Peripheral & Femoral Vein Cannulation

CLINICAL BEST PRACTICE GUIDELINE

College publications contain practice parameters and standards which should be considered by all Ontario Respiratory Therapists in the care of their clients and in the practice of the profession. College publications are developed in consultation with professional practice leaders and describe current professional expectations. It is important to note that these College publications may be used by the College or other bodies in determining whether appropriate standards of practice and professional responsibilities have been maintained.

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COLLEGE OF RESPIRATORY THERAPISTS OF ONTARIO

Acknowledgements

This respiratory therapy clinical best practice guideline (CBPG) was developed by a working group of the College of Respiratory Therapists of Ontario's (CRTO) Registration Committee comprised of practicing Registered Respiratory Therapists.

A search for related articles was performed on PubMed, MD Consult, Ovid Medline, and CIANHL (Cumulative Index to Nursing & Allied Health Literature). On Ovid, three evidence-based medicine review databases were searched. These included ACP Journal Club (ACP), Cochrane Database of Systematic Reviews (CDSR), and Database of Abstracts of Reviews of Effects (DARE). Relevant electronic books on MD Consult and Ovid were reviewed. The following terms were used: peripheral access, vascular access, peripheral vein cannulation, intravenous, femoral vein cannulation, femoral vein, and local anaesthesia for cannulation. A general search engine web search was conducted on "Google", using the same terms identified above. A structured website search was conducted on the Public Health Agency of Canada (PHAC), and the Centres for Disease Control and Prevention (CDC).

We have endeavoured to integrate individual experience and practice with the best available clinically relevant evidence from research and other sources in order to help our members make informed decisions about patient/client care. The weight of literature used to develop the document is supported with a graded level of evidence.

These guidelines are not meant to be applied in a "cookbook" fashion or to replace individual expertise. Instead they are intended to act as a tool to facilitate certification program development, and to assist clinicians as they struggle to make the best decisions in order to provide the finest possible care for the patients/clients for whom they treat.

We encourage all CRTO members to incorporate learning activities related to certification programs into the CRTO's Quality Assurance (QA) professional portfolio.

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INTRODUCTION

The *Regulated Health Professions Act* (RHPA) sets out the framework for the regulation of health professions in Ontario. The primary purpose for the regulation of the health profession is to protect the public by ensuring that practitioners meet minimum qualifications and standards of practice. In order to focus on the issue of public protection the RHPA identifies thirteen "controlled acts". These acts consist of a variety of activities that if performed incorrectly could result in serious harm to the public.

The *Respiratory Therapy Act* (RTA) authorizes Respiratory Therapists to perform four controlled acts. The Prescribed Procedures O. Reg 596/94 outlines a mandatory safeguard to help protect the public from harm that might occur when advanced prescribed procedures such as venous cannulation are performed. The College of Respiratory Therapists of Ontario (CRTO) adheres to this regulation, and requires that members performing these controlled acts undergo a certification program approved by the Registration Committee of the CRTO. Peripheral and femoral vein cannulation, are examples of advanced prescribed procedures below the dermis which carry a greater risk for the public and so necessitate that a CRTO approved certification program be in place prior to the procedure being performed on a patient/client. For more on legislation and policies please visit the CRTO's Web site: http//www.crto.on.ca/html/legpol.htm

This respiratory therapy clinical best practice guideline (CBPG) is **not** intended to replace any current certification programs that have been approved by the Registration Committee of the CRTO. The purpose of this evidence-based guidelines is to provide a consistent approach to the development of certification programs/ process which are required for the performance of prescribed procedures below the dermis under Ontario Regulation 596/94. **RRTs may use this guideline as the learning package for your certification program. For more information on this process, please see the CRTO professional practice guideline (PPG) Certification Programs for Advanced Prescribed Procedures Below the Dermis at http://www.crto.on.ca/pdf/ppgcertprog.pdf**

The advanced procedures of peripheral and femoral vein cannulation are currently the most common venous catheterization procedures being performed by Registered Respiratory Therapists. They have many shared elements and so are discussed together in this document.

This best practice guideline contains evidence-based clinical resources to support respiratory therapy practice in order to make informed patient care decisions and provide the best care possible. Evidence-based practice is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients/clients. The practice of evidence-based medicine means integrating individual clinical expertise and experience with the best available clinically relevant evidence from systematic research. (Sackett et al, 2005 LOE8)

INTERPRETATION OF EVIDENCE

References used throughout the body of the document will have a level of evidence (LOE) cited to indicate the quality and strength of the literature used. For example, a randomized clinical trial, will have LOE1 as a superscript, to identify it as having a Level of Evidence of 1 which is considered the strongest evidence available. The table below provides a description each LOE.

Levels of Evidence (LOE)

Level 1	Randomized clinical trials or meta-analyses of multiple clinical trials with substantial treatment effects.
Level 2	Randomized clinical trials with smaller or less significant treatment effects.
Level 3	Prospective, controlled, nonrandomized cohort studies.
Level 4	Historic, nonrandomized cohort or case-control studies.
Level 5	Case-series; patients compiled in serial fashion, control group lacking.
Level 6	Animal studies or mechanical model studies.
Level 7	Extrapolations from existing data collected for other purposes, theoretical analyses, e.g. critical reviews.
Level 8	Rational conjecture (common sense); common practices accepted before evidence-based guidelines. This includes material from textbooks, and editorials.

Adapted from the American Heart Association (AHA), Evidence Evaluation Process Used for the development of cardiopulmonary resuscitation (CPR) and Emergency cardiovascular care guidelines (ECC), 2005.

CERTIFICATION PROGRAM TEMPLATE FOR VENOUS CANNULATION -- PERIPHERAL & FEMORAL VEINS

The CRTO requires that certain components be included in the certification program. The required content is described in the CRTO professional practice guideline (PPG) on *Certification Programs for Advanced Prescribed Procedures Below the Dermis. The following link will take you to a list of available practice guidelines on the CRTO's Web site:* *www.crto.on.ca/html/profpractguidelines.htm*

Below is a **suggested** content list to be used in the development of a certification program for peripheral and femoral vein cannulation. Items **A through G are required content,** as described in the *Certification Programs for Advanced Prescribed Procedures Below the Dermis PPG*. All other items further support the information to be incorporated into a certification program.

Contents:

A. Certification and Recertification Requirements

Only Registered Respiratory Therapists (RRT) who hold a general certificate of registration, without terms and conditions, are authorized to perform an advanced prescribed procedure below the dermis, such as peripheral and femoral vein cannulation. Although authorized to perform the procedure, the *Respiratory Therapy Act* details the requirement of an order to enable the RT to proceed with the cannulation. An order can be in the form of a direct order or a medical directive based on the specific needs and policies of the organization or practice/setting environment.

To obtain initial certification the RRT must complete the CRTO approved certification program (O.Reg 596/94). In order to maintain certification or to be considered recertified, competence must be demonstrated under direct supervision at a minimum of every two years. This may include a review of related experience, verbal and/or written evaluation of knowledge (CRTO Certification Programs for Advanced Prescribed Procedures Below the Dermis professional practice guideline).

A certification program is made up of three components:

I. Knowledge Component
II. Observation Component
III. Demonstration Component

The purpose of a certification package is to help the learner navigate the required theory and to provide a foundation for the clinical portion which will solidify understanding of all aspects of the procedure.

Knowledge Component – The knowledge component can be evaluated by a written or verbal examination. It is recommended that a minimum mark be required in order to proceed to the observation component. An estimate of the time required to complete this portion should be described.

Observation Component – After successful completion of the knowledge component the RRT will advance to review of the skill in a simulated setting under the direction of a certified clinician. The intent of this portion of the program is to provide a safe setting for the review of the skill and competencies required in order to be successful in performing the procedure on a patient. An estimate of the time required to complete this portion should be described.

Demonstration Component – This portion requires that the procedure be performed on a patient, under direct observation by a clinician certified in the procedure and who has the skills required to teach effectively. The decision as to who the clinician(s) should be determined based on internal resources. There is no evidence to support the decision of how many times the procedure should be repeated in order to determine competence. There is only an understanding that proficiency does come with practice and that ongoing evaluation is needed in order to ensure competency.

B. Nature and Purpose of the Procedure

Each facility will have a rationale for having an RRT assume the added responsibility of performing this advanced procedure. The reasoning provided here has been described in certification programs that have been already approved by the CRTO, or have been described in literature.

Describing the nature and purpose helps establish the foundation for performing the procedure so that all readers understand its merits.

1. To standardize the approach used to perform peripheral and femoral vein cannulation performed by the Registered Respiratory Therapist based on good technique, clinical expertise and evidence-based practice.

2. To guide infection control practice related to peripheral venous access and for accessing the central circulation via the femoral vein, in order to minimize the incidence of catheter-related line infections.

3. To expedite patient care by improving timeliness of establishing venous access in situations where the physician is not immediately available.

4. To increase the numbers of qualified clinicians available to perform the procedure in order to expedite patient care.

5. To improve utilization of specialized personnel that is in-house and immediately available. This offers the advantage of a larger team trained to assist in emergency-related circumstances such cardiac and respiratory arrests, disasters and pandemics.

6. To increase the skillset of the RRT when assisting health care professionals during peripheral and femoral venous cannulation. The RRT can provide clinical expertise and enhanced technical troubleshooting advice.

C. Learning Objectives

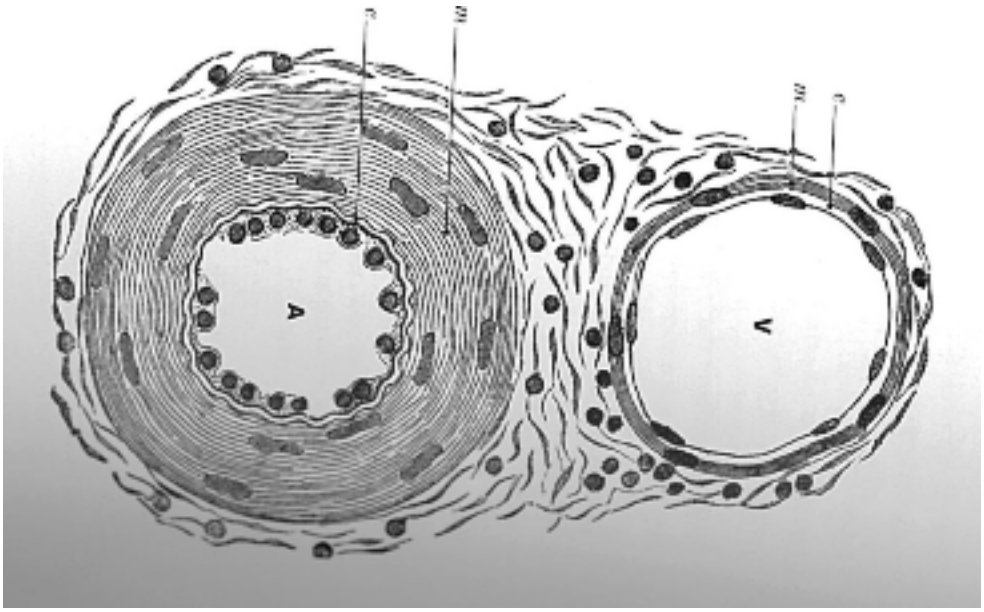
Objectives should be clear, concise and measurable. They should reflect back on curriculum content and focus on key take-away messages. Below is a list of possible objectives that may be included in the development of your certification program.

1. State the standard/policy and medical directive (if applicable).
2. Demonstrate familiarity with the equipment used.
3. Describe the indications and contraindications.
4. Assess patient appropriateness for procedure, and the need for prevention and management of pain.
5. Demonstrate appropriate knowledge of the anatomy.
6. List the potential complications and discuss their prevention and management.
7. Demonstrate an understanding of pharmacology associated with the procedure.
8. Demonstrate appropriate infection control measures.
9. Demonstrate and discuss proper technique for cannulation.
10. Demonstrate successful assessment and cannulation on patient(s)/client(s).

D. Anatomy

Peripheral venous cannulation is performed on a number of vessels including the superficial veins of the dorsum of the hand; veins in the antecubital fossa (cephalic and basilic veins); the dorsum of the foot; and in newborns and small infants, the scalp (Roberts, 2004 LOE8). Veins used to access the central circulation include vessels such as the internal jugular; external jugular; subclavian and femoral veins. In the adult population, the femoral vein is the largest vessel most commonly used for rapid volume infusion in an emergency situation such as cardiac and respiratory arrest, and shock (AHA, 2005 LOE7). This is because the femoral vein is easily identified, easy to apply pressure if needed, and does not hinder resuscitation efforts (AHA, 2005 LOE7; Weinstein, 2007 LOE8). In neonates, infants and children during an emergency, any venous access can be challenging. If it cannot be accessed quickly the intraosseous route is recommended (AHA, 2005 LOE7).

Veins are essentially hollow tubes that collapse when not filled with blood. The wall of a vein is composed of three layers, the tunica externa, tunica media, and tunica intima. Most have one-way valves to prevent gravity from causing blood to backflow and pool in the lower extremities. These are seen on the skin as small bulges. Veins can be superficial or deep. Arteries are comprised of the same three layers; however the tunica media, which is made up of smooth muscle cells is much thicker than that of the veins. This helps prevent arteries from collapsing. Arteries unlike veins do not have valves; are deep and pulsatile. (Gray, 2000 LOE8; Merck Manual, 2007 LOE8; Scales, 2005 LOE8)



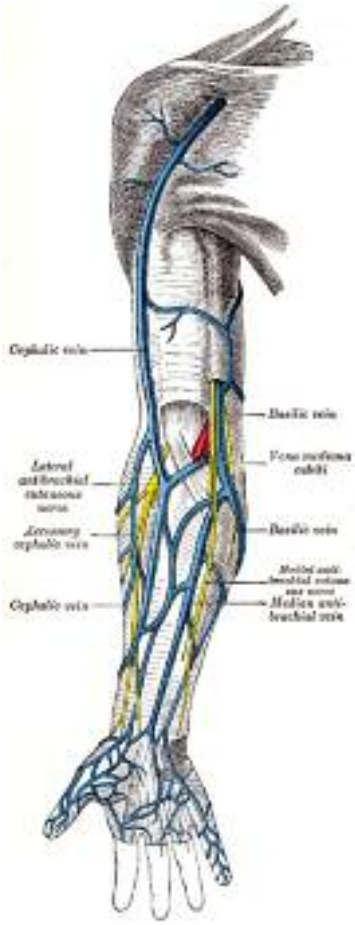
e= endothelium

m= muscular wall

This illustrates that the muscular wall of the artery is far thicker and stronger than that of the vein.

Cross section of an artery and vein
Anatomy of the Human Body, 1918
Henry Gray

Veins on the dorsum of the hand (Bourgery)
http://www.bartleby.com/107/illus573.html
Gray (2000). Anatomy of the Human Body.
Reproduced with permission.



Superficial veins of the upper extremity
http://www.bartleby.com/107/illus574.html
Gray (2000). Anatomy of the Human Body.
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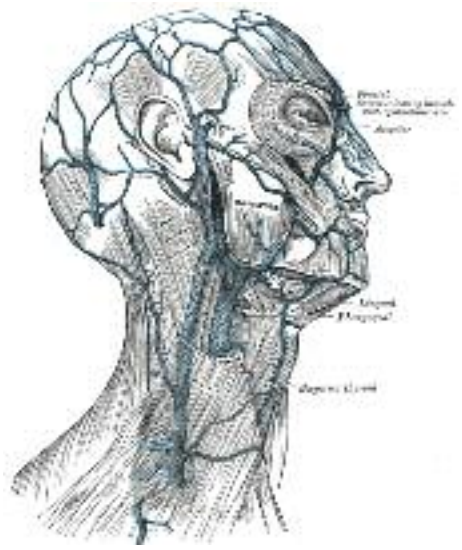
Veins of the hand

The **dorsal venous network of the hand** is a network of veins formed by the dorsal metacarpal veins. It is found on the back of the hand and gives rise to veins such as the cephalic and basilic veins. The **basilic vein** runs along the ulnar aspect of the forearm and upper arm. The **cephalic vein** runs along the radial aspect of forearm and upper arm.

Veins of the upper limb

The **antecubital fossa** is the triangular area on the front side of the elbow joint of the arm. It contains the **antecubital veins** which are the cephalic, basilic, the median cubital veins. The **accessory cephalic vein** arises either from a small tributory plexus on the back of the forearm or from the ulnar side of the dorsal venous network; it joins the cephalic. The **basilic vein** is located on the ulnar side and the **median cubital vein**, in front of the elbow joint.

The **median antebrachial** veins arise from the ulnar side of the front of the forearm and ends in the basilic vein. The **cephalic vein** is a superficial vein in the upper limb. It communicates with the median cubital vein at the elbow.



Veins of the head and neck
http://www.bartleby.com/107/illus557.html
Gray (2000). Anatomy of the Human Body.
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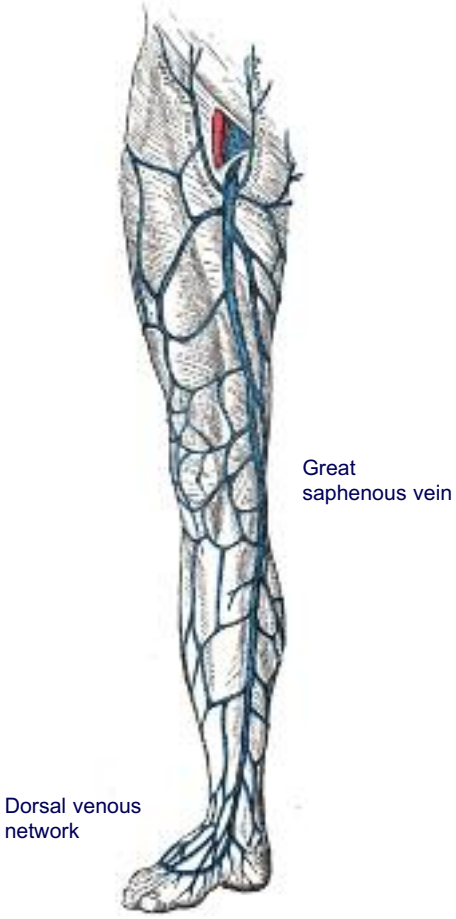


The great saphenous vein and its tributaries
http://www.bartleby.com/107/illus581.html
Gray (2000). Anatomy of the Human Body.
Reproduced with permission.

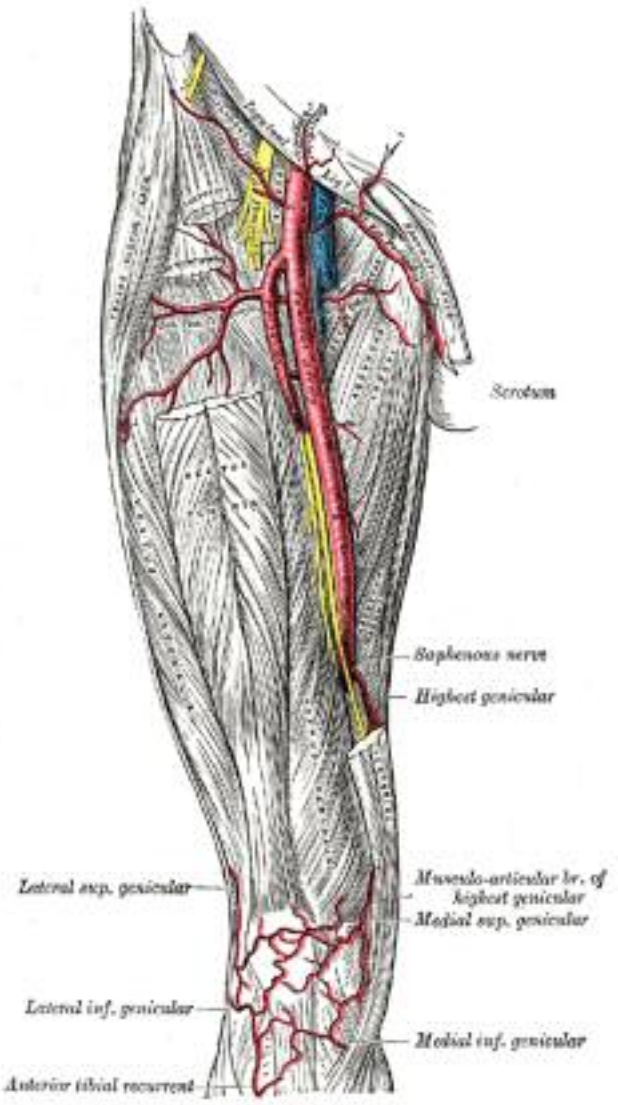
Scalp Veins

The **frontal vein** begins on the forehead. It communicates with the frontal branches of the **superficial temporal vein** on the side of the head. The **posterior auricular vein** begins upon the side of the head, and communicates with the tributaries of the occipital vein and superficial temporal veins.

Veins of the foot

Peripheral veins of the foot include the small saphenous vein, the great saphenous vein and the dorsal venous arch. The small and large saphenous veins are relatively large veins of the leg. The **small saphenous vein** is on the posterior aspect of the leg and arises from the smallest toe to merge with the **dorsal venous arch of the foot,** which attaches to the great saphenous vein. The **great saphenous vein** courses laterally to lie on the anterior surface of the thigh.

Anatomy Source: Gray, 2000 [LOE7] & Roberts, 2004 [LOE8].



The femoral artery and vein
http://www.bartleby.com/107/illus550.html
Gray (2000). Anatomy of the Human Body.
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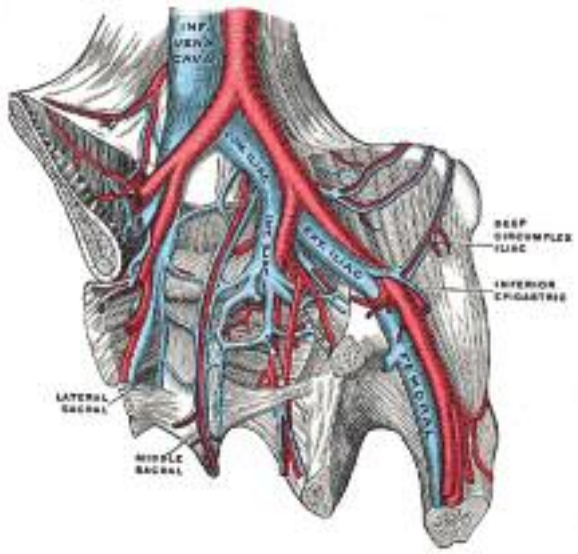
Femoral Vein

Venous cannulation to access the central circulation, such as femoral vein cannulation, provides a more stable and reliable route of venous access than peripheral venous sites. It is a commonly used vessel for rapid fluid administration in adults, as in the case of shock or cardiac/respiratory resuscitation due to its large size and non-interference with cardiac compressions. (AHA, 2005 LOE7)

The femoral anatomy is easily learned and in the case of inadvertent arterial puncture or venous laceration, hemostasis can be achieved by application of direct pressure (Roberts, 2004 LOE8). It does not expose the patient to the potential hazard of intrathoracic complications that can occur with jugular or subclavian vein cannulation (Haas, 2004 LOE7). The catheter used to cannulate the femoral vein can be advanced toward the heart until it reaches the inferior vena cava. This then can be used for haemodynamic monitoring. (Roberts, 2004 LOE8)



The iliac veins. (Poirier ad Charpy)
http://www.bartleby.com/107/illus586.html
Gray (2000). Anatomy of the Human Body.
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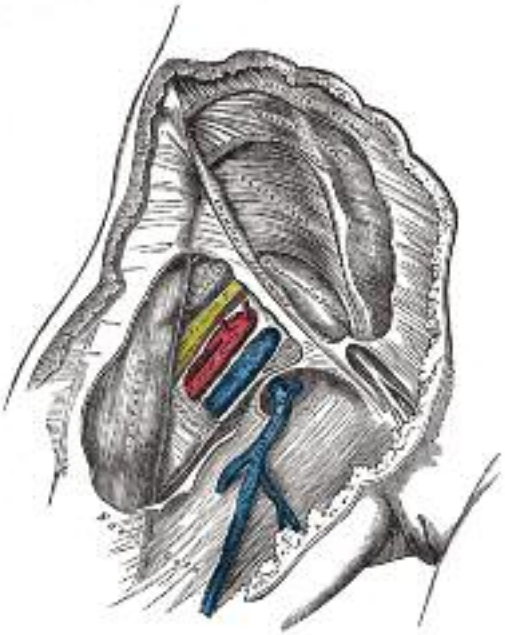
The femoral vein is a blood vessel that accompanies the femoral artery in the femoral sheath. It begins at the **adductor canal** (also known as the *Hunter's canal*) and is a continuation of the **popliteal vein**. It ends at the inferior margin of the **inguinal ligament** where it becomes the **external iliac vein** (Gray, 2000 *LOE7*). It lies immediately behind the inguinal ligament, midway between the anterior superior spine of the ilium and the symphysis pubis (Roberts, 2004 *LOE8*; AHA, 2005 *LOE7*).



Femoral sheath laid open to show its three compartments
http://www.bartleby.com/107/illus545.html
Gray (2000). Anatomy of the Human Body.
Reproduced with permission.

In the upper third of the thigh the femoral vein is contained in the **femoral triangle** which is bound laterally by the Sartorius, Adductor longus and Inguinal ligament. Approximately 1 cm below the inguinal ligament just medial to the femoral artery, the vein is closest to the surface of the skin and easily accessible. (Roberts, 2004 *LOE8*; AHA, 2005 *LOE7*)

E. Indications and Contraindications

The goal of intravenous therapy is correction or prevention of fluid and electrolyte disturbances (Perry & Potter, 2002 LOE8). It can provide maintenance fluids to support hydration, and serve as a route for administering medications such as antibiotics and enteral therapy (Roberts, 2004 LOE8).

Peripheral venous cannulation is the preferred method of vascular access in most non-emergent situations (AHA, 2005 LOE7). Venous cannulation to access the central circulation, as in femoral vein cannulation, provides a more stable and reliable route of venous access than peripheral cannulation (AHA, 2005 LOE7). This route is commonly used when peripheral veins are inaccessible and when longer term venous access is required (Taylor & Palagiri, 2007 LOE7). There are numerous other indications for femoral vein cannulation, which include rapid infusion of fluid during resuscitation; frequent blood sampling for diagnostic purposes; temporary/acute haemodyalisis; administration of potent vasoactive drugs; infusion of irritating or hypertonic solutions; infusion of incompatible medications through a multilumen catheter; hyperalimentation; haemodynamic monitoring such as for central venous pressure readings; and transvenous cardiac pacing (Taylor & Palagiri, 2007 LOE7; Miller, 2005 LOE8). In the case of resuscitation, central venous access is preferred over peripheral access due to the relatively large bore catheters that can be inserted in these vessels which facilitate rapid fluid administration (Taylor & Palagiri, 2007 LOE7; AHA, 2005 LOE7).

Contraindications for peripheral vein cannulation are related to local site selection. Sites distal to previous venipuncture sites, sclerosed or hardened cordlike veins, infiltrate site or phlebotic vessels, bruised areas and area of venous valves or bifurcation should be avoided. Fragile dorsal veins in older adults and vessels in an extremity with compromised circulation should not be used (e.g. in cases of mastectomy, dialysis graft or paralysis). In the paediatric population, veins are fragile and so extra attention to sites that can be easily disturbed by movement should be avoided. (Perry & Potter, 2002 LOE8; Roberts, 2004 LOE8)

Establishing central venous access can be lifesaving. Consequently, it can be argued that there are no absolute contraindications to femoral vein cannulation. In cases where there is a penetrating abdominal trauma or known inferior vena caval disruption, the femoral vein should be avoided because the catheter may enter the abdominal cavity and another site, such as the subclavian vein, should be used (Taylor & Palagiri, 2007 LOE7). In cases of a coagulopathy, the risk of haemorrhage increases; however, careful site selection and meticulous technique, should help keep bleeding complications to a minimum (Roberts, 2004 LOE8). If there is a known venous thrombosis another site should be considered (Taylor & Palagiri, 2007 LOE7).

Relative contraindications for both peripheral and femoral vein cannulation include local infections or burns at the insertion site; malformations or deformations that may distort vascular anatomy; vascular insufficiency of an extremity; and obstruction or compression by a tumor, abnormal vessels, coagulopathy, haematoma, thrombus, abscess, or malformation (Roberts, 2004 LOE8).

INDICATIONS	RELATIVE CONTRAINDICTION	ABSOLUTE CONTRAINDICATION
• Correction or prevention of fluid and electrolyte disturbances (Perry & Potter, 2002 LOE8) • Route for medication administration and nutritional therapy (Roberts, 2004 LOE8) • Femoral vein cannulation: rapid infusion of fluid during resuscitation; frequent blood sampling; temporary/acute haemodyalisis; administration of potent vasoactive drugs; infusion of irritating or hypertonic solutions; infusion of incompatible medications through a multilumen catheter; hyperalimentation; haemodynamic monitoring such as for central venous pressure; and transvenous cardiac pacing (Taylor & Palagiri, 2007 LOE7; Miller, 2005 LOE8)	• Local infections or burns at insertion site; malformations or deformations that may distort vascular anatomy; vascular insufficiency of an extremity; obstruction or compression of veins by a tumor, abnormal vessels, coagulopathy, haematoma, thrombus, abscess, or malformation (Roberts, 2004 LOE8) • Peripheral vein cannulation: sites distal to previous venipuncture sites, sclerosed or hardened cordlike veins, infiltrate site or phlebotic vessels, bruised areas and area of venous valves or bifurcation; fragile dorsal veins in older adults, and vessels in an extremity with compromised circulation (Perry & Potter, 2002 LOE8; Roberts, 2004 LOE8)	• Avoid femoral vein in cases of a penetrating abdominal trauma or known inferior vena caval disruption (Taylor & Palagiri, 2007 LOE7) • Select another site in the case of venous thrombosis (Taylor & Palagiri, 2007 LOE7)

F. Risk Factors, Complications and their Management

There are numerous risk factors and complications associated with peripheral and femoral vein cannulation. They include but are not limited to: haematoma; haemorrhage; arterial puncture; phlebitis; embolism; infiltration; temporary occlusion; venous thrombosis; local infection; sepsis; and arteriovenous fistula development (Roberts, 2004 LOE8; Taylor & Palagiri, 2007 LOE7). Femoral vein cannulation carries additional risk factors of retained guidewire (since it employs the modified Seldinger technique), and dysrrhythmia (when a long catheter is positioned to rest in the inferior vena cava close to the cavoatrial junction) (Miller, 2005 LOE8).

Prospective studies evaluating the risk of femoral vein placement have shown that the femoral vein is much more likely to be colonized at the time of removal of the catheter than that of the internal jugular site. The femoral site is also associated with a higher risk of catheter-related blood stream infections (CR-BSIs) and deep vein thrombosis. Therefore, when considering the femoral vein for cannulation, one must consider whether an alternate site would be more appropriate given the condition of the patient and the skill of the operator. (APIC, 2005 LOE8)

More than 15% of patients undergoing venous cannulation to access the central circulation experience some sort of complication (Taylor & Palagiri, 2007 LOE7). The most common mechanical complications are arterial puncture, haematoma and pneumothorax, though femoral vein cannulation negates the risk of pneumothorax unlike the subclavian or internal jugular sites. Venous thrombosis and catheter-related infections are also common and can be life-threatening. (Roberts, 2004 LOE8; Taylor & Palagiri, 2007 LOE7; Merrer et al, 2001 LOE1)

Catheter Material

The materials that intravascular devices are made of may be related to thrombogenicity and infections complications. Teflon® or polyurethane catheters have been associated with fewer complications than catheters made of polyvinyl chloride or polyethylene. (PHAC, 1997 LOE7; CDC, 2002 LOE7; Lambert, 1991 LOE2)

Haematoma

A haematoma is caused by a collection of blood that leaks from a vein or artery into the tissues surrounding the puncture site. It can be caused by poor technique, or failure to remove the tourniquet before removing the needle in the case of peripheral vein cannulation. If a haematoma occurs, remove the needle and then apply direct pressure until the bleeding stops. (Lavery et al, 2005 LOE7; Roberts, 2004 LOE8) A retroperitoneal haematoma is the most frequent major mechanical complication of femoral catheterization, occurring in approximately 1% of adult cases (Merrer et al, 2001 LOE1).

Phlebitis

Phlebitis is inflammation of a vein that is not caused by infection, but from the presence of a foreign body such as the cannula, intravenous fluid or medication administered. Signs and symptoms include pain, increased skin temperature, and/or erythema (abnormal redness of the skin) along the path of the vein. The treatment is removal of the cannula and recannulation at another site; however, a warm or cold compress can also help alleviate the pain. (Lavery et al, 2005 LOE7; Perry & Potter, 2002 LOE8) For irritating fluids such as Diazepam, a large vein such as the femoral vein should be used (Taylor & Palagiri, 2007 LOE7; Miller, 2005 LOE8).

Infiltration

Infiltration is the leakage of fluid into the surrounding tissue. It can be caused by puncture of vein wall during cannulation and friction or displacement of the cannula. Signs and symptoms include inflammation at or near the insertion site with swollen taut skin and pain; blanching and coolness of skin around the intravenous site; damp or wet

dressing; slowed or stopped infusion. Treatment is removal of the cannula. Other management techniques that are described include the use of warm or cold compresses and elevation of the limb, if applicable. These techniques are more commonly described in literature pertaining to children. (Perry & Potter, 2002 LOE8; Weinstein, 2007 LOE8)

Venous Thrombosis

In a large randomized controlled trial in adult patients, Merrer et al (2001LOE1) concluded that there was a higher incidence of thrombotic complications with femoral vein cannulation versus that of subclavian catheterization (21.5% versus 1.9%). This finding has been described in other studies as well (Desmond & Teece, 2004 LOE7). In children, the rate of femoral vein thrombosis has been reported to be 4% to 35%, depending on age, size and the underlying condition of the patient (Haas, 2004 LOE7). The precise relevance of this catheter-related venous thrombosis is in dispute (Taylor & Palagiri, 2007 LOE7).

Catheter-Related Infections (CRIs)

The CDC (Centers for Disease Control and Prevention) and JCAHO (Joint Commission on Accreditation of Healthcare Organizations) defines a central line as a vascular access device that terminates at or close to the heart or one of the great vessels (CDC, 2002 LOE7). Therefore, depending on the position of the femoral catheter tip, it can be considered a central line. Most serious catheter-related infections have been associated with central venous catheters, which may include femoral vein catheters. Merrer et al (2001 LOE1) reports an overall infectious complication rate of 19.8% for femoral vein catheterization versus 4.5% for the subclavian vein. Peripheral venous catheters, on the other hand, have a low incidence of local or bloodstream infections (BSIs), but given the frequency with which such catheters are used, they produce considerable annual morbidity. (CDC, 2002 LOE7)

Approximately 90% of catheter-related bloodstream infections occur with central venous lines (Safer Healthcare Now!, 2007 LOE7). The use of catheters impregnated with silver sulfadiazine and antiseptic or antimicrobial or heparin-solutions, may reduce the number of CR-BSIs for institutions unable to achieve benchmark targets for infection rates (PHAC, 1997 LOE7; Taylor & Palagiri, 2007 LOE7). Cannulae with the least number of lumens, connectors and ports should be used in order to limit the number of available sites available for possible contamination (PHAC, 1997 LOE7).

The characteristics and properties of the catheter materials may have an association with thrombogenicity and infectious complications. Resultantly, all intravascular catheters should only be placed for definite therapeutic or diagnostic indications, and should be discontinued as soon as possible. In order to prevent phlebitis, in adults, peripheral venous catheters need to be replaced every 72 hours, but in the paediatric population, unless there are signs of inflammation, cannulas do not necessarily need to be changed, as long as they remain functional and there are no complications. CRI rates have not decreased with routine replacement of venous catheters used for central access; therefore, this practice is not recommended. When infection is suspected, catheters should not be changed over a guide wire (PHAC, 1997 LOE7; CDC, 2002 LOE7)

Infections associated with intravascular devices appear to result from contamination of the catheter lumen from microorganisms in the fluid path and contamination of external catheter surfaces from migration of insertion site flora along the exterior surfaces of the cannulae. These catheters disrupt the integrity of the skin, making infection with microorganisms such as bacteria and fungi possible. Infection may spread to the bloodstream and may result in haemodynamic changes and organ dysfunction, e.g., severe sepsis. (PHAC, 1997 LOE7)

Patients/clients should be evaluated daily for evidence of infections complications (PHAC, 1997 LOE7). This may include palpation of the insertion site through the dressing or visual inspection through a transparent dressing (CDC, 2002 LOE7). If there is an unexplained fever, pain or tenderness at the insertion site, then the site must be visually inspected (PHAC, 1997 LOE7).

Infection can be prevented by following routine infection control practices and using additional precautions. Routine practice includes hand hygiene and the use of personal protective equipment (PPE). For peripheral venous cannulation, PPE includes but is not limited to such items as gloves, eye protection, gowns and masks (PHAC, 1997 LOE7). Central vein cannulation requires the application of maximal sterile-barrier precautions. Therefore, maximal sterile-barrier precautions should be used for at minimum, femoral vein cannulation that accesses the inferior vena cava. This includes long-sleeved sterile surgical gown, sterile gloves, mask, and sterile drapes. Some sources also recommend wearing a cap to cover all hair, and draping the patient head to toe with a sterile drape with a small opening for the site of insertion (Safer Healthcare Now!, 2007 LOE7; CDC, 2002 LOE7).

Hand washing remains the cornerstone of infection prevention and control (PHAC, 1997 LOE7; CDC, 2002 LOE7). Hand hygiene reduces the transmission of micro-organisms. It includes hand washing, maintaining hand health, avoiding nail polish, artificial nails or jewelry and keeping nails trimmed and clean. The fingernail area can harbour considerable flora and other micro-organisms. (CDC, 2002 LOE7; PHAC, 1999 LOE7)

Preparation of the site with good skin cleansing and antisepsis is considered one of the most important measures for preventing infections associated with intravascular devices (PHAC, 1997 LOE7; CDC 2002 LOE7). Skin must be clean, that is, free of soil, dust and organic material prior to applying the antiseptic (CDC, 2002 LOE7; PHAC, 1999 LOE7). Studies have shown that 2% chlorhexidine gluconate solution significantly lowers catheter-related infections when compared to povidone-iodine and 70% alcohol (Chaiyakunapruk et al, 1991 LOE7; Humar et al, 2000 LOE2; Maki et al, 1991 LOE2). The skin should be prepared for at least 30 seconds and allowed to air dry before catheter insertion. As some equipment may be incompatible with alcohol preparations, it is recommended that the manufacturer be consulted (PHAC, 1997 LOE7).

For more information on good infection control practices please see the CRTOs Clinical Best Practice Guideline on Infection Prevention & Control.

G. Practice Considerations and Technique

Prior to performing the cannulation, the need for prevention and management of pain should both be assessed. There are many pharmacological and non-pharmacological interventions that can be used in order to achieve a reduction in pain and anxiety that may be associated with the procedure. Some options that are available include local anaesthesia, sedation, and for the neonatal population, oral sucrose on a pacifier. For more information on pain prevention for the neonatal and paediatric patient populations, please refer to references # 3, 4 and 6 in the *Reference* section of this document.

Peripheral Vein Cannulation

To Facilitate Cannulation

- There are several techniques that are used to help produce venous dilation to improve palpability and visibility. These include the use of a tourniquet, rubber band for scalp vein cannulation, tapping or stroking of visible veins, vigorous swabbing, local warming, transillumination in the neonatal population, application of nitroglycerin ointment for paediatrics and adults, and in venous cannulation of vessels in the arm and hand, clenching the hand to pump up veins and hanging the forearm downward (Haas, 2004 LOE7; Roberts, 2004 LOE8).
- The use of nitroglycerin ointment is not recommended in neonates and premature babies, because adverse local and systemic side effects have been seen (Haas, 2004 LOE7).
- To help prevent damage to the vessel intima and ensure there is adequate blood flow past the cannula, the smallest gauge cannula should be used (Haas, 2004 LOE7).

Local Anaesthetic

- The use of local anaesthesia can be considered in the appropriate clinical setting and may help relieve pain, anxiety and vessel spasm (Bauman et al, 2005 LOE8; Miller, 2005 LOE8). Either subdermal or topical agents can be used.
- At this time, topical agents are recommended to only be used on intact skin (Crystal & Blankenship, 2005 LOE8).
- In a randomized trial EMLA, a topical anesthetic, was compared to subcutaneous lidocaine in 538 adults scheduled for coronary angiography. The results showed that cannulation was more successful in the EMLA group and pain was less severe, perhaps due to reduced arterial spasm and limitation of hand movements (Joly et al, 1998 LOE8).

1% or 2% Lidocaine without Epinephrine

- For subcutaneous local anaesthesia, a 1 or 2 % solution without epinephrine should be used.

- A 1% solution without epinephrine has an average duration of action of approximately 1.5 hours (Crystal & Blankenship, 2005 LOE8).
- The use of a small needle and slow administration of the anesthetic (30 seconds per mL) in a proximal to distal direction tend to lessen the pain of injection (Crystal & Blankenship, 2005 LOE8).
- Inject the lidocaine intradermally and subcutaneously alongside the vessel with a 25-27 gauge needle (Miller, 2005 LOE8).

EMLA

- EMLA is an abbreviation for eutectic mixture of local anaesthetic. It is a 5% emulsion preparation that contains 2.5% lidocaine and prilocaine which produces dermal cutaneous anaesthesia (Crystal & Blankenship, 2005 LOE8).
- Skin penetration is time-dependent. Studies have shown that 60 minutes is insufficient to produce effective anaesthesia (Joly et al, 1998 LOE2).
- EMLA should only be applied to intact skin (Crystal & Blankenship, 2005 LOE2).
- In infants less than 3 months of age, there is a theoretical risk of methemoglobinemia due to inadequate levels of methemoglobin reductase (Crystal & Blankenship, 2005 LOE2).

Sterile/Aseptic Field

- The optimal duration for hand washing is unknown (PHAC, 1997 LOE7). Good hand hygiene before catheter insertion for short (<6 cm) peripheral catheters, combined with proper aseptic technique during catheter manipulation, provide protection against infection (CDC, 2002 LOE7).
- Prepare the insertion site with an antiseptic of proven efficacy. Clean the site for at least 30 seconds, and allow to air dry before cannulation (PHAC, 1997 LOE7; CDC, 2002 LOE7).

Insertion Technique & Establishing the line

- Two devices are commonly used for peripheral vein cannulation: the butterfly needle and the plastic over-the-needle catheter (angiocatheter). Butterfly needles are usually used for infusions of short duration and are removed after completion, and for blood withdrawal.
- For neonates, infants and children 22 to 24 gauge catheters will in most cases be appropriate, and use of an arm or leg board will help provide stabilization of the extremity after insertion.
- Pull the skin taut below the intended puncture site to stabilize and anchor the vein. Slowly insert the angiocatheter at a 10 to 30 degree angle to the skin until blood return is noted. If a tourniquet has been used, remove and then advance the cannula into the vessel. Remove the stylet.

- Flush with 0.9% sodium chloride to check for patency and ensure that the cannula is not interstitial by looking for signs of infiltration, such as haematoma or local swelling. Attach to a fluid-filled intravenous tubing system or saline lock.
- A T-connector extension tubing is helpful for blood withdrawal, makes flushing the catheter and maintaining patency easier. It also allows for dressing changes without disturbing the dressing. (Scales, 2005 LOE8; Roberts, 2004 LOE8)

Securing the Site

- A sterile gauze dressing should be used and can be left in place until the catheter is removed, unless the gauze becomes wet, loosened or visibly soiled. Transparent or semi-permeable dressings may be considered. (PHAC, 1997 LOE1; CDC, 2002)

Femoral Vein Cannulation

To Facilitate Cannulation

- Electrocardiogram (ECG) guidance is used if a long catheter is placed. These catheters are directed into the inferior vena cava close to the cavoatrial junction and can cause a dysrhythmia (Miller, 2005 LOE8).
- Placing a patient in reverse Trendelenburg position compared to the supine position, can increase the femoral vein diameter and might increase the chance of successful cannulation (Akingbola et al, 2000 LOL5)
- Ultrasound guidance may be helpful in cases of edema and obesity which makes palpation of the vein difficult (Roberts, 2004 LOE8; Haas, 2004 LOE7).
- Using ultrasound guidance can reduce cannulation time, number of attempts needed to cannulate and minimize complications such as arterial puncture or haematoma. A valsalva maneuver enlarges the femoral vein and when combined with ultrasound, can further facilitate access (Kwon, et al, LOE3)
- Long catheters can be positioned in the inferior vena cava or the common iliac vein for central venous monitoring. Femoral cannulas that rest in the inferior vena cava are positioned under ECG guidance. (Miller, 2005 LOE8)

Landmarking & Positioning

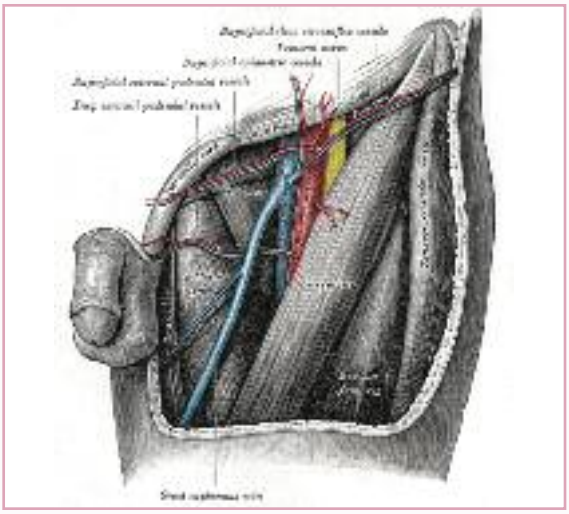
- Position the selected leg with hip flexed and abducted to allow for maximal access to the site. Immobilizing the leg may help maintain optimum position. In some situations, it may be necessary to sedate the patient/client (Hopkins, 2005 LOE7; Roberts, 2004 LOE8).
- A small towel or diaper placed under the buttocks of an infant can help flatten the inguinal area and make the angle of entry less acute (AHA, 2005 LOE7)
- Identify the femoral artery by palpation, or if pulses are absent as in cardiac arrest,

by finding the midpoint between the anterior superior iliac spine and symphysis pubis. The femoral vein is just medial to the femoral artery (AHA, 2005 LOE7)

- From the lateral to the medial, the structures are nerve, artery, and vein. Palpate the femoral vein just below the inguinal ligament.

Major Landmarks

The boundaries of the femoral triangle. The three boundaries of the femoral triangle are the inguinal ligament at the base, sartorius at the lateral side and the adductor longus at the medial side.



The left femoral triangle
http://www.bartleby.com/107/illus549.html
Gray (2000). Anatomy of the Human Body.
Reproduced with permission.

Local Anaesthetic

- The use of local anaesthesia can be considered in the appropriate clinical setting and may help relieve pain, anxiety and vessel spasm (Bauman et al, 2005 LOE8; Miller, 2005 LOE8).
- For subcutaneous local anaesthesia, a 1 or 2 % Lidocaine Hydrochloride solution without epinephrine should be used.
- A 1% Lidocaine solution without epinephrine has an average duration of action of approximately 1.5 hours (Crystal & Blankenship, 2005 LOE8).
- The use of a small needle and slow administration of the anesthetic (30 seconds per mL) in a proximal to distal direction tend to lessen the pain of injection (Crystal & Blankenship, 2005 LOE8).
- Inject the lidocaine intradermally and subcutaneously alongside the vessel with a small needle, such as 25-27 gauge (Miller, 2005 LOE8).

Sterile/Aseptic Field

- The optimal duration for hand washing is unknown (PHAC, 1997 LOE7).
- Maximum aseptic barriers must be employed. This includes long-sleeved surgical gown, sterile gloves, mask and large sterile drape (PHAC, 1997 LOE7). The CDC (2002 LOE7) and Safer Healthcare Now! (2006 LOE7) also recommend that a cap that covers all the hair be donned.
- Prepare the insertion site with an antiseptic of proven efficacy. Clean the site for at least 30 seconds and allow to air dry before cannulation (PHAC, 1997 LOE7; CDC, 2002 LOE7).

Insertion Technique & Establishing the line

- The femoral vein lies approximately 1-2 cm below the inguinal ligament medial to the femoral artery (Roberts, 2004 LOE8; Taylor & Palagiri, 2007 LOE7). It is recommended that access be established at least 5 cm below the inguinal crease for two reasons. Firstly, this area is heavily colonized with bowel organisms and yeasts and secondly, the application of a dressing will be facilitated (APIC, 2005 LOE8).
- Attempts at cannulation above the inguinal ligament are discouraged as the needle could enter the abdomen or hemorrhage into the retroperitoneal space (Taylor & Palagiri, 2007 LOE7).
- Direct the needle parallel to the arterial pulse, toward the umbilicus or cephalad, at a 30 to 45 degree angle (Roberts 2004 LOE8; Taylor & Palagiri, 2007 LOE7; AHA, 2005 LOE7) .
- The guidewire or modified Seldinger technique is used today as the standard approach to central venous cannulation (Taylor & Palagiri, 2007 LOE7).
- Femoral venous catheters placed in neonates <1500 grams should be single-lumen and 24 gauge. Larger catheters may occlude blood flow (Roberts, 2004 LOE8).
- Enter the skin at a 30 to 45 degree angle. A syringe can be attached to the needle and gentle continuous suction applied during the insertion. When blood return is noted, pass the wire gently through the needle into the vessel. If there is resistance to passing the wire, the needle and wire need to be withdrawn together to prevent shearing off the end of the wire (Roberts, 2004 LOE8).
- If unsuccessful, redirection of the needle should only occur when the needle has been retracted to the subcutaneous space (Roberts, 2004 LOE8; Taylor & Palagiri, 2007 LOE7).
- When the guidewire is in place, the needle is withdrawn. If a dilator is used to dilate the subcutaneous tissue, a small incision is made with a scalpel at the entry point (Roberts, 2004 LOE8; Taylor & Palagiri, 2007 LOE7)
- Once the catheter has been placed successfully, it should be advanced until the hub is in contact with the skin (Roberts, 2004 LOE8).

- Attach to a fluid-filled intravenous tubing system.
- If the femoral line is to be used for central venous monitoring, attach the catheter to a pressurized fluid-filled system of sodium chloride and ensure an appropriate waveform is present on the monitor.
- Femoral lines positioned in the inferior vena cava, need to have placement confirmed with an x-ray. To facilitate this, a medical directive that empowers the Respiratory Therapist to order on behalf of the physician can be developed. Alternatively, a written order can be obtained. **Medical Radiation Technologists can only accept orders for an x-ray from a member of the College of Physicians and Surgeons of Ontario**.
  To view the Medical Radiation Technology Act go to: http://www.e-laws.gov.on.ca/html/statutes/english/elaws_statutes_91m29_e.htm
- Exchange over a guidewire for an established site due to mechanical malfunction or suspected infection, is associated with an increase risk of CR-BSIs. If the site must be used as in the case of limited new access sites, then full-barrier precautions must be used to help prevent infection. (APIC, 2005 LOE8)

Securing the Site

- Secure the line by suturing, stapling or applying tape and an appropriate dressing (Taylor & Palagiri, 2007 LOE7).
- A sterile gauze should be used but a transparent semi-permeable dressing may be considered (PHAC, 1997 LOE7). Transparent dressings reliably secure the device, and permit continuous visual inspection of the catheter site.

H. References

All sources used in the development of the certification program should be cited. This should include the CRTO professional practice guideline on Certification Programs for *Advanced Prescribed Procedures Below the Dermis* and *Infection Control.*

I. Appendix

An appendix is a reference section. It can be used to describe information not included in the body of the certification program, but that is considered as a valuable resource to enhance understanding of the topic. It could cover such topics as medications or disease processes that are cited for example.

J. Certification Log

The CRTO Professional Practice Guideline, *Certification Programs for Advanced Prescribed Procedures Below the Dermis*, describes record keeping requirements. A certification log is one method that can be used to chronicle when a cannulation procedure has been performed. It is a document, that at minimum captures the date when the procedure was performed, patient data, and the signature of the certifying clinician. It can take many forms, for example, a blank sheet can be used to manually enter the information, or a table can be created that lists the required information and contains space for documentation of each cannulation.

Certification information, such as a certification log, can be incorporated in the CRTOs Quality Assurance (QA) professional portfolio. The patient identifiers need only be removed.

K. Competency Checklist

A competency checklist is a tool that can be used to guide both the certifier and the learner and to ensure that the objectives of a certification program are met. It contains specific measurable components that need to be met 100% of the time when the procedure is performed.

Area/Item	Criteria	Complete Yes (√) or No (X)
Patient/Client Assessment	Assesses appropriateness for the procedure. Checks for order, allergies, patient identification, and any contraindications. Assesses need for pain prevention and management.	
Policy & Procedure	Knows the indications, contraindications, common complications their prevention and management.	
Infection Control	Adheres to good hand washing and aseptic technique.	
Anatomy	Demonstrates knowledge of the landmarks.	
Local Anaesthetic (if required)	For subdermal lidocaine ensures no flash back and waits for medication to take effect. For topical waits for medication to take effect.	
Guidewire Use (Femoral Cannulation only)	Demonstrates knowledge of equipment and the steps required for success.	
Cannulation Technique	Appropriate local site selection for entry of the vessel and angle of approach. Confirmation of correct cannula placement.	
Documentation	Content documented as described in policy and signature with professional designation.	

L. Test

A test is an objective method employed to gauge the learner's ability to retain and apply information. It is a common educational tool used to help measure competency (knowledge, skills and judgment). A test can help reinforce key take away messages and act as a means of enforcing the objectives of a certification program.

M. Policy & Procedure

To support practice and ensure consistency between practitioners, each facility develops policies and procedures. Some facilities use the terms standard or protocol to describe the same. When a certification program is submitted to the CRTO for consideration, the organization's policy and procedure should also be tendered because it serves as part of the curriculum that must be reviewed by the learner undertaking the certification program. **Even if this practice guideline is to be utilized as the learning package for the certification program, it is still necessary to submit the facilities policy to the CRTO.**

A policy and procedure may contain a purpose statement and will include standards by which each Respiratory Therapist who performs the procedure will be held to. The following is a **suggested** template that can be used in order that all pertinent information is captured when developing a policy and procedure. An **asterisk*** identifies content that must be included in a policy and procedure in order to meet the minimum requirements of legislation and the criteria described in the *Certification Programs for Advanced Prescribed Procedures Below the Dermis* CRTO professional practice guideline.

Policy & Procedure Template

SUBJECT:*
Describes the site of cannulation and the patient population to which the procedure will apply.

Peripheral Venous Cannulation or Femoral Venous Cannulation e.g., neonates.

ISSUING BODY:
Department or Program, e.g., Respiratory Therapy Services

EFFECTIVE DATE:
Date Policy is accepted and put into effect

Policy & Procedure Template (continued)

According to the *Respiratory Therapy Act, 1991* only those Registered Respiratory Therapists (RRTs) who hold a **general** certificate of registration can perform the controlled act of "a prescribed procedure below the dermis". This is further described in the "Prescribed Procedures Regulation" made under the Act, which requires that RRTs, who will be performing this procedure, complete a certification program that has been approved by the Registration Committee of the College of Respiratory Therapists of Ontario within two years before the procedure is performed.

PURPOSE:

Describes the reason for the development of this policy and procedure.

1. To standardize the approach to, e.g., peripheral vein cannulation performed by Registered Respiratory Therapists.
2. To optimize patient care by, e.g., improving the timeliness of venous access for fluid administration.

STANDARDS:

Standards of Care outline the minimum expectations for patient care delivery in a specific area, within a discipline(s), or across the facility. They provide specific direction to the clinicians referred to in the standard. Standard statements contain expectations against which actual performance can be judged and must be met 100% of the time. The following three statements are the minimum that need to be included in a policy & procedure to meet the requirements of the CRTO.

1. Only a Registered Respiratory Therapists (RRT) who holds a general certificate of registration and has completed a certification program that has been approved by the Registration Committee of the CRTO can perform _____.*
2. Initial certification will include observation of ____ cannulations under direct supervision by _____.*
3. In order to maintain competency and certification status, the skill of _____ must be observed under direct supervision by _____ _____times at minimum every two years.*

PROCEDURE:

Outlines step-by-step how a certain task or procedure should be completed. It provides direction for day-to-day practice related to the procedure.

DOCUMENTATION:

Describe how the procedure must be captured in the patient/client chart.

DEVELOPED IN CONSULTATION WITH:

Lists all the stakeholders consulted during the development of the standard/policy and procedure. This may include individual(s) and committees.

REFERENCES:

Details all the resources used to support the narrative.

Source: St. Joseph's Health Centre, Toronto, Standards of Care Template, 2006

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This practice Guideline will be updated as new evidence emerges or as practice evolves. Comments on this practice guideline are welcome and should be addressed to:

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