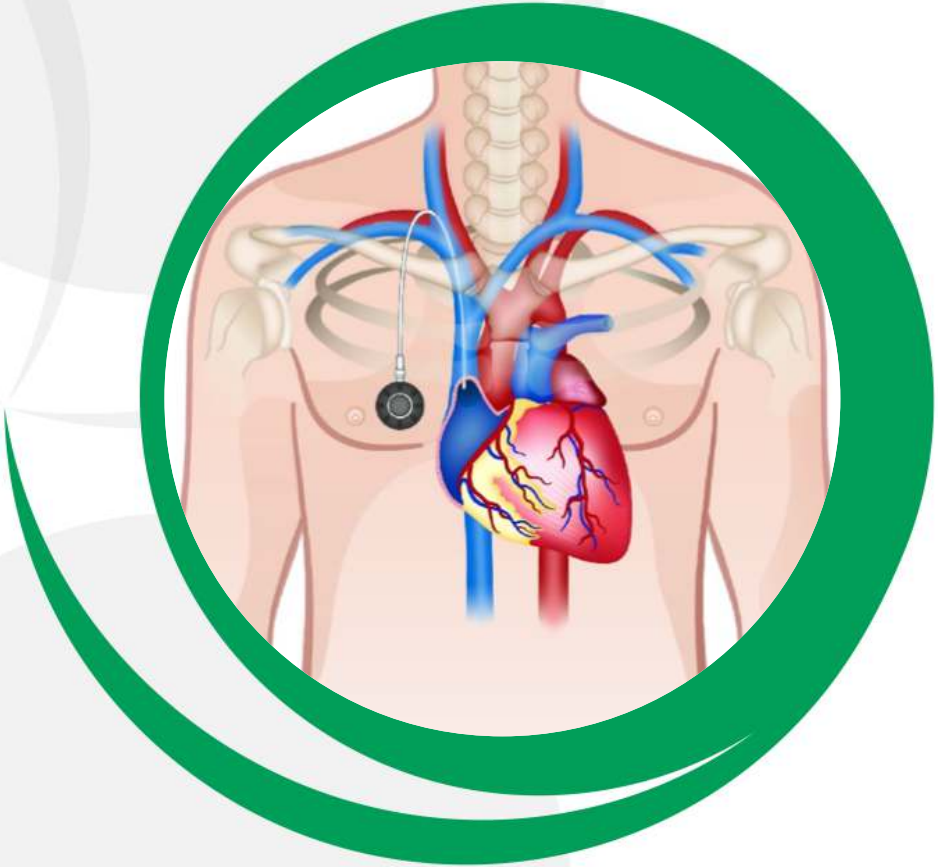


VYGON

Anatomy & Physiology

Related to Tunnelled Central Venous Catheter and Ports

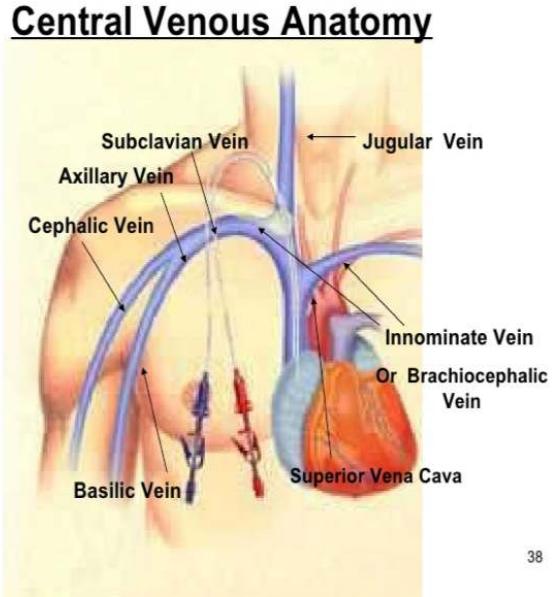
VYGON

Central Venous Anatomy

Anatomy & Physiology

Central Venous Anatomy

- This short presentation will provide information about anatomy and physiology as it relates to the insertion of Tunnelled Central Venous Catheters (TCVCs) and Totally Implanted Vascular Access Devices (TIVADs).



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Aims and Objectives

By the end of this session, you should be able to:

Identify and describe the most appropriate veins used for TCVC and TIVAD placement

Discuss the advantages and disadvantages of each approach

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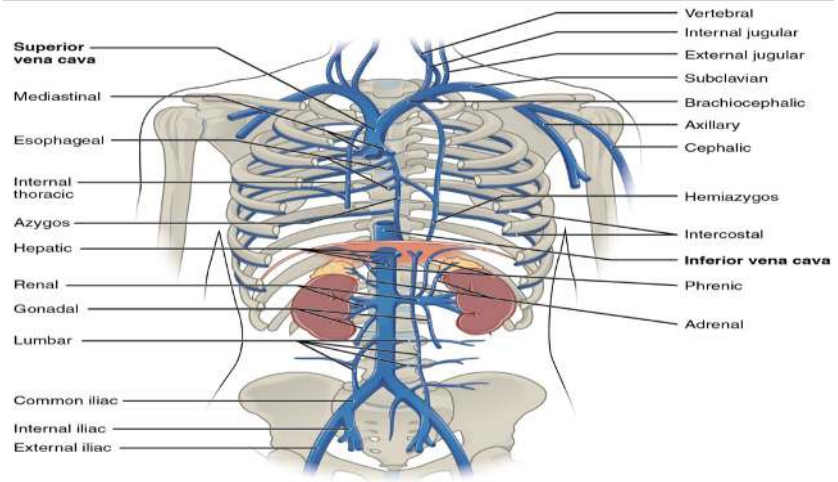
A quick overview of the venous circulatory system

- What is your current knowledge?



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Focus on Access Sites

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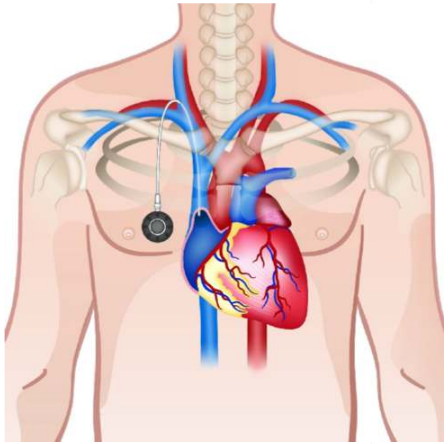
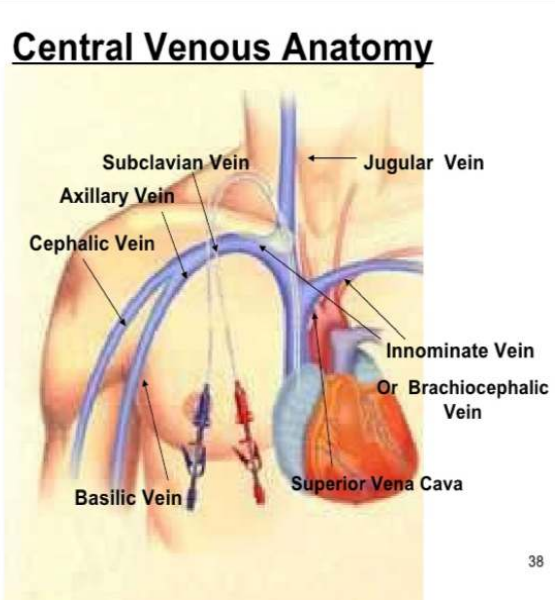
Neck and Chest Veins

The typical venous access point for TCVCs and TIVADs are:

- Internal Jugular Vein (IJ)
- Subclavian Vein
- Brachio – cephalic vein (left and right innominate veins





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Other Venous Access Options

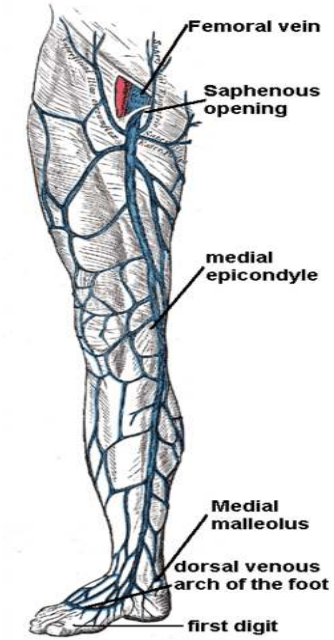
Include:

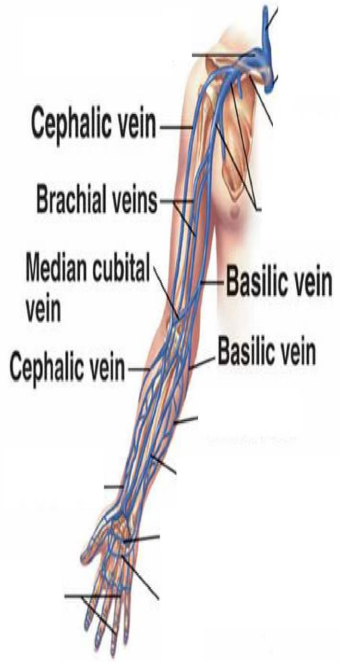
Arm veins

- Basilic vein
- Brachial vein
- Cephalic

Leg veins

- Femoral vein





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External Jugular Vein

- ❑ Posterior drains the occipital region
- ❑ Anterior drains the ear
- ❑ These both join the external jugular vein at the base of neck
- ❑ Then follows descending inward path to join subclavian vein above the mid clavicle region.

Advantages: Observable, easily punctured, complication rare

Disadvantages: Variable size, angular junction with subclavian, presence of valves

Contraindications/ complications: >catheter occlusion, phlebitis, dislodgement, difficult to dress, visibility

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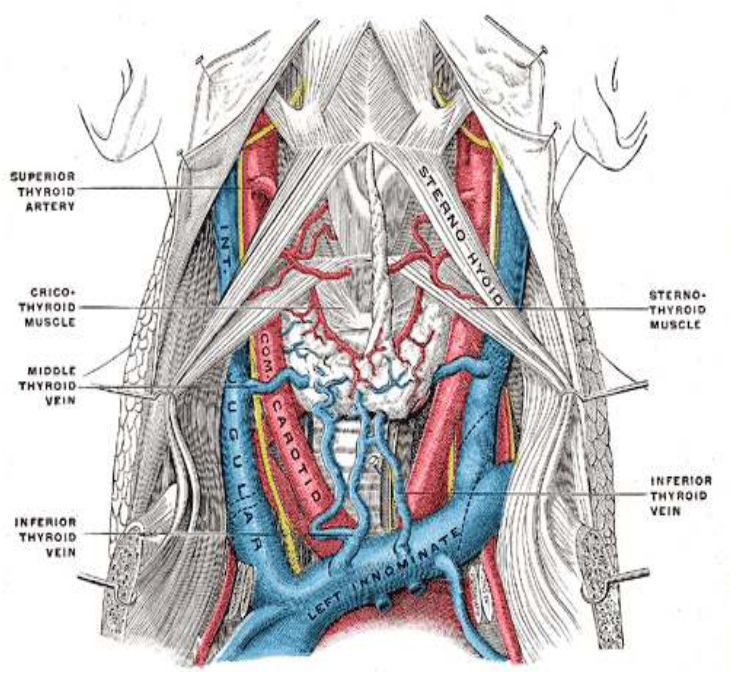
Internal Jugular Vein (IJV)

- The internal jugular vein is a popular insertion location for both TCVC and TIVAD insertions.
- The left IJV offers a direct route to the SVC
- The right IJV takes a sharp turn to get to the SVC so often requires fluoroscopy to ensure safe placement.
- The head is rotated to the opposite side and ultrasound used to identify the IJ
- The carotid artery runs along side the IJ so should also be visualized prior to puncture



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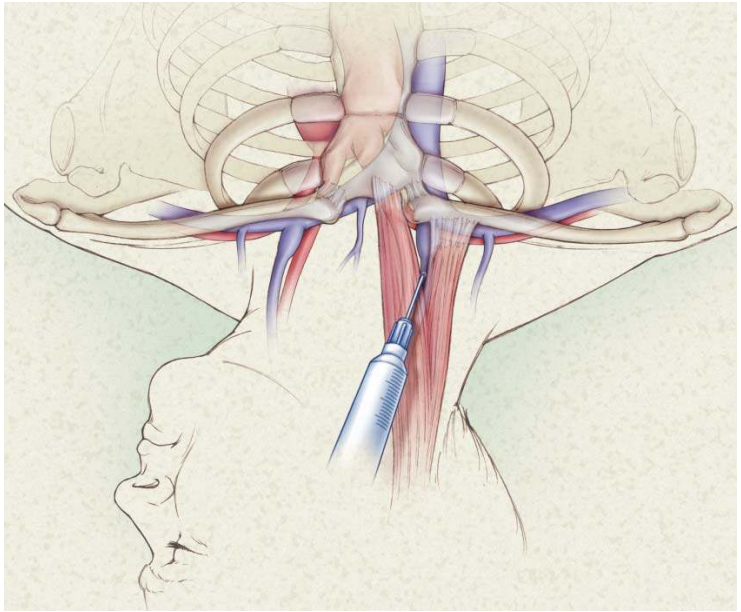
IJ Vein Puncture

The easiest approach to the IJV requires the operator to stand behind the patients head.

This allows the wire to be inserted down the IJV into the SVC.



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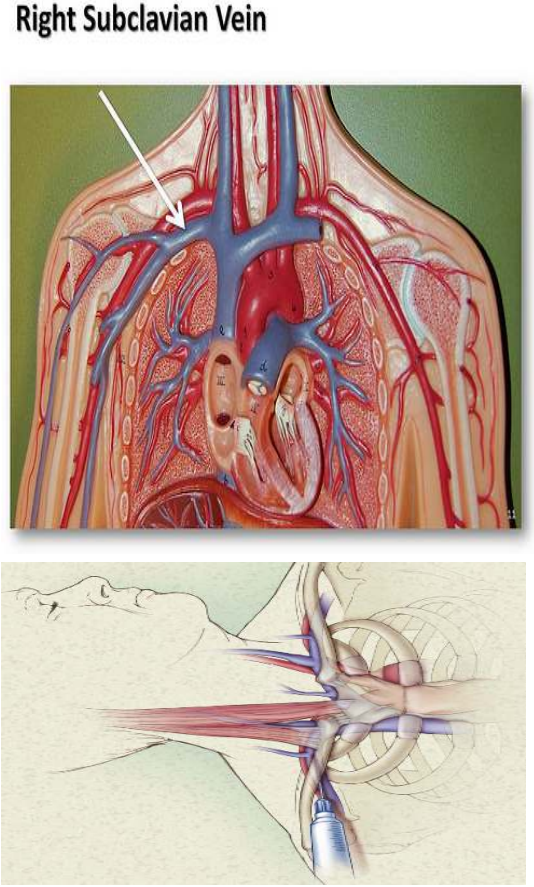
Subclavian Vein

- The Subclavian vein merges with the IJ on either side to form the innominate (or brachiocephalic veins). The subclavian vein starts when the axillary vein ends at the middle third of the clavicle.
- The subclavian vein is difficult visualize with ultrasound because its origin is posterior to the clavicle. Because the subclavian is underneath the clavicle it is difficult to compress
- Due to the close proximity to the lung, this approach is associated with pneumothorax
- Associated with pinch off syndrome



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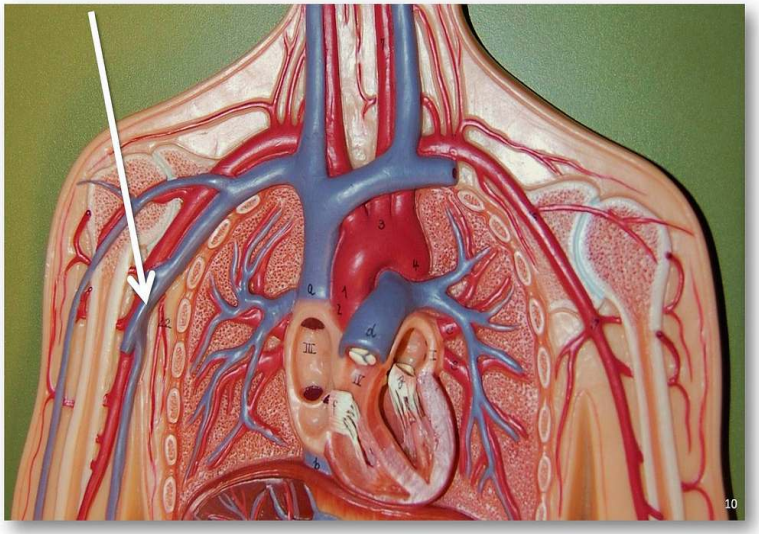
Axillary Vein

- The axillary vein is found on the anterior chest wall below the distal 1/3rd of the clavicle in the space of soft tissue lateral to the midclavicular line and the margin of the rib cages.
- This is a good access option as it is compressible with ultrasound and avoids the risk of pneumothorax associated with the subclavian approach.
- Arterial puncture could be controlled here if punctured inadvertently

Right Axillary Vein



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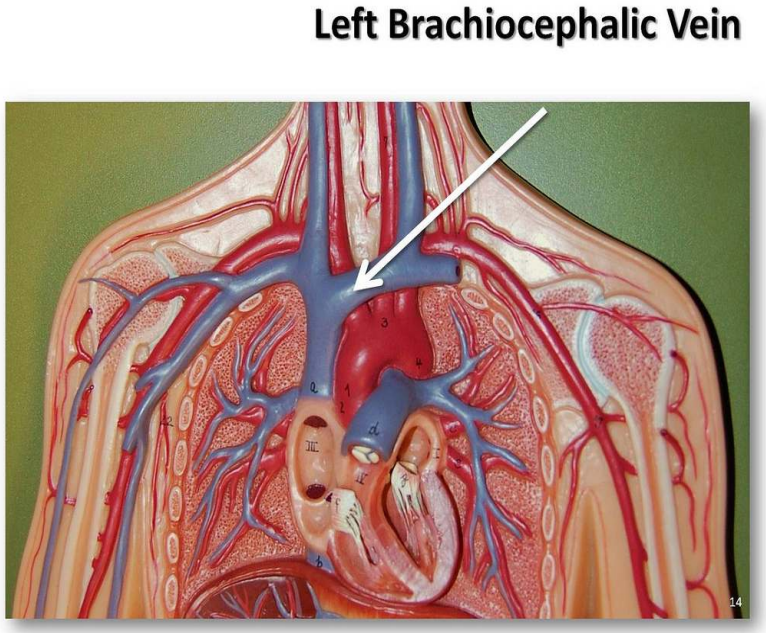
Brachiocephalic Vein

- The Brachiocephalic (innominate) vein has become a popular choice for TCVC and TIVAD insertion due to the presence of less moisture, colonization, and a better dressing / securement ability. This is compared to the neck or groin sites.



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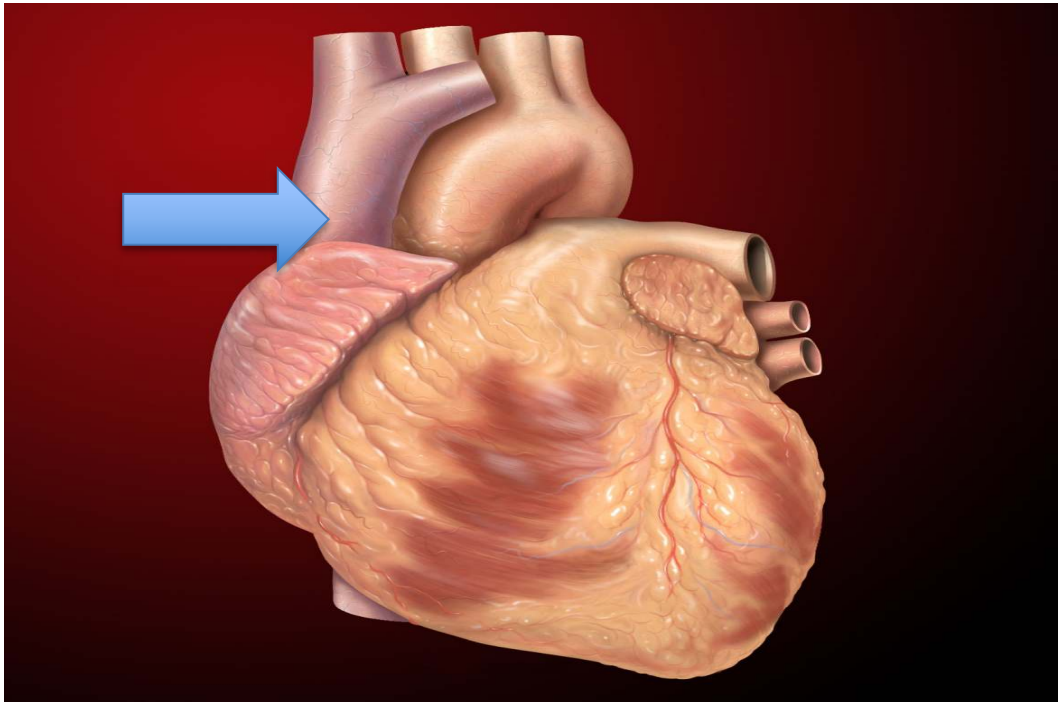
Focus on Tip Positioning



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Incorrect Tip Positioning

- The tip of TCVCs and TIVADs should terminate in one of the large central veins
- According to Warakaulle (2009) incorrect catheter placement is one of the commonest causes of early catheter malfunction.
- Commonly catheters can be misplaced in the upper SVC, internal jugular vein, angled at the vein wall, lower RA, right ventricle, innominate vein and subclavian vein (Bodenham et al. 2016).
- It is therefore necessary for tip positioned to be verified prior to use.

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The Central Veins

A central venous catheter is defined as one that terminates in one of the central veins (Chantler, 2009). Therefore TCVCs and TIVADs are CVCs

Central veins where CVC tips terminate are the superior vena cava (SVC), Inferior vena cava (IVC) or right atrium.

A central vein is one that is close to the heart (the centre of circulation).

The vessels that are in close proximity to the heart are larger and therefore they have a greater blood flow. This greater vessel width helps to reduce damage to the intima from sclerosant infusions.

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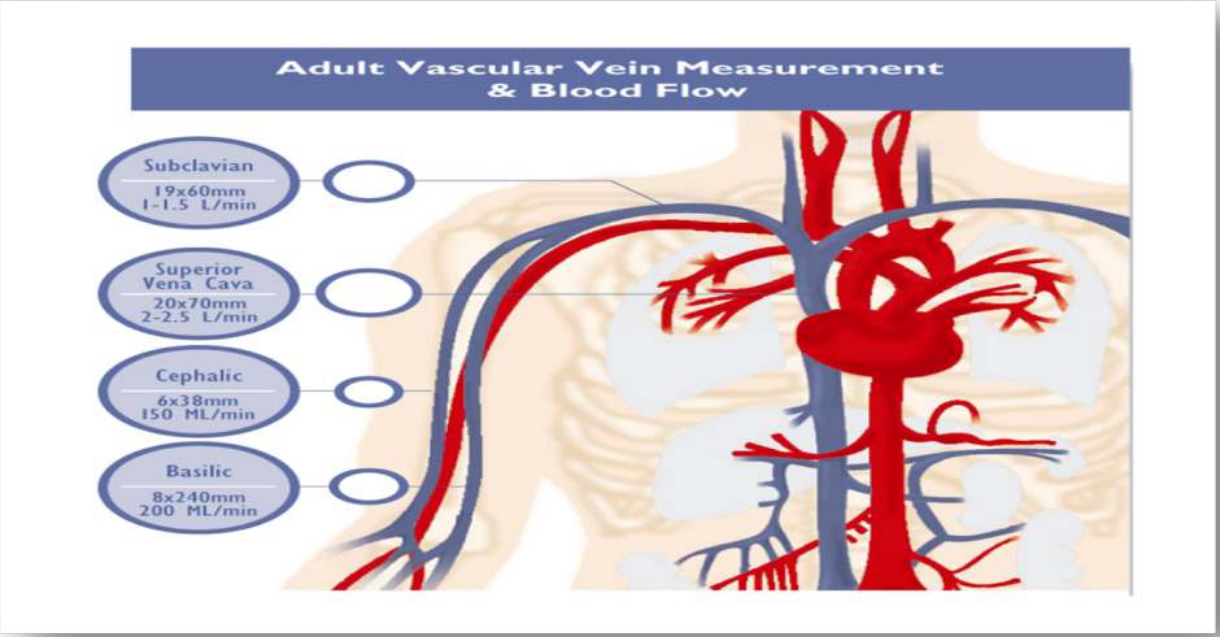
Adult Vascular Vein Measurement & Blood Flow



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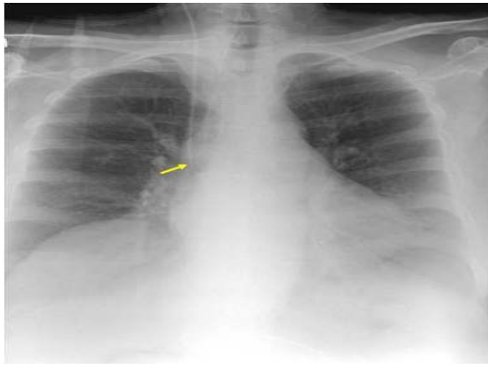
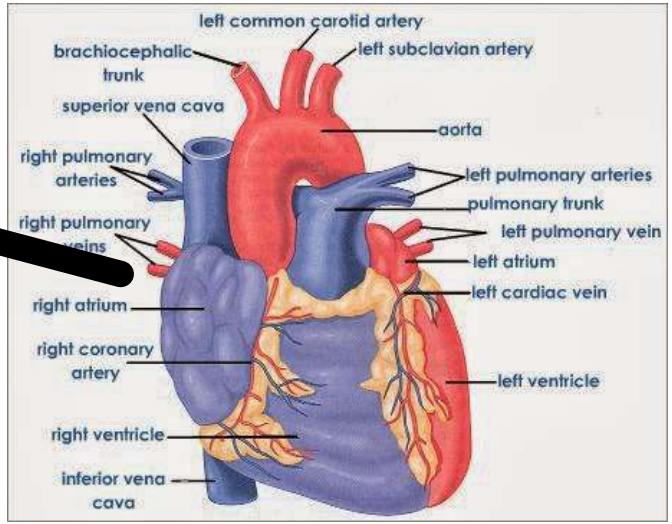
Ideal Catheter Tip Position

- The ideal catheter tip position for TCVCs and TIVADs is in the lower superior vena cava (SVC) / upper right atrium (Gorski, 2016; Denton, 2016; Bodenham et al., 2016)



Ideal catheter tip position



The Association of Anaesthetists of Great Britain & Ireland

INS Infusion Nurses Society UK and Ireland

Royal College of Nursing

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General guidance about tip positioning

The veins should be wide with a high blood flow to allow dilution of drugs and less change of vein intima damage

To avoid the catheter abutting the vein it should lie in the long axis of the vein. This position will also reduce inaccurate pressure readings

Avoid vessel junctions

Additional care should be taken when taking a left sided approach to device placement (Chantler, 2009).

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Superior Vena Cava (SVC)

The SVC carries blood from the upper part of the body. It is formed from the joining of the two brachiocephalic veins behind the lower border of the first right costal cartilage.

The SVC is approximately 2cm wide and contains no valves. In adults it is around 7cm in length. It descends along a straight path and terminates in the upper right atrium.

A branch of the SVC is the azygos vein, which ascends on the right side in the posterior mediastinum, before arching forward to penetrate the posterior wall of the SVC at the level of the fourth thoracic vertebra.

This junction is midway along the SVC and just over the pericardial reflection. Catheter tips can inadvertently lie in this junction or in the azygos vein with potentially adverse consequences (Chantler, 2009).

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The Inferior Vena Cava (IVC)

- The IVC drains blood from the lower part of the body. In the average human body the IVC is around 2.5 cm wide and contains no valves. It is formed where the two common iliac veins join and it ascends in front of the vertebral column to the right of the aorta.

- There are other veins that drain into the IVC along its path prior to it passing through the diaphragm at the caval hiatus at the T8 level. The IVC has a short intra-thoracic course before it drains into the right atrium from the lower, backside of the heart.

- The anatomical levels of the branches connected to the IVC include: hepatic veins, inferior phrenic veins, renal veins, lumbar veins and common iliac veins.

- As it is difficult to directly puncture the central veins, they are accessed from a peripheral vein that is punctured. Guidewires are then used to allow long catheters to be situated in these central veins.

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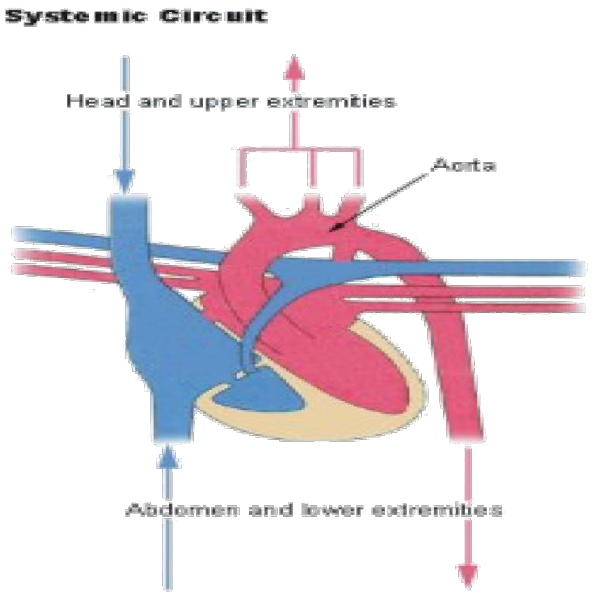
Focus on Blood Flow



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Blood Flow Dynamics Related to Vascular Access

- Blood flow is another factor that should be taken into account to try to reduce the incidence of thrombosis.

- Blood flow through a tube can either be a streamlined movement (laminar flow) or a more turbulent flow. In a healthy adult the flow would be considered laminar.

- Blood flows through the centre of a vessel faster than the blood that is in contact with the vessel wall. In a turbulent flow the fluid moves in various directions.

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Blood Flow Continued

- This type of flow occurs when blood vessels branch or make a sharp turn, when the inner layer of a vessel becomes less smooth or if there is a sudden obstruction.

- Turbulent flow can predispose patients to the formation of thrombus and this is why it is important to ensure as much as possible an adequate blood flow within the circulatory system.

- A study by Nifong and McDivitt (2011) clearly demonstrated that the larger the catheter size the greater the reduction in blood flow and therefore catheter size and vein ratio are important factors to take into account when selecting a device.

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Additional Considerations

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Adjacent Structures

Many structures can be inadvertently punctured during device insertion. These include:

- Nerves
- Arteries
- Lungs
- Lymph nodes

If this occurs it would create more complicated care and poorer outcomes.

These structures should be considered when assessing insertion sites and making a determination of where to insert and what vein to select.

Ultrasound guidance will help reduce such complications

(Bodenham, 2016)

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Persistent Left Superior Vena Cava

- It is a common normal variant (the incidence in the normal population is about 1 : 300).
- Often found incidentally during CVC placement and subsequent chest x-ray
- This variant makes the insertion of CVCs problematic
- It is a variant that vascular access specialists should be aware of

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Conclusion

- The entry site for TCVCs and TIVADs can vary and is often done to operator preference and the availability of ultrasound guidance.
- Consideration should be given to adjacent structures when decide on insertion point.
- In addition issues related to infection control and venous access site should be considered to ensure patient safety.
- Correct tip position can help to avoid late complications

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Any Questions?

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