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Clinical
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**Clinical Educators Network
nursing recommendations
for management of vascular
access in hemodialysis patients**

SUPPLEMENT I

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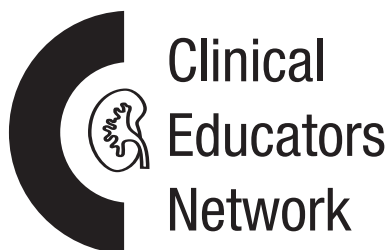


Clinical Educators Network nursing recommendations for management of vascular access in hemodialysis patients

SUPPLEMENT I

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Message from the chair of CEN



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Collaboration and sharing

This document represents the culmination of a project that was undertaken approximately two years ago by the Greater Toronto Area Nephrology Clinical Educators Network (CEN). Motivated by common challenges in nursing practices across the region related to vascular access in hemodialysis patients, the group identified the need for the collaboration and sharing of experiences and expertise, specifically in the areas of new vascular access management and central venous catheter management. These are offered as clinical practice guidelines rather than standards of practice, and are based on evidence where it exists. Some topics offered little or no published literature and in those instances, comments are based on the expert opinion of the members of the group. Our hope is that these guidelines will assist Canadian nurses in preparing unit policies and protocols, as well as education and documentation tools. Further, it is hoped that they will encourage nursing research studies that will add to the body of existing literature – in the interest of improving patient outcomes on hemodialysis.

Preamble

The members of the nephrology Clinical Educators Network (CEN) have collaborated to establish recommendations with respect to the development of and management of a new vascular access and central venous catheter for a patient on, or starting hemodialysis. This document is based on a combination of evidence found in the literature and clinical expertise. These recommendations are intended for use as a guideline, which may be personalized to meet the individual needs of any hemodialysis program, unit or patient.

Clinical practice guidelines

The CEN membership believes that wherever possible, recommendations related to the management of a new vascular access or central venous catheter must be based on existing clinical practice guidelines for vascular access such as the Canadian Society of Nephrology Clinical Practice Guidelines for Vascular Access (1999), and/or the Kidney Disease Outcome Quality Initiative (K-DOQI) Guidelines for vascular access (Update 2001).

Evidence-based practice

The CEN membership believes in the importance of providing patient care in an evidence-based environment. Therefore, wherever possible, these recommendations are based on existing evidence that has been published in the literature.

Experiential knowledge

The CEN recognizes that in some areas of practice, due to lack of evidence, experiential knowledge will be the only reference available for development of the recommendations. The

pooling of expertise among expert nurses maximizes clinical knowledge and can support recommendation development (Benner, Tanner, & Chesla, 1997). In this case, the recommendations will be made in light of the fact that there is no formal evidence upon which to base the opinion of the group, and will be identified as (opinion).

About the CEN

The CEN is a branch of the Renal Educators Network, which comprises clinical educators working in various areas of nephrology in Ontario and Eastern Canada.

Endorsement

These guidelines are endorsed by the Canadian Association of Nephrology Nurses and Technologists (CANNT).

French translation

French translation by Luce Tessier, CTr, OTTIAQ, BA(Tr).

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Chapter One: Recommendations for new vascular access management in hemodialysis patients

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- The membership of the Greater Toronto Area (GTA) Vascular Access Coordinators Network for their contribution through review and recommendations following the creation of this document
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- Hoffmann-La Roche Canada Ltd. for the provision of an unrestricted educational grant in support of the cost of printing these vascular access guidelines and translating them into French, and
- Arlette Desranleau, RN, BSc, CNeph(C), for proofreading the final drafts of both the English and French versions of this document.

The nephrology Clinical Educators Network and the **CANNT Journal** confirm that these guidelines are solely the work of the authors listed and that there was no corporate involvement around the writing or content of the guidelines.

Introduction

This document addresses the nursing role in management of a new vascular access in the hemodialysis population. Management of other complications such as infection is beyond the scope of this document. It is the opinion of the CEN sub-group that it is in the patient's best interest to limit cannulation of the vascular access or blood sampling from that extremity to persons trained in those procedures, unless its use is required in an emergency situation.

**Recommendation One:
Assessment of the
arteriovenous (AV) access**

Assessment is key to evaluating the new AV fistula or graft to determine the physical and functional maturity and readiness for use. An experienced cannulator should carry out the assessment procedure.

Tools and resources that may be utilized by experienced staff when assessing a new fistula or graft include:

- stethoscope
- ultrasound/doppler device
- tourniquet
- operative report
- vascular access nurse
- charge nurse/team leader
- clinical educator.

The assessment should be carried out as follows:

Subjective data collection

The nurse should begin the assessment process through dialogue with the patient to determine:

- the patient’s knowledge of the vascular access and how it will be used
- the patient’s experience with the surgical procedure and any concerns or complications
- the patient’s report of pain, weakness or tingling in the access extremity

Inspection

- Expose the entire arm or leg with the patient’s AV access
- Position the limb parallel to the floor – this is critical to enable proper visualization of the access
- Observe the limb for:
 - signs of infection (redness, discharge and swelling)

Table One: Generic guidelines for cannulation of an AV fistula or graft		
Standard	Guideline	Reference
Cleansing of the cannulation sites	<ul style="list-style-type: none"> • Locate cannulation sites • Cleanse the skin using antibacterial soap or scrub, and water • Cleanse the skin using 10% povidone-iodine or 2% chlorhexidine solution, using friction and a circular motion • Allow cleansing solution to dry thoroughly prior to needle insertion 	Canadian Society of Nephrology Clinical Practice Guidelines for Vascular Access, 1999
Placement of needles	<ul style="list-style-type: none"> • 7.5 cm (3 inches) apart, hub-to-hub, if needles in opposite direction • 2.5 cm (1 inch) apart, hub-to-hub, if needles in same direction on the same limb • Insertion site, or needle tip once inserted, 4 cm to 5 cm (1.5 inches to 2 inches) away from the anastomosis • Rotate sites using a rope ladder technique 	Brouwer, 1995 Northwest Renal Network, 2006
Selection of needle size	<ul style="list-style-type: none"> • Consider state of fistula maturation during assessment – use 17- or 16-gauge needle for first attempts • Use first size for approximately one week (of two-needle cannulation) • Proceed to second size for one week • Increase gradually to larger size needle as successful cannulations are achieved, aiming for long-term (chronic) use of 15- or 16-gauge needles where possible 	Brouwer, 2003 Northwest Renal Network, 2006
Personal protective devices (Standard Precautions)	<ul style="list-style-type: none"> • Eye protection (face shield or goggles) • Mask • Gloves • Should be used according to unit standards to ensure staff protection 	Centers for Disease Control and Prevention: Recommendations for preventing transmission of infections among chronic hemodialysis patients, 2001
Direction of needle placement	<ul style="list-style-type: none"> • Venous needle must be placed antegrade (with the blood flow, i.e. facing venous end of AV access) • Arterial needle may be placed antegrade or retrograde (against the blood flow, i.e. facing arterial end). In a loop AV graft, if the needles both face upward, the arterial needle would then be retrograde. 	Brouwer, 1995

continued on page 7...

- evidence of bruising
- evidence of healing of incision lines
- appropriateness of vessel size and location
- signs of cyanosis of the finger tips and delayed capillary refill of the nail beds
- if AV fistula, change position to dependent to inspect filling and signs of collateral vessel filling

Clinical consideration: Arm swelling could be a result of central vein stenosis – if generalized swelling of the arm and/or collateral veins on the upper torso are identified, the possibility of central venous stenosis needs to be ruled out. Remember that swelling with AV graft insertion may be expected up to six weeks after surgery.

Auscultation

Using a stethoscope, pressing gently:

- Listen for several pulsations to the bruit at the arteriovenous or arterial anastomosis
- Assess the quality of the bruit: a normal bruit is a continuous low pitch “whooshing” sound throughout (Brouwer, 2003)
- Continue to listen along the vascular access path, noting any changes in pitch and amplitude of the bruit.

Clinical consideration: A higher-pitched whistling, particularly at the venous end, may indicate outflow stenosis and should be noted. Absence of bruit may indicate clotting of access.

Palpation

AV Fistula

- Assess the temperature of the skin around the AV anastomosis for abnormal warmth
- Assess the comparative temperature of fingers in both access and non-access hands
- Use a two- to three-finger approach to roll your fingers across the AV fistula to determine width and depth of access
- Palpate the entire length of the AV fistula: a strong thrill should be palpable at the anastomosis, decreasing closer to the venous end
- Apply a tourniquet (or B/P cuff pumped up to 80 to 90 mm Hg) just below the axilla, tight enough to dilate veins, being careful not to occlude the flow
- Repeat the process of palpation as outlined above, identifying any collateral veins and/or areas of concern such as decreased size of vessel, or decrease in flow

AV graft

- Assess the temperature of the skin around both the arterial and venous anastomosis for abnormal warmth
- Assess comparative temperature of fingers/toes in both access and non-access hands/feet
- Assess grip strength/pedal movement for normalcy
- Use a two- to three-finger approach to roll your fingers across the AV graft to determine width and depth of the access

<i>continued from page 6...</i>		
Bevel position/ flipping of needle	<ul style="list-style-type: none"> • This is a controversial issue. Both bevel up and bevel down cannulation are acceptable until further studies can demonstrate risk/benefit of both techniques. • The most important consideration to avoid coring of the vessel is to maintain a proper angle of insertion. • The flipping of needles should be discouraged – if necessary, must be done carefully to avoid damage to the access 	Northwest Renal Network, 2006
Angle of insertion	<ul style="list-style-type: none"> • Fistula – 25-degree angle • Graft – 45-degree angle 	Brouwer, 2003
Application of local anesthetic: for example, lidocaine intradermal injection, lidocaine 2.5% and prilocaine 2.5% (EMLA®) cream.	<ul style="list-style-type: none"> • May be used in patients who are concerned with the discomfort of needle insertion • Minimum amount of lidocaine injection should be used (0.2 mL) • Consider use of lidocaine only if access well-developed and minimal swelling exists – injection may reduce ability to palpate the access properly • Lidocaine injection itself is painful, and there is added risk of accidental intravenous infusion 	Brouwer, 1995
Number of attempts	<ul style="list-style-type: none"> • Maximum two attempts, then seek assistance • After an additional attempt by another expert cannulator, consider appropriateness of continuing to attempt cannulation • If infiltration occurs, consider resting the access for one week or until infiltration and bruising are resolved. 	Northwest Renal Network, 2006 (See Figure One)
Securing of needles	<ul style="list-style-type: none"> • As per unit policy • Needles and tubing should be well-secured during treatment to avoid inadvertent dislodgment • Insertion sites should be visible at all times and inspected at each patient check – limb exposed, not covered by blankets 	

- Palpate the entire length of the AV graft, noting location, integrity and depth

To determine direction of flow in a loop graft

- Review operative note for anatomical position
- Palpate for a thrill – the thrill should be stronger at the arterial anastomosis
- Verify the direction of flow by partially occluding the mid-point of the graft for a few seconds while feeling on either side of this mid-point for a thrill. The arterial side can be determined by a stronger thrill than the venous side (Brouwer & Peterson, 2002).

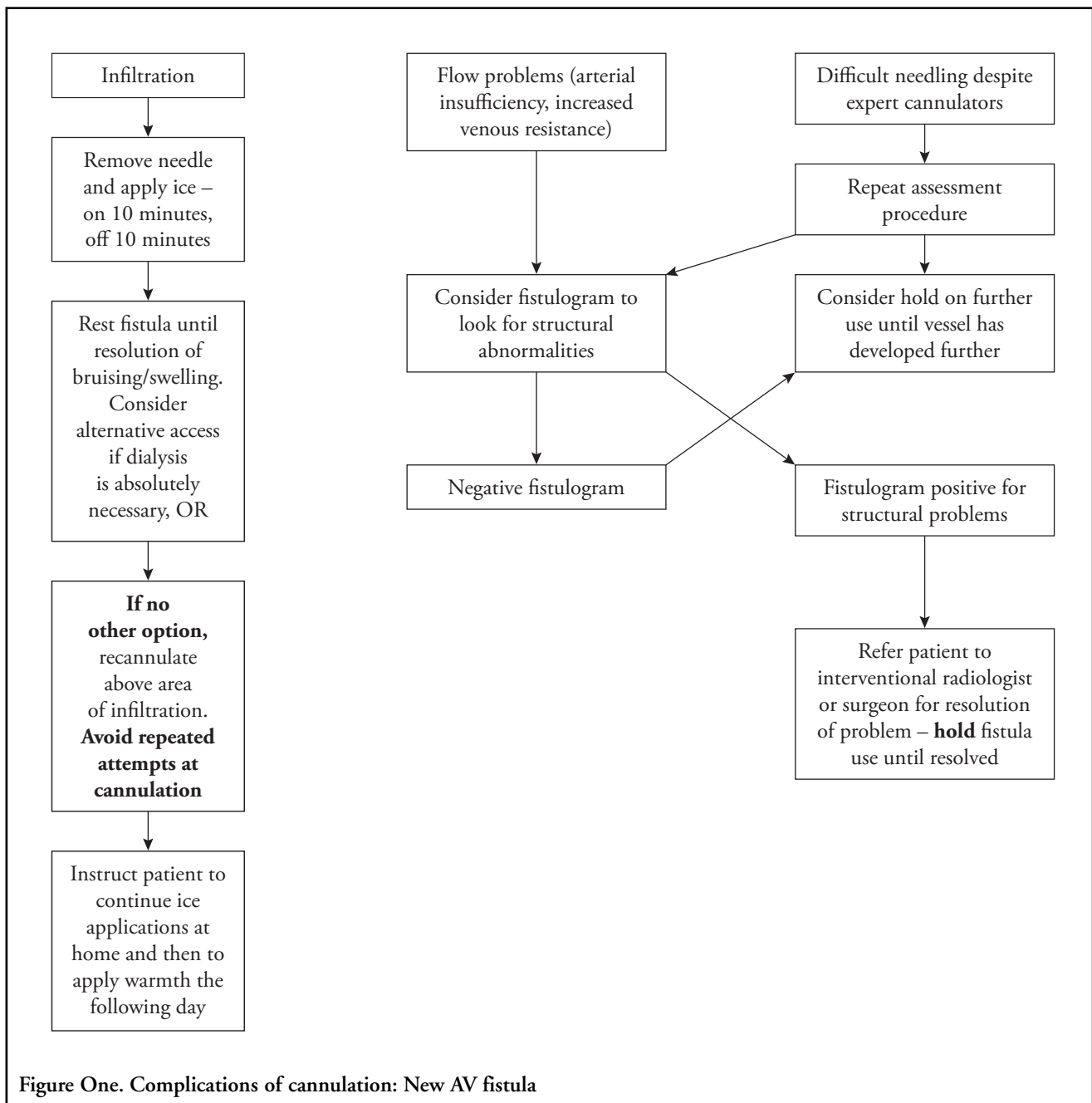
Clinical consideration: Tourniquets should never be used on polytetrafluoroethylene (PTFE) grafts due to the risk of thrombosis (Brouwer, 2003).

Recommendation Two: Determination of cannulation sites

Following assessment of the vascular access, determination of appropriate sites for cannulation should be made.

Cannulation **should be avoided** and the nephrologist or designate consulted when, during assessment:

- Signs and symptoms of infection are noted
- Absence or poor quality of bruit and thrill are noted
- A pulse is palpated instead of a thrill and this is abnormal for the access in question – this is suggestive of diminished access flows
- A significant increase in pitch is noted on auscultation – this is suggestive of a potential stenosis
- Extreme edema or other factors (e.g. rash or unexplained aneurysm) which, in clinical judgment, would render the cannulation inappropriate.



Needle placement is paramount to maintenance of a healthy, well-functioning access. Therefore, prior to cannulation, it is important to attempt to visualize where the needle tip will end up and to determine appropriateness of the selected site (to prevent inadvertent placement of a needle tip in an area too close to the other needle, or in a narrow portion of an access). It may be appropriate to use an ultrasound/doppler machine, if available, to determine quality cannulation sites.

Clinical consideration: Needle tip, once the needle is threaded, must be 4 cm to 5 cm (1.5 inches to 2 inches) away from the anastomosis (Northwest Renal Network, 2006)

Recommendation Three: Cannulation procedures – AV fistula and AV graft

The CEN recognizes that cannulation policies vary from centre to centre. Generic guidelines for cannulation with appropriate references are outlined in Table One.

Recommendation Four: Cannulation of a new AV fistula with no existing central venous catheter

In the case where an AV fistula is the only available access, cannulation should be approached as per Recommendation Three, and as follows:

- Book the first dialysis treatment in a non-rush/low-patient-turnover time to allow for a relaxed atmosphere
- Attempt to use non-pharmaceutical relaxation methods
- *Cannulation should be performed by a nurse with recognized expert skills in cannulation for the initial two to four weeks to minimize risk of infiltration and trauma* (opinion) (see Figure Two).

Recommendation Five: Cannulation of a new AV fistula with an existing central venous catheter

A patient may initiate hemodialysis therapy with only a central venous catheter in place because of need for dialysis prior to creation and maturation of an internal AV access. It is always preferable to have an internal vascular access rather than a catheter. The overall risks of bacteremia to the patient from use of central venous catheters are greater than the risks of bacteremia from an internal access such as a fistula or graft (Jindal et al., 1999). When an existing central venous catheter is in place as well as a new fistula, use of one needle in the AV fistula may enhance maturation of the fistula (opinion). Figure Three delineates an approach to such cannulation, with the main goal being to discontinue use of the central venous catheter as soon as possible.

Clinical consideration: Depending on unit protocol, the new AV graft may be treated in the same manner as the AV fistula (that is, gradual introduction to use with one needle), or may be cannulated following the guidelines for cannulation with no central venous catheter – using two needles with the first dialysis.

All steps in this procedure should be completed over no less than a two-week timeframe.

Step 1:

The first time the AV fistula is cannulated, the fistula should be needled with only one needle, and that needle used for arterial supply. This will allow for:

- Assessment of maturity of and arterial feed to the access
- Decreased risk of infiltration (and therefore a more positive experience for the patient).

The AV fistula should be used as the arterial source only for no less than three successful cannulations, with blood flow rate at 250 mL/min or maximum flow within acceptable arterial and venous pressure limits of -250 and +250 mm Hg respectively (opinion).

Step 2:

The AV fistula should then be used for venous return only for no less than three successful cannulations, with blood flow rate at 250 mL/min or maximum flow within acceptable arterial and venous pressure limits of -250 and +250 mm Hg respectively (opinion).

Step 3:

Subsequently, the AV fistula should be cannulated using two needles, using the rope ladder technique for site rotation.

Step 4:

The AV fistula should be cannulated with two needles for one to two weeks successfully (with no infiltrations) and maximum blood pump speeds attained prior to planning for the removal of the central venous catheter.

If, at any point, the attempt at needling fails, the cannulator should revert back to use of the central venous catheter to avoid trauma or damage to the fistula. Continued use on the next dialysis date should be determined through proper assessment as outlined in Recommendation One (see Figure Three).

Recommendation Six: Use of the buttonhole cannulation method

Buttonhole cannulation may prolong the use of an AV fistula and may assist in alleviating anxiety for patients with a needle phobia (Ball, 2006). Buttonhole technique is recommended for use only with an AV fistula, not an AV graft.

Step 1: Establish the tunnel:

- Assign one primary cannulator for up to eight treatments if possible (if not possible to assign only one, then a maximum of two is recommended). Use the same angle, depth, and site of needle insertion at each cannulation to properly form the tunnel track.
- Have the patient wash both hands and the access with anti-bacterial soap upon arrival to the dialysis unit.
- Cleanse the buttonhole sites well, soaking to soften up the scab.
- Remove scabs using a sterile gauze, a set of tweezers or, if necessary, a blunt fill needle, being careful to maintain the integrity of the buttonhole.
- Cleanse the sites again thoroughly in a circular motion as in surgical preparation. Ensure all scab is removed.
- Cannulate using sharp needles, using the same angle of entry, until the tunnel is established (approximately six cannulations).

Clinical consideration: A recent publication by Marticorena et al., 2006, has described a modified method for buttonhole track creation that may be employed in a busy hemodialysis unit.

Step 2: Maintain the buttonhole sites:

- Use blunt needles once the tunnel is established to access the fistula.
- Cleanse the buttonhole sites properly both pre- and post-scab removal in order to prevent infectious complications.
- Consider protecting the site post-dialysis with a sterile dressing and incorporate this into the dialysis unit's buttonhole cannulation policy.

Clinical consideration: Some authors have reported inflammation and infection in their buttonhole patient population (Marticorena et al., 2006; Twardowski & Kubara, 1979) and, therefore, consideration for stringent cleansing of the sites both pre- and post-dialysis is encouraged. While one study (Twardowski & Kubara, 1979) simply recommended the use of a dressing post-dialysis for 12 hours, the other (Marticorena et al., 2006) suggests the use of antibiotic ointment at the buttonhole sites post-treatment for a period of six hours as prophylaxis against infection.

Recommendation Seven: Needle removal and hemostasis

Needle removal technique is important to protect the access from damage and to facilitate proper hemostasis.

- Needle removal should be performed at the same angle as was used to insert the needle.
- Pressure should not be applied to the exit site until the needle is removed entirely from both the vessel and the skin.
- Hemostasis should be obtained using a two-digit technique (this is particularly important with AV grafts, less so with an AV fistula):
 - one finger at the vein or graft puncture site (internal)
 - one finger at the skin exit site (external)

Clinical consideration: These two sites, particularly in a graft cannulation situation, will be staggered due to the angle of needle insertion.

- Hold sites, or encourage the patient to hold sites, for a minimum of 10 minutes without releasing to encourage hemostasis. While compressing, ensure a thrill can be felt in the access. If a thrill can no longer be felt, then the digital pressure needs to be reduced.

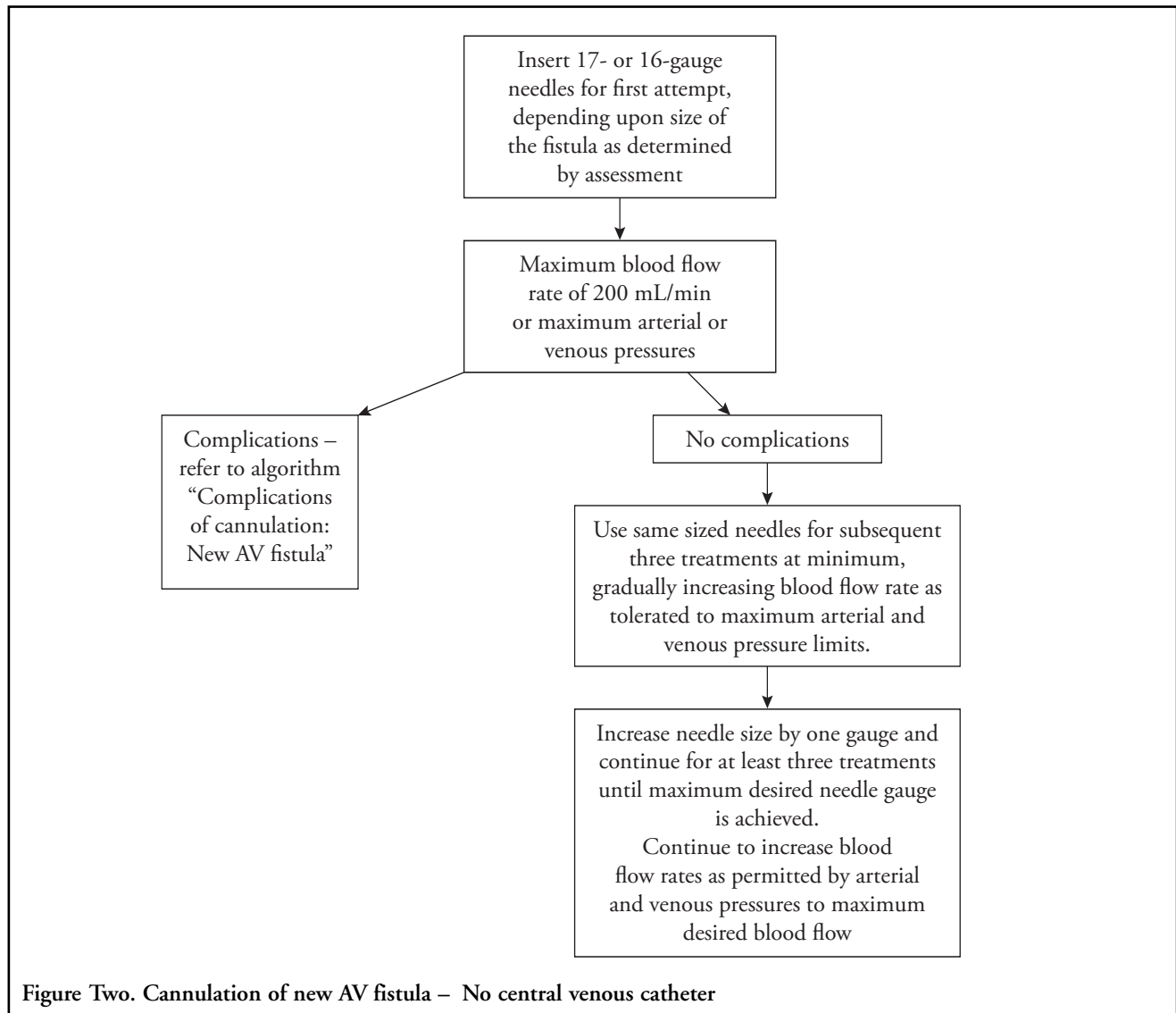


Figure Two. Cannulation of new AV fistula – No central venous catheter

Clinical consideration: Excessive bleeding post-dialysis can be a sign of venous outflow stenosis in a patient with normal bleeding times. If prolonged hemostasis is ongoing, re-assess anticoagulation, review dynamic venous pressure readings, and perform access flow studies to rule out stenosis as a cause.

- Use of clamps to assist with hemostasis should be discouraged. In spite of that fact, if necessary, clamps must be used with caution for only as long as necessary to establish hemostasis. When clamps are applied, they should only be applied to a mature access with a strong flow, monitored closely, and should be used only if flow can still be palpated in the AV fistula or graft while the clamp is in place.
- Dressing of needle sites may be achieved using any number of options including gauze and tape, adhesive bandages (plain or specialty), with or without hemostatic agent. If

gauze and tape are used, care must be taken not to wrap tape circumferentially around the arm to avoid constriction of blood flow to the access. The patient should be taught to remove dressings within 24 hours.

Recommendation Eight: Monitoring and maintenance of the AV access

Baseline flow studies should be carried out in a new vascular access (fistula or graft) following consistent two-needle cannulation with minimum blood flow rate of 300 mL/min.

When access flow technology is available, it is recommended that flow studies be carried out in established accesses as follows:

- fistula – every two months
- graft – monthly

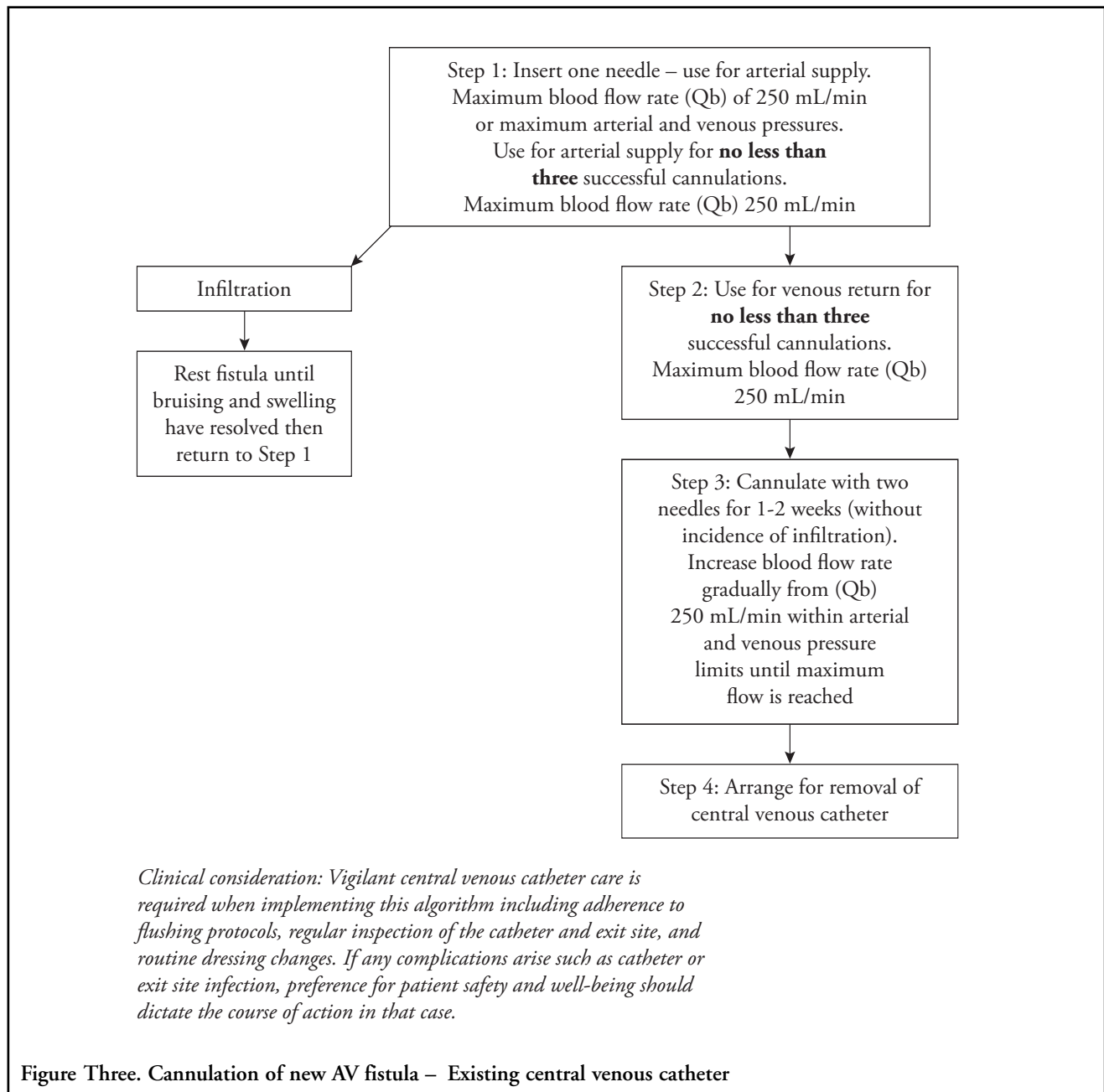


Figure Three. Cannulation of new AV fistula – Existing central venous catheter

Investigation of change in flow should be carried out:

- if fistula flow <500 mL/min or drop of >20% of previous value
- if graft flow <650 mL/min or drop of >20% of previous value

When access flow technology is not available, access monitoring should be carried out using:

- physical assessment
- dynamic venous pressure monitoring (see Appendix A)
- routine blood work, dialysis adequacy studies

Maintenance indicators for investigation of access flow:

- post-angioplasty (within two weeks of intervention)
- post-embolectomy (within two weeks of intervention)
- needling concerns
- venous or arterial pressure concerns
- prolonged bleeding
- just prior to central venous catheter removal
- inadequate or decreasing per cent reduction of urea (PRU) on dialysis (Jindal et al., 1999).

Recommendation Nine:

Patient education

All patients should receive education about their vascular access from the health care team either in the chronic kidney disease clinic or the dialysis unit, or both. This education should involve the following information:

Pre-operative education:

- What is a fistula or graft?
- Why it is necessary?
- What are the advantages of a fistula or graft over a central venous catheter (CVC)?
- How long each may last
- How they are going to be accessed
- What does the operative procedure involve?

Post-operative education:

- What is a bruit or thrill, and what do these terms mean
- What activities to self-advocate for (no blood pressure measurement, blood work, or IV punctures in the access arm)
- When is it appropriate to call and whom to call for advice or assistance
- What is the appropriate care for operative site(s)
- How to decrease swelling of operative limb with AV graft by elevation of limb
- How to exercise a new fistula

Appendix A:

Dynamic venous pressure monitoring protocol

- Establish a baseline by initiating measurements when the access is first used.
- Measure venous pressure from the hemodialysis machine at a blood flow rate of (Q_b) 200 mL/min during the first two to five minutes of hemodialysis at every hemodialysis session.
- Use 15-gauge needles (or establish own protocol for different needle size)
- Ensure that the venous needle is in the lumen of the vessel and not partially occluded by the vessel wall.
- Note the pressure must exceed the threshold three times in succession to be significant.

- How to identify and deal with potential problems
 - decreased or absent thrill
 - pain, redness or swelling
 - bleeding

Care of the AV fistula or graft:

- Daily care of the AV access (checking for thrill, cleansing of skin on the access limb)
- Activities to avoid or to perform with caution (wearing a watch or bracelet on the access limb, sports or physical activities that may occlude flow)
- Care of the access post-dialysis (observation, removal of bandages after dialysis)

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- Assess at same level relative to hemodialysis machine for all measurements.

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Chapter Two: Recommendations for central venous catheter management in hemodialysis patients

Participants in the development of these guidelines included the following individuals who were part of the working group for guideline development:

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Introduction

This document addresses the nursing role in maintaining central venous catheter function in the hemodialysis patient population. Management of other complications such as infection or catheter displacement is beyond the scope of this document. It is the opinion of the CEN sub-group that it is in the patient's best interest to limit persons who access the central venous hemodialysis catheter to persons trained in those procedures, unless its use is required in an emergency situation.

Recommendation One: Use of central venous catheters as long-term dialysis access

Central venous catheter (CVC) use should be reserved for situations where no other permanent vascular access is available (for example, as a bridge to fistula creation) or feasible (for example, fistula or graft failure and no other possibility of revision or alternate site [National Kidney Foundation, 2001]). A CVC may be elected to be used in extraordinary circumstances such as poor long-term patient prognosis or potential renal recovery.

Recommendation Two: Post-insertion care

Immediate and frequent post-catheter insertion observation for bleeding should be carried out with dressing changes as necessary. If bleeding is noted, it is important to attempt to identify if the source of the bleeding is the actual exit site, or if it is initiating from within the subcutaneous tunnel. Application of direct pressure will stop the bleeding in most cases, as long as the source is identified and the pressure is applied directly over the bleeding source. Application of a hemostatic agent such as Gelfoam® sponge is only useful if the bleeding is occurring right at the exit site, and should not be left on after bleeding stops as it is a potential source of infection if left on over a prolonged period of time (Pharmacia & Upjohn, 1999). If the PTT is prolonged, indicating that heparin has been infused during insertion, use of protamine as ordered by the attending physician may assist in controlling bleeding.

Prolonged or brisk bleeding that is not managed by pressure and above methods may require further investigation and management by radiology or vascular surgery and should be reviewed with the attending nephrologist or vascular access coordinator.

Patient teaching should be carried out prior to discharge and should include the following:

- How to manage pain following catheter insertion
- What to do if the dressing is soiled or becomes dislodged
- What steps to take if bleeding occurs
- Whom to call in case of questions or concerns
- How to take a shower

Recommendation Three: Central venous catheter dressings

There are differences of opinion with respect to the type of dressing that should be used in order to avoid infection in permanent, tunneled central venous catheters. Available evidence supports the use of a gauze and povidone-iodine ointment or gauze and polysporin triple ointment dressing, especially in patients with *Staphylococcus aureus* carriage (Jindal et al., 1999; Lok et al., 2003; National Kidney Foundation, 2001).

Recommendation Four: Blood flow

Central venous catheters for hemodialysis should be able to provide a minimum blood flow rate of 300 mL/min consistently in order to maintain adequacy of dialysis (Besarab &

Brouwer, 2004). Blood flow may be maximized according to arterial and venous pressures to a unit-specific maximum not exceeding -250 mm Hg (arterial) and +250 mm Hg (venous), or as ordered by the attending physician/nurse practitioner (Depner, 2001).

N.B. In a case where a catheter's flow is not optimal, the minimum blood flow that can be accepted to maintain treatment is 200 mL/min in order to maintain a blood circuit free of clots and an adequate amount of clearance *for that treatment only* (opinion).

Clinical consideration: Rationale for 300 mL/min blood flow rate recommendation: The definition of catheter malfunction remains controversial. Throughout the guideline development process, the writing group felt that the K/DOQI guidelines (2001) represented a reasonable approach to this issue and, by setting a similar blood flow recommendation, that all patients would receive intervention in a timely manner for catheter malfunction. However, patients who dialyze at the prescribed dose at a chronic blood flow rate of <300 mL/min are, of course, an exception to this guideline. In this situation, a blood flow change of >20% of usual over three consecutive treatments is an alternative approach to problem identification and initiation of the algorithm (see Figure One) (opinion).

Recommendation Five: Dynamic pressure monitoring

Pressures should be documented at the beginning of every dialysis treatment with a blood pump speed set at 200 mL/min. This will facilitate trending of usual pressures for the individual patient and catheter and will provide a standard for identifying catheter dysfunction.

Trends in pressure should be reviewed:

- Monthly as a minimum standard, OR
- Whenever reversal of dialysis line is required to establish adequate flow for dialysis, OR
- When arterial and/or venous pressures result in a need to reduce the blood pump speed more than 20% of usual value (opinion). (For example, usual blood pump speed is 400 mL/min, but blood pump speed today needs to be reduced to 300 mL/min due to one of venous or arterial pressures reaching maximum limits at that blood pump speed.)

Clinical consideration: If the catheter is new (that is, inserted within the previous seven days), poor flow should be followed up by a chest x-ray – posterior/anterior (PA) and lateral to reconfirm catheter position.

Recommendation Six: Flushing with 0.9% saline

Regular flushing with 0.9% saline solution is recommended to assist in maintenance of catheter patency (Canadian Intravenous Nurses Association, 1999). Flushing with 0.9% saline should be carried out at beginning and end of treatment, as follows (see Table One).

Recommendation Seven: Interdialytic catheter locking

Capping of the catheter lumens with an anticoagulant agent is performed to avoid catheter clotting in the interdialytic period. Various locking solutions and protocols are available

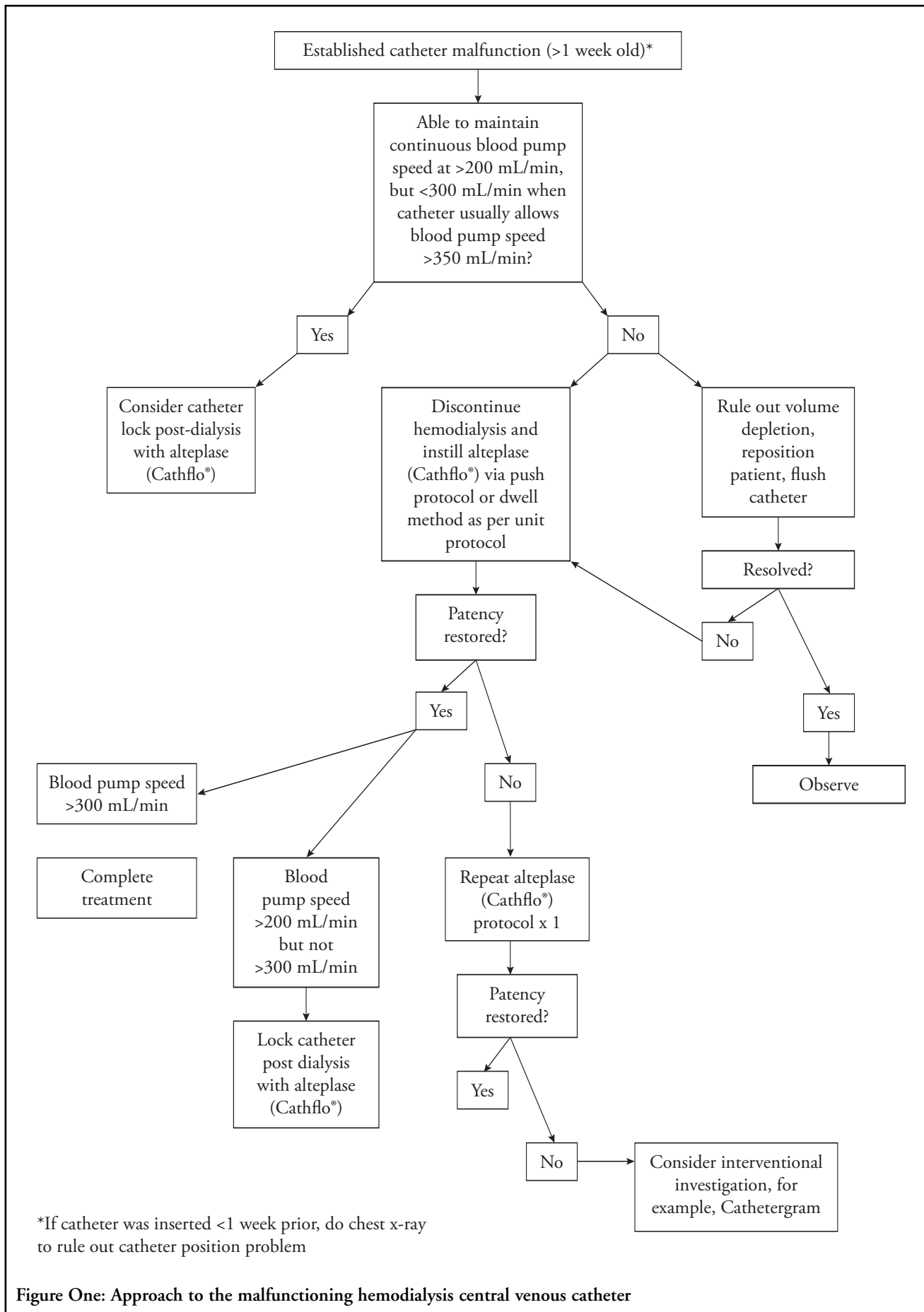


Figure One: Approach to the malfunctioning hemodialysis central venous catheter

Flush Schedule	Method	Comments
Beginning of treatment	<ul style="list-style-type: none"> Aspirate no less than 5 mL of blood and anticoagulant solution after uncapping 	<ul style="list-style-type: none"> Ensures removal of anticoagulant and clot
	<ul style="list-style-type: none"> Instill 0.9% saline in a syringe no smaller than 10 mL 	<ul style="list-style-type: none"> Safety – to ensure no excessive pressure is applied if using a small syringe
	<ul style="list-style-type: none"> May then flush in and aspirate back, and repeat x 3 to assess flow 	<ul style="list-style-type: none"> Back and forth motion assesses flow prior to initiation of dialysis – 10 mL should flush and aspirate freely without hesitation
	<ul style="list-style-type: none"> Prior to accessing the second lumen, the first should be flushed with 0.9% saline 	<ul style="list-style-type: none"> Avoids clot formation in the interim period before dialysis is commenced
	<ul style="list-style-type: none"> If unable to aspirate 5 mL: Flush gently if no resistance as per unit policy Follow unit policy as to notification of MD or charge RN and observation for bleeding if anticoagulant solution is instilled rather than aspirated 	<ul style="list-style-type: none"> If lumen flushes but does not aspirate, may indicate a clot or fibrin “flap” exists and it may be possible to use the lumen for venous return, according to unit policy
End of treatment	<ul style="list-style-type: none"> After retransfusion, perform a turbulent flush with a minimum of 10 mL 0.9% saline (some high-flow catheter manufacturers recommend 20 mL saline flush) 	<ul style="list-style-type: none"> “Scrubs” the catheter walls and eliminates debris adhering to the catheter Prepares the catheter for the instillation of the locking solution

Anticoagulation Agent	Dose
Heparin 1,000 units/mL	Exact volume to fill catheter lumen
Heparin 10,000 units/mL	Exact volume to fill catheter lumen <i>OR</i> 0.5 mL (5,000 units) mixed in 0.9% saline to a total volume equal to the size of the lumen <i>OR</i> 0.5 mL (5,000 units) straight heparin, regardless of the volume of the lumen <i>OR</i> 10,000 units/mL heparin diluted in equal parts saline, to yield 5,000 units/mL solution, instill to volume of lumen (for example, in a 3 mL syringe, mix 1.5 mL heparin and 1.5 mL normal saline for injection and instill to volume of lumen e.g. 2.3 mL).
4% trisodium citrate solution	Exact volume to fill lumen <i>OR</i> 2.5 mL in each lumen, regardless of lumen volume (Polaschegg & Shah, 2003).
Anticoagulant + Antibiotic	Variable – follow unit guidelines
<p><i>Clinical consideration: Trisodium Citrate: Studies are in progress to evaluate four per cent trisodium citrate as a catheter lock solution. Advantages include increased accuracy of international normalized ratio (INR) measurements from central venous catheters and decreased risks of incidental bleeding (as compared to heparin). Volume of citrate instilled is variable depending on the centre, but anecdotal evidence suggests that 2.5 mL instilled in each lumen regardless of lumen volume is not associated with increased risk of bleeding.</i></p> <p><i>Clinical consideration: Anticoagulant + Antibiotic Combinations: Clinical studies describe options including routine combination of antibiotic and anticoagulant such as gentamicin and heparin (Allon, 2004; Allon, 2005; McIntyre, Hulme, Taal, & Fluck, 2004).</i></p>	

for use and the local protocol should be utilized and evaluated for efficacy. The basic philosophy should be to decrease risk of bleeding to the patient by using the lowest dose possible to achieve optimum results in maintenance of optimal catheter function for hemodialysis (see Table Two).

Recommendation Eight: Management of catheter malfunction (no inflow or outflow)

Compromised catheter flow may present with various scenarios in actual clinical practice. In some cases, dialysis treatment will not be possible. In other cases, a limited dose of dialysis may be provided as a temporary measure. The recommendations for management of catheter malfunction, as outlined in Figure One, are based on the presentation and the ability to maintain adequate blood flows.

For purposes of standardization, the terms “push”, “dwell”, and “lock” are defined as follows:

Push: Instillation of thrombolytic with subsequent advancement of the drug into the catheter manually, by pushing with normal saline, in an amount of approximately 2 mL per unit of time (usually 10-minute intervals), while lysis is occurring.

Dwell: Instillation of thrombolytic as per unit protocol and subsequent capping of the catheter for a specified period, usually one to two hours to allow lysis to occur, then removal of the agent to determine catheter function and initiate hemodialysis.

Lock: Instillation of thrombolytic to be retained in the catheter throughout the interdialytic period, usually 48 hours.

Recommendation Nine: Thrombolytic agent

Thrombolysis should be carried out using an appropriate thrombolytic agent such as alteplase (Cathflo®) 1 mg/mL to fill the catheter volume up to a maximum of 2 mg (2 mL), as indicated on the product monograph (Hoffmann-La Roche, 2003).

Should the catheter volume exceed 2 mL, any additional catheter volume may be filled through instillation of 0.9%

saline solution behind the thrombolytic in the amount required to fill the lumen in order to ensure that the alteplase reaches the catheter tip (Semba et al., 2000).

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Identification of research opportunities

In reviewing the literature to find supporting evidence during the development of these recommendations, the development team noted areas in which there were research gaps relevant to the nursing management of vascular access for hemodialysis. The following is a list of those identified gaps that offer potential for future nursing research topics and that have the potential to benefit hemodialysis patients through improved outcomes:

Interventions

- Impact of the expert RN cannulator in the success of new fistula or graft cannulation
- Effectiveness of various locking solutions in the prevention of hemodialysis catheter flow malfunction
- Effectiveness of various methods of administration of thrombolytic agents for treatment of catheter flow problems

- Optimal performance (blood flow) of the hemodialysis central venous catheter
- Definition of catheter malfunction from a nursing perspective

Monitoring/evaluation

- Access monitoring – approaches to scheduling and workload
- Access monitoring – efficacy in maintaining access patency
- Access monitoring – when to intervene
- Development and validation of evaluation tools for expert cannulators

Education

- Effectiveness of a targeted patient education program on the prevalence of AV fistulae in a hemodialysis unit
- Effectiveness of a patient-specific, self-monitoring tool used to monitor access performance in maintenance of access patency and function

Clinical Educators Network nursing recommendations for management of vascular access in hemodialysis patients

By Alison Thomas, RN, MN/ACNP, CNeph(C)

Case one

Ms. Best, 60 years old, is a new patient who is starting dialysis today. She has been followed by the team in the chronic kidney disease clinic for the past few years, and had a left-arm radio-cephalic arteriovenous (AV) fistula created three months ago.

Questions 1-4 refer to this case.

1. After introducing herself to Ms. Best and orienting her to the dialysis procedure, the nephrology nurse's first step towards cannulation of Ms. Best's new AV fistula should be to:

- (a) cleanse the forearm using 10% povidone-iodine solution or 2% chlorhexidine solution, according to unit policy
- (b) gather the cannulation supplies, taking into consideration the need for small-sized (17-gauge) fistula needles
- (c) carefully and thoroughly assess the AV fistula by performing inspection, auscultation, and palpation procedures
- (d) explain the cannulation procedure to the patient

2. In order to maximize the longevity of the fistula, the nephrology nurse cannulating Ms. Best's fistula should:

- (a) always cannulate in spots where she is confident that she will be successful, even if it means using the same sites repeatedly

- (b) rotate cannulation sites using the rope ladder technique
- (c) always place the arterial needle retrograde to the flow of the fistula
- (d) only cannulate with 17-gauge needles for the first six months the fistula is in use

3. The nephrology nurse should teach Ms. Best to examine her fistula:

- (a) daily
- (b) weekly
- (c) monthly
- (d) bi-monthly

4. Buttonhole cannulation has been described as a method that may prolong the use of the fistula and result in less painful cannulation once tunnel tracks are created. An important component of tunnel-track creation that the nephrology nurse needs to be aware of is that:

- (a) tunnel tracks can be created by many nurses for a single patient
- (b) tunnel tracks can be created in as few as three or four treatments
- (c) the same angle, depth and site of needle insertion at each cannulation is important for proper tunnel-track creation
- (d) after the first sharp cannulation, subsequent cannulations can be made through the same tunnel track with dull buttonhole needles

Case two

Mr. Jones, 65 years old, has diabetic nephropathy and had missed several appointments at the chronic kidney disease clinic. Three months ago, he had to start urgently on hemodialysis and had a central venous catheter inserted by interventional radiology. Two months ago, Mr. Jones had an arteriovenous fistula created in his left forearm. Today, the nephrology nurse is planning on cannulating the fistula of Mr. Jones for the first time.

Questions 5-7 refer to this case.

5. When a new arteriovenous (AV) fistula is cannulated in the presence of an existing central venous catheter, the approach to cannulation should include:

- (a) the same protocol as for use of a new AV access without an existing central venous catheter
- (b) the insertion of only one needle at the first cannulation, used for venous supply
- (c) the insertion of only one needle at the first cannulation, used for arterial supply
- (d) the insertion of two needles, with a blood flow rate of 300 mL/min for the first two treatments

CONTINUING EDUCATION STUDY QUESTIONS – CONTINUED

6. Four weeks later, the nephrology nurse has been able to cannulate the fistula of Mr. Jones with two needles on a regular basis and obtain regular blood pump speeds of 400 mL/min. Adequate fistula flow rates for Mr. Jones as demonstrated by access flow technology should be:

- (a) > 200 mL/min
- (b) > 300 mL/min
- (c) > 400 mL/min
- (d) > 500 mL/min

7. The risk of bacteremia is highest for patients on hemodialysis who have:

- (a) a lower-arm arteriovenous fistula
- (b) a central venous catheter
- (c) an upper-arm arteriovenous graft
- (d) a loop arteriovenous graft

Case three

Mr. Smith, 25 years old, has end stage renal disease secondary to focal segmental glomerulosclerosis (FSGS) and had a deceased donor renal transplant two years ago. Recently, his original kidney disease has recurred in the transplanted kidney and he is now requiring acute dialysis. His vascular access is a right internal jugular (IJ) tunneled catheter.

Questions 8-15 refer to this case.

8. After the catheter insertion, Mr. Smith has a small amount of fresh blood on the hemodialysis catheter dressing. The nephrology nurse should first:

- (a) reinforce the existing dressing
- (b) identify the source of bleeding
- (c) order an international normalized ratio (INR)
- (d) call radiology immediately

9. Mr. Smith's tunneled central venous catheter should be considered to be:

- (a) a bridge to a permanent arteriovenous (AV) access, preferably a fistula
- (b) the only vascular access he will need as he will go back on the transplant list as soon as possible
- (c) a good long-term vascular access with a low complication rate

(d) an issue of low importance as he is having difficulty accepting his return to hemodialysis anyway

10. Mr. Smith's catheter usually provides 400 mL/min of blood flow and his per cent reduction of urea (PRU) is always at >70%. The nephrology nurse should be first concerned about Mr. Smith's central venous catheter performance when:

- (a) the catheter will not provide more than 300 mL/min flow without exceeding the venous and arterial pressure limits for more than three consecutive treatments
- (b) the catheter will not provide more than 250 mL/min flow without exceeding the venous and arterial pressure limits for more than three consecutive treatments
- (c) the catheter will not provide more than 200 mL/min flow without exceeding the venous and arterial pressure limits for more than three consecutive treatments
- (d) the per cent reduction of urea (PRU) concentration has decreased by >20% over one month

11. Mr. Smith's catheter begins to provide poor blood flow rates (<250 mL/min) on hemodialysis with frequent arterial and venous pressure alarms. The nephrology nurse practitioner orders alteplase (Cathflo®) instillation according to the hospital policy, which is to use the push protocol. Before initiating the algorithm and ordering the alteplase (Cathflo®), the nurse practitioner should:

- (a) check to see if the patient has a therapeutic international normalized ratio (INR)
- (b) check whether or not the patient has a heparin or citrate lock protocol ordered
- (c) determine if this is a new central venous catheter, inserted less than one week ago
- (d) determine if the patient has fluid volume overload

12. If a thrombolytic agent, for example alteplase (Cathflo®), is ordered by the physician to "lock" the catheter post-dialysis, then the nephrology nurse would instill the thrombolytic agent to fill the catheter lumen:

- (a) for one hour, then resume the dialysis treatment
- (b) for two hours
- (c) for 24 hours
- (d) for 48 hours, until the next dialysis treatment

13. To assist in maintenance of central venous catheter patency, the Canadian Intravenous Nurses Association (CINA) recommends:

- (a) gentle flushes with 5 mL of normal saline solution when accessing the catheter for treatment initiation
- (b) turbulent flushes with 5 mL of normal saline solution when accessing the catheter for treatment initiation
- (c) gentle flushes with 10 mL of normal saline solution prior to instillation of the catheter lock
- (d) regular, turbulent flushing with at least 10 mL of normal saline solution both before and after use for treatment

14. In order to identify catheter dysfunction, the nephrology nurse should document arterial and venous pressures at the beginning of every dialysis treatment for Mr. Smith, with the blood pump speed set at:

- (a) 100 mL/min
- (b) 200 mL/min
- (c) 300 mL/min
- (d) 400 mL/min

15. Trends in dynamic pressure monitoring should be reviewed for Mr. Smith by the nephrology team at least:

- (a) monthly
- (b) bi-monthly
- (c) six monthly
- (d) yearly

CONTINUING EDUCATION STUDY ANSWER FORM

CE: 3.0 hrs continuing education

Clinical Educators Network nursing recommendations for management of vascular access in hemodialysis patients

By Alison Thomas, RN, MN/ACNP, CNeph(C)

Volume 16, Supplement 1

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	1	2	3	4	5	1	2	3	4	5
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