a clean surface.
5. Put on gloves.
6. Clamp catheter, if appropriate.
7. Cleanse catheter/needleless connector junction with 3 alcohol swabs, applying friction for one minute.
8. Remove the needleless connector from the catheter and attach the 3ml syringe with the 70% ethanol solution. Unclamp the catheter and slowly inject the solution, using a “push-pause” action on the syringe plunger to maximize solution mixing.
9. Clamp the catheter (if appropriate). Remove the syringe and attach an empty 10ml syringe. Wait 1 hour.
10. If successful, aspirate the instilled drug and at least 4-5ml of blood into the syringe.
11. Clamp the catheter (if appropriate) and remove the syringe.
12. Flush the catheter with 10ml of 0.9% sodium chloride (USP), following manufacturer’s instructions for maintaining positive or neutral pressure in the catheter. Volume of flush may be modified for infants or small children. Only preservative-free 0.9% sodium chloride shall be used for pediatric or neonate patients.
13. Remove the syringe and attach a needleless connector.
14. Flush the catheter with heparin (if appropriate). Attach new Swab Cap.
15. Document the procedure in the patient’s medical record.

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RESPONSIBILITY

The Clinical Specialist has the responsibility for approval of, compliance with, and revisions to this policy.

MODIFICATION/REVISION

This policy is subject to modification or revision in part or its entirety to reflect changes in conditions subsequent to the effective date of this policy.

REFERENCES

1. Infusion Nursing Standards of Practice – Revised 2016; Journal of Infusion Nursing, Supplement to January/February 2016, Volume 39, Number 1S.
2. Infusion Nursing: An Evidence-Based Approach, Third Edition edited by Mary Alexander, Ann Corrigan, Lisa Gorski, Judy Hankins, and Roxanne Perucca.
3. INS (Infusion Nurses Society) Policies and Procedures for Infusion Nursing, 3rd Edition.