Canterbury
District Health Board
Te Poari Hauora ō Waitaha

PERIPHERAL INTRAVENOUS CANNULATION

SELF LEARNING PACKAGE

First Edition
2010

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Author: Elizabeth Culverwell

Review by:

Dr Heather Byrne PDU Nurse Manager
Dr Simon Burrows – Anaesthetic Consultant
Kerry Davis – IV NE
Tina Hewitt - ME
Sharron Ellis –CNS Haematology day Ward
Leona Robertson – NE Emergency Department

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B-Braun
3M

CONTENTS

Introduction

Intravenous (IV) therapy is commonplace in acute care settings, with an estimated 50-70% of patients having some form of IV access device inserted as part of their treatment (Wilkinson, 1996). Yet it is not without risk. Complications range from mild local irritation to blood stream infections associated with significant mortality and morbidity (Lundgren & Wahren, 1999). It is imperative that clinicians involved in the care of IV access devices, are competent to do so, because the level of skill is critical in reducing and preventing complications (Robert, et al., 2000).

With increased scope of practice comes increased professional accountability established through:

1) Demonstrating a level of practice and professional accountability, appropriate to extending of skills
2) Having sound knowledge of the normal patient response to cannulation
3) Possessing the necessary interpersonal skills for accurate assessment and treatment negotiation
4) Performing accurate assessment through identifying patient-specific indications, contraindications and associated risks
5) Acquiring and maintaining competence in the technical skills necessary to perform IV cannulation
6) Utilising critical thinking skills and evidence based practice to achieve best patient outcomes
7) Confidently articulating scope of practice, identifying and acknowledging limitations and seeking assistance appropriately

Competence

Competence in IV therapy is defined as “performing IV therapy in an exact and effective manner using the appropriate knowledge of nursing, technical expertise, and specialized skills” (Dugger, 1997, p293). Ongoing compliance is monitored via audits.

At Canterbury District Health Board (CDHB), competency in IV cannulation is achieved through:

1) Completing the on line self learning package and test
2) Returning completed test to Professional Development Unit(PDU)
3) Completing the workshop and lab practicum
4) Completing work place practical assessment with cannulating IV Link staff, or NE/ME Educator. Four cannulations are required
5) CDHB staff - return completed assessment form to the PDU. For *Partnering Organisations – this is marked by your line manager*
6) CDHB staff - on successful completion, name is entered onto competency Training Data base. *For Partnering Organisations your line manager will retain this information*

Pre-Requisites:

1. Complete the Level one IV Therapy competency
2. Complete the venepuncture competency

Self Learning Package

This package is designed as a self-directed learning resource for clinicians who are routinely required to perform peripheral IV cannulation of adult patients as part of their practice. The handbook describes the knowledge and techniques for practice requirements to form a comprehensive manual that will guide you through the process for attaining cannulation competency.

Learning Outcomes

On completion of the Self Learning package, test and attendance at the workshop, the nurse will be able to:

- Describe relevant anatomy and physiology of peripheral venous system
- Identify Blood borne pathogens
- Demonstrate familiarity with equipment components and appropriate selection to meet the goals of IV therapy
- Identify peripheral veins suitable for cannulation
- Cannulate peripheral veins safely under simulated conditions
- Identify measures to minimize and address difficulties encountered during cannulation
- List complications associated with IV cannulation, prevention and management strategies and cannula removal
- Describe infection control considerations and interventions
- Describe the action required in the event of a hollow bore needle stick injury
- Describe the Four Tenets of Sharps Safety Devices
- Articulate essential aspects of patient communication

Enrolled Nurses Please Note:

This course is available to Transitioned Enrolled Nurses who have been recommended by their Line Manager.

Anatomy & Physiology

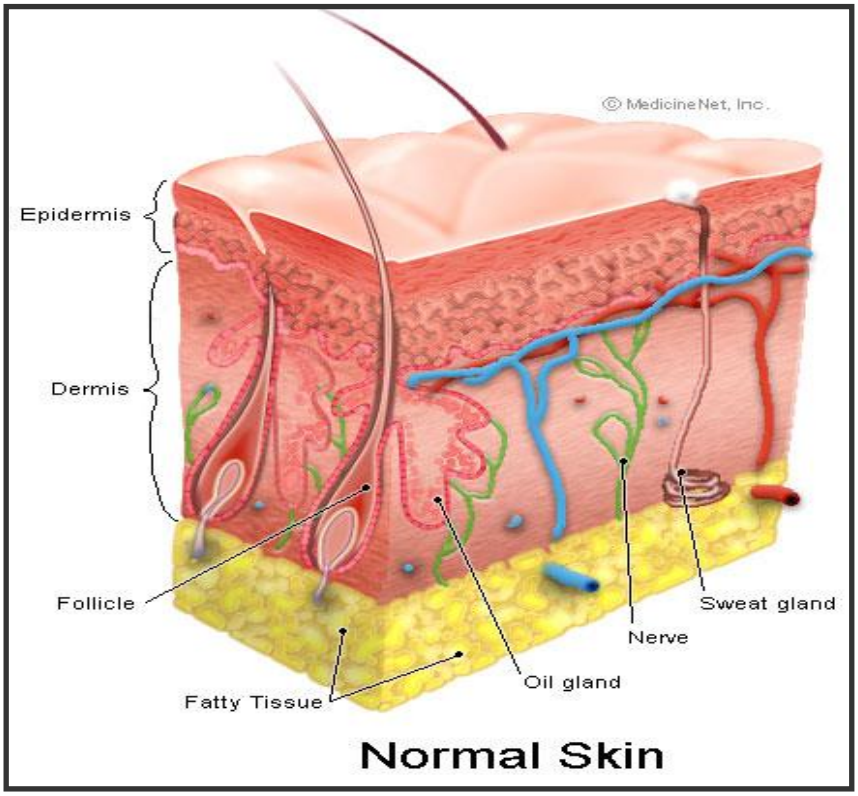
Seventy five percent of blood volume is contained in the venous system. The veins, because of their abundance and location, present the most readily accessible route for cannulation. To initiate IV therapy effectively, a clinical understanding of the anatomy and physiology of the skin and peripheral venous system is essential.

Skin Structure

The first barrier to successful cannulation is the skin. It consists of two main layers:

1) **The Epidermis –** is the least sensitive layer, largely comprised of dead squamous cells. In general, the epidermis is thickest on the palms of the hands and soles of the feet and thinnest on the inner surfaces of the extremities. But, thickness can vary depending on age and exposure to the sun or wind. The most important function of the epidermis is to act as the first line of defence against infection.

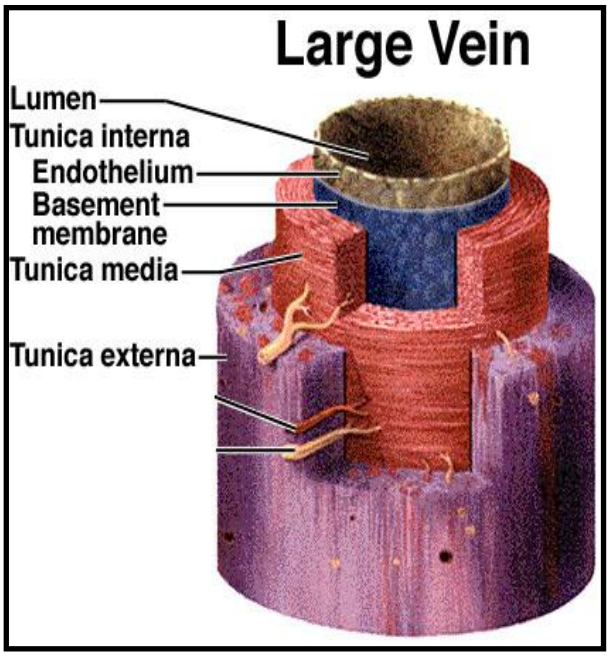
2) **The Dermis –** is the thicker and more sensitive layer, as it is well supplied with nerves. It contains blood vessels, hair follicles, sweat glands sebaceous glands, small muscles and nerves. For example, one square cm contains 4 metres of nerves, 200 nerve endings for pain and a metre of blood vessels.



Vein Anatomy & Physiology

Knowledge of the basic anatomy and physiology of the vein is essential and will assist you to become a successful IV cannulator. It will enable you to utilise normal physiological responses to your advantage, for example, using venous dilation techniques such as opening and closing the hand, tapping the vein or applying heat to the area of choice.

The following diagram depicts the three different layers of the vein, also known as coats or 'tunics' (hence the Latin tunica).



1) The outermost layer is the ***tunica externa*** or ***adventitia,*** and is composed of connective tissue, which supports the vessel.

2) The middle layer, the ***tunica media*** is composed of primarily smooth muscle. It contains nerve fibres that cause veins to contract or relax in response to cold or heat. This layer also responds to chemical or mechanical stimulation, such as pain. Pain sensed in the tunica media can elicit vasovagal response (Hadaway, 1999) and should be anticipated in sensitive individuals.

3) The third or inner layer is the ***tunica intima.*** This innermost layer is less muscular and thin, accounting for only about 10% of the vessel diameter. It consists of three parts. 1) An innermost layer of squamous epithelium, 2) a basement membrane, overlying some connective tissue and 3) a layer of elastic fibres, or elastin.
   Elastin fibres make the lumen very distensible and one-way valves of endothelial tissue direct blood flow. This means that cannulae should only be placed in the direction of blood flow. The valves are usually found near branches of the vein and may inhibit threading of the cannula into the lumen. There are approximately 40 venous valves between the hand and axilla.

It is important to understand that any damage or abrasion occurring to the tunica intima during cannula insertion, the duration of cannula dwell, or during removal, encourages thrombus formation, caused by cells and platelets adhering to the roughened vessel wall. Damage to this layer causes phlebitis, thrombophlebitis or even result in occlusion of the vessel from a thrombus. Your insertion technique and subsequent management of a cannula can contribute to these complications.

Differences between Arteries & Veins

It is important to be able to distinguish between arteries and veins because the aim is to perform a venous cannulation NOT arterial. The following table describes the distinguishing features.

Arteries	Veins
• More muscle for their diameter, therefore appear more round in cross-section	• Less muscle therefore tend to look more collapsed in cross-section • Have a stress relaxation phenomena
• No valves	• Have valves
• Deep and protected	• More superficial /often visible
• Pulsatile	• Non-pulsitile

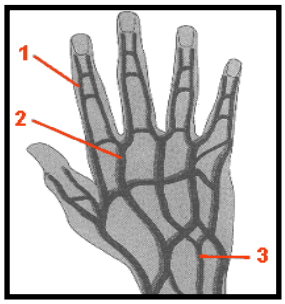
ALERT: While an artery can inadvertently be cannulated, it is uncommon. Having a good understanding of your venous anatomy and checking for pulsation prior to cannulation is important. This is discussed under “Potential Complications”.

Vein Location & Characteristics

Superficial veins of the hand and arm include the digital, metacarpal, cephalic, basilic and median veins. The following two sections 1) Veins of the Hand and 2) Veins of the Forearm provide details of vein location, characteristics and clinical considerations that will ensure you develop competent assessment and selection skills that will positively impact on the quality of care your patient receives.

Veins of the Hand & Wrist

The following list of veins can be identified by the corresponding number in the hand diagram.

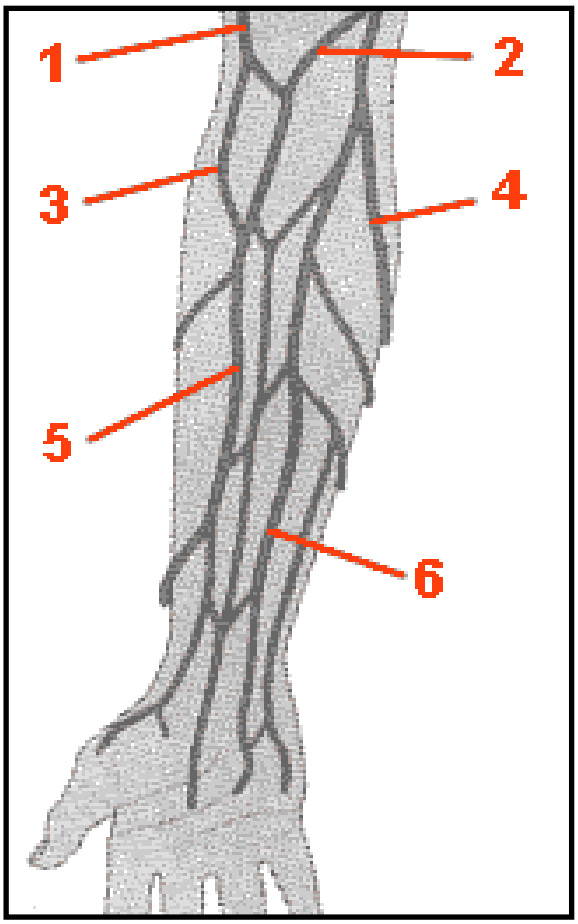
Location/ Characteristics	Clinical Considerations
1) Dorsal digital veins • Found along the lateral portion of the fingers and thumb • Veins small & fragile	• Last resort cannula site, as subject to mechanical phlebitis. • To be cannulated only by an expert clinician • If used, must be immobilized by a finger splint 
2) Dorsal metacarpal veins • Between the metacarpal bones on the back of the hand • Superficial veins usually of good size and easily visualised	• Good site to start IV therapy for some patients • Can accommodate 24-20g cannula • Tip of catheter should not extend over wrist joint • Catheter should lie flat on the back of hand • Hub of catheter should not extend over knuckles • Should not be used for vesicant medication/ fluids
3) Dorsal venous network • Formed by the union of metacarpal veins, on the dorsal aspect of the forearm • Not always prominent	• Comfortable site for the patient • Can accommodate 24-20g cannula • Angle of the vein may deter choice of site • Avoid placement over the wrist/ prominent ulna bone which can cause mechanical phlebitis or dislodgement • Should not be used for vesicant medication/ fluids

Veins of the Forearm

The following list of veins can be identified by the corresponding number in the arm diagram.

Location/ Characteristics	Clinical Considerations
1) Cephalic Vein • Runs the entire length of the arm from the wrist to the shoulder • Located above antecubital fossa, may be difficult to visualise	• Accommodates 22-18g cannula • Excellent choice for cannulation • Should not be used for patient that require fistula formation • Radial nerve runs parallel so avoid wrist area
2) Median Cubital Vein • Lies in antecubital fossa • Large vein, easily visualised and accessed	• Usually used to draw blood • Veins of choice for trauma or shocked patients as they can accommodate a large bore cannula 16-14g • Limited use for short peripheral cannula due to joint articulation, limit to patient mobility and difficulty of detecting infiltration • Complications at this site mean that veins below this point are not recommended
3) Accessory Cephalic Vein • Branches off the cephalic vein • Located on the top of the forearm • Usually good size	• Easily stabilized • Accommodates 22-18g cannula • Avoid catheter tip placement at joint articulation
4) Basilic Vein • Runs the entire length of the arm from the wrist to axilla • Depicted in the diagram along medial aspect of upper forearm	• Can accommodate 22-16g cannula • Vein rotates around the arm and requires firm skin tension to stabilize vein. • Increased success can be achieved by placing the patients arm across their chest and approaching from the opposite side of the bed
5) Dorsal Basilic Vein	• If accessing the dorsal basilica have the patient flex the forearm at the elbow(this will also enhance venous filling and minimize 'rolling') and face the patients feet to work on the exposed underside of the arm • Alternatively have the arm fully extended and supinate the arm with palm up
6) Median Vein • Arises from the palm of the hand, flows upward in the centre of the underside of the forearm • Medium size & generally easy to visualize	• Accommodates 24-20g cannula • May be difficult to palpate • Runs in close proximity to the nerve

Veins of the Forearm



Infection Control

Risks of infection associated with cannulation can be minimised by adherence to standard precautions and a strict aseptic technique.

Risks of Infection

Cannulation and IV therapy present risks for infection for several reasons.

1) A device penetrates and bypasses the protective barrier of the patient's skin.
2) An in-dwelling device is in situ, providing portal entry for micro-organisms to enter directly into the patient's bloodstream.
3) Immune-suppressed or compromised patients are especially vulnerable to infection.
4) Inadequate skin antisepsis and hand hygiene.
5) Poor securement technique increases the risk of phlebitis and infection.
6) IV infusions have the potential to become contaminated through manipulation and/or disconnection and glucose containing fluids provide an excellent media for bacterial growth.

Sources of Infection

The source of infection may be endogenous (part of the patient's own skin flora) or exogenous (from the surrounding environment or people).

Ports of bacterial entry, in order of significance are:

1) Skin colonization.

2) Hub colonization.

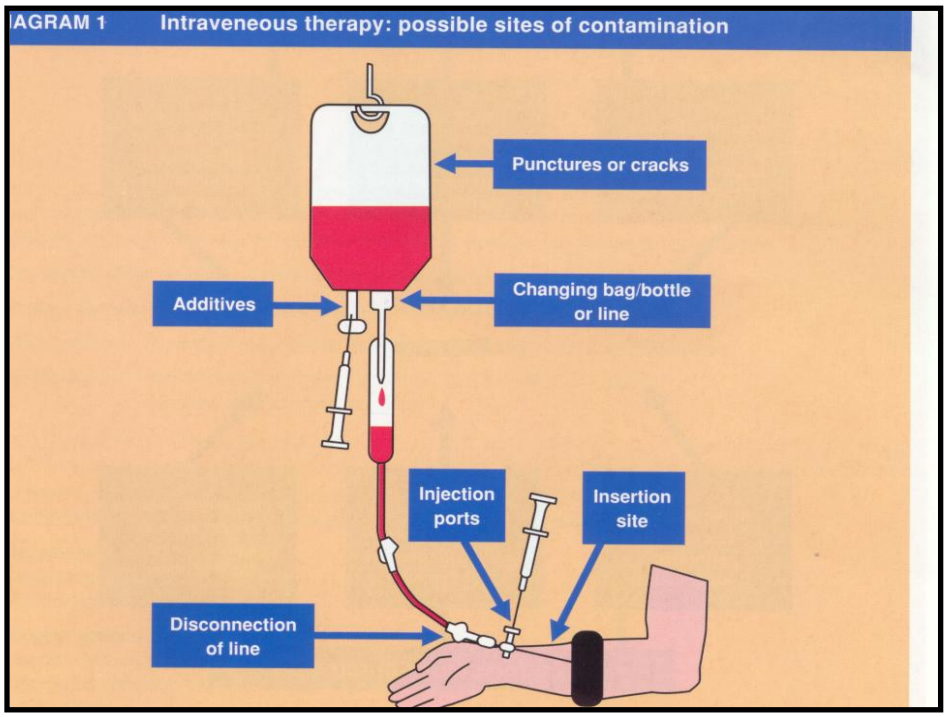
3) Contaminated infusates or transducer domes.

4) Haematogenous seeding of infection from remote sources within the body.

5) Skin colonization from remote sources of infection within the body.

PERFORM THE FIVE MOMENTS OF HAND HYGIENE FOR ALL CANNULATION PROCEDURES

The following diagram summarises the possible routes of bacterial entry



Infection may develop where the cannula enters the skin. Infection is indicated by inflammation or the presence of pus and may progress to:

1. Cellulites in the surrounding tissues, with inflammation of the vein or phlebitis
2. Bacteraemia (bloodstream infection), is the most serious infection associated with IV therapy. This is frequently life threatening and involves additional pain and suffering for patients and their families, as well as extra treatment costs. Some common causes of cannula related infection are Staph epidermidis, Pseudomonas, Enterobacter and MRSA.

BLOODBORNE PATHOGENS

In addition to the well known blood borne pathogens responsible for sero-conversion following a sharps injury there is an additional 20 potential blood borne pathogens that may be transmitted through sharps injury. Ref to the list below.

Hepatitis B,C,D	Staphylococcus Aureus
HIV (AIDS)	Streptococcus Pyrogene
Blastomycosis	Syphilis
Ebola Fever	Toxoplasmosis
Diptheria	Leptospirosis
Herpes Simplex	Brucellosis
Cryptococcosis	Treponenma Pallidium
Dengue Fever	Tuberculosis
Malaria	Mycobacterium Marinum
Necrotising Faciitis	Scrub Typhus

Source: International Health Care Workers Safety Centre, Charlottesville, VA

Prevention of Infection

Hand hygiene is key to minimizing /avoiding cross contamination.

Effective hand hygiene is achieved by using a combination of hand washing and alcohol hand gel that kills both transit and normal skin flora. Hands should be cleaned before and after palpating, inserting, accessing, replacing or dressing an IV cannula
(Centers for Disease Control and Prevention USA 2002 CDC Guidelines).

Aseptic Technique

Sterile equipment and an aseptic non-touch technique is used for the insertion and management of peripheral IV cannula. Non sterile gloves should be used when inserting a cannula or changing a dressing (CDC Guidelines, 2002). Gloves are essential because of the significant health and safety risk to you, of infection from blood-borne pathogens.

Where breaks in aseptic technique are likely to have occurred e.g. ambulance or emergency situation, it is recommended that cannula be re-sited within 24 hours (CDC Guidelines, 2002), in order to minimize the risk of infection to the patient.

Antisepsis

Chlorhexidine 2% aqueous has proved superior for skin antisepsis because its effect is not reduced when in contact with blood and its antibacterial activity persists for hours following application (Baranowski, 1993). When combined with 70% Isopropyl Alcohol (CDC Guidelines 2002) becomes a very effective skin disinfectant.(Infect Control Hosp Epidemiol 2008)
Based on this evidence the skin antisepsis of choice at CDHB is an anti microbial wipe containing 2% chlorhexidine and 70% alcohol. The importance of the cleaning technique using friction to remove pathogens from skin and also prior to accessing the access port is very important. (EPIC, 2004)

Occlusive Dressing

Transparent occlusive dressings have been widely accepted due to their advantages of improved visualisation with early detection of complications, less catheter manipulation, bathing possible without exogenous contamination, less frequent dressing changes and increased patient comfort. The transparent occlusive dressings should last the life of the cannula (i.e. 72 hours). However when the dressing becomes loose, damp or soiled it should be replaced immediately. (CDC, 2002)

IV cannula dressings need to provide securement in a manner that prevents mechanical phlebitis, infiltration or dislodgement. The CDHB preferred transparent dressing is the Tegaderm™ IV Transparent Dressing 1633 which includes additional sterile tape to secure the cannula thus maintaining the aseptic integrity of the hub and insertion site.

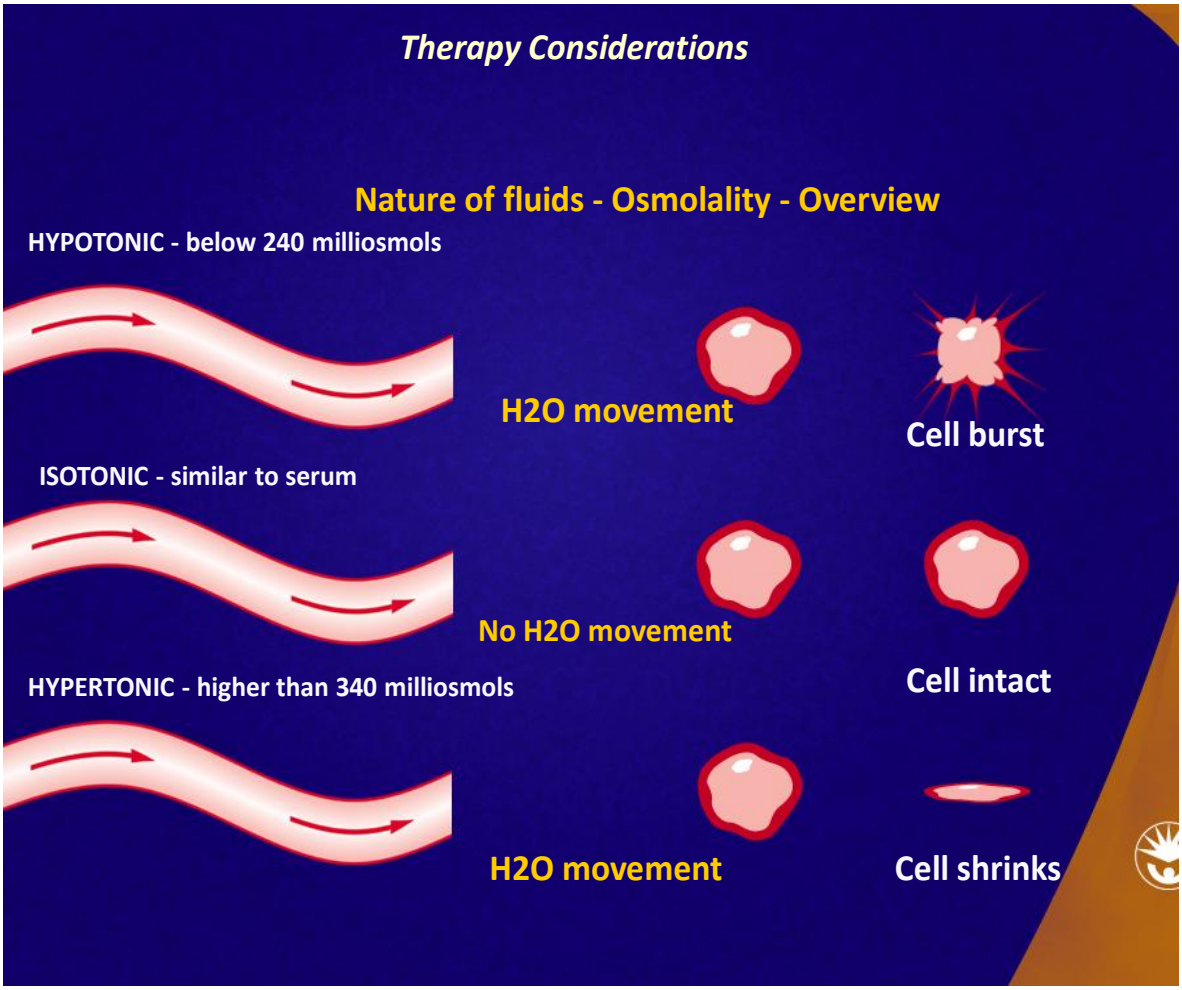
Site Care

Patients most at risk of peripheral IV site infection are those over 60 years of age, who have had a previous IV phlebitis or site infection, are malnourished, or immunocompromised. The most conclusive sign of infection is purulent discharge, but this may not be evident until the device is removed. If the site appears inflamed or other local and systemic signs of infection are present, such as inflammation, heat and pain, remove and re-site the cannula and document findings in the patient's clinical notes.

In order to prevent infection, observation of the cannula site is required at the time of IV drug administration or saline flush. The cannula should be flushed every 8 hours with Normal Saline 0.9% 5ml when not in use. In addition, peripheral IV cannula should be routinely replaced every 72 hours (CDC, 2002) to prevent phlebitis and infection. In the event that you are asked to replace a cannula due to suspected phlebitis it is important you recognise the signs and symptoms and have an understanding of phlebitis.(ref: page 18)

THE EFFECTS OF IV SOLUTIONS AND MEDICATIONS

Knowledge of the pH and osmolality of solutions to be infused through peripheral cannula is critical to best patient outcomes. Utilize the resources in your clinical area to gain a better understanding of the IV fluids or medication to be administered.



Hypotonic solutions (less than 240mOsm/liter)

Hypertonic solutions (greater than 340mOsm/liter)

Phlebitis

Phlebitis is an acute inflammation of the vein directly related to the presence of an intravenous cannula (Jackson, 1998). It is a frequent cause of pain and discomfort to patients. Studies have shown that 27%-70% of patients receiving peripheral IV therapy develop phlebitis that requires the removal of the cannula (Maki et al 1991) there are three main causes of phlebitis:

1) **Mechanical:** Mechanical phlebitis is caused by either a difficult insertion and / or poor securement causing movement of the cannula inside the vein resulting in the vein becoming irritated, inflamed and oedematous. Mechanical phlebitis can be reduced by adding an extension set (Hadaway, 1999; Millam, 2000; CDC Guidelines 2002). This will reduce the amount of movement caused by accessing the injection port at the insertion site.
2) **Chemical:** Chemical phlebitis occurs when the pH of a medication (eg ciprofloxacin) or the osmoality of infusates (eg potassium) irritates the lining of the smaller peripheral veins. This occurs because the flow rates are lower in the periphery than those of larger central veins, therefore haemodilution of solutions is less giving rise to the potential for intima damage. Therefore the length of the medication or fluid regime will need to be assessed. For example, length of therapy, method of delivery and dilution. Can the medication be further diluted without compromising efficacy i.e. peak blood level. An alternative IV device may need to be considered such as a central venous catheter (CVC) or a peripherally inserted central line (PICC).
3) **Bacterial:** Bacterial phlebitis is caused through contaminated infusates, equipment, inadequate hand hygiene or poor skin antisepsis resulting in bacteria finding a point of entry at the insertion site. This occurs when accessing the injection site or administering IV fluids past the expiry date.

Assessment

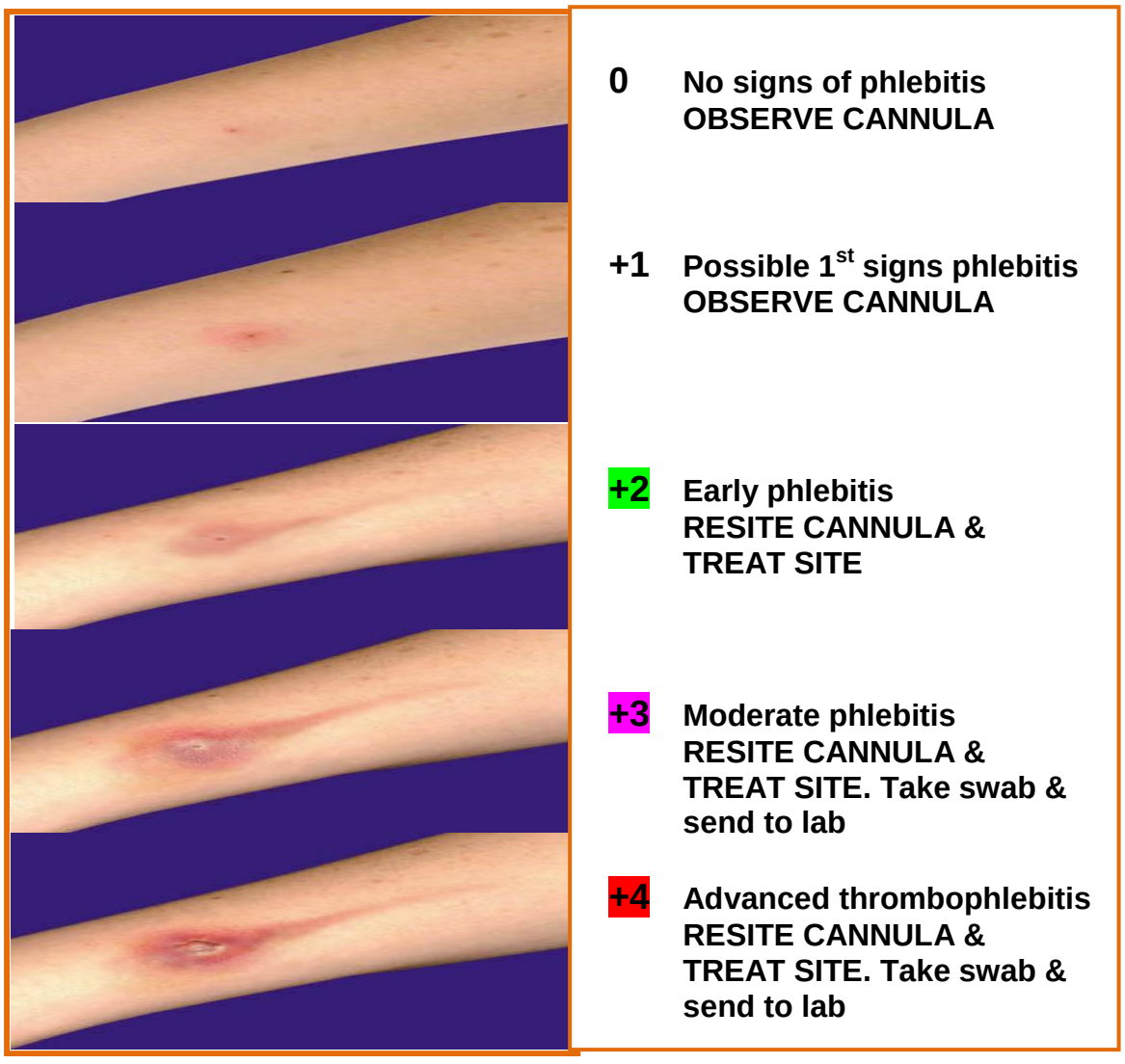
In order to detect phlebitis early, it is important to know the properties of the drug or infusates you are administering and to be aware of patient factors that predispose to phlebitis. Patient factors that increase risk of phlebitis include age, gender, (for example elderly and women) presence of disease (such as diabetes) severe debilitation, and level of activity (Campbell, 1998).

There is also some evidence to suggest that there is variable individual susceptibility to phlebitis. Patients who develop phlebitis with the first cannula are more likely to develop severe phlebitis with the second.(Maki et al 1991) In addition, upper extremity cannula insertions have lower risk of phlebitis than lower extremity and hand cannulation has a lower risk of phlebitis than the upper arm or wrist.

Early signs of phlebitis present as erythaema and pain. It is important to remember however, that by the time erythaema is seen, and inflammation has progressed through all layers of the vein wall to the epidermis (Angeles, 1997). Pain may only initially be felt on palpation and may not be a reliable indication of phlebitis (Jackson, 1998). Induration and cording (hardness), of the vein on the other hand, is considered highly indicative of phlebitis (Bohoney, 1993). If left unchecked, phlebitis quickly advances and may result in thrombophlebitis and thrombosis and complete occlusion of the vein or infection leading to septicaemia (Campbell, 1998; Jackson, 1998).

The use of a phlebitis scale is recommended for promoting prompt identification of problems, early intervention and reducing the incidence of phlebitis (Campbell, 1998).

The occurrence of phlebitis impacts not only on increased resource utilisation but most importantly compromises the patient through pain, discomfort and limb immobility affecting independence, reduced venous access and altered body image (Jackson, 1998). Research also indicates that phlebitis lengthens hospital stay (Campbell, 1998). For this reason it is essential that phlebitis is detected and promptly managed.



Phlebitis Scale. Ref: Intravenous Nurses Society (2000). Infusion Nursing Standards of Practice.

Management

Researchers have established the benefit of using an extension set to reduce the incidence of mechanical phlebitis (Hadaway, 1999; Millam, 2000; CDC Guidelines 2002). However, should phlebitis occur, complete the following:

- Remove the cannula and cover with sterile dressing
- Mark the area if reddened
- Send swab and IV cannula, to laboratory if infection is suspected
- Document event in patient's clinical notes
- Rest and elevate the affected limb on pillow
- Apply cold or warm compresses and hirudoid cream, according to patient comfort

Post-infusion phlebitis can occur up to 96 hours post cannula removal therefore continued assessment of the site post removal is recommended (Angeles, 1997).

Removal:

If you don't need it, REMOVE it!

- Research has shown that cannulae are frequently left unused is situ for two or more consecutive days (Laderle, Parenti, Berskow, & Ellingson, 1992). This poses a significant unnecessary risk to the patient. Leaving unused IV cannulae in situ is avoidable if careful documentation, monitoring and prompt removal practices are adhered to.
- The risk of phlebitis from cannula placement increases as dwell time increases (Fuller, 1998). Routine removal at 72 hours or at the first sign of phlebitis is warranted (Briggs, 1998; CDC Guidelines, 2002).
- Where adherence to aseptic technique has been compromised, i.e. when a cannula is inserted during emergency situations, replace cannula as soon as possible and after no longer than 48 hours (CDC Guidelines 2002).

Sharps Safety

The CDHB is sharps safety conscious and to protect staff from potential needle stick injuries provides sharps safety engineered devices to minimize needle stick injury. The IV cannula used is the INTROCAN™ B-Braun safety cannula.

'*Sharps must be handled with care at all times, disposed of safely immediately following use, and not re-sheathed, bent , broken or manipulated by hand'(Australia, New Zealand College of Anaesthetics (p 4 2005)*

It is the responsibility of the person using the sharp to ensure it is safely disposed of. Dispose of equipment safely into a sharps container at point of use. Ensure sharps containers are conveniently placed, either on the trolley or on a stable surface. If a needle stick injury should occur follow CDHB policy found in the Infection Control Manual and follow prompts on the Staff Accident form.

In the event of a Needle Stick Injury

- Wash wound under running water with soap
- Cover with band aid
- Have blood taken from you by a colleague trained in venepuncture. (go to the Emergency department if out of hours)
- Have blood taken from the source
- Complete separate laboratory forms for self and the source
- Send both blood specimens, lab forms and blood/serum/fluid report form to Microbiology Canterbury Health Laboratories immediately
- If you have been exposed to a known hepatitis B, C or HIV source contact the Microbiologist on call immediately via the switchboard

Preparation

When the decision is made to cannulate a patient there are a number of factors that need to be considered. Firstly you need to have a good understanding of the indications for cannulation and goals of IV therapy. Appropriate decisions about vein, site and cannula type can only be made on the basis of a thorough patient assessment. Once these have been established patient teaching and preparation is needed.

Assessment

Intravenous access devices should be selected depending on individual patient needs. This requires comprehensive assessment of the patient, equipment, therapy, environment and operator skill. The following questions should be considered

- Is the therapy short or long term?
- Is it continuous or intermittent therapy?
- What types of drugs or therapies are needed? (osmolality, pH, viscosity, speed/volume, and compatibility with other therapy)
- Does the patient have a history of lymphoedema, mastectomy, previous access device insertion problems, surgical or radiotherapy intervention to access site or fractures?
- Does the patient have pre-existing co-morbidities such as coagulopathy, sepsis or immunocompromised?
- What is the allergy status of the patient? (local anaesthetic, skin antiseptic, dressings)
- Does the patient have good or poor venous access? (poor venous access may be obvious due to poorly visible, bruised or thrombosed arm vessels)
- What is the patient's preference?
- What is the knowledge and skill of the person inserting the cannula?

(Hadaway, 1999; Dougherty, 2000)

In addition to these questions, read the clinical notes and consider any factors that will influence effective cannulation e.g. extremes of age, steroid therapy, repeated cannulation, history of phlebitis. You will need to identify and establish the patient's previous experience of cannulation and history of a vasovagal response. Patients with a positive history of vasovagal reactions are 7.5 times more likely to have a reaction during venepuncture (Hadaway, 1999). Anxiety and pain can exacerbate this (Hadaway, 1999). These patients may be good candidates for local anaesthetics such as Amitop cream which takes approximately 20min to be effective.

Practice point: Ensure an appropriate amount is applied to a suitable cannulation site and remove the cream prior to cleaning the skin and inserting the cannula.

Teaching & Consent

The Code of Rights states that patients have the right to be fully informed and to have informed consent. You will need to put your knowledge to good use when explaining to the patient the procedure and reasons for needing an IV cannula,. Your explanation should include:

- The need for therapy
- Medications, fluids to be infused
- Probable duration of therapy
- How the patient might feel
- Possible related complications
- A response to any questions or concerns
- Consider the family/Whanau wishes

Patients should also be made aware of the risks associated with IV cannulation [anxiety pain/discomfort, site infection, haematoma formation, arterial puncture and nerve damage (Workman, 1999)] and any treatment alternatives. Obviously the patient needs to give verbal consent for the procedure.

An adequate explanation and information for the patient should help reduce the autonomic 'fear' response and minimise venous vasoconstriction (which could potentially hinder successful cannulation). Explaining the procedure and ongoing care considerations will also encourage the patient's participation in monitoring for possible complications and side effects.

Selection of Suitable a Vein

Aside from considerations of the purpose and duration of IV therapy, there are two key determinants to vein selection 1) the vein itself and 2) the location or site.
Selection of a suitable vein is achieved by examining the veins of the patient's forearm or hand. The tourniquet will need to be applied to do this. A suitable vein for cannulation should feel round, firm, elastic, and engorged – not hard, bumpy or flat. Inspect and palpate the vein for any potential problems. Avoid cannulating veins that are:

- Covered by bruising, inflammation, skin disease and/or otherwise injured skin
- Sclerosed or thrombosed (hard and/or tortuous) Distal to the site of an infiltration or phlebitis or at flexion of joints

Practice Point: The importance of proper and adequate lighting when selecting a vein for cannulation should not be overlooked.

Patients who have had several courses of IV therapy in recent times are likely to have fewer suitable veins. Therefore, only a skilled clinician/nurse should perform cannulation on patients with limited and/or 'difficult 'veins and those individuals that are particularly anxious or distressed.

Selection of Suitable Site

There are some general guidelines to selection of an appropriate site, which include:

- For most adults, select veins in the non-dominant hand and arm
- Always examine both arms before making a decision as to the best vein available
- Start at a distal site so that there are veins available for subsequent cannulae to be placed proximal to the previous site.
- If replacing an IV cannula, alternate the sites by cannulating above the previous site avoiding tributaries of that vein use a vein that runs parallel to the previous site or select a vein in the opposite arm.
- Before performing cannulation at any site, palpate for arterial pulsation to exclude / prevent inadvertent arterial cannulation. The brachial and ulnar arteries can be quite shallow therefore this area should be avoided.

Veins in the antecubital fossa and above should not ***routinely*** be used for insertion of peripheral cannulae. Use of the antecubital fossa site particularly limits the patient's range of movement, is uncomfortable, interferes with blood sampling, results in positional fluid infusion, increases the risk of mechanical phlebitis and infiltration and may limit cannulation distally if infection occurs*. (Midwives ref: p 39-40)* In addition to this, the following sites should be avoided:

- Lower extremities – these should be cannulated only in emergency situations by experienced physicians
- Any areas of flexion
- Hands and joints of arthritic patients or those using crutches or walkers, whenever possible
- Previous cannulation sites
- Presence of a plaster, dressing, or operation sites
- Areas of poor venous return or lymphoedema

Cannula Selection

The patient's IV therapy requirements should determine the most appropriate IV device to be utilised (Hamilton, 2000). Ensure you have a selection of cannulae available on the trolley to take to the bedside. The decision on cannula length / size may change when examining the condition of the patient's veins.

As a general rule, the cannula selected should have the smallest diameter for the purpose to allow blood flow around the cannula thereby lessening the risk of phlebitis (Hadaway, 1999; Millam, 2000). The following two points are particularly important when selecting the gauge and type of cannula:

- *SIZE* of the vein. It needs to support the gauge and length of cannula to be inserted.
- Type of *FLUID* that is to be infused, e.g. blood. The cannula needs to be of acceptable diameter to allow infusion of the product.

The following table is a general guide for INTROCAN Safety Cannula to assist selection of an appropriate cannula.

Guide to INTROCAN™ IV Cannula

Gauge	Length	Uses	Considerations
24 (yellow)	19mm	Neonates Paediatric, Elderly Haematology / Onco patients	Suitable for extremely small veins, Slow flow rates.
22 (blue)	25mm	Paediatric Elderly Haematology & Onco patients	Easy to insert Suitable for small or fragile veins, short lengths. Can use for blood products & all IV fluids & medications
20 (pink)	25mm	Adolescents, adults, elderly	Most commonly used for all IV fluids & medication & blood products
18 (green)	32mm	Adults	Suitable for the administration of viscous fluids (e.g. blood)or when high flow is required
16 (grey)	32mm	Adults/maternity patients	Suitable for administration of large quantities of IV fluid. Rapid flow rate. Painful at insertion, requires a large vein

Equipment

Collect all the equipment needed for IV cannulation before going to the bedside or take a pre-prepared cannulation trolley where practicable. This will ensure you:

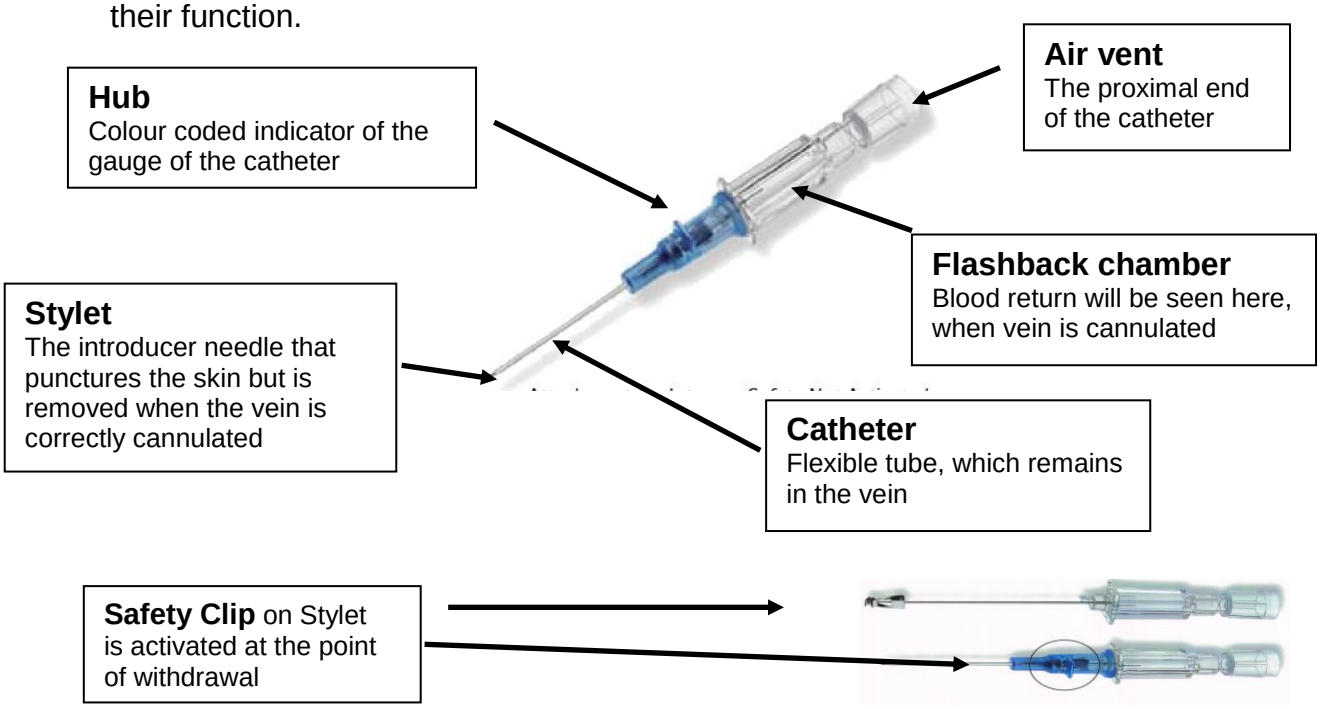
- Eliminate the need to leave the patient until the procedure is completed
- Avoid breaks in asepsis
- Promote patient confidence in your skills

Your equipment should include:

- Gloves non-sterile
- Chlorhexidine 2% & alcohol 70% wipe
- Tegaderm IV transparent Dressing1633
- Selected cannula x2 & local anesthetic optional
- Tourniquet
- Extension set/luer plug –primed with sodium chloride 0.9%
- Posiflush 10mLpre-filled syringe sodium chloride 0.9%
- Sterile guard & blue plastic backed sheet
- Multi sorb gauze swab
- Green ID labels x2

Parts of the INTROCAN ™ Safety Cannula

Familiarity with the components of a cannula is essential if you want to competently perform cannulation. The following diagram names the components and describes their function.



Insertion Procedure

The following describes the particular skills of cannulation and their rationale.

Preparing the Patient

In addition to providing adequate explanation and gaining consent for the procedure, ensure:

- The patient is warm and comfortable.
- Restrictive clothing on the arm is removed.
- Good lighting to promote easy visualisation

Initially choose your patients carefully, only attempting to cannulate patients with good veins, when there is plenty of time, when you feel relaxed and have backup available.

Don't feel discouraged if you are not successful at first. This skill takes time to perfect and you will improve with practice.

Checking the Cannula

You need to examine the cannula for integrity of product prior to use. In particular, check expiry date on the package. Be familiar with the manufacturers recommendations i.e. don't attempt to re-insert the safety stylet. Discard if any irregularities are evident (flared tip, plastic burrs on edges, dislodged needle through cannula).

Applying the Tourniquet

The tourniquet is applied approx 15 cm above the selected site (Millam, 1992). It should be pulled tight enough to cause engorgement of the lower capillaries and veins, without cutting off arterial flow. If the skin becomes mottled or blue or you can't feel a pulse below the tourniquet (or if the patient complains of discomfort) then the tourniquet is too tight.

Single use disposable tourniquets are recommended (Intravenous Nurses Society, 2000). The same tourniquet used on multiple patients may lead to cross contamination. Re-useable tourniquets should be cleaned after each use.

Be aware that tourniquets can also be a source of latex contact, so assess the patient's allergy status prior to use.

Preparing the Site

Preparing the site involves skin antisepsis and hair removal. Some authors recommend that antimicrobial solution should be applied to the site in a circular motion, starting at the intended insertion point and working outward, using firm friction (Baranowski, 1993; EPIC, 2004).

Although the surface area for prepping depends on the size of the extremity, in adult patients an area of approximately 50 – 100mm in diameter is usual. Never blot excess solution at the insertion site. Let the solution air dry completely. Do not re-palpate the site once skin antisepsis is complete, unless you are wearing sterile gloves (CDC Guidelines, 2002).

Hair on the skin that prevents adhesion of the transparent dressing will require removal. Hair removal is best achieved with clippers. 3M clippers have been supplied to all clinical areas. These come with detachable single-use heads. **Shaving is not recommended** it can cause micro abrasions of the skin and increase the potential for infection (Intravenous Nurses Society, 2000).

Methods of Vein Dilation

Once the tourniquet is in place promote vein dilation. Vein dilation can be achieved in a number of ways. You may have to do one or a combination of the following:

1) Ask the patient to open and close their fist – use a soft ball or washcloth for the patient to squeeze if making a fist is difficult.

2) Place the selected arm in a position below the level of the heart to help engorge the veins and increase visibility then tighten tourniquet.

3) Gently tap the area to release histamine beneath the skin and cause vasodilation.

4) Apply warmth to the area 5 – 10 minutes beforehand to dilate veins.

NB if the patient is cold, applying heat to the area for cannulation will ensure a successful procedure and patient satisfaction.

Following these measures the vein should feel elastic and have rebound resiliency i.e. when you press and release the vein, it should spring back to a rounded, filled state. Achieving this may take some time or may not occur at all and re-selection of a vein may need to take place.

Holding the Device: Becoming comfortable when holding the cannula, may take time, however it is important for successful cannulation.

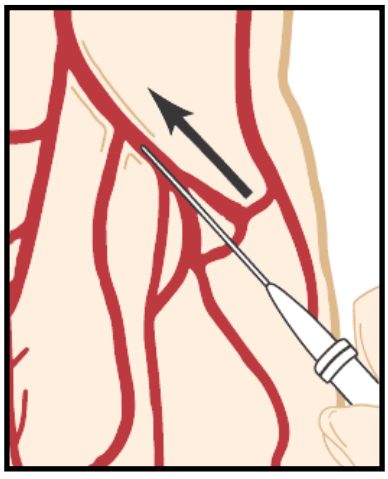
- Hold the cannula horizontal with hand on top of the device. This way the proper entry angle is assured and allows maximum flexibility of wrist when inserting the device.
- Fingers should be on the flashback chamber – not on the colour portion of hub. This is to ensure you are ready to thread the cannula into the vein. (You can't do this if you have hold of it).
- Never hold cannula like a "Dart". Cannulation is distinctly different from an IM injection. Using the cannula like a 'dart' will not only cause discomfort but is likely to result in transecting the vein.

Immobilising the Vein

Vein stabilisation is performed with the non-dominant hand and maintained until the cannula has been threaded into the vein. Stretching the skin distal to the vein will maintain the vein in a taut, distended, stable position and reduce the tendency to roll. This can be done by gently pulling the skin in a downward motion.
Superficial veins have the greatest tendency to roll. Hand veins are generally easier to immobilise and can be easier to cannulate because they're usually surrounded with less fatty tissue. Using a good technique to immobilise the vein is critical to success.

Approaching the Vein

There are several ways an IV cannula can be inserted. Regardless of which method is used, the cannulae should enter the skin at such an angle that the needle punctures the vein wall and enters the lumen without piercing the opposite wall.



The most common methods are:

Approaching the vein from the top

Approaching the vein from the side

Approaching the vein at a bifurcation

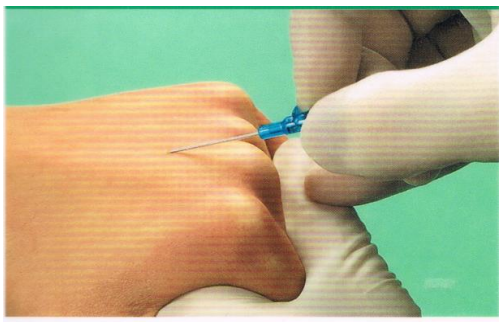
Practice Point: Always keep your fingers behind the point of the stylet at all times

For further information read the article:

Starting IV's: How to develop you venipuncture expertise by D. Millam (1992) (for full details see References).

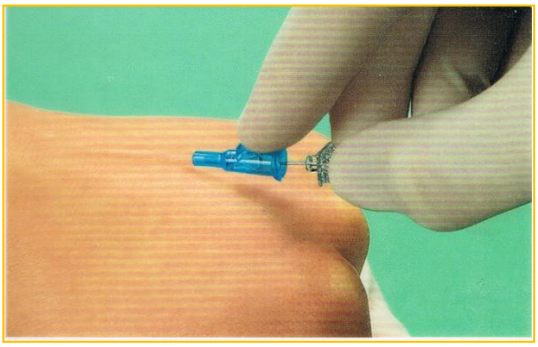
Inserting the Cannula:

The stylet is inserted bevel up at 10 - 45° angle (Briggs, 1998) depending on the depth of the vessel. The stylet is inserted bevel up to minimise discomfort and reduce the risk of puncturing the back wall of vein. The INTROCAN ™ Safety Cannula has a push off tab and when uppermost this confirms the bevel is in the correct position for insertion



1. The skin is pierced using a smooth firm action. Blood will appear in the hub of the cannula as soon as the vein is entered.
   The appearance of blood in the hub is usually a sign of successful cannulation.

Blood may also enter the hub if the vein has been transected i.e. punctured through. If this occurs, you will not be able to advance the cannula (see next step) and a haematoma will usually immediately appear.

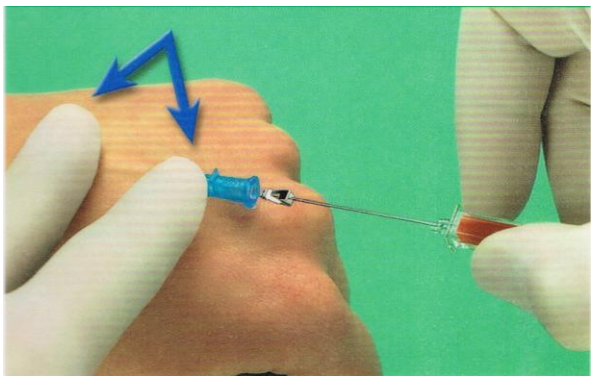


Advancing the Cannula

2. Once blood is seen in the hub, advance the device *slightly* and then 'level off' the entry angle by lowering the cannula and stylet level with the patient's skin. This ensures that the cannula is well within the lumen of the vein and reduces the chance of creating a false lumen between the vein wall layers. Still retracting the skin, gently push the hub to slide the cannula off the stylet and advance completely into the lumen of the vein.

Release the Tourniquet!

Releasing the tourniquet at this point ensures that when you proceed to removing the stylet, less blood will ooze from the cannula.



Remove the Stylet

3. In addition apply digital pressure beyond the cannula tip to prevent blood spillage. Stabilize the hub with the non-cannulating hand (see finger position above) and withdraw the needle/stylet.
   Discard the stylet immediately into the sharps container.

An acronym to help reinforce the crucial steps in the cannulation procedure is:

B L A T S	
B	lood return, advance cannula slightly
L	evel off
A	dvance into vein using push off tab
T	ourniquet removal
S	tylet removal

Attach Extension Set

With the hub still stabilised, attach the primed SmartSite extension set with injection port (luer plug). An extension set is recommended to reduce mechanical phlebitis (Hadaway, 1999; Millam, 2000;CDC Guidelines 2002). Flush the cannula to ensure patency. It should flush easily. If any immediate swelling is observed the cannula should be removed. If stinging, or significant patient discomfort occurs, reassess the site, ease of insertion and consider the need for removal.

SECUREMENT & DRESSINGS

There is an expectation that the device will achieve a 72 hour dwell time.
Therefore it is essential that an appropriate dressing and securement technique is used.

Use the recommended TEGADERM™ IV Cannula dressing which includes sterile tape to secure the cannula. The first tape is placed over the cannula hub, the dressing applied and the second tape is applied just below where the extension set and hub connect.
Do not completely obscure the entry site with tape, otherwise monitoring for phlebitis may become difficult. Excessive manipulation should be avoided to prevent trauma at the site and inadvertent dislodgement (Rosenthal, 2003). Inadequate securing of the cannula will allow catheter movement and provide access for bacteria, potentially leading to phlebitis, thrombosis and infiltration (Hadaway, 1999).

A transparent dressing is applied over the sterile tape. Apply the transparent dressing up to where the cannula hub and extension set met. If the connection with extension set is taped over it does not allow for disconnection or changing if necessary. Press the dressing into place to seal the dressing firmly to the patient's skin.

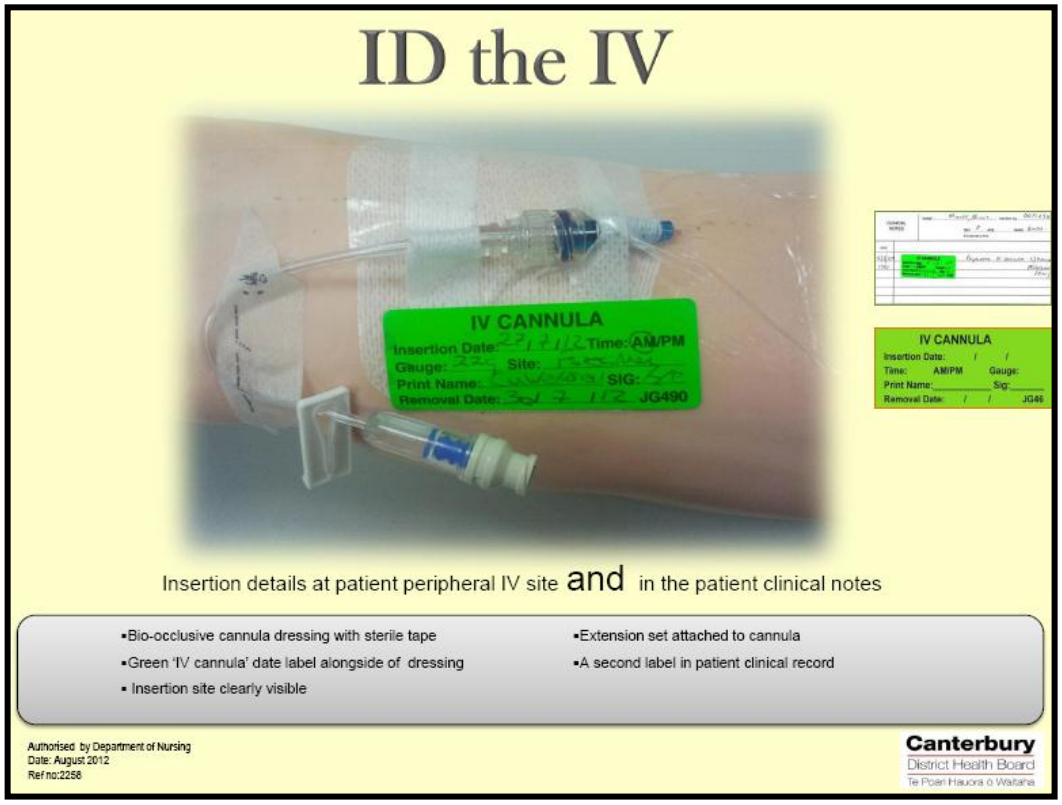
Practice Point: Apply the dressing directly to the site without stretching, as this may cause irritation to the patient's skin.

DOCUMENTATION

Document accurately as follows:

1) **At the site** –the 1st **GREEN ID** label complete with the date, time, inserters name, signature and expiry then attach to the side of the dressing so as not to obscure the insertion site .
2) **Patient Clinical Record** – the 2nd **GREEN ID** label completed as above is placed in the patients clinical notes. In addition, record any variances of procedure along with patient teaching / education that was provided including explanation of risks and consent to procedure. It is important to note the patients response, any adverse effects and action taken (see potential complications)

For more information read the article:
Where did this patients IV therapy go awry by K Rosenthal (2004) (for full details see References)



THE COMPLETED IV CANNULA DRESSING

Trouble Shooting

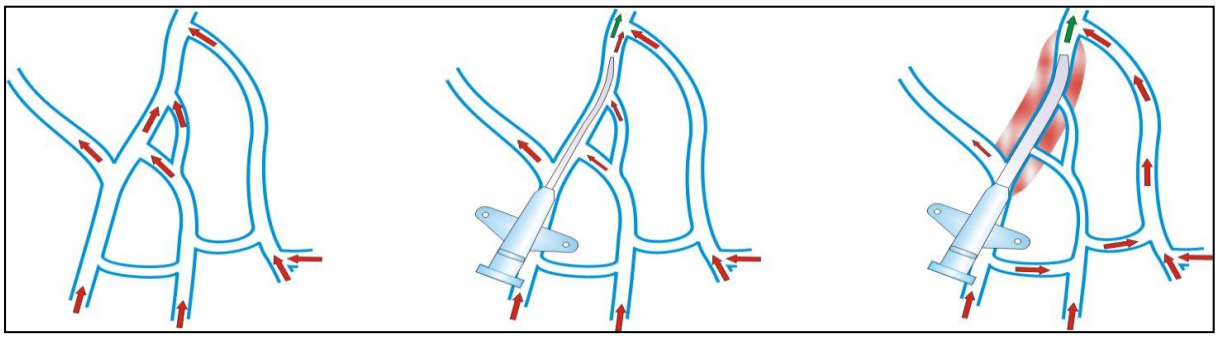
Problem	Practice tips
Difficulty dilating the vein	If the patient is cold, hypotensive or nervous and experiencing vasomotor changes, you can expect to spend a little extra time dilating the vein before cannulation. Apply the tourniquet and assess the veins. If they are slow to fill, try the following tips: • Position the arm below heart level or hang the arm down to encourage capillary filling. • Gently rub or stroke the arm to warm the skin. • Cover the arm with a warm towel for 5-10 minutes to trigger vasodilation. • Get patient to open and close hand to aid venous dilation • Apply heat to area for 5-10 minutes
Puncturing the Vein	If blood backflow stops when you remove the stylet, the cannula may have passed through the opposite wall. If this is suspected, you may still be able to complete a successful cannulation; • Without removing the tourniquet, retract the cannula slightly until blood flashback appears again, indicating that you've pulled the tip back into the lumen of the vein. • 'Level off' the angle and advance the cannula into the vein and promptly remove the tourniquet. ***Never try and reinsert the stylet***
Failure to Insert the Cannula	Inappropriate insertion angle (too steep or not steep enough) can cause the cannula to ride on top of or below the vein. If the cannula won't move freely, it usually means that it has been inserted too deep, and it is embedded in fascia or muscle. The patient may also complain of severe discomfort. Action: • Adjust the angle of entry. • If still not successful, remove and reassess. • Repeat attempt no more than two times, before seeking assistance from a more experience clinician
Inability to Advance the Cannula	This can occur if you have hit a valve or if you have failed to adequately anchor the surrounding skin. Try: • Attaching a saline filled syringe and gently flushing. If no resistance is felt, advance the cannula, while flushing, as this may open the valve allowing the catheter to move through. • Any twisting of the vein or continued resistance, abandon the cannulation attempt and re-site elsewhere.

Problem	Practice tips
Fragile skin	Patient with fragile skin are at increased risk of tissue trauma and failure to cannulate. • Use the smallest cannula possible e.g. 24g or 22 g • Encourage vein dilation with warmth. • Apply minimal tourniquet pressure or substitute for a blood pressure cuff inflated just enough to distend veins • Use decreased angle of entry
Venous Spasm	Venous spasm is a sudden involuntary contraction of the vein into which a cannula or solution is being placed (3M, 1999) and may result from traumatic cannulation. It is characterised by sharp, cramping, pain above the insertion site and skin blanching. • A warm compress can be applied to the site (3M, 1999; Springhouse, 1999). • If unrelieved, re-site the IV cannula.

POTENTIAL COMPLICATIONS

All complications should be clearly documented in the patient's clinical records, including patient response and actions taken. If the nature or complication is serious then an event form should be completed

Complication	Action
Infiltration Infiltration can occur through using a large cannula in small vein or is the result of a cannula puncturing the vein wall causing the leakage of infusate into the subcutaneous tissue and swelling at the site. The surrounding skin is usually cool to the touch, there may be evidence of blanching and fluid may leak at the entry site.	• Remove the cannula • Establish whether cannula needs to be re-sited • Re-evaluate size of cannula • Re-site new cannula • Where prescribed, recommence infusion
Arterial Cannulation Arterial cannulation is identified by the appearance of bright red pulsating blood in the hub of the cannula (when the tourniquet and other proximal occlusions are absent). Blanching, pain or diminished pulse may be noted distal to the cannula.	• Stop cannulating immediately. • Remove the cannula and apply pressure for at least 5 minutes or until no bleeding occurs / visible haematoma formation. • Document incident and actions in clinical notes



Normal Blood Flow	Smaller Cannula ***Reduces Blood Flow*** Around Cannula but still allows flow around cannula	Large Cannula ***No Blood Flow Around*** Cannula (Blood detours around obstruction)

Complication	Action
Haematoma Haematoma is an interstitial swelling at / near insertion site caused by bleeding into the tissues. Possible causes include: • Insertion angle too deep, or not steep enough • Failure to 'level off' after entering the vein • Fragile veins due to age, medical condition, steroids use etc. • Vein has been punctured • Capillaries have been damaged at point of insertion	Ways to prevent this happening include: • Correct angle of insertion and levelling off once in the vein lumen • Choosing best possible vein, with good blood volume • Using a smallest cannula needed • Try to avoid small capillaries that lie over the vein If haematoma does occur, usually the cannulation has to be abandoned. Occasionally the cannulation attempt is successful. However the resultant haematoma significantly reduces the dwell time of the cannula and increases the risk of phlebitis and infection.
Nerve Injury Nerve injury should be suspected if the patient complaints of pain, 'pins and needles' / or sharp sensation going down to the fingertips.	• Immediately remove the cannula and inform the doctor • Explain possible cause and actions to patient • Provide reassurance as appropriate • Document incident in clinical notes
Vasovagal Reaction (Syncope) A vasovagal reaction is characterised by light-headedness, blurred vision, sweating, nausea & tinnitus. During cannulation this reaction is usually caused by blood or injury phobia. Pain and anxiety in turn result in inappropriate triggering of the autonomic response that causes vasodilation and bradycardia (Wright & Arnolda, 2003). In the sensitive individual it may progress to syncope, although this is extremely rare Deacon & Abramowitz, 2006). Simple vasovagal reaction will usually respond to stopping the stimulus (Kinsella & Tuckey, 2001).	Where vasovagal reaction/ syncope known, prevention strategies include: • Cannulation by skilled practitioner only • Apply topical local anaesthesia prior to insertion • Have the patient in the supine position In event of vasovagal reaction: • Stop the cannulation (or complete procedure promptly) • Call for help lie the patient supine • Administer oxygen • If the patient appears to 'fit', prevent injury If reaction is pronounced consider: • Administration of atropine or alpha-agonist (as prescribed) • IV fluid bolus where hypovolemia suspected (as prescribed)

ADDITIONAL INFORMATION:

The most common mechanical complications of intravenous therapy administered via a peripheral vein are thrombophlebitis and infiltration with extravasation of the infusate. (Goodinson 1990)

Infiltration.
Infiltration is the leaking of non- vesicant drugs or infusates from the cannulated vein into the surrounding tissue causing inflammation, pain and oedema. Causes of infiltration are, tight tape, bandage or clothing above the cannulation site, cannula too large for the vein, the opposite wall of the vein has been transected. Non vesicant drugs or infusates do not cause tissue necrosis.

Extravasation.
Extravasation refers to the leaking or infiltration of a vesicant drug or solution into the surrounding subcutaneous tissues causing tissue necrosis and sloughing (Goodinson 1990)
This can occur as the result of vein damage during cannulation, infusing the drug or solution too quickly, using a peripheral cannula that is too large for the vein, using limbs with compromised circulation or sites that have been exposed to radiation. In addition, tight clothing or bandages above the cannula site can also contribute to extravasation.
A variety of non cytotoxic fluids and drugs which are of different osmolality or pH from the tissues or have a vaso constrictive action are also capable of causing severe tissue damage if extravasated. These include:

Potassium Chloride (>40mmol/l)	Amphotericin
Digoxin	Calcium Chloride
Phenergan	Calcium Gluconate
Diazepam	Alcohol
Tetracyclines	Phenytoin
Cefotaxime	Sodium Bicarbonate (>5%)
Ganciclovir	Mannitol
Sodium thiopental	Vancomycin
Aciclovir	TPN
Aminophyllins	Contrast dye

(http://www.extravasation.org.uk/home.html)

Management of Extravasation:

- Stop administration immediately and notify medical staff
- Do not flush cannula
- Try to withdraw any solution by pulling back on syringe
- Remove cannula apply gauze over area. Do not use occlusive or tight dressings
- Mark area with a pen
- Moist cold compresses may be helpful or cover with ice pack for 24hrs
- Document incident in clinical notes and complete the Quality Improvement Event Reporting Form

Refer to Pharmacist for appropriate antidotes

Prevention is the best treatment

EXTRAVASATION ASSESSMENT TOOL

Skin Colour	Normal	Pink	Red	Blanched area surrounded by red	Blackened
Skin integrity	Unbroken	Blistered Consider plastics referral	Superficial Skin loss	Tissue loss Exposed subcutaneous tissue	Tissue loss & exposed bone/muscle with necrosis
Skin temperature	Normal	Warm	Hot		
Oedema	Absent	Non-pitting	Pitting		
Limb Mobility	Full	Slightly limited	Very limited	Immobile	
Pain	**Grade using a scale of 1-10; where 0 = no pain and 10 = worse pain**				
Fever	Normal	Elevated			

Follow up Guidelines in the event of an extravasation

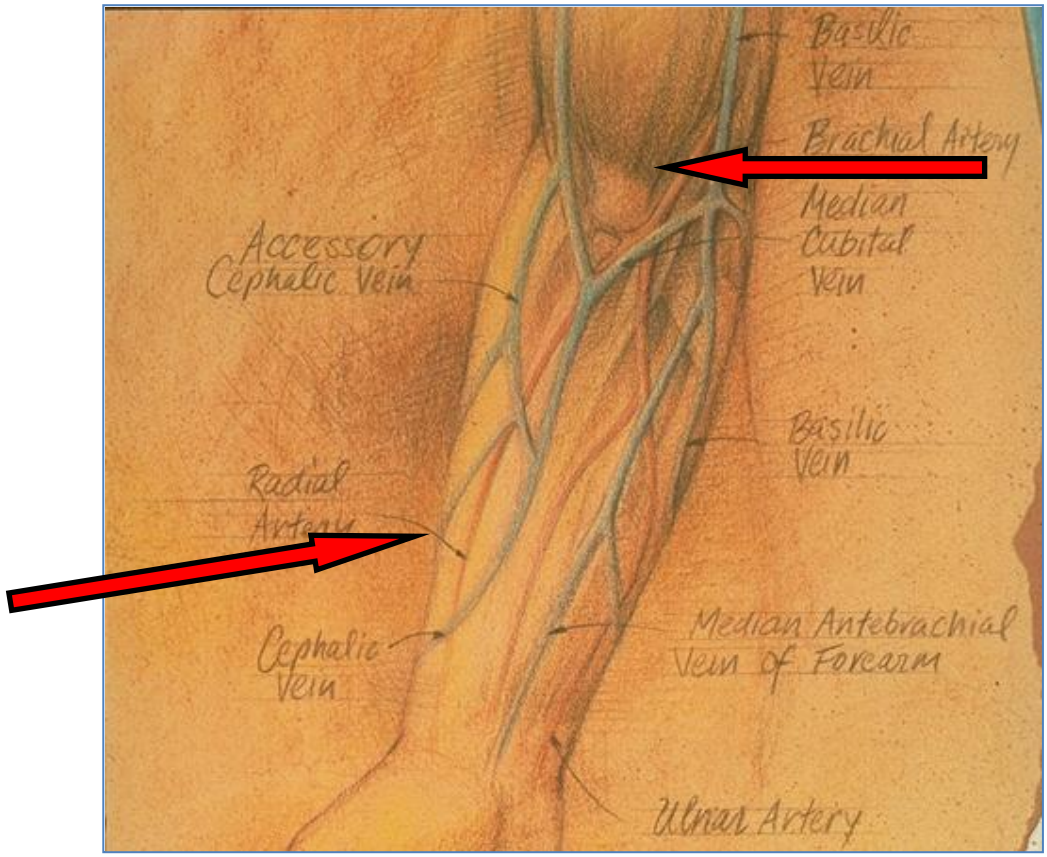
- Follow up should occur on day 2 (ie, day after extravasation) 3,5 and 7
- Follow up on days 4 and 6 can be via a telephone call(outpatients) if appropriate
- Frequency of follow up after day 7 will depend on assessment of the site but injury will need to be assessed weekly for the first four weeks Ref: 2188 Oncology /Haematology CDHB Extravasation Document 2009

Additional Information:

Women in labour:
Midwives cannulate in a wide variety of situations including emergencies, where women are in labour.
When pregnant women bleed, they loose large volumes of blood very quickly. Blood flow over the placental site is approximately 500mls per minute. When the uterus does not contract efficiently following placental separation, a woman is at risk of losing her entire blood volume in less than 10 minutes. This is categorised as a medical emergency.

Whilst the veins of choice for midwives are usually the dorsum of the hand or lower forearm, in an emergency situation the large veins of the anti cubital fossa are the veins of choice. These veins provide easy access, the ability to accommodate 16 or 14 gauge cannula and allow for high flow rapid infusions of IV fluids, blood and blood products. These veins are also commonly used by the Emergency Department.

Intra-arterial cannulation: Although rare, the most risky area is the medial side of the antecubital fossa where the brachial artery is quite shallow. It lies close to the median cubital vein.

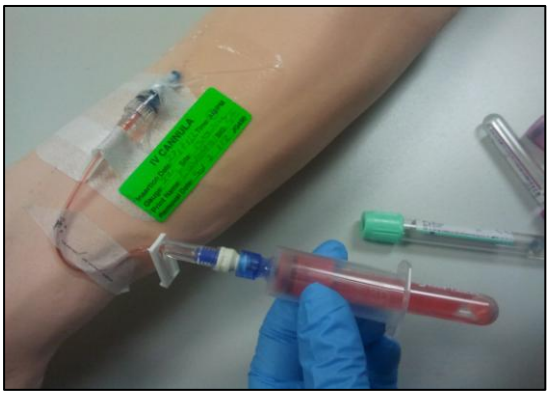


Practice Point: To provide patient comfort, it is strongly recommended that a local anaesthetic of lignocaine 1% is administered as a small sub-dermal bleb at the chosen site for cannulation prior to inserting an 18g -16g cannula.

Taking a Blood Sample from a Peripheral IV Cannula:

The most accurate method for blood sampling is by using venepuncture. However whilst not recommended the cannula may be used to withdraw blood for the purpose of blood sampling.

Practice Point:
If a blood sample is required at the time of cannula insertion connect a blue tip male adapter vacutainer to the SmartSite luer plug and insert blood tubes in correct order of draw.(Ref to images below)
The CDHB policy states that non sterile gloves are to be worn during cannulation and blood sampling for personal protection against blood borne pathogens.



Child Health:

Please refer to local IV cannulation policy in Paediatrics Guidelines.

Cannulation of Renal Patients

A Renal patient is classed as any patient under the care of the 'Nephrology Department' for chronic renal disease or end stage renal disease.

The following guidelines should be adhered to when performing Cannulation (or venepuncture) on renal patients.

- Avoid puncturing the cephalic vein of either arm
- Access the patient's DOMINANT arm if at all possible (an AVF will always be formed in the non dominant arm when possible).
- The best site for Cannulation is the back of the patient's hand.
- Where Cannulation of the cephalic veins cannot be avoided refer to Nephrologist or Nephrology Registrar BEFORE proceeding

IMPORTANT PRACTICE POINT:
Preventing damage to the vessel that may subsequently be required for AVF formation is key to patient treatment outcomes.

References:

3M Skin Health Programme – IV Complications. (1999). (Retrieved June 2002). www.3m.com/us/healthcare/professionals/skinhealth/pdfs/iv_complications.pdf

Angeles, T. (1997). How to prevent phlebitis, *Nursing97*, January, 26

Australia, New Zealand College of Anaesthetists. (2005). Guidelines on infection control in anaesthesia. ANZCA. Retrieved February 13 2006, from http://www.anzca.edu.au/pdfdocs/PS28_05.PDF

Bohony, J. (1993). Common IV complications and what to do about them. *American Journal of Nursing,* 93, (10), 45-49.

Campbell, L. (1998). IV-related phlebitis, complications and length of hospital stay: 1*. British Journal of Nursing,* 7, (21), 1304-1312.

Campbell, T. & Lunn, D. (1997). Intravenous Therapy: current practice and nursing concerns. *British Journal of Nursing, 6*(21), 1218 – 1228.

Centres for Disease Control. (2002). Guidelines for the prevention of intravascular catheter-related infections. *Morbidity & Mortality Weekly Report, 51*(RR10), 1-32.

Deacon, B. & Abramowitz, J. (2006). Fear of needles and vasovagal reactions among phlebotomy patients. *Journal of Anxiety Disorders*, retrieved from www.sciencedirect.com

Dougherty, L. (1996). Intravenous Cannulation. *Nursing Standard, 11*(2) 47-54.

Dugger, B. (1997). Intravenous nursing competency: why is it important. *Journal of Intravenous Nursing, 20*(6), 287-297.

EPIC – National Evidence Based Guidelines for preventing hospital-acquired infections associated with the use of central venous catheters – Part A www.epic.tvu.ac.uk/PDFFiles/CVC%20Tech%20Report%20part%20A.pdf

Fuller, A. (1998). The management of peripheral IV lines. *Professional Nurse*, 13, (10), 675- 678.

Goodinson,S.M.(1990) The risk of IV therapy. *Professional Nurse 5*(5): 235-238

Hadaway, L. (1999). Vascular access devices: meeting patients' needs. *MEDSURG Nursing, 8*(5), 296-303.

Hamilton, H. C. (2000). Selecting the correct intravenous device; nursing assessment. *British Journal of Nursing 9*(15), 968 – 978.

Intravenous Nurses Society. (2000). Infusion Nursing Standards of Practice. *Journal of Intravenous Nursing, 23*(6S), S1-S88.

Jackson, A. (1998). A battle in vein: infusion phlebitis. *Nursing Times, 94*(4), 68, 71

Jagger, J., Perry, J. ,Safer needles: Not optional. *Nursing2002. 32(10):p.20.*

Kinsella, S. M. & Tuckey, J. P. (2001). Perioperative bradycardia and asystole: relationship to vasovagal syncope and the Bezold-Jarisch reflex. *British Journal of Anaesthesia, 86*(6)859-868.

Lundgren, A. & Wahren, L. K. (1999). Effect of education on evidence-based care and handling of peripheral intravenous lines. Journal of *Clinical Nursing, 8*, 577-585.(2005)

Maki,D.G.,Ringer,M., (1991) Risk Factors for Infusion-related Phlebitis with Small Peripheral Venous Catheters. *Annals of Internal medicine* Vol1.14;No.10,15 May

Millam, D. A. (2000). On the road to successful IV starts. *Nursing 2000. 30*(4) 34 – 48.

Robert, J., Fridkin, S. K., Blumber, H. M., Anderson, B., White, N., Ray, S. M., Chan, J. & Jarvis, W. R. (2000) The influence of the composition of the nursing staff on primary blood stream infection rates in a surgical intensive care. *Infection Control and Hospital Epidemiology, 21*(1), 12-17.

Rosenthal, K. (2003). Pin-pointing intravascular device infections. *Nursing Management, 34*(6), 35-43.

Rosenthal, K. (2004). Where did this patients IV therapy go awry. *Nursing2004, 34*(5), 56-57.

Small,H.Adams,D,Casey,A.Crosby,C.Lambert,P(*2008*.) Efficacy of adding 2% Chlorhexidine to 70% isopropyl alcohol for skin disinfection prior to peripheral venous cannulation. *Infection Control and Hospital Epidemiology. October,Vol.29,No.10*

Stranz, M. (2002). Adjusting pH and osmolarity levels to fit standards and practices. *JVAD*. Fall: 12-17.

Tarantola,A., Abiteboul, D., Rachlinec,A (2006.) Infection risks following accidental exposure to blood or body fluid in health care workers: A review of pathogens transmitted in published cases. *Am J Infect Control;34:367-75.*

UK National Extravasation Information Service. (http://www,extravasation.org.uk/home html

Vaghadia, H., al Ahdal, O. A., & Nevin, K. (1997). EMLA patch for intravenous cannulation in adult surgical outpatients. *Canadian Journal of Anaesthesia. 44*,(8), Aug: 798 – 802.

Volume 12 CDHB Fluid & Medication Management Policy

Weinstein, S. M. (2000). Certification and credentialing to define competency-based practice. *Journal of Intravenous Nursing, 23*(1), 21-28.

Wilkinson, R. (1996). Nurses' concerns about IV therapy and devices. *Nursing Standard, 10*(35), 35-37.

Workman, B. (1999). Peripheral intravenous therapy management. *Nursing Standed.14*(4):53-60

Wright, J. J. & Arnolda, L. F. (2003). Dizziness and loss of consciousness: cardiovascular causes. *Australian Family Physician, 32*(4), 207-210.

Additional References for use of extension sets:

- RNAO Registered Nurses Association of Ontario 2005
- Hadaway L.(2010) Infusion Therapy
- Leeds teaching Hospital NHS Trust Peripheral cannulation Guidelines (2008)7,(6.5.11)
- Gloucester Hospital NHS (2012) p7