PROVINCIAL STANDARDS & GUIDELINES

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Buttonhole Cannulation of AV Fistulas For Self-Cannulation

Created December 2009; Updated December 2017
Approved by the BCPRA Hemodialysis Committee and the
BCPRA Home Hemodialysis Committee

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IMPORTANT INFORMATION

This BCPRA guideline/resource was developed to support equitable, best practice care for patients with chronic kidney disease living in BC. The guideline/resource promotes standardized practices and is intended to assist renal programs in providing care that is reflected in quality patient outcome measurements. Based on the best information available at the time of publication, this guideline/resource relies on evidence and avoids opinion-based statements where possible; refer to www.bcrenalagency.ca for the most recent version.

For information about the use and referencing of BCPRA provincial guidelines/resources, refer to http://bit.ly/28SFr4n.

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1.0 Scope

This guideline makes recommendations on the use of and procedures for establishing and maintaining tunnel tracks for **buttonhole (BH) cannulation of AV fistulas (AVFs**).

This guideline applies to:

- Self-cannulating patients (regardless of location of hemodialysis); and
- Adults (over the age of 18 years).

Buttonhole or constant-site cannulation is a cannulation method in which the AV fistula is cannulated in the exact same spot, at the same angle and at the same depth of penetration every time. With time and repeated cannulations, a scar tissue tunnel track develops, enabling the subsequent use of blunt (BH) needles for cannulation and dialysis.

Establishment of a buttonhole track is typically performed using the sharps method (a series of successive sharp needle cannulations) or the angiocath method (leaving two angiocaths in situ for 10 days to establish a scar track that will permit subsequent blunt needle cannulations). This guideline limits discussion to the sharps method as this method is most commonly used and is referenced in most of the literature. The angiocath method is newer and there is less literature to support its use. Blunt needles are used once the track has been established using sharp needles.

2.0 Summary of the Literature

In the development and updating of this guideline, a review of the literature and relevant guidelines was undertaken:

- Canadian Association of Nephrology Nurses and Technologists (CANNT) 2015 Nursing Recommendations - Management of Vascular Access in Adult Hemodialysis Patients.
- Canadian Society of Nephrology (CSN) 2013 Guideline - Management of Patients with ESRD Treated with Intensive Hemodialysis.
- KDOQI 2006 Guideline - excerpts on BH technique of cannulation.
- MEDLINE databases - to November 2016.
- See reference section for specific articles reviewed.

The literature and guideline review included:

- Six systematic reviews, including the reviews conducted by the CSN and CANNT.
- Five randomized control trials (RCTs) comparing BH and rope ladder technique.

Highlights of the review

The quality of the studies on the use of BH vs rope ladder cannulation is limited. =

- The majority of studies were observational, although 5 RCTs have been published between 2003 and 2013.
- Most studies involved a mixture of patients who dialyzed in facilities and at home. Some patients self-cannulated and some had multiple cannulators.
- The generalizability of these studies to patients who dialyze at home and/or self-cannulate is unknown.

When compared to the rope ladder method:

- Some studies/reviews report that the buttonhole method results in fewer needling attempts, fewer hematomas, reduced number of infiltrations, reduced number of aneurysms and aneurysm size and less likelihood of “area” cannulation (Wong et al, 2014; Varhallen et al, 2007; Marticorena et al, 2006; Toma et al, 2003).

- Some studies/reviews report a reduction of pain with needle insertion (observational studies only) (Varhallen et al, 2007; Marticorena et al, 2006; Toma et al, 2003) while others report the same or an increase in pain (MacRae, 2012; Zimmerman, 2012; Chow, 2011; van Loon, 2010).
- Several studies/reviews reported an increased risk of infection (Nicolo et al, 2016; Nadeau-Fredette, AC, 2016; Lyman M et al, 2016; Wong et al, 2014; Muir C, 2013; MacRae et al, 2012; O'Brien et al, 2012; Zimerman & Lok, 2012; Chow et al, 2011).
    - These included local and systemic infections and infectious complications such as septic arthritis, bacterial endocarditis and bacteremia.
    - The incidence of infection varied between studies (and by patient population and locality). One systematic review of observational and randomized studies reported an increased relative risk of 3.15 to 3.34 when comparing rope ladder and BH cannulation respectively (Muir et al, 2013). A retrospective study reported a bacteremia rate of 0.073 per thousand AVF days for BH patients, compared with no bacteremia for rope ladder patients (O'Brien et al, 2012).
    - Several strategies were suggested to reduce this risk - see below.

Poly carbonate pegs (not currently used in BC) are emerging as preferred tools with which to create BHs. The peg is a small, sterile, thumbtack-shaped plug used to maintain the needle track between cannulations. Scar tissue forms around the peg, which facilitates the development of the BH tract. The use of a poly carbonate peg may lead to improved track creation, which may in turn improve AVF survival (Faratro, 2016; Vaux et al, 2013).

Most studies propose the use of only one cannulator for BH tracks and ideally the patient him/herself (Faratro, 2016; CANNT, 2015).

Most studies agree that the BH method may be beneficial in these situations (Faratro et al, 2016; Nicola et al, 2016; CANNT, 2015; Atkar and MacRae, 2013):

- AVF is/has:
    - short In length (< 2 inches or 5 cm) or has short usable segments
    - tortuous
    - aneurysmal dilatation
    - difficult to cannulate
    - mature
    - frequent infiltrations
- Daily dialysis
- Patient is a self-cannulator
- Patient expresses fear related to self cannulation (needle phobia).

Factors that reduced the risk of infection (Faratro et al, 2016; Nicola et al, 2016; CANNT, 2015; CSN, 2013; Ball, 2010):

- Using facemasks on the patient (and staff/helper, if applicable) to lower the theoretical risk of nasal transmission of Staphylococcal aureus during cannulation.
- Keeping tunnel as close to the diameter of the needle as possible (to reduce the amount of manipulation down the tunnel which can cause a break in the epithelium lining).
- Using a tourniquet to "plump up" the vessel to enable a complete assessment and facilitate correct angle of insertion of needles.
- Stretching skin taut from side-to-side to keep the vein stable and minimize needle movement. Using a rigorous technique for skin cleaning prior to inserting needle: washing access just prior to sitting down in the dialysis chair; clean sites before

scab removal and after scab removal with adherence to contact and drying time for cleansing solution.

- Ensure scab is removed completely.
- Using only blunt needles in an established BH track (sharp needles cause scarring of the tunnel and blood vessel wall).
- Keeping 2 mm of needle exposed to prevent the hub from contracting the patient's skin (to prevent "hubbing"; Ball, 2010).
- Using a hand disinfectant prior to de-cannulation.
- Using topical antimicrobial prophylaxis after withdrawal of needles. Options for topical agents include: Polysporin triple ointment, povidone-iodine ointment,mupirocin ointment or polyhexamethylene biguanide (PHMB).
- Performing routine audits of patient cannulation technique on a quarterly basis.

Conclusion

- The BH method of cannulation may have advantages for appropriately selected patients.
- There is an increased risk of infection with the BH method when compared to the rope ladder method of cannulation. Strategies can be employed to minimize this risk.
- The increased risk of infection should be discussed with patients allowing them to make an informed decision on the benefits versus risks.
- BH tracks should be needled by only one cannulator and ideally the patient him/herself. Nurse cannulation of established BH tracks is not recommended.

3.0 Recommendations

Recommendation 1: A Nephrologist's order and confirmation from a Vascular Access or Home Hemodialysis Nurse is required prior to establishing a BH track.

Relative contraindications for using the BH technique:

1. Valvular heart disease
   a) Mechanical heart valve
   b) Rheumatic heart disease
   c) History of previous endocarditis
2. Other prosthetic intravascular material which could cause serious problems if infected (i.e., permanent pacemaker, aortic graft material).
3. Immune suppression
   a) Systemic Lupus
   b) Patients on prednisone
   c) Failed transplants.
4. Active staphylococcus infection (anywhere)
5. Persistent skin irritation or local infection along access arm

Vascular access patch graft material is **not** a contraindication due to the superficial location and relative ease of access for removal if necessary.

Risk factors for unsuccessful buttonholes:

- Thin subcutaneous tissue
- Poorly functioning fistula

Recommendation 2: BH technique is appropriate for patients who are capable of self-cannulation and, upon assessment by the nephrologist, VA Nurse and/or Home Hemodialysis Educator, are deemed competent to manage the responsibility of BH cannulation. If these criteria cannot be met, rope ladder technique is recommended.

Patient/caregiver characteristics for self/ caregiver cannulation:

- Currently on or is a candidate for home hemodialysis (may also be an in-centre and/ or community dialysis patient if the remaining characteristics apply).
- Wants to self-cannulate and/or has a caregiver willing to cannulate.
- Good hand dexterity (able to hold the needle and not shaky).
- Good sensation in fingers.
- Good eyesight.
- Good personal hygiene.
- Mental capacity to be successful at self/ caregiver cannulation.
- Received specific education on self-cannulation.
- Lower arm fistula on the non-dominant arm is the easiest to self-cannulate.

Decision criteria for use of rope ladder vs. buttonhole technique:

ROPE LADDER	BUTTONHOLE
• Capacity to understand the concept of rope ladder and assess and track rotation of sites. • Willingness to undertake rope ladder technique. • Risks of rope ladder technique reviewed with the patient. • Fistula easy to cannulate. • Easily palpable vein. • Large area of straight vein available for cannulation.	• Willingness to undertake BH technique. • Risks of BH technique reviewed with the patient (there is a slightly higher risk of infection with the type of needling, although the risk is still small). • Fistula has short, limited space for cannulation. • Deemed to be appropriate for the BH method of cannulation by nephrologist, VA Nurse and/or Home Hemodialysis Educator

Recommendation 3: BH tracks may be established on new or mature, well functioning fistulas; however, mature fistulas are preferred.

Points to consider when **establishing** BH tracks:

- Choose sites easy for the patient to cannulate.
- When choosing sites, try to choose straight, relatively unused sections of the access. If possible, allow at least 2 inches between the tips of the needles. Start near the AV incision to leave room for future BH sites.
- Avoid compromised areas such as aneurysms or areas without sufficient subcutaneous tissue to enable a tunnel track to develop.
- Create buttonhole sites at the centre of the vessel, not on the sides.
- If available, use bedside ultrasound to map BH sites.
- Measure and document BH site locations and needles used. BH site locations:
- Upper arm BH sites: measure in centimeters from the antecubital fosssa/elbow crease with the arm bent at a 90 degree angle.
- Forearm BH sites: measure in centimeters from the bent wrist.
- Photograph of the BH sites and angle of cannulation is recommended for the Kardex/ patient record.

Recommendation 4: BH tracks may be established by patients/caregivers or by a designated nurse who is a home HD nurse and/or an advanced cannulator (advanced cannulators are designated by the vascular access nurse).

General:

- If possible, encourage patients/caregivers to establish the BH track. If a nurse is initially required to do establish the track, work toward transferring the function to the patient/ caregiver as soon as possible.
- Same cannulator should cannulate the access until the track is established (usually takes 8 – 18 cannulations; upper arm fistulas with higher flows and/or patients with diabetes or deeper vessels may require more cannulations to establish the track).

If the patient/caregiver is unable to self-cannulate and/or the nurse cannulator for that patient is not available and/or not successful:

- Cannulate the track using conventional sharp needles placed antegrade and a MINIMUM of 1 inch (2.5 cm) away from the BH site.
- If there is insufficient space to place two conventional sharp needles (i.e., BH sites are last resort), place one between the buttonhole sites and dialyze with a single needle.
- DO NOT use a sharp needle in the BH track.

Recommendation 5: Once a BH track is established, the track is cannulated by the patient/caregiver using a blunt needle. Sharp needle may only be used after consultation with nephrologist. Nurse cannulation of established BH tracks is not recommended.

Recommendation 6: Reduce the risk of infection by teaching patients/families rigorous cleansing of the arm/site prior to needling, appropriate needling techniques and application of an antimicrobial gauze or antibiotic cream after withdrawal of the needles.

There is a slightly higher risk of infection with buttonhole cannulation than rope ladder cannulation, although the risk is still small. The literature review in section 2.0 identified several ways to reduce the risk.

Rigorous cleansing of the arm/site and using the appropriate needling technique have been recommended in the literature for several years. The prophylactic application of an antimicrobial gauze or antibiotic cream after withdrawal of the needles is a relatively new recommendation for BH sites. Recent studies in the literature that applied antimicrobial gauze or antibiotic cream to the exit sites have noted a reduction in exit site infections (Marticorena et al, 2006 & 2009; Nesrallah et al, 2010). This recommendation was incorporated into the VA guidelines developed by CANNT (2015) and the CSN (2013).

In BC, it is recommended that one of the following be applied: (1) antimicrobial gauze; or (2) Mupirocin antibiotic cream (apply with a sterile cotton swab or gauze).

Recommendation 7: In the event a BH site becomes infected:

- If the BH infection is localized to the puncture site and there are no signs of systemic infection/deep infection, DO NOT use the BH sites and follow the protocol for VA Related local Infections in the BCPRA guideline ***Prevention, Treatment and Monitoring of VA Related Infection in HD Patients*** (includes a culture of the local site and 2 – 3 week course of topical and/or oral antibiotics). An attempt could be made at needling the original BH site once the course of antibiotics is complete.
- If an abscess has developed, the entire AVF has become infected and/or the patient demonstrates clinical signs of bacteremia, DO NOT use the BH sites and follow the protocol for VA Related Bacteremia in the BCPRA guideline for ***Prevention, Treatment and Monitoring of VA Related Infection in HD Patients*** (includes a culture of the local site, 2 sets of blood cultures drawn 5 minutes apart and a 6 week course of IV antibiotics). Establish a new BH site once the course of antibiotics is complete.
- Document the infection in PROMIS.

tFor specifics, refer to ***Prevention, Treatment, & Monitoring of VA Related Infection in HD Patients*** at bcrenalagency.ca ▶ Health Professionals ▶ Clinical Resources ▶ Vascular Access ▶ Resources ▶ Related Infections

4.0 Procedure

The next section describes 2 procedures and tips/troubleshooting for BH cannulation:

a) **Establishing** a BH track using the sharps method
b) Cannulating an **established** BH track
c) Trouble-shooting BH tracks

4 (a) Establishing a Buttonhole Track Using the Sharp Needle Method

First Cannulation (prefer this be done by patient/caregiver but may be done by advanced cannulator and/or home HD nurse)

1. Consult a physician **and** vascular access (VA) or home HD nurse to confirm that the access is ready to cannulate and the patient meets the criteria for establishment of a buttonhole track.
2. Assess access for signs of infection (redness, swelling, tenderness or drainage) and that it is working by feeling a thrill (pulsation or vibration).
3. Instruct the patient to wash their hands and access with anti-bacterial soap or scrub and water using friction; patient may apply Emla or other topical anaesthetic cream to needle sites for analgesia during the establishment of

the BH tracks; Emla cream is discouraged and should not be required once the BH tracks are established.

4. Select appropriate arterial and venous sites for cannulation (see recommendation 3). If available, use bedside ultrasound.
5. Cleanse each needle site with a cleansing solution using a back and forth rubbing motion. Allow to dry.

SOLUTION	CONTACT TIME[1]	CANNULATION
Chlorhexidine 2%[2] with alcohol 70%	30 seconds	When dry
Chlorhexidine 2% with no alcohol	3 minutes	When dry
Sodium hypochlorite 0.11% (ExSept Plus® or Amuchina 10%), if available	2 minutes	When dry
Povidone iodine 10% (Betadine®)	3 - 5 minutes	When dry

[1] Contact times were pulled from a variety of sources including:

- Manufacturer's instructions (where indicated)
- Safer HealthCare Now (June 2012). Prevent Central Line Infections: Getting Started Kit. http://www.saferhealthcarenow.ca/EN/Interventions/CLI/Documents/CLI%20Getting%20Started%20Kit.pdf
- DeBaun B (2008). Evaluation of the antimicrobial properties of an alcohol-free 2% chlorhexidine gluconate solution. AORN. May; 87(5): 925-33.

[2] Recommendations in this document re: the use of chlorhexidine are for children > 2 years of age; the literature makes no recommendations for infants < 2 years of age (unresolved issue; CDC, 2011, p. 13).

If patient is allergic to all solutions above, try using any of the agents above and washing off with saline immediately after application. If allergic reaction persists, use normal saline only.

6. Apply tourniquet 4 inches higher than the venous (top) needle site.
7. Put on clean gloves.
8. Insert arterial needle:
   a) Remove cap and hold needle (15 or 16 gauge, 1 in or 1.25 in long) by the plastic wings with the opening (bevel) facing up.

   Note: 1.25 in needle is only used for patients with deep fistulas.

b) Pull back on the skin with light pressure below where the needle will be placed.

c) Insert needle using a 25 degree angle, although this may vary depending on the depth of the fistula.

d) Flatten angle once you see blood pulsing (flash back). Slowly advance needle almost to the end in the same direction as the fistula. To prevent the "hubbing" effect[3], leave the last 2 mm of metal part of the needle exposed (prevents the hub of the needle from touching the entrance sites).

e) Holding the wings of the needle, check the flow of the blood by pulling up and down on the syringe. Syringe should be in a vertical position.

f) Place folded gauze under the needle if required.

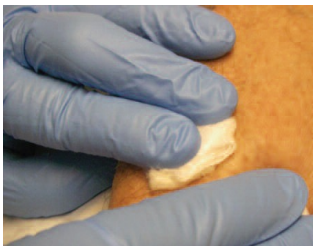
g) Tape needle securely leaving exit site covered with tape or dressing.

h) Clamp needle.

9. Repeat step 6 to insert the venous needle.
10. Remove tourniquet.
11. Check flows and give initial heparin dose by replacing the empty syringe with the heparin-filled syringe.
12. Proceed with dialysis.

First Needle Removal

13. Wash hands with anti-bacterial soap using friction or hand sanitizer.
14. Clamp both needles. Place a drape under arm.
15. Put on clean gloves.
16. Hold needle while removing tape. Place gauze over the needle site without applying pressure.
17. Remove needles one at a time by grasping the needle wings and placing gauze over the puncture site. Pull needle out slowly at the same angle as the track.
18. After the needle is out, apply mild, direct pressure for 10-15 minutes to each site, using sterile gauze and a two-digit technique:
    - One finger at the vein site (internal)
    - One finger at the skin exit site (external)



The Two-Digit Technique

19. Once the site has stopped bleeding:
    - Cover the exit site with an antimicrobial and tape in place using paper tape (one band-aid per site). Instruct the patient to remove the gauze after 4 – 6 hours; OR
    - Apply 2% Mupirocin cream about the size of a pea to each BH site with a sterile cotton swab (one swab per site) or sterile 2x2 gauze. Make sure the tube of Mupirocin cream does not contact the skin. Cover the exit site with a sterile 2x2 gauze and tape in place with paper tape. Instruct the patient to remove the gauze after 4 - 6 hours and, using a sterile gauze, wipe away excess Mupirocin cream.

Cannulation #2 and until BH track is established (if initial cannulation done by advanced cannulator nurse, transfer function to patient as soon as possible)

Same process as for the first cannulation except that the BH scab needs to be removed.

[3] "Hubbing" is when BH sites start developing a widening and a bowl-like indentation at the entrance. This makes it difficult to remove scabs and increases the chances of infection (Ball, 2010).

20. Procedure for removing BH scabs:
    - Apply a disinfectant-soaked gauze or tape an alcohol wipe over buttonhole sites for 10 minutes or more until the scab softens. If patient is sensitive to disinfectant, use a normal saline-soaked gauze. Remove gauze in wiping motion.
    - If scabs are not removed with soaking, gently remove with a red blunt fill needle or SteriPick (one for each site) and discard. Do not use reusable, non-sterile tweezers or fingernails to remove the scab.
    - Cleanse each needle site again with a disinfectant-soaked gauze.

Needle Removal

21. Follow steps 13 – 20.

4 (b) Cannulating an Established Buttonhole Track

22. Once BH track is well established, transition to blunt needle cannulation.
    - BH site looks well-healed;
    - BH site has a round hole; and
    - Resistance in the track is decreasing with each use.

    Note: Blood leakage at the BH site may also be an indication that it is time to transfer to blunt BH needles.

23. Follow same as previously outlined steps (assess access, remove scab and insert needles) except using a blunt needle.
    - If mild to moderate resistance is met when attempting to insert the needle, rotate the needle as the needle is being advanced, using gentle pressure.
    - If resistance continues to be felt, gently pull the needle back but not out of the tunnel, wait x 20 seconds and try to advance the needle again.
    - If unsuccessful with the blunt needle, remove the needle and hold site with sterile gauze.
    - If bedside ultrasound is available, attempt to visualize the BH track.
    - Reposition the tourniquet, palpate the vessel, repeat cleansing procedure and try cannulating the site again using a new blunt needle.
    - If unsuccessful cannulating the BH site the second time, cannulate a new rope ladder site at least 1 in away from the BH track using a sharp needle.
    - Consult a nephrologist if difficulty cannulating with a blunt needle at more than one consecutive HD session.

Needle Removal

- Follow steps 13 – 20.

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6.0 Sponsors

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Developed by:

- Vascular Access Educators Group in partnership with the BC Home HD Nurses Group

Approved by:

- BCPRA Hemodialysis Committee
- BCPRA Home Hemodialysis Committee
- BCPRA Medical Advisory Committee

For information about the use and referencing of BCPRA provincial guidelines/resources, refer to www.bcrenalagency.ca.

7.0 Effective Date

- Effective date: December 8, 2009; Revised: Mar 24, 2013 and Jan 23, 2017.
- This guideline is based on scientific evidence available at the time of the effective date; refer to www.bcrenalagency.ca for most recent version.