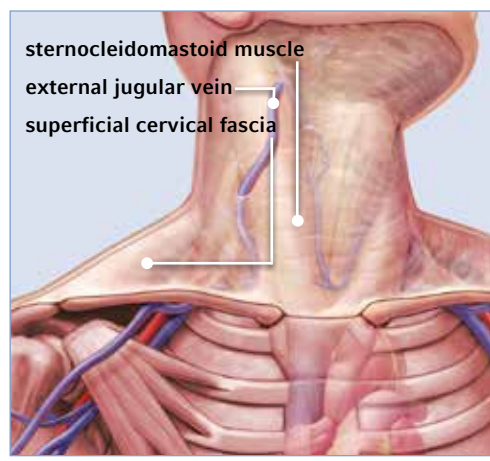


INSERTION SITES, LANDMARKS AND INSERTION ORIENTATION

Practitioners must become familiar with the signs, symptoms, interventions and preventive measures for catheter-related complications at all insertion sites.

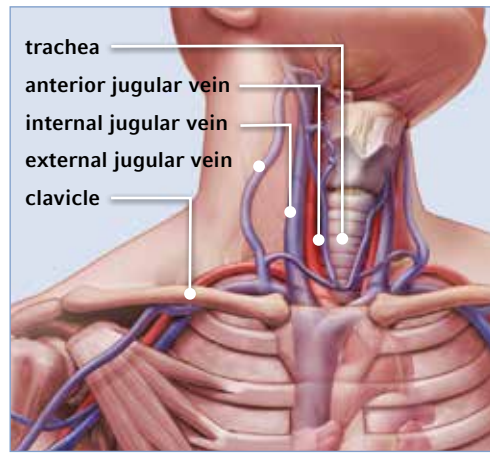
EXTERNAL JUGULAR (EJ)



- LANDMARKS**
- vessel is part of surface anatomy
- INSERTION ORIENTATION**
- needle can be inserted into vessel as visualised in the neck
- ADVANTAGES**
- easy to locate, visible
- DISADVANTAGES**
- difficult to cannulate (vessel rolling, valves, tortuous path)
 - higher complication rate compared with other sites (thrombosis, infection)
 - problematic in patients with tracheostomies
 - difficult dressing maintenance

- ADJACENT ANATOMY**
- carotid artery
 - phrenic and vagus nerves
 - pulmonary apex
 - thoracic duct (left side only)
- POSSIBLE COMPLICATIONS**
- arterial puncture
 - nerve damage
 - pneumothorax
 - pleural effusion
 - chylothorax (Thoracic duct)

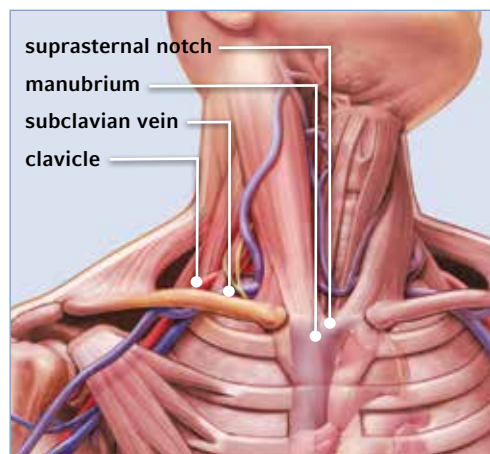
INTERNAL JUGULAR (IJ)



- LANDMARKS**
- angle of mandible
 - two heads of sternocleidomastoid muscle
 - clavicle
 - external jugular vein
 - trachea
- INSERTION ORIENTATION**
- Central:** Insert needle at apex of triangle formed by the two portions of the sternocleidomastoid muscle and the clavicle. Insertion depth 3 cm–5 cm.
 - Anterior:** Insert needle at midpoint of sternal head of the sternocleidomastoid muscle (approximately 5 cm from the angle of the mandible) and aim towards the feet and ipsilateral nipple. Insertion depth 2 cm–4 cm.
 - Posterior:** Insert needle approximately 1 cm to the rear of where the EJ and the sternocleidomastoid muscle meet. Insertion depth 5 cm–7 cm.

- ADVANTAGES**
- large vessel size
 - easy to locate
 - easy access
 - short, straight path to superior vena cava (right side)
 - low complication rate
- DISADVANTAGES**
- close proximity to carotid artery
 - higher infection rate compared with other sites
 - problematic in patients with tracheostomies
 - uncomfortable to patient
 - difficult dressing maintenance
- ADJACENT ANATOMY**
- carotid artery
 - phrenic and vagus nerves
 - pulmonary apex
 - thoracic duct
- POSSIBLE COMPLICATIONS**
- arterial puncture
 - nerve damage
 - pneumothorax
 - pleural effusion
 - chylothorax

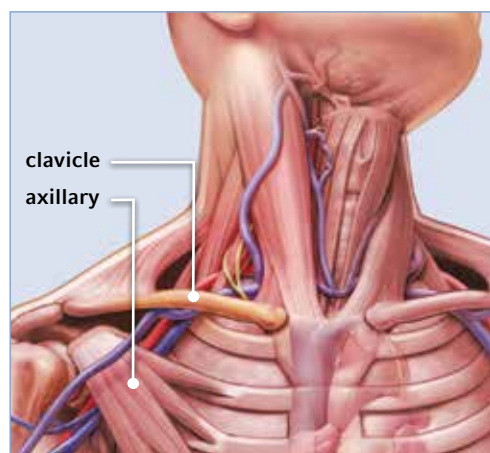
SUBCLAVIAN



- LANDMARKS**
- clavicle
 - two portions of sternocleidomastoid muscle
 - suprasternal notch
 - manubriosternal junction
- INSERTION ORIENTATION**
- Infraclavicular:** Insert needle 2 cm–3 cm caudal to midpoint of the clavicle where the clavicle slants towards the manubrium. Insertion depth may be as much as to 10 cm.
 - Supraclavicular:** Insert needle into the angle formed by the clavicle and the sternocleidomastoid muscle at 45 degrees. Insertion depth 1 cm–4 cm.
- ADVANTAGES**
- large vessel with high flow rate
 - lower infection rate compared with other sites
 - easy to maintain dressing
 - less restricting for patient

- DISADVANTAGES**
- lies close to the lung apex (pneumothorax risk)
 - close proximity to subclavian artery
 - difficult to control bleeding (noncompressible vessel)
 - risk of pinch-off
 - difficult to visualise when using ultrasound
- ADJACENT ANATOMY**
- subclavian artery
 - pulmonary apex
 - right lymphatic duct
 - costoclavicular ligament, first rib
- POSSIBLE COMPLICATIONS**
- arterial puncture
 - pneumothorax, pleural effusion
 - chylothorax
 - pinch-off

AXILLARY



- LANDMARKS**
- lateral to clavicle
 - inferior to the axillary artery
 - deltopectoral groove
 - deep to pectoralis minor muscle
- INSERTION ORIENTATION**
- Ultrasound guided, transverse (out of plane)**
Needle is guided into the axillary vein at a steep angle (45–90 degrees), in the inferior-lateral portion of the deltopectoral groove. Insertion depth, 1.5–5 cm.
 - Ultrasound guided, longitudinal (in plane)**
This approach uses a flatter angle, in the lateral portion of the deltopectoral groove. The shaft of the needle is seen throughout the course of the insertion. Insertion depth, 1.5–5 cm.

- ADVANTAGES**
- large vessel with high flow rate
 - lower infection rate compared with other sites
 - easy to maintain dressing
 - easy to control bleeding (compressible vessel)
 - patient comfort
- DISADVANTAGES**
- potentially a longer learning curve than the IJ vein
 - deeper than the IJ vein
 - proximity to the axillary artery
- ADJACENT ANATOMY**
- axillary artery
 - pleural space
 - brachial plexus
- POSSIBLE COMPLICATIONS**
- arterial puncture, haematoma
 - pneumothorax
 - nerve injury

BASILIC VEIN

- ADVANTAGES**
- largest, straight pathway in the upper arm
 - enhanced by positioning the arm at 90-degree angle from body

- DISADVANTAGES**
- may be located too far towards the middle or back, making insertion and care difficult
 - close proximity to brachial artery and some branches of the internal cutaneous nerve

BRACHIAL VEIN (Only used with ultrasound-assisted insertion)

- ADVANTAGES**
- large vessel
 - usually undamaged, even in patients with history of many IVs

- DISADVANTAGES**
- deep location. Insertion requires ultrasound guidance
 - proximity to median nerve poses risk of nerve injury

CEPHALIC VEIN

- ADVANTAGES**
- easy access for insertion and care
 - easy to palpate and locate visually

- DISADVANTAGES**
- vessel may be small with a tortuous pathway
 - joins axillary vein at an angle that may make advancement difficult
 - vessel narrows as it ascends the upper arm

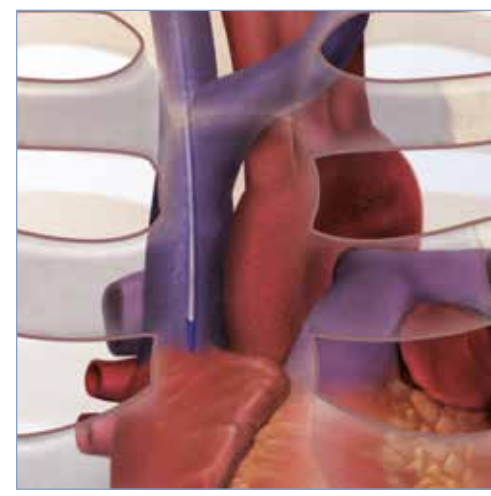
MEDIAN CUBITAL VEIN

- ADVANTAGES**
- easy access for insertion and care
 - may be most prominent vessel in the antecubital fossa

- DISADVANTAGES**
- anatomy may vary from person to person
 - may be difficult to insert due to valve locations

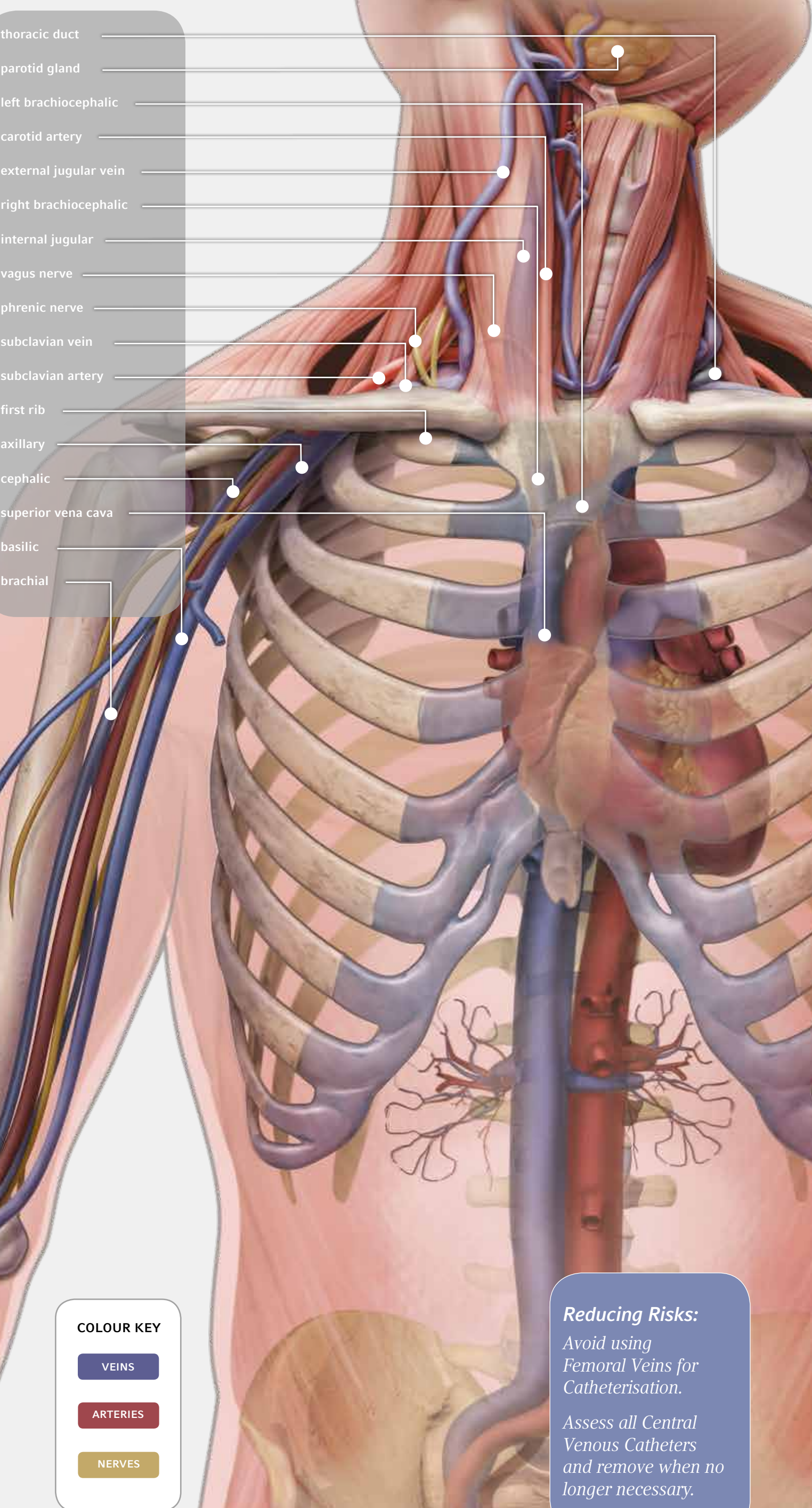
SECURE, DRESS AND CONFIRM CATHETER PLACEMENT

- SECURE AND DRESS THE CATHETER**
- In accordance with hospital policy, utilise the following method for catheter securement and dressing:
- clean blood or exudates from site using sterile saline or skin antiseptic solution
 - apply a chlorhexidine sponge dressing
 - use sutures or manufactured stabilisation device to secure catheter
 - apply transparent semi-permeable dressing securely over site
 - change the dressing at established intervals and when visibly soiled or compromised



- VERIFY CATHETER TIP POSITION**
- In accordance with hospital policy, utilise one of the following methods to verify tip placement:
- radiographic imaging (chest film, fluoroscopy)
 - physiological feedback such as EKG
 - other approved methods
- Appropriate tip placement for central venous catheters (other than dialysis catheters) is in the lower one-third of the superior vena cava or at the cavoatrial junction
- If catheter tip is malpositioned, reposition and check tip position.

ANATOMY OVERVIEW

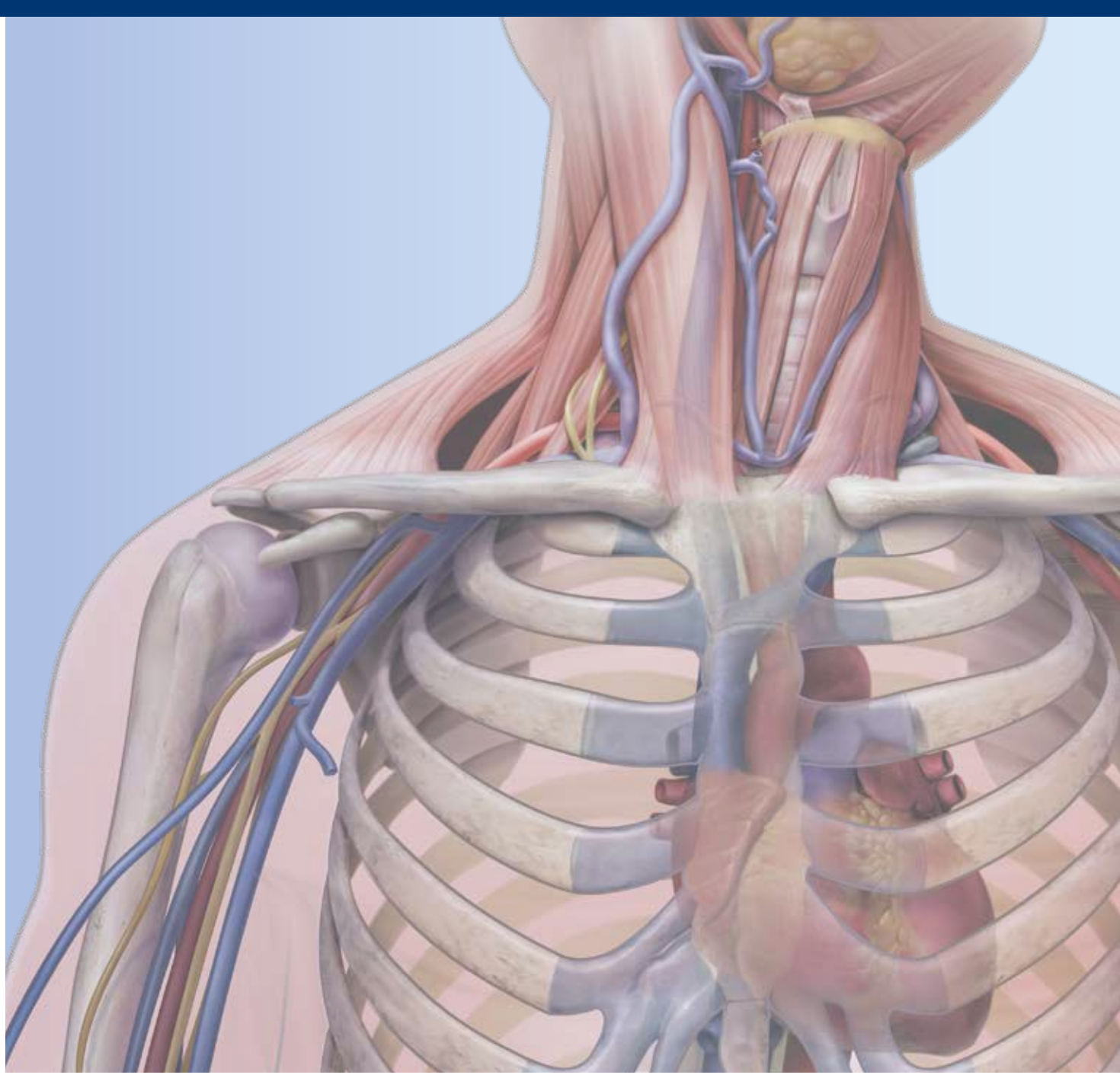


COLOUR KEY

- VEINS (Blue)
- ARTERIES (Red)
- NERVES (Yellow)

Reducing Risks:
Avoid using Femoral Veins for Catheterisation.
Assess all Central Venous Catheters and remove when no longer necessary.

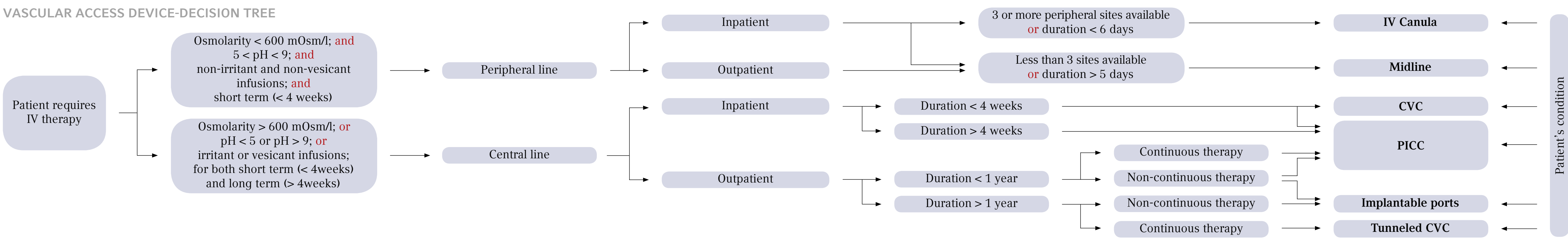
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PRINCIPLES OF VASCULAR ACCESS INSERTION

PRINCIPLES OF VASCULAR ACCESS INSERTION

VASCULAR ACCESS DEVICE-DECISION TREE



SELDINGER TECHNIQUE

- After administering local anaesthetic, locate vein using thin-wall introducer needle. Vessel may be prelocated with a smaller needle.
- Remove syringe. Confirm venous placement by using haemodynamic monitoring or checking for pulsatile blood flow. Pulsatile flow is usually an indicator of inadvertent arterial puncture.
Warning: The colour of blood is not always an accurate indication of venous entry.
- Immediately occlude needle lumen to prevent air embolism or bleeding.
- Using a straightening tube, straighten J tip of spring wire guide, if used, and advance into vessel through needle.
- Hold spring wire guide in place and remove needle.
Precaution: Maintain a firm grip on spring wire guide at all times.
- If making skin-nick, enlarge cutaneous puncture site with cutting edge of scalpel positioned away from spring wire guide.
- If using tissue dilator, pass it over spring wire guide to enlarge site as needed.
Warning: Do not apply excessive force while advancing the dilator, spring wire guide damage can occur. To avoid possible vessel wall perforation, do not leave tissue dilator in place as an indwelling catheter.
- Thread tip of catheter over spring wire guide allowing spring wire guide to exit hub.
- Grasping catheter near skin, advance into vein with a slight twisting motion.
Warning: Maintain control of spring wire guide at all times to avoid wire embolisation.
- Advance catheter into final indwelling position. Hold catheter and remove spring wire guide. Check lumen placement by aspirating through hub.

USING RAULERSON SYRINGE

- After administering local anaesthetic, locate vein using thin-wall introducer needle attached to Raulerson syringe.
- Verify venous access by inserting fluid-primed transduction probe into rear of Raulerson syringe and through syringe valves. Observe for venous placement via wave form obtained by a calibrated pressure transducer. Remove transduction probe.
- Using the spring wire guide advancer, straighten J tip of spring wire guide, if used, and advance through rear of syringe plunger.
Warning: To avoid severing or damaging wire, do not cut spring wire guide to alter length, or withdraw spring wire guide against needle bevel. Do not insert stiff end of soft tip guidewire into vessel as this may result in vessel damage.
- Hold spring wire guide in place and remove Raulerson syringe and needle.
Precaution: Maintain a firm grip on spring wire guide at all times.
- If making skin-nick, enlarge cutaneous puncture site with cutting edge of scalpel positioned away from spring wire guide.
- If using tissue dilator, pass it over spring wire guide to enlarge site as needed.
Warning: To avoid possible vessel wall perforation, do not leave tissue dilator in place as an indwelling catheter.
- Thread tip of catheter over spring wire guide allowing spring wire guide to exit hub.
- Grasping catheter near skin, advance into vein with a slight twisting motion.
Warning: Maintain control of spring wire guide at all times to avoid wire embolisation.
- Advance catheter into final indwelling position. Hold catheter and remove spring wire guide. Check lumen placement by aspirating through hub.

Reducing Risks:
There are two key benefits to using the Raulerson syringe. First, it lessens the exposure to blood and can lower the risk of air embolism. Second, it enables you to place the catheter in fewer steps, with less risk of dislodging needle from vessel.

MODIFIED SELDINGER TECHNIQUE

- Catheter/Needle assembly may be used in place of the thin-wall introducer needle.
- Remove needle and syringe, leaving catheter in vessel.
Warning: To avoid possible catheter embolus, do not reinsert needle into catheter.
- Immediately occlude catheter lumen to prevent air embolism or bleeding.
- Advance wire through IV catheter.
Warning: Do not cut spring wire guide.
- Hold spring wire guide in place and remove IV catheter.
Precaution: Maintain a firm grip on spring wire guide at all times.
- If making skin-nick, enlarge cutaneous puncture site with cutting edge of scalpel positioned away from spring wire guide.
- Thread tissue dilator with peelable sheath onto the wire and through the subcutaneous tissue using a slight twisting motion, to a depth sufficient to enter the vessel.
- Remove the tissue dilator and wire as a unit, leaving peelable sheath in the vein. To control blood loss as you remove dilator, place gloved finger over the sheath opening.
- Thread the catheter slowly through the peelable sheath.
Warning: If you meet resistance, retract catheter, reposition arm and reattempt to insert catheter. When inserting the last 20 cm of a PICC, ask patient to turn head toward arm with PICC and tuck chin into clavicle. This will reduce the chance of internal jugular placement.
- Withdraw peel-away sheath from catheter until free from venipuncture site. Grasp tabs of peel-away sheath and pull apart, away from catheter, until sheath splits down entire length. Advance catheter into final indwelling position. Check lumen placement by aspirating through the hub.

RECOMMENDATIONS FOR CENTRAL LINES INSERTION & REMOVAL

HAND HYGIENE AND ASEPTIC TECHNIQUE

Maintain hand hygiene, either by washing hands with conventional soap and water or with alcohol-based hand rubs (ABHR). Hand hygiene procedures should be performed before and after palpating catheter insertion sites as well as before and after inserting, replacing, accessing, repairing, or dressing an intravascular catheter. Category IB.

Maintain aseptic technique for the insertion and care of intravascular catheters. Category IB.

Sterile gloves should be worn for the insertion of arterial, central, and midline catheters. Category IA.

MAXIMAL STERILE BARRIER PRECAUTIONS

Use maximal sterile barrier precautions, including the use of a cap, mask, sterile gown, sterile gloves, and a sterile full body drape, for the insertion of CVCs, PICCs, or guidewire exchange. Category IB.

SKIN PREPARATION

Prepare clean skin with a > 0.5% chlorhexidine preparation with alcohol before central venous catheter and peripheral arterial catheter insertion and during dressing changes. If there is a contraindication to chlorhexidine, iodine tincture, an iodophor, or 70% alcohol can be used as alternatives. Category IA.

No recommendation can be made for the safety or efficacy of chlorhexidine in infants aged < 2 months (unresolved issue).

Antiseptics should be allowed to dry according to the manufacturer's recommendation before placing the catheter. Category IB.

SELECTION OF CATHETERS AND SITES

Weigh the risks and benefits of placing a central venous device at a recommended site to reduce infectious complications against the risk for mechanical complications (e.g., pneumothorax, subclavian artery puncture, subclavian vein laceration, subclavian vein stenosis, haemothorax, thrombosis, air embolism,

and catheter misplacement). Category IA.

Avoid using the femoral vein for central venous access in adult patients. Category IA.

Use a subclavian site, rather than a jugular or a femoral site, in adult patients to minimise infection risk in nontunneled CVC placement. Category IB.

Avoid the subclavian site in hemodialysis patients and patients with advanced kidney disease, to avoid subclavian vein stenosis. Category IA.

Use a CVC with the minimum number of ports or lumens essential for the management of the patient. Category IB.

Use ultrasound guidance to place central venous catheters (if this technology is available) to reduce the number of cannulation attempts and mechanical complications. Ultrasound guidance should only be used by those fully trained in its technique. Category IB.

CENTRAL LINES REPLACEMENT & REMOVAL

Do not routinely replace CVCs, PICCs, hemodialysis catheters, or pulmonary artery catheters to prevent catheter-related infections. Category IB.

Promptly remove any intravascular catheter that is no longer essential. Category IA.

When adherence to aseptic technique cannot be ensured (i.e. catheters inserted during a medical emergency), replace the catheter as soon as possible, i.e. within 48 hours. Category IB.

REFERENCE

CDC: Guidelines for the Prevention of Intravascular Catheter-Related Infections 2011
Naomi P. O'Grady, M.D.1, Mary Alexander, R.N.2, Lillian A. Burns, M.T., et Al.