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Appendix

Buttonhole Tract Formation Using Polycarbonate Pegs

Procedure

- Remove the hemodialysis needles after dialysis per protocol
- Stop the bleeding
- Insert the peg into the established puncture sites using aseptic technique
- Some centers recommend using topical antibiotic cream at the time of peg insertion, but not all buttonhole protocols include antibiotic prophylaxis
- Cover the pegs with waterproof plaster dressing
- Leave pegs in situ until the next dialysis session
- Remove pegs immediately prior to dialysis session
- Prepare the cannulation sites per unit protocol
- Insert needles into site vacated by the pegs. The BH is created by approximately 8 to 12 cannulations using the peg
- Observe for infection, dislodgement of peg, and bleeding
Criteria for Determining Type of Self-Cannulation

For patients with arteriovenous fistulas (AVF), rope ladder (RL) cannulation technique is the preferred cannulation method for teaching patients self-cannulation. If all indicators are check marked, initiate patient self-cannulation training using RL cannulation technique.

<table>
<thead>
<tr>
<th>Indications for Rope Ladder Cannulation</th>
<th>Check Items That Apply</th>
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<tbody>
<tr>
<td>AVF is relatively straight</td>
<td></td>
</tr>
<tr>
<td>AVF is newly created and dynamic (developing and changing)</td>
<td></td>
</tr>
<tr>
<td>Patient experiences hand tremors</td>
<td></td>
</tr>
<tr>
<td>Poor technique may lead to the creation of multiple tracts if buttonhole (BH) cannulation is used</td>
<td></td>
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<tr>
<td>Patient reports or demonstrates difficulty with vision</td>
<td></td>
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<tr>
<td>Poor vision and improper placement of needle on the BH may lead to the creation of multiple tracts if BH cannulation is used</td>
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<tr>
<td>Patient expresses fear related to self-cannulation, but is nonetheless prepared to attempt self-cannulation</td>
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Total Number of Check Marks:

<table>
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<tr>
<th>Indications for Buttonhole Cannulation</th>
<th>Check Items That Apply</th>
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<tr>
<td>AVF is short in length or short usable segments</td>
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<tr>
<td>AVF has torturous anatomy</td>
<td></td>
</tr>
<tr>
<td>AVF developed aneurysmal dilation</td>
<td></td>
</tr>
<tr>
<td>AVF is mature and no longer dynamic</td>
<td></td>
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<tr>
<td>AVF is difficult to cannulate</td>
<td></td>
</tr>
<tr>
<td>The patient is unable to self-cannulate use the RL technique</td>
<td></td>
</tr>
<tr>
<td>Patient displays needle phobia</td>
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</tr>
<tr>
<td>Patient expresses considerable fear related to self-cannulation</td>
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Total Number of Check Marks:

## Arteriovenous Fistula/Graft Audit Tool

### Instructions:
- Use a “+” if performed correctly
- Use a “○” if not performed correctly

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<th>Date</th>
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<th>Date</th>
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</table>

### Cannulation: Rope Ladder Technique
- Hand hygiene: wash hands and access with soap and water
- Skin cleansed with antiseptic
- Antiseptic allowed to dry
- Cannulation performed aseptically
- Patient connects aseptically

### Cannulation: Buttonhole Technique
- Hand hygiene: wash hands with soap and water
- Skin and buttonhole sites cleansed with antiseptic
- Scab removed with sterile blunt tip or needle sterile pack
- Needle or pick use 1 time only
- Skin and buttonhole sites cleansed with antiseptic a second time
- Scab removed completely
- No evidence of bleeding after scab removal
- Cannulation performed aseptically
- Patient connects aseptically

---

Tool adapted with permission from University Health Network, Toronto, Ontario, Canada.
### Arteriovenous Fistula/Graft Audit Tool (cont’d)

**Instructions:**
- Use a “+” if performed correctly
- Use a “O” if not performed correctly

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<th>Date</th>
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<tbody>
<tr>
<td>Perform hand hygiene using hand sanitizer</td>
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<tr>
<td>Antiseptic ointment or cream applied to sites</td>
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<tr>
<td>Clean gauze or bandage applies to sites</td>
<td></td>
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</tbody>
</table>

**Comments:**

---

Tool adapted with permission from University Health Network, Toronto, Ontario, Canada.
# Central Venous Catheter Audit Tool

**Instructions:**
- Use a “+” if performed correctly
- Use a “○” if not performed correctly

<table>
<thead>
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<th>Date</th>
<th>Date</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand hygiene: wash hands with soap and water</td>
<td></td>
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<tr>
<td>Tego connector changed aseptically every 7 days or as required</td>
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<tr>
<td>Catheter hub soaked and then scrubbed with antiseptic</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Catheter hub antiseptic allowed to dry</td>
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<tr>
<td>Tego connector Luer locked aseptically to catheter hub every 7 days or as required</td>
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<tr>
<td>Tego connector soaked and scrubbed with antiseptic</td>
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<tr>
<td>Tego connector antiseptic allowed to dry</td>
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<tr>
<td>Patient connects aseptically</td>
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<table>
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<td>Perform hand hygiene using hand sanitizer</td>
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<tr>
<td>Patient disconnected aseptically</td>
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<tr>
<td>Tego connector soaked and scrubbed with antiseptic</td>
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<tr>
<td>Tego antiseptic allowed to dry</td>
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<tr>
<td>Catheter locked aseptically</td>
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Tool adapted with permission from University Health Network, Toronto, Ontario, Canada.
## Central Venous Catheter Audit Tool (cont’d)

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<td>Date</td>
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<tr>
<td>Use a “⚽” if not performed correctly</td>
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### Catheter Exit Site Care

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<th>Date</th>
<th>Date</th>
<th>Date</th>
<th>Date</th>
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<tbody>
<tr>
<td>Hand hygiene: Wash hands with soap and water</td>
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<tr>
<td>Exit site cleaned with antiseptic</td>
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<tr>
<td>Antiseptic allowed to dry</td>
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<tr>
<td>Antimicrobial ointment or cream applied to exit site</td>
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<tr>
<td>Dressing applied aseptically</td>
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<tr>
<td>Shower technique</td>
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### Comments:

Tool adapted with permission from University Health Network, Toronto, Ontario, Canada.
Appendix

Mupirocin Protocol: Information for Patients
Mupirocin Nasal Ointment to Eliminate Nasal Carriage of Staphylococcus aureus

Why do I need mupirocin nasal ointment?
Recent nasal swab results have indicated that you are carrying a common type of bacteria called *Staphylococcus aureus* ("staph").

This organism is often found on the skin and in the noses of healthy people where it is generally harmless. In patients who have hemodialysis (HD) access (ie, a catheter, fistula, or graft), this bacteria needs to be treated to prevent any possible spread of infection. An effective treatment to get rid of the bacteria is to apply an antibiotic ointment called mupirocin into both nostrils.

How long will treatment be required?
Treatment for 3 months is required to successfully remove the bacteria. The recommended schedule varies depending on whether you are currently on HD or have not yet started dialysis.

Where can I get the nasal ointment?
You will need to get a prescription for the ointment from your healthcare provider. The ointment can then be purchased at a pharmacy.

Technique for applying mupirocin ointment

- Wash hands well with soap and water or disinfect hands with alcohol gel/rub.
- Open the mupirocin nasal ointment tube.
- Place a small amount of ointment (about the side of a match head) onto a clean cotton swab and massage gently around the inside of the nostril, particularly toward the front of the nostril.
- Do not insert the cotton swab too deeply into the nose—no more than 1 cm inside the nostril.
- Using a new cotton swab, repeat for the other nostril. Using a new cotton swab will prevent contamination of the ointment tube.
- After applying the ointment, press a finger against the nose next to the nostril opening and use a circular motion to spread the ointment inside the nose.
- Wash or disinfect hands after applying the ointment.
Patients on Hemodialysis

Instructions: Apply ointment inside each nostril 2 times per day for 14 days, and then continue to apply 3 times per week after dialysis on dialysis days only. Continue course for 3 months in total.

Check each box when you have applied the ointment to remind you when you need to reapply.

Stage 1: Apply TWICE daily for 14 days

<table>
<thead>
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Stage 2: After the first 14 days, continue to apply to the inside of each nostril AFTER dialysis on dialysis days ONLY. Continue for a total of 3 months.

Ointment applied after dialysis until the following date: ____________

NOTE: It is extremely important to complete a total of 3 months of treatment. You should have a repeat nasal swab performed at your center after completing the course of therapy to ensure the therapy has been effective.
Appendix

Patients Who Have Not Started Dialysis

<table>
<thead>
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**Instructions:** Apply ointment inside each nostril **2 times per day** for 5 days. Repeat this course of treatment each month for 3 months.

Check each box when you have applied the ointment to remind you when you need to reapply.

**NOTE:** It is extremely important to complete a total of 3 months of treatment. You should have a repeat nasal swab performed at your center for laboratory testing after completing the course of therapy to ensure the treatment has been effective.

<table>
<thead>
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Protocol adapted with permission from Metro South and Ipswich Nephrology and Transplant Services (MINTS), Queensland, Australia.
Fear of needles is an important issue to acknowledge and address when the patient is considering home hemodialysis therapy as a treatment modality. Regardless of the cannulation technique that is being considered (rope ladder or buttonhole), instruction on self-cannulation should incorporate strategies for patients coping with fear of cannulation. Presented below are some useful strategies and techniques that can be implemented during training that may help a patient cope when learning to self-cannulate.

Coping strategies to reduce patient distress during self-cannulation

♦ **Staff behavior:** Patience is a virtue. Staff is encouraged to modify the pace of training based on the patient’s skill and level of comfort. Staff can encourage patient involvement by asking the patient to assess the access, preparing the accessories required for cannulation, and observing the cannulation process.

♦ **Hand holding:** Staff can help patients to slowly engage in self-care by asking them to hold the needle while the nurse cannulates the vessel.

♦ **Warm compress:** Apply a warm compress to the access site 5 minutes prior to cannulation. This activity has 2 effects. First, the access dilates and becomes engorged, allowing for ease of cannulation. Second, the warmth of the compress is associated with comfort and relaxation.

♦ **Topical analgesic:** Topical analgesic can be used to reduce the pain associated with needle insertion. Removing the element of pain will allow the patient to focus on self-cannulation.

♦ **Peer modeling:** Peer support helps connect patients who are diagnosed with chronic conditions such as end stage renal disease. The chronically ill patient is not alone and can find comfort by sharing knowledge and experiences with others who are in similar situations. Peer support can improve patient self-efficacy and attitudes toward self-management.

Useful Resources:


Fear of Needles (cont’d)

♦ Imaginal Exposure Therapy: Imaginal therapy involves the client imagining the situation until acclimatization occurs. Fears should be arranged in a hierarchy from least to most anxiety evolving. The client is encouraged to “be in the scene.” The therapist describes the event while the client describes what he or she sees, hears, tastes, smells, and feels. The client is asked to rate the level of anxiety (scale from 0-10, where 10 is extreme) and return immediately to the scene. The session can be recorded and utilized regularly.

♦ Hypnotherapy: Hypnosis can be used to encourage an individual to respond to suggestions and thus alter a habit or attitude for the benefit of health. Hypnotherapy can be used to decrease anxiety and change the patient’s reaction and attitude toward needles.

♦ Medication: Medications to alleviate anxiety can be given prior to cannulation. This is a temporary measure and the prescribed medication should be limited to the initial first few cannulation events.

Patient training can become a positive experience when simple strategies are implemented to help the individual cope with fear of needles.
Appendix

Buttonhole Cannulation Protocol for Creation and Maintenance of Tract with Intravenous Needle and Cannula

(Arteriovenous Fistula Only)

The intravenous (IV) cannula with blunt tip can be used for the maintenance of buttonhole (BH) tracts.

Procedure

1. Wash hands and the arteriovenous fistula (AVF) with soap and warm running water for at least 20 seconds.
2. Dry hands and the AVF with clean towel.
3. Clean the buttonholes (BHs) with a cleansing agent. Note: Some patients find it easier to remove the scab if the BH sites are soaked with cleansing agent or saline saturated gauze. If this is the case, soak for 2 to 5 minutes.
4. Completely remove scab on arterial BH site with 18-gauge blunt needle.
5. Discard 18-gauge blunt needle. Do not reuse needle.
6. Completely remove scab on venous BH site with 18-gauge needle.
7. Discard 18-gauge blunt needle. Do not reuse needle.
8. Clean AVF with cleaning agent again.
9. Apply tourniquet above the AVF.
10. Remove the IV needle with cannula needle from protector.
11. Align IV needle with cannula at the same angle as previous cannulations, with bevel facing up over the BH site.
12. Insert IV needle with cannula into arterial BH.
13. Blood will backflow into needle hub.
14. Lower the angle of the needle.
15. Continue to advance IV needle with cannula into the AVF approximately 1 cm into blood vessel.

Supplies

1. Clean towel
2. IV needle with cannula (eg, Supercath needles, 17-gauge)
3. 18-gauge needles
1. Package 4 x 4 gauze
2. Cleansing swabsticks
1. Dressing to secure needles
2. Forceps
2. 10-mL syringes prepared with 6 mL normal saline (0.9%)
1. Tourniquet
1. Alcohol wipe
Appendix

Buttonhole Cannulation Protocol for Creation and Maintenance of Tract with Intravenous Needle and Cannula (cont’d)

16. With free hand hold the rubber adapter with thumb and forefinger, extend the thumb and pull the inner needle out of the outer needle while the palm of the same hand anchors the inner needle.

17. Continue to advance the outer needle while continuing to withdraw the inner needle until the outer needle is tressed within the vessel completely and the outer needle is completely withdrawn.

18. Release the tourniquet.

19. Secure the needle with dressing.

20. Clamp catheter with forceps.

21. Remove rubber adapter (cap).

22. Luer connect 10 mL syringe prepared with 6 mL normal saline to needle.

23. Remove forceps then aspirate and flush the catheter. Assess flow.

24. Clamp catheter with forceps.


Protocol adapted with permission from University Health Network, Toronto, Ontario, Canada, cannulation protocol.
Appendix

Removal of Intravenous Needle with Cannula

Procedure

1. Retransfuse blood at end of treatment, per protocol.
2. Prepare gauze with a dab of antibacterial cream/ointment.
3. Ensure extracorporeal lines are clamped.
4. Ensure arterial needle is clamped.
5. Ensure venous needle is clamped.
6. Do not disconnect extracorporeal lines from arterial and venous needles.
7. Remove venous needle dressing.
8. Apply gauze with dab of cream/ointment to venous needle buttonhole (BH) site.
9. Apply gentle digital pressure to the venous BH needle site with the free hand.
10. With access hand grip the venous blood circuit tubing between thumb and forefinger and withdraw needle completely while continuing to apply digital pressure with the free hand to BH site.
11. Allow hemostasis to occur.
12. Apply bandage.
13. Remove arterial needle dressing.
14. Repeat steps 8 through 12.
15. Continue with end of treatment protocol.

Supplies

1. Clean towel
2. Bandages
3. Package 4 x 4 gauze
4. Antibacterial cream/ointment

Protocol adapted with permission from University Health Network, Toronto, Ontario, Canada, cannulation protocol.
Appendix

Buttonhole Cannulation Technique with Dull (Blunt) Bevel
(Arteriovenous Fistula Only)

Procedure

1. Wash hands and the arteriovenous fistula (AVF) with soap and warm running water for at least 20 seconds.
2. Dry hands and the AVF with clean towel.
3. Remove dull/blunt fistula needles from package.
4. Attach 10-mL syringe prepared with normal saline to each needle.
5. Prime the fistula needles.
7. Clean the buttonholes (BHs) with a cleansing agent. (Note: Some patients find it easier to remove the scab if BH sites are soaked with cleansing agent or saline-saturated gauze. If this is the case, soak for 2 to 5 minutes.)
8. Completely remove scab on arterial BH site with 18-gauge blunt needle or BH pick. Do not reuse needle or pick.
9. Discard 18-gauge needle or discard pick.
10. Completely remove scab on venous BH site with 18-gauge blunt needle or BH pick.
11. Discard 18-gauge needle or discard pick. Do not reuse needle or pick.
12. Clean AVF with cleansing agent again.
13. Apply tourniquet above the AVF.
14. Tighten the tourniquet.
15. Pinch wings of dull/blunt buttonhole needle carefully, remove tip protector.
16. Align BH needle cannula at the same angle as previous cannulations, with bevel facing up, over buttonhole site.
17. Insert needle into established BH site at the same angle as previous cannulations.

Supplies

1. Clean towel
2. Dull bevel buttonhole needles
3. 18-gauge blunt needles
4. Package 4 × 4 gauze
5. Cleansing swabsticks, chlorhexidine 2%/alcohol 70%
6. Normal saline (0.9%) saturated gauze
7. Dressings to secure needles
8. 10 mL-syringes prepared with 6 mL normal saline (0.9%)
9. Tourniquet
10. Personal protective equipment (eg, mask)
Appendix

Buttonhole Cannulation Technique with Dull (Blunt) Bevel (cont’d)

18. Advance BH needle along the developed tunnel tract. If mild-to-moderate resistance is met, using gentle pressure, rotate dull/blunt needle back and forth.

19. Allow the dull/blunt needle to seek the vessel entrance, advance dull/blunt needle into the AVF.

20. Release the tourniquet.

21. Check the position of the needle. First, pull back blood into 10-mL syringe, then flush and check the return flow.

22. Clamp needle.

23. Secure the needle with dressing.

24. Repeat steps 14 to 23 to cannulate the second needle.

Protocol adapted with permission from University Health Network, Toronto, Ontario, Canada, cannulation protocol.
Appendix

Removal of Dull/Blunt Dull (Blunt) Bevel Needles from Arteriovenous Fistula

Procedure

1. Retransfuse blood at end of treatment, per protocol.
2. Prepare gauze with a dab of antibacterial cream/ointment.
3. Ensure extracorporeal lines are clamped.
4. Ensure arterial needle is clamped.
5. Ensure venous needle is clamped.
6. Disconnect extracorporeal lines from arterial and venous needles.
7. Remove venous needle dressing.
8. Apply gauze with dab of cream/ointment to venous needle buttonhole (BH) site.
9. Apply gentle digital pressure to the venous BH needle site with the free hand.
10. With access hand grip the venous needle tubing between thumb and forefinger and withdraw needle completely while continuing to applying digital pressure with the free hand to BH site.
11. Allow hemostasis to occur.
12. Apply bandage.
13. Remove arterial needle dressing.
14. Repeat steps 8 through 12.
15. Continue with end of treatment protocol.

Supplies

1. Clean towel
3. Package 4 x 4 gauze
2. Bandages
1. Antibacterial cream/ointment

Protocol adapted with permission from University Health Network, Toronto, Ontario, Canada, cannulation protocol.
Taping Method for Hemodialysis Needle

Transparent Dressing

- Transparent dressing is compatible with sensitive skin and adheres well, even when exposed to moisture
- Skin barriers can be used to help prevent irritation
- Apply skin barrier before application of dressing

Apply tape strip to secure needle

Apply second tape strip under needle and over wings of needle

Rose Faratro, RN, BHSN, CNeph(C)
University Health Network, Toronto, Ontario, Canada
Remove the back lining from the transparent dressing. Apply dressing over needle.

Smooth transparent dressing over the needle and surrounding area. Allow tubing to come through the deep notch of dressing.

Remove top lining of transparent dressing.
Appendix

Taping Method for Hemodialysis Needle (cont’d)

Stabilization fold

Gently peel off the back lining of the stabilization fold

Apply the stabilization fold portion of the dressing and smooth over skin
Taping Method for Hemodialysis Needle (cont’d)

Secure and smooth down second stabilization fold

Pinch transparent dressing at the deep notch

Check stabilization of needle
Taping Method for Intravenous Needle with Cannula

Transparent Dressing
- Transparent dressing is compatible with sensitive skin and adheres well, even when exposed to moisture
- Skin barriers can be used to help prevent irritation
- Apply skin barrier before application of dressing

Apply tape strips to secure cannula using the chevron taping method

Remove the back lining from the transparent dressing. Apply dressing over cannula

Rose Faratro, RN, BHScN, CNeph(C)
University Health Network, Toronto, Ontario, Canada
Smooth transparent dressing over cannula and surrounding area

Apply and smooth down stabilization folds

Check stabilization of cannula
Appendix

Heparin Locking of Central Venous Catheters

Procedure

1. Use alcohol wipe to clean table.
2. Wash hands for 2 minutes. Dry thoroughly.
3. Open supplies and place on table.
4. Wash hands for 30 seconds and apply sterile gloves.
5. Use the 3-mL syringes and needles to draw up the appropriate volume of heparin as indicated on the lumens of each catheter (volume varies).
6. Ensure lines are clamped.
7. Remove caps from lumens. Clean the end of the lumen using the antiseptic wipe or swab. Allow to dry.
8. Connect the heparin-containing syringe to the arterial lumen and instill heparin solution. Replace cap. Repeat for venous lumen.
9. Allow heparin solution to dwell in the lumens until the next dialysis run.
10. Use the antiseptic wipe or swab to clean the ends of the lumens.
11. Aspirate heparin from the lumens using a 3-mL syringe.
12. Use the 10-mL syringes and needle to draw up sodium chloride using separate syringes for each lumen. The total volume in each syringe should be twice that of the lumen. When using Tego connectors, add 0.1 mL to volume.
13. Flush lumens with sodium chloride solution.
14. Perform dialysis, per protocol.
15. Adjust postdialysis heparin bolus to account for heparin used in lock.

Supplies

1. Dialysis dressing pack
2. Personal protective equipment (eg, apron, gloves)
3. 10-mL syringe with Leur lock
4. 3-mL syringe with Leur lock
5. Sterile Leur lock caps or Tego connectors
6. 18-gauge needle
7. 10-mL ampules of 0.9% sodium chloride
8. Antiseptic wipe or swab (eg, isopropyl alcohol 70%/chlorhexidine 2%)
9. 6mL heparin sodium, 5000 units per 1 mL (number of ampules determined by volume of catheter, as indicated by lumen)
10. Alcohol disinfecting wipe

Protocol adapted with permission from Metro South and Ipswich Nephrology and Transplant Services (MINTS), Queensland, Australia.
Appendix

Heparin Flushing of Cannulas

1. Cannulate the access using standard rope ladder or buttonhole protocol.
2. Draw up 1000 units of heparin sodium using a 10-mL syringe and needle.
3. Dilute the heparin in the syringe by drawing up sodium chloride 0.9% to a total volume of 10 mL (concentration now 100 units/mL).
4. Flush each cannula with 5 mL (500 units) of the diluted heparin/sodium chloride solution.
5. Flush cannulas before initiating dialysis using the usual procedure.
6. Reduce the postdialysis heparin bolus by 1 mL (1000 units) to account for the amount used to flush the cannulas.

Note: If patients typically use enoxaparin instead of heparin, advise them to withdraw the heparinized saline from the cannulas (instead of flushing) before using them for HD. Patients should flush the cannulas with sodium chloride 0.9% to ensure proper position before initiating dialysis. Enoxaparin should be administered, as usual.

Protocol adapted with permission from Metro South and Ipswich Nephrology and Transplant Services (MINTS), Queensland, Australia.
Appendix

Showering Protocol

Procedure

1. Gather all supplies and equipment before entering the shower.
2. Ensure all catheter caps are secure before entering the shower.
3. Remove exit site dressing, dispose of dressing, and inspect the site for signs and symptoms of infection (see below).
   - If signs and symptoms of infection are present, **DO NOT USE SHOWER TECHNIQUE.** Use a covered or modified shower technique. Contact your hemodialysis clinician to notify them of possible infection.
4. While in the shower, wash and rinse face, hair, and body using 1 face cloth. The catheter area should be cleaned last.
5. Use the second face cloth and soap to wash the area around the exit site.
6. Rinse thoroughly and exit shower.
7. Dry the catheter area first by gently patting with a dry towel.
8. Dry the rest of the body using a dry towel.
9. Apply a cleansing agent to the area nearest to the catheter and move in a circular pattern away from the catheter.
10. Clean the catheter from the exit site to hub a second time using the cleansing agent.
11. Allow area to dry.
12. If necessary, apply antibiotic ointment to the area.
13. Apply dressing.

Required Supplies

- 2 clean face cloths
- Clean towels
- Mild soap with pump dispenser
- Cleansing agent recommended by the dialysis unit (eg, chlorhexidine, povidone iodine)
- Dressing supplies

Signs of Skin Infection

- Redness
- Swelling
- Unusually warm skin
- Fever
- Fragile skin that bleeds easily
- Pus or other liquid oozing from skin
- Foul odor
- Increased pain or change in pain
- Cracked skin

Protocol adapted with permission from the Home Dialysis Interest Group, Toronto, Canada, document “Shower Technique for Hemodialysis Access”.

International Society for Hemodialysis

Implementing Hemodialysis in the Home

A Global Perspective

28
Central Venous Catheter Antibiotic Treatment Protocol

Purpose

1. To provide evidence-based practice guidelines for the management of suspected systemic central venous catheter (CVC)-related infection in the hemodialysis (HD) outpatient population.

Note: This is a guideline ONLY; there may be times when, based on individual assessments, there is a need to operate outside of this protocol.

2. To provide an accurate and comprehensive record of all vascular access infections via a single point of entry to aid in the development of targeted strategies to reduce vascular related infection rates and optimize patient outcomes.

Personnel Permitted to Perform Procedure

1. Registered nurses (RNs), graduate nurses, and licensed practical nurses (LPNs; in consultation with an RN) who have completed specialized, comprehensive HD training.

2. Patients/designated helpers who have received specialized and comprehensive training by a trained home HD-registered nurse may administer intravenous (IV) antibiotics at home if trained in the procedure and with dosage instructions from the home HD RN (in conjunction with this protocol).

Policy

1. A physician’s order is required to initiate the antibiotic protocol

- When a patient presents with suspected CVC bacteremia infection, the attending nephrologist must be notified of any significant clinical findings and diagnostic testing prior to the nurse proceeding with antibiotic treatment (ie, Appendix I: “Phase I — Algorithm for SUSPECTED Systemic Catheter Associated Bacteremia”)

- When blood culture specimen results are confirmed to be positive, the attending nephrologist will be notified of the results and the plan to continue with the antibiotic protocol (ie, Appendix II: “Phase II — Antibiotic Protocol for CONFIRMED Catheter Associated Bacteremia”)

- Antibiotics should be prescribed in accordance with Appendix III: “Gentamycin, Vancomycin, CeFAZolin, CefTAZidime Dosing Charts”

- If the blood culture results are negative, the antibiotic protocol will be discontinued. The attending nephrologist will be notified of the negative results and the clinical status of the patient

Definitions

- **Bacteremia**: Presence of bacteria in the circulating blood

- **Coagulase-negative Staphylococcus** (*Staphylococcus epidermidis*): Normal bacterial skin, gut and upper respiratory tract flora. It is a true opportunistic pathogen. Infection is associated with skin penetration from CVC or peritoneal dialysis (PD) catheter insertion; implanted prosthesis (eg, heart valves); and in immunocompromised patients such as those individuals with end-stage renal disease

- **Enterococcus fecalis**: Opportunistic gram-positive bacterium that has become one of the most troublesome pathogens. Lives peacefully in the gut but thrives in wounds. Extremely hardy and can survive for weeks on environmental surfaces

- **Gram-negative microorganisms**: Examples are *Klebsiella*, *Pseudomonas aeruginosa*, *Escherichia coli* (E coli)

- **Metastatic infection**: Transmission of infection from an original site to 1 or more sites elsewhere in the body
2. When a patient becomes an inpatient, the attending physician will assume responsibility for management of the infection (ie, will choose to order the antibiotic protocol or provide individualized prescriptive care).

3. The access nurse and/or designate unit-specific access expert will be notified of all suspected and/or confirmed infections.

4. Strict aseptic technique must be used when performing CVC-related interventions.

5. In the event of suspected catheter-related infection, patient assessment will include the following general clinical manifestations of bacteremia (see Appendix I, “Phase I — Algorithm for SUSPECTED Catheter Associated Bacteremia”).

Note: Patients who have artificial heart valves or those who are taking steroids or immunosuppressant medications are more prone to develop systemic infection.

- Fever ≥ 38°C and/or chills and rigors
- Hypothermia
- Confusion or altered level of mental state
- Hyperglycemia
- Nausea and/or vomiting
- Complaint of general and unusual feeling of unwellness
- Signs and symptoms of any of the following:
  - Respiratory infection (eg, cough, colored phlegm or sputum production, hemoptysis, shortness of breath, crackles and/or wheezes on auscultation, oxygen desaturation on room air, increased need for oxygen replacement)
  - Gastrointestinal infection (eg, diarrhea, abdominal cramps, loss of appetite, abdominal distention and/or tenderness)
  - Genitourinary infection (eg, hematuria, pyuria or dysuria in patients with some residual function, pain in lower back, hips or thighs)
  - Integumentary or access site infection (eg, redness, tenderness, serous or purulent exudates, pallor or bruising, cool or warm to touch, edema)
  - Metastatic infection (eg, red, tender, and/or swollen joints; new or worsening cardiac murmur, congestive heart failure)
- Elevated white blood cell (WBC) count

**Definition (cont’d)**

- **Sepsis:** Severe and potentially fatal illness caused by overwhelming infection of the bloodstream by toxin producing bacteria
- **Staphylococcus aureus:** Gram-positive microorganism that commonly colonizes the human skin and nasal mucosa. Can enter into the blood stream through breakage of the skin or may be ingested in contaminated food particles. Once in the body, it can produce poisons and toxins causing severe illness
- **MSSA:** Methicillin-sensitive *S aureus*
- **MRSA:** Methicillin-resistant *S aureus*
- **Streptococcus viridans:** Hemolytic streptococcus that is usually the main culprit for endocardial infection
Appendix

Central Venous Catheter Antibiotic Treatment Protocol (cont’d)

6. An RN or an LPN (in consultation with a RN), without a physician’s order, may obtain the following laboratory specimens:
   ♦ Blood culture specimens: 2 sets of 2 (4 total) or 1 set of 3 (local laboratory dependent)
   ♦ Complete blood cell count
   ♦ Swab(s) for culture and sensitivity from sites where exudate is present
   ♦ Sputum and/or urine for culture and sensitivity if indicated
   ♦ Predialysis antibiotic levels if the patient is already being treated for suspected or confirmed infection
     ▪ If the CVC is locked with an antibiotic solution, draw antibiotic levels per PT/INR method (start dialysis, wait 5 minutes, and then draw level). Consult physician if unable to withdraw antibiotic lock solution from the CVC
     ▪ If the predialysis antibiotic levels are not available before the patient completes the dialysis session, the next antibiotic dose can be given during the next session unless the levels are below target. In this case, it is advisable to bring the patient back for dosing. If the patient refuses or there is uncertainty (ie, close to target), check with the nephrologist

7. Unless otherwise ordered, the patient’s standard lock solution will continue to be used. Note: There may be some situations where the physician requests use of vancomycin/heparin OR cefTAZidime/heparin lock solution (to replace the patient’s standard lock solution).

8. Antibiotics will be adjusted based on the following predialysis antibiotic levels:
   ♦ Vancomycin greater than 19 mg/L: Hold vancomycin
   ♦ Gentamicin less than 1.5 mg/L or greater than 3 mg/L: refer to Appendix III. “Gentamycin, Vancomycin, CeFAZolin, CefTAZidime Dosing Charts”

Note for home HD patients: Alternatively, vancomycin 25 mg/kg load followed by 500 mg every HD session to a maximum of 4 sessions/week, may be given without pursuing vancomycin levels.
Appendix

Procedure for Antibiotic Lock Preparation

(refer to Appendix II — “Phase II Antibiotic Protocol for CONFIRMED CVC Associated Bacteremia According to Bacterial Organism”)

1. Prepare vancomycin and heparin lock solution, if ordered, for CVC Locks: Note: Vancomycin lock solution should be prepared immediately prior to administration as it is good for 72 hours only (this will ensure potency is maintained within the catheter lumen until the next run). Also note that prevancomycin levels may be influenced by the vancomycin/heparin lock solution and unusual results should be brought to the attention of the physician.

   A. Gather equipment/supplies
      - Vancomycin 500-mg vial
      - Sterile water for reconstitution
      - Heparin 10,000-units/mL vials
      - Sodium Chloride 0.9% 50 mL minibag
      - Needles, 18 gauge × 5
      - Syringes, 3 mL × 3; 10 mL × 4
      - Medication labels, if required

   B. Prepare vancomycin 2.8 mg/mL
      - Add 10 mL sterile water for injection to a 500-mg vial of vancomycin powder to make a 50-mg/mL solution
      - Shake to dissolve
      - Withdraw and discard 4 mL from a 50-mL minibag of sodium chloride 0.9% (this is the standard average overfill in a minibag)
      - Inject 3 mL (150 mg) of vancomycin into the minibag and apply medication label
      - Final concentration: 150 mg in 53 mL = 2.8 mg/mL vancomycin

Points of Emphasis

- Patients must be educated on the signs of CVC access infection and the need to seek immediate medical attention in urgent or emergent situations (eg, septicemia)
- Antibiotic doses may be verified by 2 nurses (1 must be a RN) or 1 nurse and 1 pharmacist at the discretion of the RN
Appendix

Procedure for Antibiotic Lock Preparation (cont’d)

C. Prepare heparin lock solution
   ✦ Into a 3-mL syringe, draw 0.3 mL (3000 units) from a 10,000-units/mL vial of heparin
   ✦ Using the same syringe, withdraw 2.7 mL (7.5mg) of vancomycin from the above minibag
   ✦ Repeat above 2 steps, using a second 3-mL syringe
   ✦ Flush both lumens with 10-mL sodium chloride 0.9%
   ✦ Instill vancomycin/heparin lock solution equal to the volume of CVC lumens
   ✦ Apply medication labels to the lumens

D. Final products (reflected on medication label)
   ✦ Vancomycin 7.5 mg/3 mL = 2.5 mg/mL
   ✦ Heparin 3000 units/3 mL = 1000 units/mL

2. If cefTAZidime/heparin lock is ordered
   For inpatients: Order from pharmacy
   For outpatients: Mix as follows (prepare immediately prior to administration)

A. Gather equipment/supplies
   ✦ CefTAZidime 1-g vial
   ✦ Heparin 10,000-units/mL vials
   ✦ Sterile water for injection 10 mL
   ✦ Sodium chloride 0.9% 50-mL minibag
   ✦ Needles, 18 gauge × 5
   ✦ Syringes, 10 mL × 4; 3 mL × 3; 1 mL × 1
   ✦ Syringe-to-syringe transfer device × 2
   ✦ Medication labels

B. Reconstitute cefTAZidime
   ✦ Inject 4.4 mL sterile water for injection to 1-g vial of cefTAZidime
   ✦ Shake well to reconstitute
   ✦ Yields a 200-mg/mL solution

Bibliography


Procedure for Antibiotic Lock Preparation (cont’d)

C. Prepare lock solution

♦ Draw up 0.25 mL (50 mg) cefTAZidime
♦ Draw up 2.5 mL (25,000 units) heparin using the 10,000-units/mL solution
♦ Using a syringe-to-syringe transfer device, transfer the contents of both syringes to a 10-mL syringe
  ▪ Fill this final syringe to 10 mL using sodium chloride 0.9%
  ▪ Mix well
  ▪ Using syringe-to-syringe transfer device, fill 2, 3-mL syringes with cefTAZidime/heparin lock solution
  ▪ Flush both lumens with 10 mL sodium chloride 0.9%
  ▪ Instill cefTAZidime/heparin lock solution equal to the volume of CVC lumens
  ▪ Apply medication labels to lumens
♦ Final product (reflected on medication label):
  ▪ CefTAZidime 5 mg/mL + heparin 2500 units/mL lock solution

Bibliography (cont’d)

Appendix

Appendix I. Phase I - Algorithm for Suspected Systemic CVC-Associated Bacteremia

Patient with HD CVC

Presents unwell
(symptomatic or asymptomatic)

For example, fever ≥ 38°C, chills, rigors, hypothermia, confusion or altered mental state, hyperglycemia, nausea and/or vomiting, complains of general or unusual/vague feeling of unwellness

Perform clinical assessment
(refer to Policy Statement 6)

Signs and symptoms of respiratory, gastrointestinal, genitourinary, integumentary, or metastatic infection, elevated WBC

Obtain lab specimens
(refer to Policy Statement 7)

Blood cultures; CBC; swab(s) for culture and sensitivity from sites where exudates are present; sputum and/or urine for culture and sensitivity, if indicated; pre-dialysis antibiotic levels if patient is already being treated

Check for allergies

To vancomycin, ceFAZolin, gentamicin, and cefTAZidime

If allergies exist to any antibiotics

• Check with pharmacy to determine if applicable to any of the protocol recommended drugs
• Defer to the physician for individualized care
• Do NOT proceed with the Antibiotic Protocol

If no allergies and pending cultures, obtain physician order to initiate the Antibiotic Protocol

Initiate Antibiotic Protocol

• If patient presents clinically unwell (ie, symptomatic) obtain physician order to administer vancomycin + ceFAZolin + gentamicin*, consider immediate CVC removal (unless another source of infection has been identified), and admit patient to hospital
• If patient appears clinically well (ie, complains of general or unusual/vague feeling of unwellness but otherwise asymptomatic), administer vancomycin + gentamicin*, leave CVC in place, and treat as an outpatient until cultures return
• If patient is gentamicin intolerant, substitute with cefTAZidime*

Predialysis Antibiotic Levels

Vancomycin target = 15 - 19 mg/L

• For home HD patients, refer to Policy Statement 9
• Vancomycin level will be reduced by 30% after dialysis

Gentamicin target = 1.5 - 3.0 mg/L

• Patients should be questioned regularly about hearing problems and/or dizziness (signs of ototoxicity)

If blood culture results are known to be positive, with no other obvious source of infection, the attending nephrologist will be notified of the results and the plan to continue with the Antibiotic Protocol physician (proceed to Appendix II: Phase II for antibiotic choice and duration of therapy)
• If positive swab but negative blood cultures, check with physician for exit site treatment
• If positive sputum, would and/or urine, check with physician for next steps
• If all diagnostic tests are negative, notify physician and, unless the patient is clinically symptomatic, discontinue antibiotic therapy

* Dosing per Appendix III
Appendix II. Phase II – Antibiotic Protocol for Confirmed CVC-Associated Bacteremia According to Bacterial Organism

Treatment for Organism-Specific CVC-Associated Bacteremia

Note: Significant if ≥ 2 culture bottles positive for organism listed below

Coagulase-Negative Staphylococcus (antibiotics x 3 weeks)

- If clinical assessment is negative, leave catheter in place, give IV vancomycin* x 3 weeks total; use standard lock solution unless vancomycin/heparin lock solution ordered
- If clinical assessment positive, obtain physician order to remove the CVC

Note: Significant if ≥ 1 culture bottle positive for organism listed below

Staphylococcus aureus (antibiotics x 4 to 6 weeks)

- Given the high risk of metastatic complications it is ideal practice to remove the CVC and replace at a new site even if clinical assessment is negative (guidewire exchange should not be done)
- If MSSA positive, give ceFAZolin* x 4 weeks
- If MRSA positive, give vancomycin*
- If clinical assessment positive, admit patient to hospital and physician will assume responsibility for prescribing antibiotics (cloxacillin 2 g IV q 4 - 6 h x 4 weeks is recommended)
- If metastatic complications, treatment duration is 6 weeks

Note: Significant if ≥ 1 culture bottle positive for organism listed below

Enterococcus fecalis (antibiotics x 3 weeks)

- Plan for CVC removal and hospital admission; physician will assume responsibility for prescribing antibiotics (ampicillin 2 g IV post HD x 3 weeks is recommended)
- If CVC is left in place, physician will assume responsibility for prescribing antibiotics (vancomycin/ampicillin + gentamicin is recommended)
- Follow sensitivity to ampicillin; if resistant, change to vancomycin

Clinical Assessment

If any of the following are positive, the ideal practice is to remove the catheter and insert a new catheter at a new site:

- Patient is clinically unwell (e.g., general malaise, hypotensive, septic, altered mental state, chills, sweating)
- Persistent fever ≥ 38°C
- Recent CVC bacteremia (with same CVC)
- Signs and symptoms of exit site infection or metastatic infection
- History of prosthetic heart valve

If the catheter is left in place, the physician may order one of the following antibiotic locks (refer to Procedural statements 1 and 2 for mixing):

Vancomycin/heparin lock
- Vancomycin 7.5 mg/3 mL = 2.5 mg/mL
- Heparin 3000 units/3mL = 1000 units/mL

CefTAZidime/heparin lock
- CefTAZidime 5 mg/mL
- Heparin 2500 units/mL

Draw follow-up blood cultures 2 weeks after the last dose of antibiotics

*Dosing per Appendix III
Appendix II. Phase II – Antibiotic Protocol for Confirmed CVC-Associated Bacteremia According to Bacterial Organism (cont’d)

Enterococcus fecium (antibiotics x 3 weeks)
- Plan for CVC removal and hospital admission; physician will assume responsibility for prescribing antibiotics (may order Antibiotic Protocol)
- Combination therapy: ampicillin 2 g q24h (post HD on HD days) x 3 weeks and gentamicin recommended
- Follow sensitivity to ampicillin; if resistant, change to vancomycin
- Look for abdominal source or endocarditis

Streptococcus viridans (antibiotics x 3 weeks)
- Guidewire exchange OK if clinical assessment negative
- Give ceFAZolin

Gram-negative organism (antibiotics x 3 weeks)
- Remove CVC (guidewire exchange OK) if clinical assessment positive
- If clinical assessment negative, leave CVC in and give cefTAZidime or gentamicin x 3 weeks (according to sensitivities) and ceftAZidime lock if ordered

Pseudomonas aeruginosa (antibiotics x 4 weeks)
- Irrespective of clinical assessment, removal of catheter is recommended
- If catheter is not removed, use dual antibiotics (cefTAZidime + gentamicin x 4 weeks) pending verification of cultures
- If multidrug resistant, consult the infectious disease team

*Dosing per Appendix III
### Appendix III. Gentamycin, Vancomycin, CeFAZolin, CefTAZidime Dosing Charts

<table>
<thead>
<tr>
<th>Patient Weight, kg</th>
<th>Gentamicin Dose, mg (1.5 mg/kg rounded to the nearest 10th)</th>
<th>Gentamicin Dilution Amount Required, mL (gentamicin 40 mg/mL vial)</th>
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**Notes**

- Draw predialysis gentamicin level on next session after gentamicin loading dose
- If level is therapeutic (1.5 - 3.0 mg/L) or greater than 3.0 mg/L, proceed with maintenance dose
- If level is < 1.5 mg/L, proceed with a maintenance dose that is increased by 25%
### Appendix III. Gentamycin, Vancomycin, CeFAZolin, CefTAZidime Dosing Charts (cont’d)

<table>
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<th>Patient Weight, kg</th>
<th>Gentamicin Dose, mg (1.5 mg/kg rounded to the nearest 10&lt;sup&gt;th&lt;/sup&gt;)</th>
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<td>1.5</td>
</tr>
<tr>
<td>65-74</td>
<td>70</td>
<td>1.75</td>
</tr>
<tr>
<td>75-84</td>
<td>80</td>
<td>2.0</td>
</tr>
<tr>
<td>85-94</td>
<td>90</td>
<td>2.25</td>
</tr>
<tr>
<td>95-104</td>
<td>100</td>
<td>2.5</td>
</tr>
<tr>
<td>105-114</td>
<td>110</td>
<td>2.75</td>
</tr>
<tr>
<td>115-124</td>
<td>120</td>
<td>3.0</td>
</tr>
<tr>
<td>&gt; 134</td>
<td>130 (maximum recommended dose)</td>
<td>3.25</td>
</tr>
</tbody>
</table>

### Notes
- Draw predialysis gentamicin level at least twice weekly and the next dialysis session after a dose change or nontherapeutic level.
- If level is < 1.5 mg/L, increase dose by 25%.
- If level is > 3.0 mg/L, hold next dose, then decrease dose by 25% once level has returned to therapeutic range (1.5 - 3.0 mg/L).
- Question patient at each session about hearing problems or dizziness (signs of ototoxicity).
### Appendix III. Gentamycin, Vancomycin, CeFAZolin, CefTAZidime Dosing Charts (cont’d)

#### CefTAZidime Dose

2 grams IV every dialysis session up to a maximum of 4 doses per week

<table>
<thead>
<tr>
<th>Patient Weight, kg</th>
<th>CeFAZolin Dose, mg (20 mg/kg rounded to the nearest 500mg)</th>
<th>CeFAZolin Dilution Amount Required, vials (ceFAZolin 1000mg/10mL sterile water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 60</td>
<td>1500</td>
<td>1.5</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>2000 (maximum recommended dose)</td>
<td>2</td>
</tr>
</tbody>
</table>

#### Vancomycin Dose

<table>
<thead>
<tr>
<th>Patient Weight, kg</th>
<th>Vancomycin Dose, mg (20 mg/kg rounded to the nearest 250mg)</th>
<th>Vancomycin Reconstitution Amount Required, mL (vancomycin 1000mg/20mL sterile water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>31-43</td>
<td>750</td>
<td>15</td>
</tr>
<tr>
<td>44-56</td>
<td>1000</td>
<td>20</td>
</tr>
<tr>
<td>57-68</td>
<td>1250</td>
<td>25</td>
</tr>
<tr>
<td>68-81</td>
<td>1500</td>
<td>30</td>
</tr>
<tr>
<td>82-93</td>
<td>1750</td>
<td>35</td>
</tr>
<tr>
<td>&gt; 94</td>
<td>2000 (maximum recommended dose)</td>
<td>40</td>
</tr>
</tbody>
</table>

#### Notes

- Draw vancomycin levels before each dialysis session
- If level is > 19 mg/L, hold next vancomycin dose
Alteplase Use in Hemodialysis Central Venous Catheters

Purpose
To use a fibrinolytic agent to restore and maintain patency of occluded hemodialysis (HD) central venous catheters (CVCs). This may involve 1 or both lumens of the CVC.

Policy
1. This procedure may be done on tunneled or nontunneled CVCs, but only with a physician’s order.
2. Strict aseptic technique is to be used when performing this procedure.
3. The reconstituted product must be carefully inspected for particulate matter and not administered if it is present. To minimize risk, a 5-μm filter needle must be used to withdraw the reconstituted product from the vial prior to patient administration.
4. Before alteplase use, the CVC should be thoroughly evaluated to determine other causes of occlusion and/or inability to sustain required flows.
5. Indications of CVC malfunction include:
   ♦ Difficulty aspirating and/or infusing
   ♦ Inability to maintain a sustained blood flow rate (QB) > 250 mL/min for 2 consecutive HD sessions
   ♦ Inability to initiate a QB > 200 mL/min for 1 HD session
   ♦ Arterial pressure of ≤ -250 mm Hg and/or venous pressures of ≥ 250 mm Hg
   ♦ Line reversal to achieve QB > 250 mL/min
6. All efforts should be made to limit a maximum of 2 doses of alteplase within a 2-week time period and/or a maximum allotment of 4 mg per dialysis session. If this has occurred, the patient’s primary nephrologist should be notified and CVC viability should be assessed.
   ♦ Note: Alteplase should not be ordered for CVCs that have been placed within 1 week, as problems related to occlusion of CVCs during this period are likely a result of mechanical problem; therefore, line exchange should be considered
7. All patients whose lumens are routinely locked with alteplase (indication for this is rare)
   ♦ Will receive 1 mg per lumen of alteplase lock solution
   ♦ Will be assessed by the vascular access team and primary nephrologist for other potential alternatives

Points of Emphasis
1. Alteplase contains no antibacterial preservatives and should be reconstituted immediately before use. Reconstituted solution may be used within 24 hours after reconstitution if stored in the refrigerator
2. Relative contraindications to alteplase include:
   ◆ Recent (within 2 months) central nervous system surgery or severe trauma
   ◆ Known active internal bleeding
3. Lyophilized (not reconstituted) alteplase should be stored at refrigerated temperature
4. No other medications should be added to solutions containing alteplase
Appendix

Alteplase Use in Hemodialysis Central Venous Catheters (cont’d)

Procedure

1. Evaluate and troubleshoot the patency of the catheter as instructed in the Appendix “Alteplase Algorithm”.

2. If indicated, obtain physician’s order for alteplase administration, verifying the method of administration.
   - 30-minute dwell (for lumen occlusion)
   - Intravenous infusion (for sluggish flow)
   - Lock

3. Obtain alteplase and reconstitute as follows:
   
   A. Reconstitute the 2-mg vial of alteplase with 2.2 mL sterile water for injection (result is 1 mg/mL alteplase)
   
   B. Inject the sterile water into the 2-mg alteplase vial, directing the diluent stream into the powder. Slight foaming may occur; allow the vial to stand undisturbed until large bubbles have dissipated
   
   C. Mix by gently swirling the vial until the contents are completely dissolved. DO NOT SHAKE
   
   D. Inspect the product for foreign matter and discoloration. The reconstituted 2 mg alteplase preparation should appear as a colorless to pale yellow transparent solution

4. Explain the procedure to the patient. Obtain baseline vital sign measurements and document them in the patient chart.

Equipment

- On/off supplies
- 3-mL syringes
- 10-mL prefilled normal saline (0.9%) syringes
- Blunt fill needles
- Gauze (4 × 4)
- Two 5-μm filter needles
- Alteplase 2-mg vial
- Sterile water for injection
- Labels for syringes
5. Instill the alteplase solution as follows:

30-minute dwell

A. Note: If resistance is felt at any time, use a gentle push/pull motion to instill the lumen. Never use excessive force

B. Using a 5-μm filter needle, withdraw 1 mL reconstituted alteplase (1 mg) into 2 separate 3-mL syringes. Apply alteplase labels to the syringes

C. Using 2 additional 3-mL syringes, withdraw normal saline solution equal to the remaining volume of each lumen plus 0.9 mL (used to advance alteplase)

D. Instill 1-mL alteplase solution (1 mg) into each lumen

E. Instill normal saline equal to the volume of each lumen, then advance alteplase by 0.3 mL (0.6 mL will be left in each syringe)

F. Clamp lumens, leaving syringes attached. Wait 10 minutes

G. Advance alteplase by 0.3 mL using saline solution (0.3 mL will be left in each syringe)

H. Clamp lumens and leave syringes attached. Wait 10 minutes

I. Advance alteplase using the last 0.3 mL of saline. Clamp lumen. Wait 10 minutes

J. Use prefilled 10-mL normal saline syringes to briskly flush and aspirate each lumen to assess function

K. If unable to flush or withdraw alteplase, attempt to reposition the patient and ensure the catheter is not kinked. Attempt again to flush with 10 mL normal saline

Bibliography


Dinwiddie LC. Managing catheter dysfunction for better patient outcomes. Nephrol Nurs J. 2006;31:653-660, 671.


Appendix

**Alteplase Use in Hemodialysis Central Venous Catheters (cont’d)**

**Intravenous infusion**

A. Use a 5-μm needle to withdraw 2 mL reconstituted alteplase (2 mg) into a 3-mL syringe

B. Add 2 mg alteplase to a 50-mL minibag of 0.9% normal saline solution

C. Attach minibag to the infusion pump, and then to the venous chamber of the blood line

D. Infuse alteplase over 1 hour (rate of 50 mL/h) as follows:
   - With the CVC lumens in the “reverse” position for the first 30 minutes
   - With the CVC lumens in the “normal” position for the last 30 minutes. If unable to infuse in the “normal” position, administer the last 30 minutes in the “reverse” position

**Alteplase lock**

A. Use a 5-μm needle to withdraw 1 mL reconstituted alteplase (1 mg) into 2 separate 3-mL syringes

B. Using 2 additional 3-mL syringes, withdraw normal saline equal to the remaining volume of the lumen plus 0.2 mL each (used to advance alteplase)

C. Instill alteplase 1 mL (1 mg) into each lumen

D. Instill normal saline equal to the remaining volume of each lumen, then advance alteplase by 0.2 mL

E. Clamp lumen, apply injection clamps, and apply alteplase labels to the lumens

F. Allow alteplase to dwell in the lumens until the next HD treatment

6. If catheter is patent, commence dialysis and administer heparin as prescribed.

7. If catheter is patent and the heparin lock solution has been flushed through the catheter, commence dialysis but do not administer heparin bolus as prescribed.

8. If the alteplase procedure (30-minute dwell or infusion) was performed at the end of dialysis or on a nondialysis day, flush the lumens with 10 mL 0.9% saline and lock with anticoagulant.

**Bibliography (cont’d)**


Protocol adapted with permission from Southern Alberta Renal Program, Alberta, Canada.
### Alteplase Algorithm

**CVC Troubleshooting Performed with No Success**

- **Lumens occluded**
  - Inability to aspirate and flush lumens
  - Patient has received ≥ 2 doses of alteplase in a 2-week time period
  - Patient has already received maximum allotment of 4mg alteplase during this treatment
  - CVC was placed < 1 week ago

- **CVC lumens sluggish**
  - Inability to maintain a blood flow >250 mL/min, and/or
  - High venous and low arterial pressure, and/or
  - CVC lumen can be flushed but not aspirated

**Yes to any**

- Call physician for possible line exchange and inform vascular access team

**No to all**

- Lumen remains occluded
  - Call physician for alteplase 30 minute dwell
  - Instill alteplase 1mg into lumen (procedural statement 5a)

  - Resume dialysis and slowly attempt to maximize pump speed

- Blood flow < 200 mL/min, or
  - Inability to maintain blood flow > 250 mL/min for 2 consecutive HD sessions
  - Call physician for alteplase infusion
  - Initiate alteplase infusion 2mg/50 mL (procedural statement 5b)

**If unsuccessful, flush lumens using a brisk motion**

Note: when flushing the CVC, watch the point where the catheter is attached to the hub. If ballooning occurs at this point of the catheter, stop the flush. Ballooning indicates too much pressure is being exerted and may cause catheter rupture.

**If catheter is occluded, do not flush**

*Determine which lumen aspirates/flushes easiest and select this lumen to flush*

- Briskly flush the lumen with 5-10 prefilled syringes, sequentially and without aspirating between flushes
- Attempt to aspirate, giving 2-3 brisk flushes/aspirations/flushes with the blood that has been aspirated

  - Resume dialysis and slowly attempt to maximize pump speed
  - Target weight loss may need to be adjusted to reflect the normal saline flush amount

  - If unsuccessful, notify vascular access experts and/or the physician for consultation and consideration of line exchange

  - Note: If unsuccessful, alteplase may be repeated once (maximum 4 mg/day)