



education
safety
quality

MASTERY SKILLS PATHWAY

CENTRAL VENOUS CATHETER INSERTION



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01 MASTERY SKILLS PATHWAY OVERVIEW

NHS Lothian Mastery Skills Pathway has been developed to enhance the technical and non-technical skills of clinicians undertaking complex clinical procedures



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MASTERY SKILLS PATHWAY OVERVIEW

A NEW DEVELOPMENT

Welcome to the NHS Lothian Mastery Skills Pathway Central Venous Catheter Insertion Reading Pack. We hope you find this pack a valuable learning resource to complement your simulated practice sessions.

The Mastery Skills Pathway is an educational, quality assurance and patient safety initiative to promote high-quality training and safe, effective patient care for high-risk procedural skills.

Your pre-learning (Videos and Reading pack), Deliberate Practice and Simulation-based assessment sessions will optimally prepare you for real-life procedural performance, under direct supervision.



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METHODS

GAINING COMPETENCY

We recognise that the traditional model of “see one, do one, teach one” is no longer realistic. Our new approach allows development of fundamental skills, in a completely safe manner before real-life practice.

In addition, this novel approach allows refreshment of old skills, minimising the effects of potentially harmful skill decay.

The path to procedural competency for clinicians is supported by the following:

- A trained faculty
- Knowledge packs containing a combination of written and video educational resources for each procedural skill, with a consistent emphasis on patient safety
- Self-directed deliberate practice where you can spend as much time as you like familiarising yourself with the technical aspects of the procedure
- A supervised simulated checklist-based assessment session where you will receive feedback on your performance from your tutor
- Real-life practice under direct supervision until you are independently competent





MASTERY PROCEDURE PHASES

PROCEDURAL PHASES

Complex procedural skills can be daunting prospects initially. It is not uncommon for novices to become overwhelmed when performing such procedures, resulting in avoidable error or harm. It can be helpful to fragment the task into discrete, manageable parts, ensuring one is complete before moving onto the next.

Our "Mastery Procedural Phases" is one method of approaching any complex skill. Six Procedural Phases have evolved to help break down skills into more manageable components. These can be more broadly grouped into domains of Pre-procedure, Procedure and Post-procedure (as shown across). This will be discussed more in the videos and simulation skills sessions.

Phase 1 - Preparation, Assistance and Positioning

Consider whether a procedure is indicated, that no contraindications exist and that informed consent has been given. An appropriately trained assistant should be available to assist you with preparing equipment and in positioning the patient correctly to make the procedure as easy as possible.

Phase 2 - A Three-point Procedural Pause *

The procedural pause is an opportunity for all those involved in the procedure, including the patient, to acknowledge that they are content and happy to proceed.

1. Ensure that the patient is comfortable and that they are happy to proceed
2. Your assistant should have the opportunity now to voice any concerns, identify any problems or anything else that needs addressed
3. The clinician should ensure that the equipment is all present, checked and laid out in the order of use.

Once this is completed the insertion can begin.

Phase 3 - Asepsis and Local Anaesthetic Infiltration

Asepsis should be strictly observed to prevent potentially life altering infective sequelae. Local anaesthetic should be used to minimise any discomfort experienced by the patient.

Phase 4 - Insertion

This phase will be covered in a later section of this pack and during the video demonstration.

Phase 5 - Anchor & Dress

All indwelling devices must be secured & dressed to minimise risk of movement, failure and contamination.

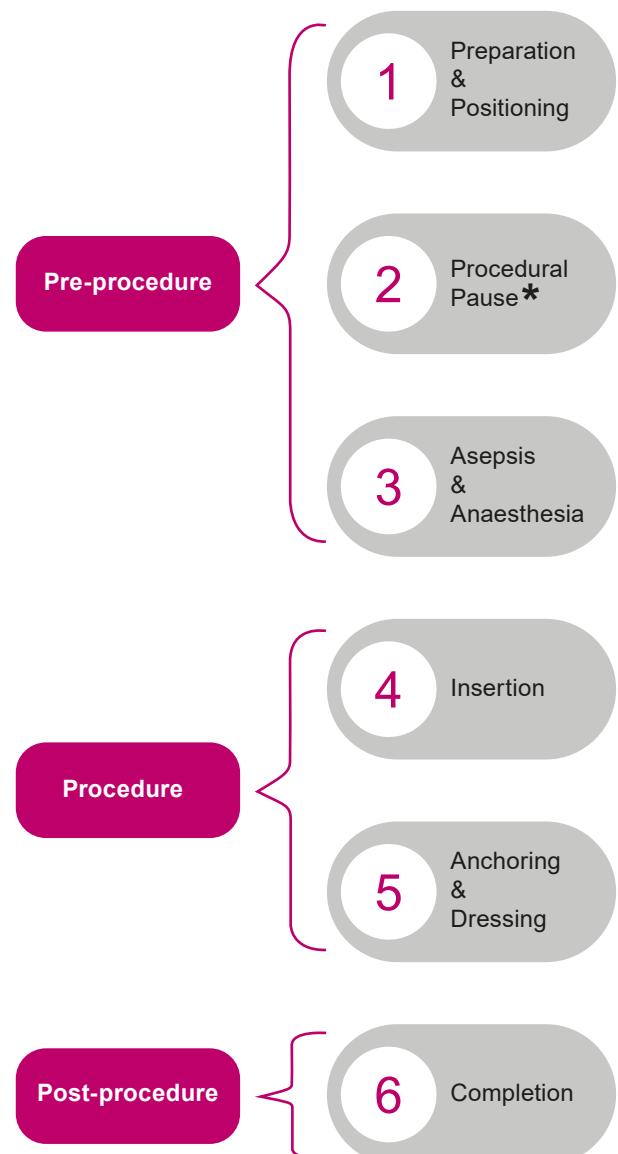
Each procedure has specific requirements.

Phase 6 - Completion

You should communicate with the patient and the team looking after them, particularly with regard to symptoms to report and observations required.

Document the procedure, in detail, including any difficulties encountered and immediate complications.

* please note that you can pause as often as desired. Some clinicians prefer to perform the three point pause after the insertion of local anaesthetic (ensure local anaesthesia is excluded first).





02 LEARNING OUTCOMES

Each skill covered in NHS Lothian Mastery Skills Pathway has been assigned learning outcomes for you to achieve



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LEARNING OUTCOMES

After reading and viewing the content contained within this pack the trainee should gain the following:

1

An understanding of the indications for inserting a central venous catheter and its use in the clinical practice

2

An understanding of risk assessment, patient safety concerns and contraindications to the procedure

3

An understanding of the potential complications of the procedure and the basic principles of their management

4

An understanding of the practicalities of the procedure in a safe and structured fashion

5

An awareness of your own personal limitations and when to obtain help from a senior clinician





03 INDICATIONS & RISK ASSESSMENT



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INDICATIONS

Monitoring	Drug Administration	Procedural
Central venous pressure	Poor peripheral access	Haemofiltration
Central venous blood oxygen saturations	Irritant drugs	Haemodialysis
Targeted temperature management	Total parenteral nutrition	Pulmonary artery catheter
Pulmonary artery pressure	Long term intravenous treatment	Cardiac pacing wires
	Large volume replacement	

CONTRAINDICATIONS

Complications that may occur in relation to CVC insertion are related to their insertion site, patient related factors and the skills and experience of the operator.

These factors can be optimised in most situations, however each insertion should be a careful consideration of the indication for CVC insertion and the appropriate time frame for this.

In rare situations, insertion of a central venous catheter may be a life-saving procedure and therefore **the only absolute contraindication** is refusal from a competent patient.

Relative contraindications to insertion of CVC include:

- coagulopathy (INR > 1.5)
- thrombocytopenia (platelets < 50)
- existing pneumothorax or respiratory illness
- vessel thrombosis, stenosis or disruption
- overlying skin infection

Experienced clinicians can make decisions to insert central venous access despite these relative contraindications but you should discuss any plan to insert a CVC in the context of a relative contraindication with a senior anaesthetist or intensivist.

For standard elective insertion, in the presence of coagulopathy a risk benefit analysis needs to be carried out as to the risks of line insertion and consideration given to correction of coagulopathy.





04 PATIENT SAFETY CONSIDERATIONS

With all skills, time should be taken to consider patient safety and how and potential risk factors can be mitigated



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SAFETY

SPECIFIC CONSIDERATIONS

As with any clinical procedure, the goal is to safely perform CVC Insertion having removed or minimised any potential risk factors.

If there is any concern that significant risk of harm may compromise patient safety, delay the procedure and seek senior advice.

Specific safety considerations are listed below:

Mandatory Component	Comments
Access to full resuscitation equipment	<ul style="list-style-type: none">• Location of resuscitation trolley should be known• Ensure access to airway and suction equipment• Consider establishing IV access pre-procedure
Competent Practitioner	<ul style="list-style-type: none">• Experienced supervisor for trainee (senior registrar, experienced associate specialist or consultant)
Appropriate Assistant	<ul style="list-style-type: none">• Must be present throughout the procedure• Competent to contribute to equipment checking and ensure patient comfort etc





QUESTIONS TO CONSIDER

ALWAYS CONSIDER THE FOLLOWING

- Are there any absolute or relative contraindications to insertion?
- Does it need to be done?
- Does it need to be done now?
- Am I competent to do this?
- Is supervision / assistance available?
- Am I familiar with the equipment?
- Is this the correct environment to insert the CVC?
- Does the patient have capacity to consent to the procedure?
- In NHS Lothian, CVC should be inserted in either the Emergency Department, Critical Care or Anaesthetic Theatre, where the environment is set up to maintain sterility, provide mandatory monitoring, and staff who are familiar with procedure

PATIENT EDUCATION

ALWAYS TALK WITH THE PATIENT

Communicating and informing the patient of exactly what the procedure involves can reduce anxiety and facilitate better positioning for the procedure.
The patient should be made aware why they are having the procedure, the benefits, the potential risks / complications and the alternatives to the procedure.

Once this has been done, informed consent should be sought and documented.

If the patient does not have any capacity to give informed consent, and the procedure is deemed clinically necessary, ensure an Adults with Incapacity form is completed.

Always establish whether the patient has any known allergies prior to the procedure - they may have an allergic reaction to local anaesthetic or antiseptic skin preparation.

IN SUMMARY

Tell the patient:

- Why there is a need for the procedure
- How the procedure will be performed
- What the potential risks / complications are
- What the alternatives are

Gain consent.

Always offer the patient the opportunity to ask questions.





05 POTENTIAL COMPLICATIONS

There are several complications associated with CVC insertion. Some of these, although rare, can be extremely serious. It is your responsibility to explain these risks so that the patient may make an informed decision about their care.





COMPLICATIONS

	Complication	How to minimize the risk
Thromboembolic	Air embolism	<ul style="list-style-type: none">• Needle inserted with patient head down and avoid open lumens
	Wire embolism	<ul style="list-style-type: none">• Ensure wire controlled throughout procedure, aiming to have a grip on it as much as possible
	Catheter related thrombosis	<ul style="list-style-type: none">• Appropriate VTE thromboprophylaxis
	Pulmonary embolism	<ul style="list-style-type: none">• Appropriate VTE thromboprophylaxis
Mechanical	Arterial puncture	<ul style="list-style-type: none">• Needle insertion under ultrasound guidance
	Intra-arterial placement of catheter	<ul style="list-style-type: none">• Needle insertion under ultrasound guidance• Ultrasound wire position prior to dilating tract• Transduce CVC at the end of the procedure
	Haemorrhage	<ul style="list-style-type: none">• Optimise coagulopathy prior to insertion
	Pneumothorax	<ul style="list-style-type: none">• Insertion under ultrasound guidance• Avoid going low in the neck if using internal jugular vein• Post-insertion CXR. High index of suspicion if patient deterioration• If unsure, seek help
	Arrhythmia	<ul style="list-style-type: none">• ECG monitoring throughout the procedure• Particular notice during wire insertion
	Thoracic duct injury	<ul style="list-style-type: none">• Post insertion CXR for chylothorax
	Cardiac tamponade	<ul style="list-style-type: none">• ECG monitoring and post-insertion CXR
Infectious	Catheter colonization	<ul style="list-style-type: none">• Aseptic technique on insertion• Use of 2% chloraprep to clean skin for insertion (can use appropriate chloraprep sponges)
	Catheterrelated blood stream infection	<ul style="list-style-type: none">• Transparent dressing• Daily review of need for CVC and remove if signs of infection





COMPLICATIONS

THROMBOEMBOLIC COMPLICATIONS

The presence of a central venous catheter is an independent risk factor for the development of thromboembolism. Anticoagulation is not recommended even in longer central venous access. A high index of suspicion is required, especially in patients who are higher risk (e.g. with cancer, hypercoagulable states, increased age and with a history of DVT/PE).

MECHANICAL COMPLICATIONS

One of the most common complications whilst learning CVC insertion is arterial puncture. Using ultrasound guidance will minimize this risk but does not exclude it. Ensure that you are clear which vessel is arterial and which is venous prior to needle insertion. If you are not clear do not continue and seek assistance.

When you do insert the needle and remove the syringe, the blood coming out of the needle should not be actively pulsatile or high pressure, and if in doubt remove the needle and reassess.

If you think you have punctured the artery, after removing the needle compress the neck for a few minutes and seek assistance before repeat puncture.

Always check that the wire is within the vein by repeat ultrasound prior to dilating up the tract.

INFECTIOUS COMPLICATIONS

- If infection is suspected at CVC insertion site, consider removal
- Re-insertion should occur at a separate site
- Consider antimicrobial treatment from either antimicrobial guidelines or local advice from a microbiologist
- A transparent dressing allows easy visualization of the site and permits cleaning of patients





COMPLICATIONS

CATHETER RELATED BLOOD STREAM INFECTIONS (CRBSI)

- Bacteraemia originating from an indwelling intravenous catheter and resulting infection is a rare but significant and potentially harmful late complication of central venous cannulation. Mortality rates due to catheter related sepsis are reported from 3-25%
- Following insertion, the surfaces of the catheter become coated with plasma proteins and fibrin and are colonised by organisms within hours of insertion. Thrombi adherent to the catheter also encourage bacterial growth and bacteraemia can occur once organisms reach a threshold count. Metastatic infection can occur from the lines and become deep seated, e.g. endocarditis, septic thrombus and septic arthritis
- The subclavian route of venous cannulation is the least likely site to lead to infection but this needs to be balanced against risks of insertion at this site
- Immunosuppression, the prevailing microbiological environment, e.g. ICU; frequent CVC access and poor aseptic technique are all associated with a higher risk of CRBSI. The cumulative risk of CRBSI also increases with length of time from insertion





COMPLICATIONS

DIAGNOSIS OF CRBSI IS BASED ON THE FOLLOWING:

- (i) The presence of a CVC
- (ii) Signs of catheter insertion site infection
- (iii) Clinical symptoms and signs of bacteraemia,
- (iv) Resolution of the symptoms and signs of bacteraemia after removal of the suspect CVC
- (v) Positive blood culture
- (vi) Growth of the same organism from the catheter

Often 2 of these criteria are used to make a potential diagnosis and unfortunately distinguishing growth from an infected catheter from a colonised catheter can be challenging.

Taking blood peripherally and through the CVC simultaneously can be used to distinguish likelihood of CRBSI using time to positivity or the relative numbers of bacteria through CVC related to the peripheral bacteraemia.

PREVENTION OF CRBSI

- Use a single-lumen catheter unless multiple ports are essential, in critical care however, multiple lumens are usually required
- For TPN, a dedicated CVC or lumen should be used exclusively
- If in long-term, use an implantable or tunneled catheter
- Consider the use of an antimicrobial impregnated catheter for patients at high risk of CRBSI
- Consider the route of insertion - balance site infection against other risks
- Consider the use of peripherally inserted catheters as an alternative to CVCs
- Aseptic technique during insertion and use alcoholic chlorhexidine solution
- A transparent, semi-permeable dressing should be used so the insertion site can be regularly inspected
- Regular catheter and catheter site care
- Change administration sets as per unit protocol (normally every 24 – 72 hours)
- Only access the line when absolutely necessary and using aseptic non-touch technique
- The need for central venous access should be reviewed on a daily basis and the CVC removed if possible





06 BASIC SCIENCES

A sound understanding of the relevant basic sciences related to central venous catheter insertion will allow you to improve your practice, predict and prevent problems



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ANATOMY

Central venous catheters are usually inserted in either the internal jugular, subclavian or femoral veins. The tip usually lies in the superior or inferior vena cava. Central access can also be via peripherally inserted central catheters (PICC) inserted usually into a vein via the antecubital fossa.

(Note insertion of PICC lines will not be covered in this programme)

Site	Advantages	Disadvantages
Internal Jugular	<ul style="list-style-type: none">• Easy to ultrasound / access• Low risk of pneumothorax• Easy to control bleeding• Cleaner site than femoral• Direct line into SVC	<ul style="list-style-type: none">• Higher rate of arterial puncture• Difficult landmarks in obesity• Access can be limited in patients with a tracheostomy / possible cervical spine injury• Can be uncomfortable for patients
Subclavian	<ul style="list-style-type: none">• Most comfortable for patients• Easily identifiable landmarks• Low risk of thrombosis / infection	<ul style="list-style-type: none">• Difficult to ultrasound• Higher risk of pneumothorax• Long passage from skin to vein
Femoral	<ul style="list-style-type: none">• No risk of pneumothorax	<ul style="list-style-type: none">• Higher rates of line infection• Inaccurate CVP monitoring• Prevents patient mobilising• Vein can be posterior to artery• Often need help with abdominal retraction

All sites can be visualised using ultrasound to minimise inadvertent damage or puncture to near-lying structures but a good knowledge of the surface and neighbouring anatomy is also vital to minimise risk. This program teaches using ultrasound. This is recommended by NICE guidelines and is the gold standard for central venous access; we therefore do not advocate using landmark techniques following this course unless separately trained, although these are possible and valid.

The cannulation of subclavian veins is not taught on this program and therefore separate training should be sought in this before practice.



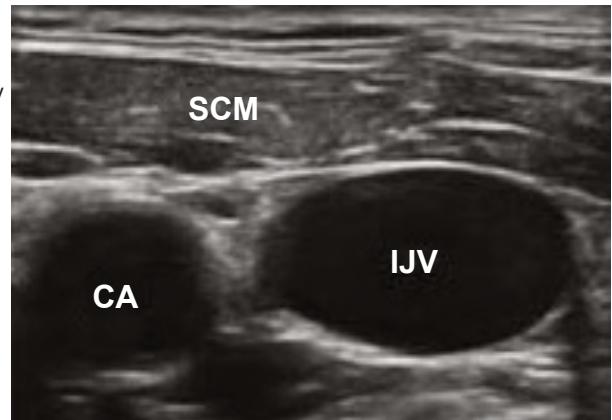
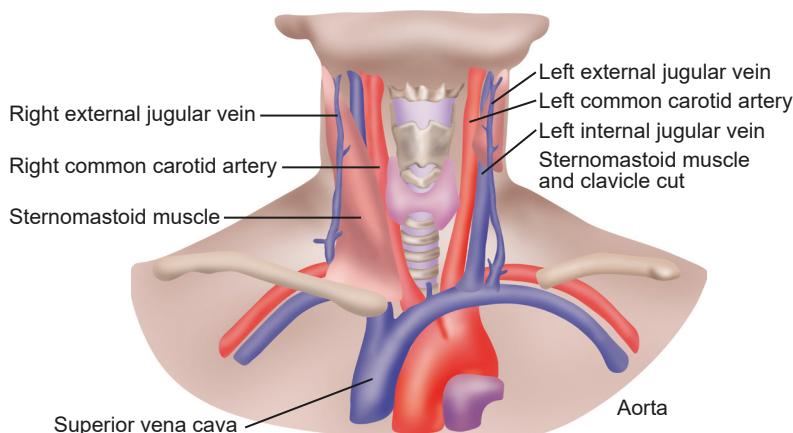


ANATOMY

ULTRASOUND ANATOMY OF THE NECK VEINS

The picture below shows the ultrasound anatomy of the internal jugular vein relevant to CVC insertion. Ensure that you are aware of the anatomy of the area as this will greatly aid use of ultrasound and insertion.

(SCM = Sternocleidomastoid, CA = Carotid Artery, IJV = Internal Jugular Vein)

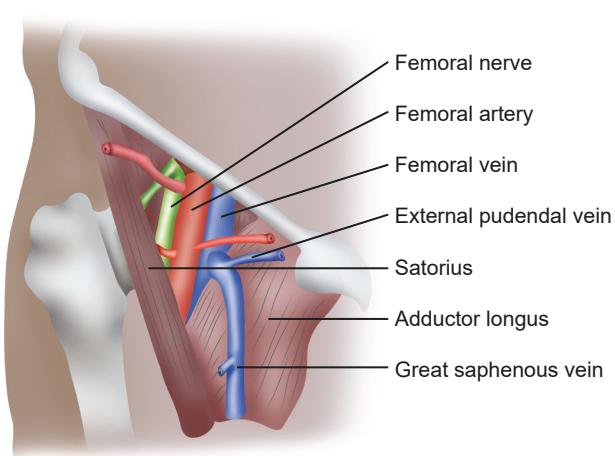


TIPS TO AID DISTINGUISHING VEIN AND ARTERY

- The position of the vein in relation to the artery relies on correct probe orientation and varies as you travel down the neck
- Beware of anatomical variants
- Absence of visible pulsation in vein
- Absence of pulsatile flow with colour doppler in vein
- The vein should be easy to compress with pressure, whereas the artery should not be
- The vein will vary in size with valsalva, patient respiration and coughing

ULTRASOUND ANATOMY OF THE FEMORAL VEIN

The picture demonstrates the ultrasound anatomy of the femoral triangle relevant to CVC insertion in this area. (V = Femoral Vein, A = Femoral Artery)





ULTRASOUND

Medical Ultrasound uses the transmission and reflection of electromagnetic waves between 2.5 and 15 MHz to visualise tissues. Interfaces between different tissues reflect ultrasound waves and the amplitude of each reflected wave is represented by a dot on the screen. All dots from different depths of tissue are combined to form an image on the screen. Stronger reflections create brighter area on the image (e.g. bone or gallstones) and weaker reflections create less bright, grey areas (e.g. most organs and muscles). Fluid does not reflect the ultrasound waves so the image shows a dark black area. These differences allow us to create a picture of tissues and their relative position and depth.

The probe used is important; a higher frequency emission probe has very good resolution but poor tissue penetration. These are best used for more superficial structures such as internal jugular vein CVC insertion. Lower frequency emission probes have better penetration for deep structures, (e.g. in the abdomen) but have poorer resolution.

Ultrasound machines are expensive and need to be used with care, cleaned following their use and used with appropriate sterile covers. Care should be taken not to damage the probe with needles.

Despite the differences in machines, the main controls to be aware of on the ultrasound machine are:

Depth allows you to increase the depth of the tissue ‘slice’ seen on the screen

Gain can make the brighter areas whiter - hence increasing contrast in some cases

Colour uses Doppler to superimpose direction and velocity of any flow over the 2D ultrasound image. This can be useful in distinguishing types of fluid on ultrasound

Benefits of using ultrasound for CVC insertion include:

- Detection of anatomical variants and exact vessel location
- Avoidance of thrombosed veins
- Confirmation of guidewire and catheter placement
- Increased success of CVC insertion and reduced number of attempts
- Reduced risk of insertion-related complications

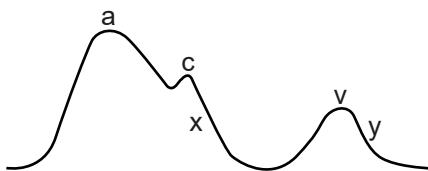




CENTRAL VENOUS PRESSURE

ULTRASOUND ANATOMY OF THE NECK VEINS

The central venous pressure (CVP) waveform reflects the changes within the right atrial pressure during the normal cardiac cycle.



- waves** (increases in right atrial pressure)
- a-wave:** right atrial contraction to expel blood into right ventricle
- c-wave:** isovolumetric ventricular contraction causing the closed tricuspid valve to bulge back into right atrium
- v-wave:** passive right atrial filling against closed tricuspid valve descents (decreases in right atrial pressure)
- x-descent:** combined atrial relaxation and reducing ventricular pressure due to opening of the pulmonary valve
- y-descent:** passive right atrial filling with open tricuspid valve

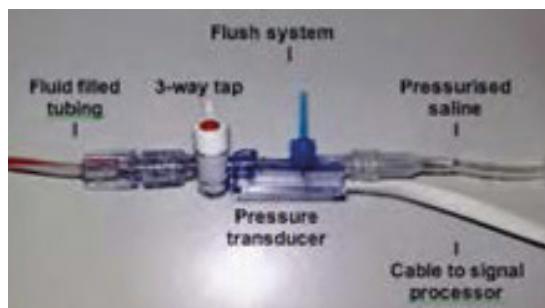
The CVP waveform, as seen above, is achieved by attaching an electrical transducer to the central line which can convert the mechanical energy from the central venous pulse to electrical energy that can be displayed on the monitor.

TRANSDUCING THE CVC

In theatre, intensive care and high dependency care, electrical transducers are used to produce a central venous pressure waveform on the monitor. The transducer converts the mechanical energy of the central venous pulse to electrical energy and a pressure waveform. A pressurised saline filled line is attached to one lumen of the central venous access and pulsation within this moves a diaphragm within the transducer. This is attached to a strain gauge and the resultant changes in electrical resistance represent waveforms, which are then displayed on the monitor.

Equipment required to transduce the central line:

- Pressure bag
- Transducer and fluid giving set specific to central lines (see below picture)
- 500ml 0.9% saline



To ensure accurate pressures, the transducer must be positioned at the level of the patient's right atrium, which acts as a haemodynamic reference point for all monitoring devices. In addition to the transducer being positioned at the correct height, the reading must also be zeroed to atmospheric pressure.





07 EQUIPMENT & RESOURCES

Taking time to ensure you have the equipment and resources you require will ultimately make your task easier, allowing you to consider eventualities and how you will deal with them



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CHECKLIST

EQUIPMENT AND RESOURCES

The following should be available before commencing the procedure:

- Place of safe and sterile insertion (Theatres, HDU, ITU)
- Experienced and skilled assistant +/- competent supervisor
- Bed that can be tilted
- Inco pads
- Large sharps bin
- Procedure trolley
- Appropriate monitoring
 - 3 Lead ECG & SPO₂ as a minimum
 - Consider NIBP and ETCO₂
- Transducer equipment for line
- Ultrasound machine with linear probe, sterile probe cover & sterile gel
 - Us used for skin to sheath contact must be properly sterile double wrapped gel
- Sterile gloves, surgical barrier mask and surgical headcap
- Antiseptic solution (1 of):
 - 2% Chloraprep sponge applicators (recommended)
 - Iodine based solution
- CVC insertion pack (usually includes)
 - Surgical gown
 - Surgical drape (ideally a transparent window drape with adhesive edges)
 - Scalpel
 - Sterile swabs
 - Suture (e.g. Mersilk)
 - Tray
 - Gallipots x2
 - 10ml syringe x2
 - 5ml syringe x1
 - Green (21g) needle x1
 - Large sterile adhesive dressing
- Central line (should include line, guidewire, dilator and needle / cannula)
- Smart sites and 3 way taps as required for line
- Lignocaine 1% or 2%
- 0.9% Sodium chloride 20mls





08 INSERTION PROCEDURE

Phase 1 - Preparation & Positioning

Phase 2 - Procedural Pause

Phase 3 - Asepsis & Anaesthesia

Phase 4 - Insertion

Phase 5 - Anchoring & Dressing

Phase 6 - Completion



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PHASE 1 - PREPARATION AND POSITIONING

OBTAINT INFORMED CONSENT FOR THE PROCEDURE

- Explain the procedure and provide patient information leaflet if possible
- Explain the alternatives to the procedure
- Discuss potential complications and their management
- Written informed consent is the gold standard
- Adults with incapacity form if appropriate

ASSESS RELATIVE CONTRAINDICATIONS

- Check for anticoagulant or antiplatelet medications
- Clotting Screen and platelet count
- Ensure competent practitioners and adequate supervision available
- If the patient is seriously unwell and/ or agitated, contact ICU senior for advice and assistance (it may be that the patient would be better served by being sedated +/- intubated prior to line insertion)

PATIENT AND CLINICIAN PREPARATION

- The patient may wish to visit the bathroom prior to positioning
- Ensure bed height is appropriate and seat available if required
- Remove pager and mobile phone
- Ensure your assistant is prepared and appropriately skilled to support you
- Reassure patient
- Attach patient monitoring - ECG and SPO₂ mandatory, consider NIBP

PATIENT POSITIONING

- For internal jugular CVC insertion, lie patient on bed with head on a pillow and head turned facing slightly away from the insertion site
- Bed should be tipped to a head down position and height adjusted as necessary
- Check patient is comfortable in this position
- Visualise the veins using non-sterile ultrasound at this stage to check normal anatomy and no obvious thrombus in vein

ARRANGE EQUIPMENT

- Ascertain best ergonomics of patient, ultrasound display and tray around yourself
- Your assistant will now retrieve your central line pack, line and all necessary equipment onto your tray whilst maintaining sterility. Do not open pack until you have scrubbed, to avoid contamination by water splashback
- Ensure trolley on correct side for clinician





PHASE 2 - PROCEDURAL PAUSE

- Visualise the procedure in the correct order
- Perform a verbal rehearsal with your assistant
- Perform a 3 point check; Patient, Assistant and yourself
- Provide everyone present the opportunity to speak up prior to commencing
- Perform a final equipment check



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PHASE 3 - ASEPSIS & ANAESTHESIA

ASEPSIS

- Ensure that the patient is lying on absorbent pads and that clothing has been moved out of the way
- Put on surgical mask and hat
- Surgically scrub hands and dry with sterile hand towels before sterile pack is opened by assistant, to reduce risk of contamination from splash back
- Put on sterile gown and gloves
- Apply antiseptic skin wash via non-touch technique
- Allow skin to dry

DRAPE THE PATIENT

- Take care not to touch the patient or surroundings
- Ensure a large enough sterile field (including ability to feel and reassess landmarks without contamination)
- Assistant may need to tape corners of drape to patient's gown etc

IDENTIFY CVC INSERTION SITE

- Place ultrasound into sterile sheath using sterile gel inside and outside sheath
- Maintain sterility whilst doing so
- Re-visualise anatomy using gel on patients neck and double check probe orientation and that you are sure which vessel is venous and which arterial
- Draw up 10mls 0.9% saline and flush all central line lumens
- Stop and check before needle to neck

LOCAL ANAESTHETIC

- Infiltrate skin and subcutaneous tissue with local anaesthetic under ultrasound guidance
- Ensure local anaesthetic covers areas where stitches will be inserted
- Use the depth of this needle to the vein as a guide as to the depth to the vein
- Allow local anaesthetic time to work





PHASE 4 - INSERTION

Please note there will be a degree of individual clinician variation here. Clinicians may have a preferential order for insertion of introducer needle, guidewire and skin incision. All are valid, as long as performed in a safe manner.

INSERT INTRODUCER NEEDLE OR CANNULA

- Insert the needle attached to a syringe or over a cannula
- Direct the tip of the needle under ultrasound guidance into the vein, withdrawing the plunger throughout
- Take care to know where the tip of your needle is at all times and to watch the ultrasound rather than the needle itself
- Set yourself a maximum depth and if you have not got flashback at this point, remove the needle and review
- As soon as you can feel or see entry into the vein, either advance the cannula over the needle, or keep the needle still whilst removing the syringe from the needle

INSERT GUADEWIRE

- Thread the guidewire through the needle or cannula
- No resistance should be felt if the needle is in the vessel; do not force the wire at any time. If you experience resistance, stop and review the situation. If in doubt, remove the wire
- Watch the patient's ECG (or ask someone else to) as you may cause ectopic beats if the guidewire reaches the heart. If this happens, pull the wire back until they cease
- Remove the introducer needle over the guidewire making sure that the guidewire remains at the same depth and does not move
- Use the ultrasound to visualise the guidewire within the vein
- Guidewire must be under clinician's control throughout

INCISE SKIN

- Carefully apply scalpel in the direction of the wire, with the straight edge of the blade to the wire and the cutting edge facing away from the wire
- Make a small nick / incision in a horizontal plane to the skin. Too big an incision will cause bleeding at the insertion site
- Expect mild bleeding / ooze - wipe with sterile gauze





DILATE TRACT

- Advance dilator over wire
- Warn patient that they may feel pressure / discomfort
- Only dilate subcutaneous tissue (any further may cause vessel damage)
- Keeping the guidewire still, remove the dilator. Usually the dilator would be advanced to about 5-6 cm.
- Expect more bleeding - wipe with sterile gauze

INSERT CENTRAL VENOUS CATHETER

- Advance central line over guidewire. It should enter the vessel easily
- Ensure that the guidewire protrudes from the end of the central line before this enters the patient. The guidewire will leave through the distal lumen of the central line
- Keeping hold of the guidewire, insert up to an appropriate patient-dependent length (16cm lines should be placed to the hilt in the left internal jugular and femoral)
- Keep hold of the wire at all times
- Remove the guidewire completely - ensure no air entry through open lumen
- Check line is in vessel by aspirating and flushing all lumens with saline
- Transduce the CVC to ensure venous placement





PHASE 5 - ANCHORING & DRESSING

INSERT SUTURE

- Insert suture ensuring that the actual CVC is secured to the skin at a minimum of 2 points with at least 2 separate sutures
- Ideally 2 sutures through the eyes on the CVC hilt
- Suturing and securing the line using standard or non standard approach shown below

Standard Approach

All left internal jugular, left sub-clavian and femoral lines should be inserted to the hilt and secured using 3 separate sutures as shown:



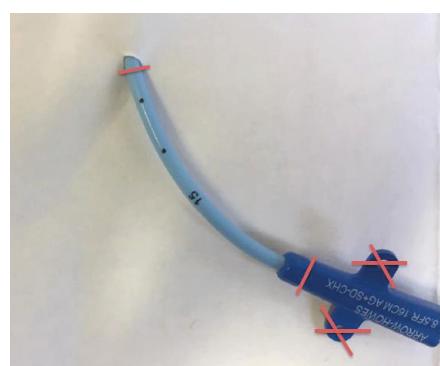
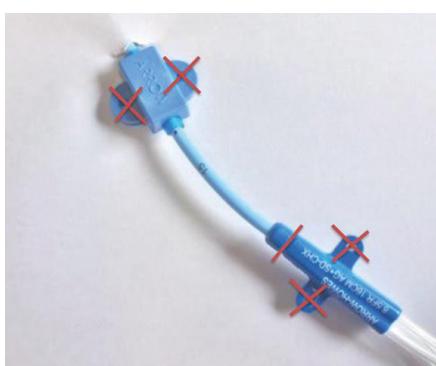
The vast majority right internal jugular and right subclavian lines will also be suitable for this standard technique.

Non Standard Approach

A very small number of patients may have anatomy (ie extreme short stature) that suggests there is a risk that a standard line when placed to the hilt may leave the tip of the CVC in the right ventricle. In this instance the line insertion depth and therefore securing technique should be adjusted. The decision to deviate from the standard insertion technique should be discussed with a senior tier trainee or consultant.

In this instance once the line is at the required depth, the CVC should still be secured using the above 3 suture technique. The line will also require to be secured at the skin insertion point. This may be done using a looped suture (termed "Scotty" knot) if the user is proficient in this technique.

It may also be done using the provided clip with 2 separate sutures:





DRESS CVC

- using central line dressing

FIX SMART SITES

- All lumens should have a smartsite when finished
- Consider keeping a lumen protected for TPN
- Ensure smart sites are tightly fixed to prevent entraining air

TRANSDUCE THE CVC

- Whilst sterile, attach the prepared transducer line to the distal lumen of the central line
- Zero the line and check that the pressure is likely to be venous and a central venous waveform is produced
- Prior to use, ALL central lines must be transduced to ensure venous placement





PHASE 6 - COMPLETION

- DISPOSE OF WASTE AND SHARPS APPROPRIATELY
- ENSURE PATIENT COMFORTABLE AND SAFE
- PROVIDE INSTRUCTIONS TO PATIENT AND NURSING STAFF

PATIENT INSTRUCTIONS

- Please let the team know if you have any pain, notice any bleeding from the site of insertion or feel short of breath or dizzy

STAFF INSTRUCTIONS

- Central venous catheters should only be managed by staff that are trained and competent to do so. Please refer to your local policies

DOCUMENTATION

- Document the procedure
- Complete invasive devices record

ORDER AND REVIEW A CHEST X-RAY

- To check appropriate placement of central line in the superior vena cava above the level of the carina
- Document CXR review on invasive devices chart

HANOVER OF INFORMATION

- To the team regarding ongoing care of the line, suitability for use and plans for reviewing need / replacement with an appropriate timescale for removal

ULTRASOUND MACHINE CARE

- Ensure US machine has been cleaned appropriately and returned





09 APPENDICES

[Central Line Insertion Mastery Checklist](#)

[Appendix 1 - Consent](#)

[Appendix 2 - Essential Equipment](#)

[References](#)



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Central Line Insertion Checklist

(Ultrasound Guided)

Name			Date		
Grade			Tutor	Session	
Hospital			Unit		

Skill Phase & Component	Start Yes	Start No	End Yes	End No
Phase 1 - Preparation & Positioning				
Discusses consent, contra-indication and patient preparations (appendix 1)				
Lists risks (see appendix 1)				
Lists correct equipment (see appendix 2)				
Optimises environment and ergonomics, minimises distraction				
Indicates site and visualises anatomy with ultrasound				
Establishes satisfactory position (discussion and demonstration)				
Phase 2 - Procedural Pause				
Performs 3-point check: Patient, Assistant and Clinician				
Phase 3 - Asepsis & Anaesthesia				
Puts on Surgical Mask & Hat / Washes Hands / Gown & Sterile Gloves				
Applies antiseptic to skin and allows to dry				
Drapes patient with fenestrated drape				
Performs final equipment check, primes & closes lumens (except brown)				
Sheathes ultrasound probe				
Phase 4 - Insertion				
Infiltrates local anaesthetic				
Inserts introducer needle or cannula (under ultrasound guidance)				
Inserts guide-wire – J tip first, appropriate length, monitoring ECG				
Checks wire position on ultrasound				
Incises the skin				
Dilates tract to suitable depth				
Inserts central line				
Aspirates and flush all lumens to ensure system functional				
Maintains control of wire throughout				
Transduces line				
Phase 5 - Anchoring & Dressing				
Inserts suture(s) to secure line				
Applies adhesive dressing(s) over insertion point				
Ensures all 3-way taps are close to patient & considers TPN isolation				
Phase 6 - Completion & Global Points				
Maintains sharp safety throughout, disposes appropriately				
Maintains asepsis throughout				
Completion (discussion – assess Pt, CXray, documentation, clean USS)				
Total Score (out of 25)	/ 25		/ 25	

Comments:





APPENDIX 1 - CONSENT

CENTRAL LINE INSERTION (Ultrasound Guided)

Item	Achieved
Describes procedure	
Indications: Vasoactive drugs, TPN, Renal replacement therapy, CVP monitoring, Cardiac output monitoring	
Contraindications: Patient refusal, local infection, bleeding diathesis (relative contraindication), thrombosis, cardiac instability (relative contraindication)	
Risks	
Thromboembolic (air embolism, wire embolism, catheter related thrombosis, pulmonary embolism)	
Mechanical complications (arterial puncture, intra-arterial placement of catheter, haemorrhage, pneumothorax, arrhythmia, thoracic duct injury, cardiac tamponade)	
Infectious complications (catheter colonisation, catheter-related blood stream infection)	
Informed consent if patient has capacity, or AWIA if not	
Safety	
Identifies correct patient & well enough for procedure	
Checks bleeding risks (Plt > 80 / INR < 1.4 / Drugs e.g. LMWH/DOAC)	
Patient position	
Tilting (head down) bed	
Personal preparation: Empty bladder, hand over bleep, brief nursing assistant, fatigue, hunger/thirst, distractions, safety on the ward	





APPENDIX 2 - ESSENTIAL EQUIPMENT

CENTRAL LINE INSERTION (Ultrasound Guided)

Item	Achieved
Tilting bed	
Transducer kit, run through and set up	
Surgical gown, sterile gloves, face mask and surgical headcap	
Appropriate monitoring (3 lead ECG & O2 saturations probe)	
Ultrasound machine & sterile sheath	
CVC insertion pack	
Antiseptic solution - 2% chloraprep sponge applicators (recommended) OR - Iodine based solution (if no allergy)	
Central line (should include, swabs needle, cannula, guidewire, dilator, line & syringe)	
Lignocaine 1% or 2%	
Sterile ultrasound gel	
Needles for local anaesthetic	
Appropriate sized syringes	
Suture	
Dressing	
Sterile 0.9% sodium chloride	





REFERENCES

Catheter-related bloodstream infection; Fletcher, S. Continuing Education in Anaesthesia, Critical Care & Pain: 5(2); 2005.

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