

Venous Access - Concerns for Transfusionists and Apheresis Physicians



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Why this topic?

- One of the most frequent procedures
- Children - challenging by anatomical factors, small mobile veins, subcutaneous fat
- Less co-operative, psychological trauma
- Repeated procedures in the conscious patient

Learning Objectives

- Vascular access for children
- Peripheral IVs and difficult venous cannulation
- Tunneled & non tunneled Central venous access devices (CVADs)
- Apheresis

Difficult venous access

- Clinical condition in which multiple attempts and/or special interventions are anticipated or required to achieve and maintain peripheral venous access
- Multiple needle sticks - anxiety, pain, and suffering
- negative impact on health care workers including doctors and nurses
- Good preparation - alleviates patient distress, cooperation
- DIVA score

DIVA score

- Cumulative number of points for 4 factors:
- Vein not being visible (2 points),
- Vein not being palpable (2 points)
- History of prematurity (3 points)
- Age 1 to 2 years (1 point)
- Younger than 1 year (3 points)
- First attempt success rate < 50% with a composite DIVA score ≥ 4

Options for IV access

- Peripheral IVs
- Central Vascular Access Devices
 - Non-tunneling
 - Tunneling
 - Implanted
- Emergency
 - Intraosseous - administration of blood without lysis of blood cells
 - Venous cut down

Peripheral IVs

- Most distal veins first
 - Extravasation at the upstream failed cannula site
- DIVA
 - Intravenous team, anesthetist
 - Gentle tapping, tourniquet or blood pressure cuff
 - Warming the limb
 - Topical application of nitroglycerin ointment alone or EMLA cream - local vasodilation
 - Trans-illumination - infrared source of light
 - Ultrasound may also be useful



Peripheral IVs

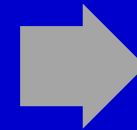
Role

- Short term (96 hrs.)



Advantages

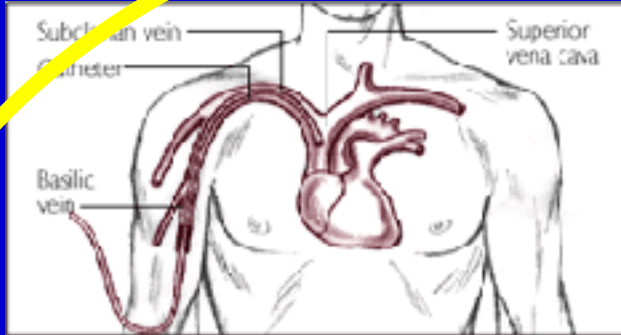
- Ease of insertion
- Low cost
- Minimal complications



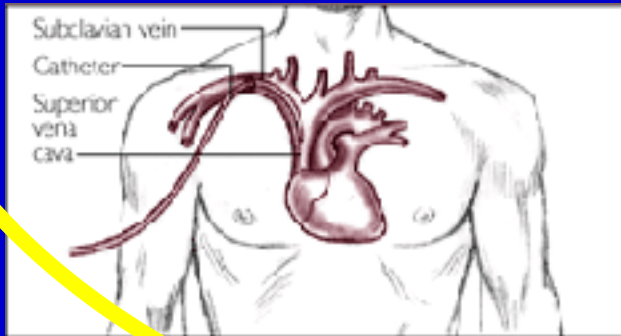
Disadvantages

- Easily occluded
- Potential for local tissue

Central Venous Catheters

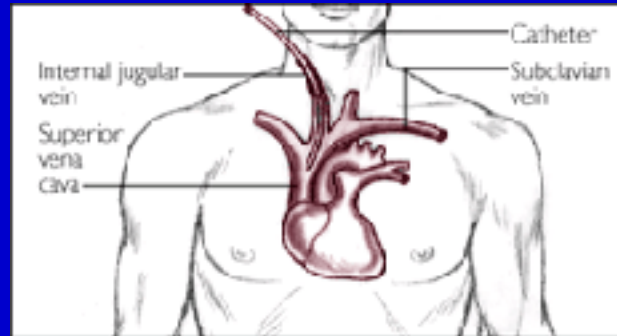


PICC (Peripherally inserted Central Catheter)

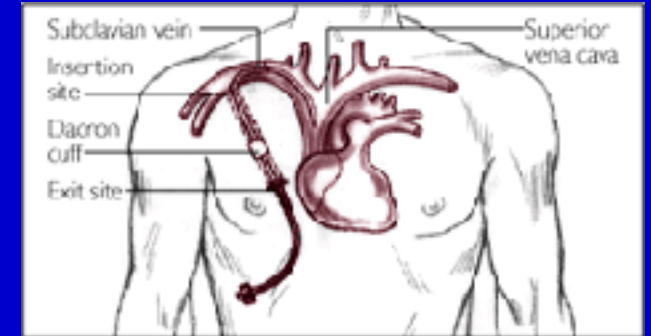


Percutaneous (Subclavian)

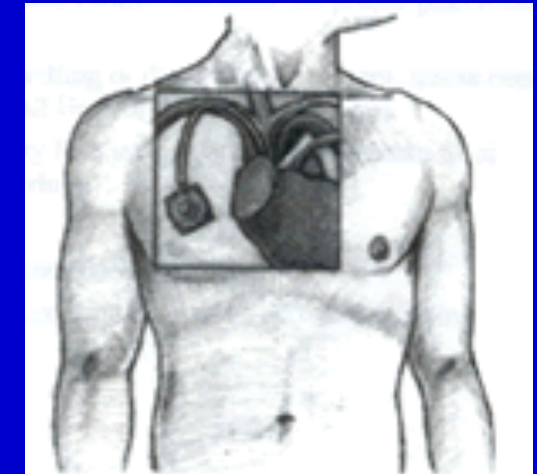
Non-tunneled



Percutaneous (IJ-Int. Jugular)



Tunneled (Hickman)



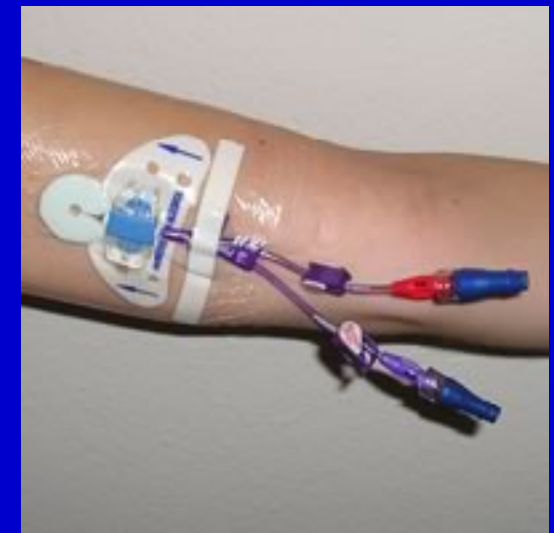
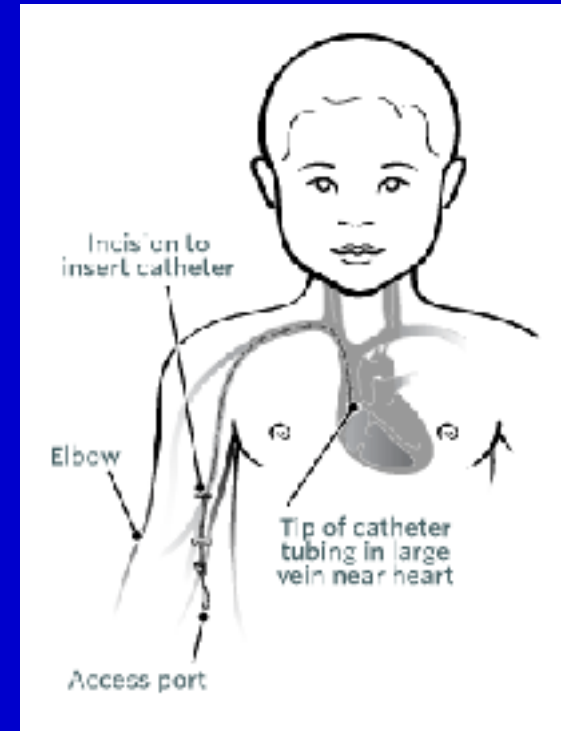
Implanted Port (single or double lumen)

Non-Tunneling CVAD

- Direct venipuncture through the skin into a selected vein.
 - Peripherally inserted central catheter
 - Percutaneous catheters (CVC)

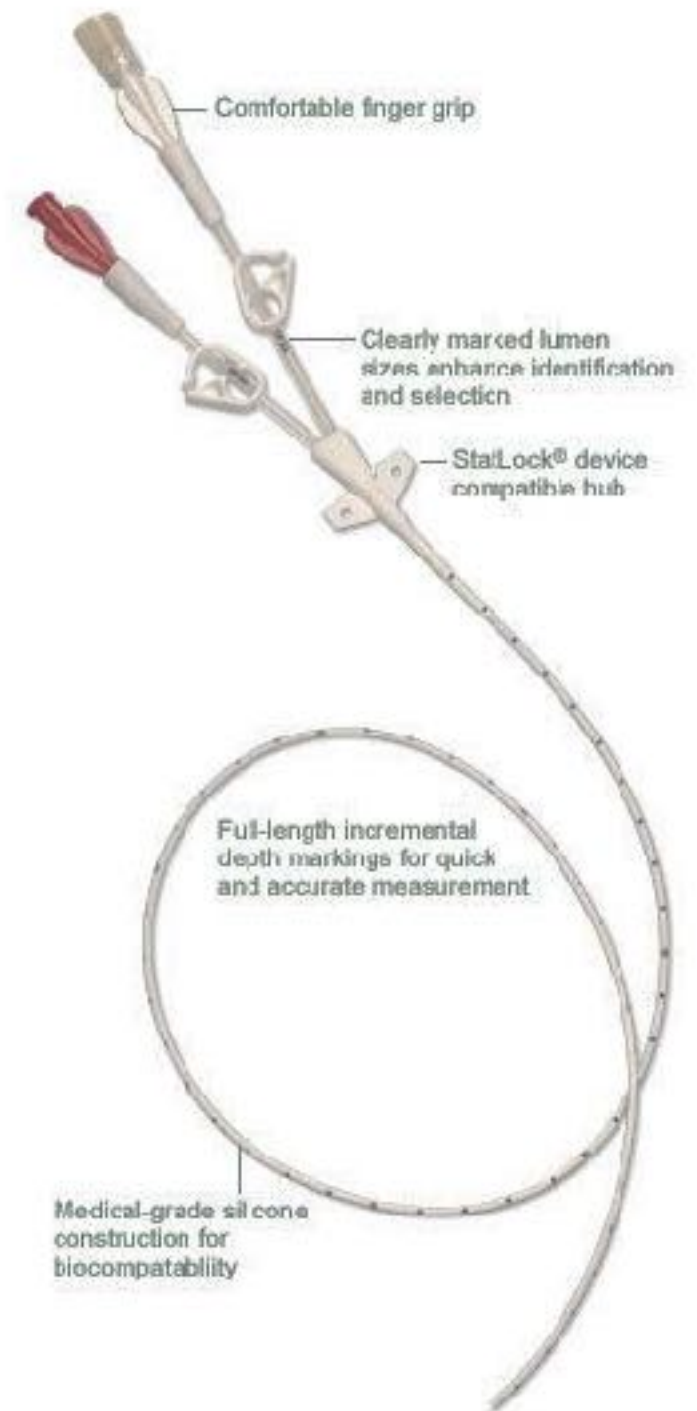
Non-Tunneling - PICC

- **Peripherally inserted central catheters (PICC)**
 - Central venous catheter inserted at or above the ante cubital space, distal tip of the catheter is positioned at the superior vena cava or superior vena cava , right atrial junction.
- **Midline**



Non-Tunneling PICC

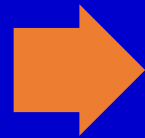
- Useful - long term medication therapy, chemotherapy or TPN
- Useful for frequent blood sampling
- Single, double or triple-lumen configurations
- 28 G catheters - in premature neonates to 7 Fr
- Single-lumen catheters - gauge
- Multi-lumen catheters - French (Fr) size)
- Size of the access vein and the therapy



Non-Tunneling PICC

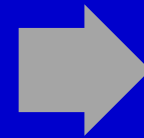
Role

- Short-to-long term



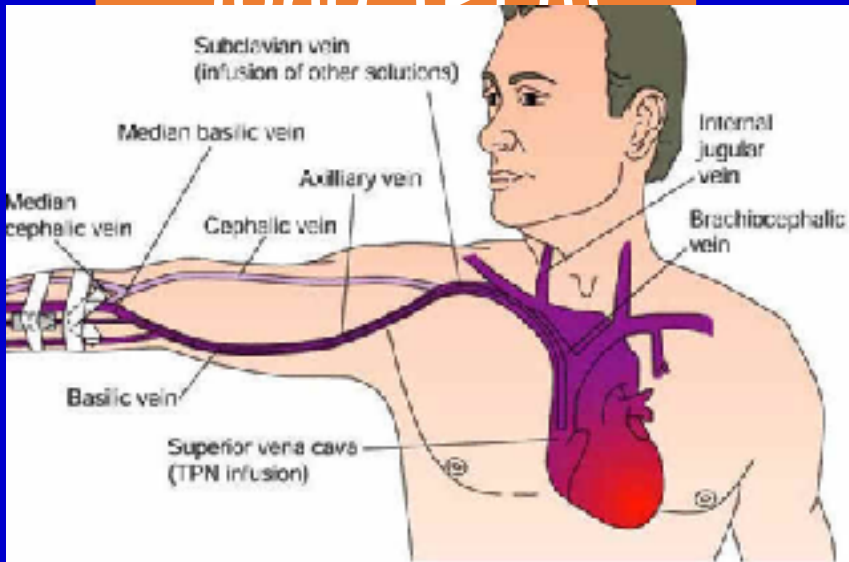
Advantages

- Ease of insertion (bedside)
- Can be used with variety of



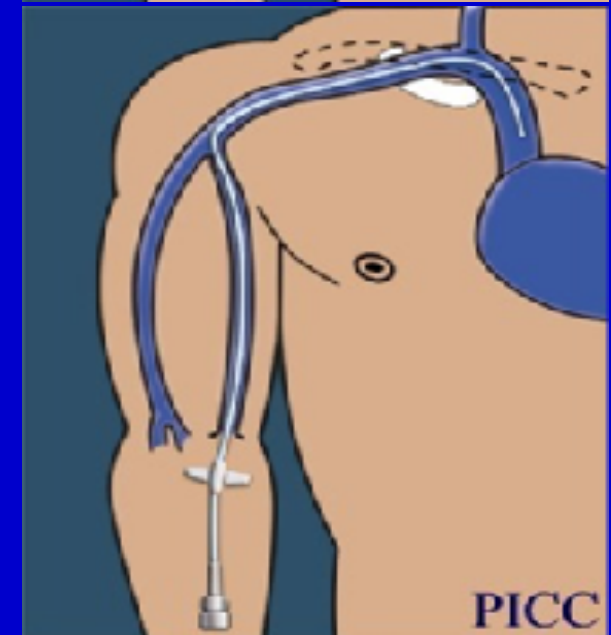
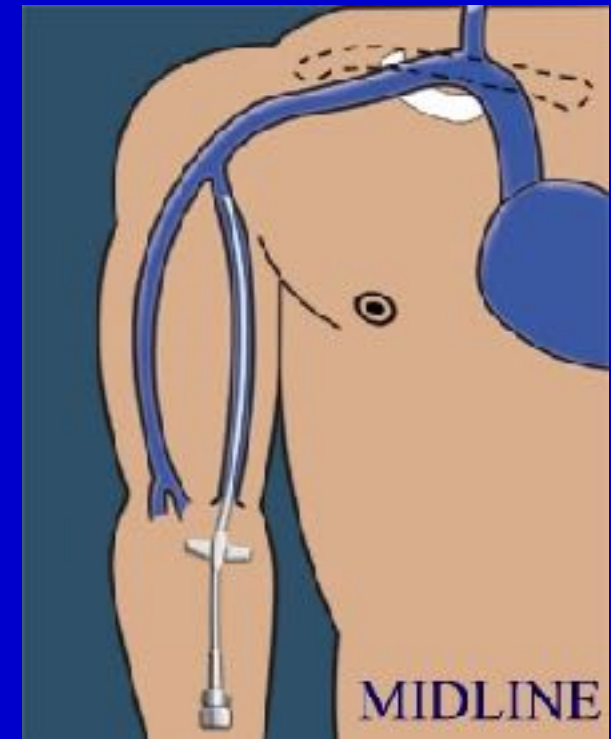
Disadvantages

- Potential for occlusion
- Can be difficult



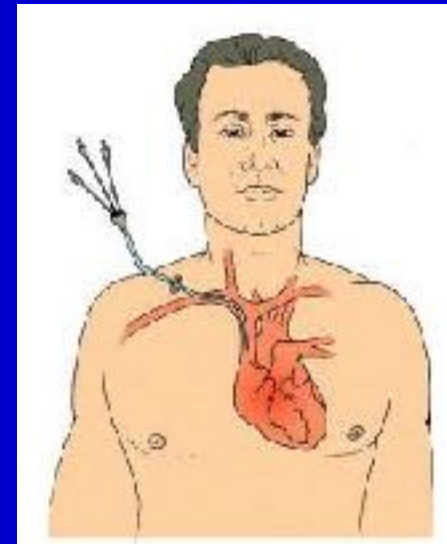
Non-Tunneling - Midlines

- Used for shorter term intravenous therapy (up to 4 weeks)
- Used for frequent blood sampling
- Distal end positioned at the proximal end of the upper extremity
- Out of vogue - risks, no added advantage



Non-Tunneling - CVC

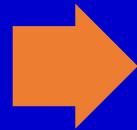
- Percutaneous catheters
- Also known as: Central Venous Catheters (CVC)
 - Subclavian, femoral or internal jugular
 - Single, double or triple lumen
- All blood and blood products
- ? Platelets



Non-Tunneling CVC

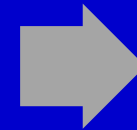
Role

- Can be maintained over the medium term (upto one month)



Advantages

- Reliable method of infusing large volumes of fluid



Disadvantages

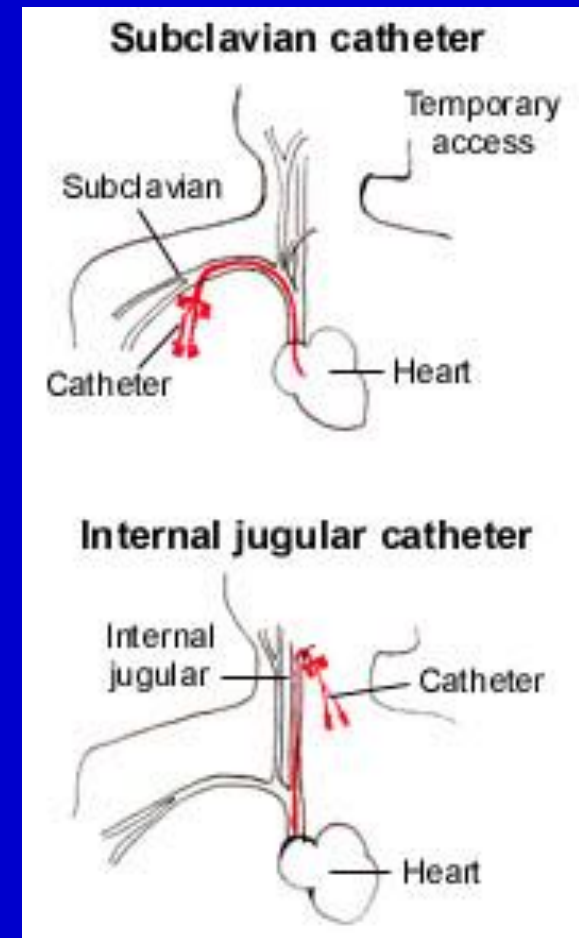
- Require expertise, GA in children
- Potential

Choice of CVC site

	Advantages	Disadvantages
Internal jugular	Simple to insert Direct route to central veins High flow rate, low risk of thrombosis Lower risk of pneumothorax	Patient discomfort Higher rate of late complications, especially infection Tunnelling more difficult to chest wall
Subclavian/axillary	Less patient discomfort Lower risk of long term complications	Curved insertion route Difficult to access Acute complications – pneumothorax, haemothorax, nerve damage
Femoral	High flow, good for dialysis Easy insertion	Higher rate of infection/thrombosis More discomfort Difficult in obese patients

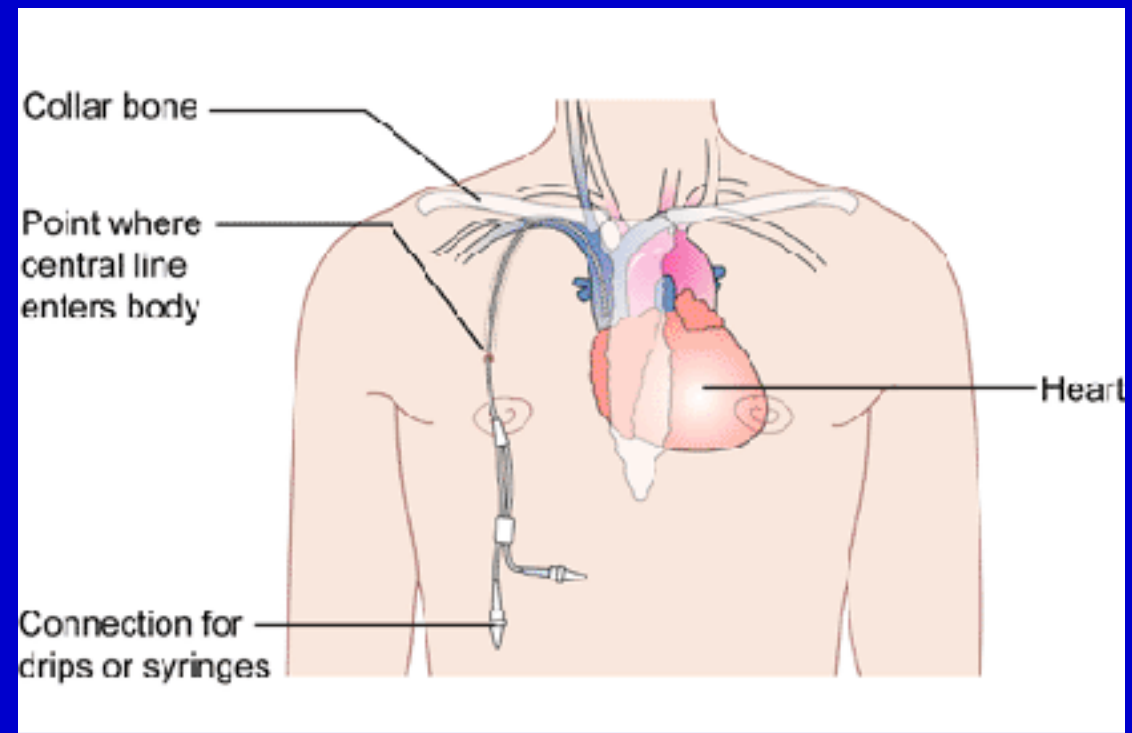
Non-tunneling - CVC

- Tip advanced to superior vena cava or SVC and right atrium junction
- Apt for long term chemotherapy or TPN
- size 4-5 Fr catheters - infants <6 months
- size 5 Fr - 6 months to 5 yr.
- size 7 Fr for >5 yr.
- Internal jugular insertion
- <15 Kg - 5 cm lines
- 16-40 kg - 8 cm
- >40 Kg - 13 cm



Tunneling - CVCs

- Hickman®
- Broviac®
- Groshong®



Tunneling - CVCs

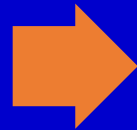
- Inserted into a central vein via percutaneous venipuncture or cut down
- Catheter then tunneled in the subcutaneous tissue
- Exited in a convenient location
- Dacron cuff hold the catheter in place
- All blood products



Tunneling - CVCs

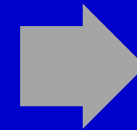
Role

- Long term (indefinite)



Advantages

- Less thrombogenic
- Decreased infection rate

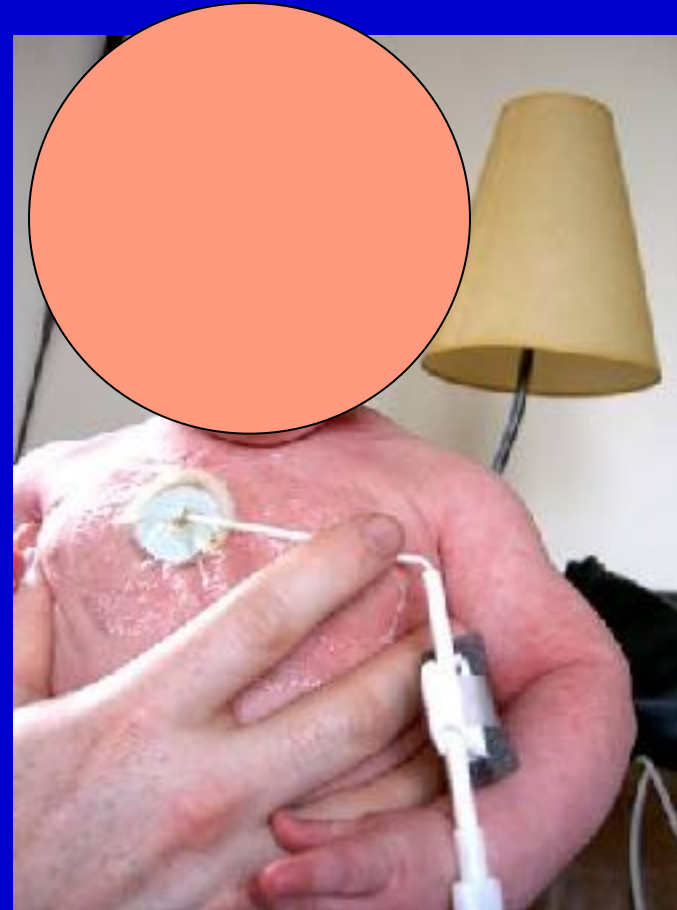


Disadvantages

- Increased cost
- Requires surgical insertion

Tunneling - Broviac[®]

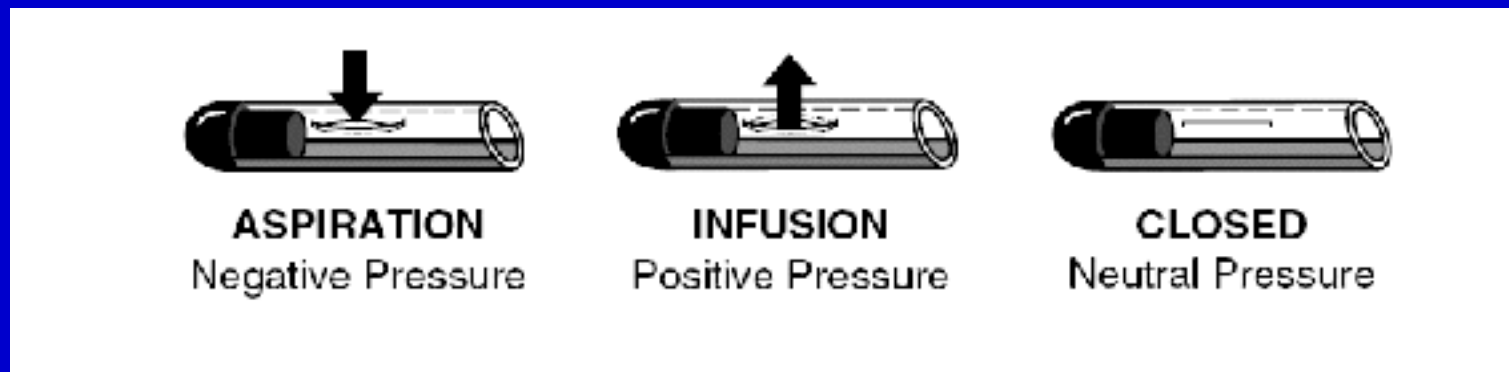
- Similar to Hickman, smaller size
- Pediatric patients.



Tunneling - Groshong[®]



- Similar to Hickman[®] & Broviac[®]
- With closed ended patented 3-way valve
- No Heparin lock required



Implanted VADs - Ports

- Catheter attached to a self-sealing silicone septum surrounded by a titanium, stainless steel or plastic port
- Port sutured under the skin
- Some brand names:
 - Port-a-cath®
 - Infus-a-port®
 - Power Port®



Implanted VADs - Ports

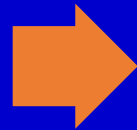
- Catheter runs from port to superior vena cava at the right atrium
- No part of the device is exposed outside the body
- Can deliver chemotherapy,
- TPN, antibiotics
- Blood products & blood sampling



Implanted VADs - Ports

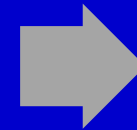
Role

- Long term or permanent



Advantages

- Low visibility
- Lowest rate of infection



Disadvantages

- Increased cost
- Requires surgical insertion

VASCULAR ACCESS FOR APHERESIS

- Good vascular access - sine qua non
- Peripheral veins safest, Central venous catheters (CVCs) often reqd.
- Two separate vascular access ; One - remove blood & Second - simultaneously return the blood back
- Combination of peripheral IVs, CVCs, arterial catheters, AV fistulas, AV grafts and high flow ports
- Choice - Short or long term
- Peripherally inserted central catheters (PICC) are contraindicated due to the high flows & pressures which can cause rupture of the PICC

VASCULAR ACCESS FOR APHERESIS

Peripheral Venous Access Devices

Generally not suitable

- Minimal inlet flows 20-40 ml/min
- Draw - 18-gauge or larger dialysis type steel needle placed in the antecubital vein
- Return - 22-gauge or larger placed in peripheral vein of opposite arm; lower arm or hand, away from joints
- One arm - recirculation of blood and/or longer procedures
- Short-term or intermittent procedures
- Not in peripheral leg veins

Central Venous access for Apheresis

- Dual lumen central venous catheters
- Single lumen catheters in very small children in combination with peripheral vein
- Femoral venous catheters , urgent situations - few or temporary
- Stiff bodied, large bore, dual lumen catheters (VASCATHS)
- Non tunnelled long term lines (PERMACATHS)
- Staggered ends withstand draw and return pressures, simultaneous draw & return without recirculation
- Dual or triple lumen catheter placed in children for chemotherapy - too small, too pliable

Central Venous Access For Apheresis

- Paediatric CVC length and Fr - based on body size & weight
- Minimum CVC size 7Fr and maximum CVC length 36cm
- Formation of fibrin sheath, biofilm build up and thrombosis can occlude the lumens
- Adequate care & anticoagulation of CVCs is vital

Tunneled Lines & Ports in Apheresis

- Tunneled catheters (ex. Hickman lines)
- Return flow
- Not suitable for draw flow - small lumen does not withstand high pressure and flow rates generated

- Implanted intravascular access devices (Ports)
- Special high flow dual (VORTEX) ports used with large bore non coring needles are suitable
- Standard porta caths - not suitable

Arterial Access

- Umbilical artery - newborns
- Placement of lines more challenging
- 24-22 G cannulas for infants and 22-20 G for children
- Non-ported cannula-over-needle devices (e.g. Jelco®)
- Devices using the Seldinger technique for insertion are available, for example, 22 G Leaderflex®
- Rarely, a surgical cutdown - arterial access.
- Real-time ultrasound guidance with Doppler facility

Neonatal apheresis

In	Out
Umbilical vein	Umbilical vein
Umbilical vein	Peripheral artery
Peripheral vein	Umbilical vein
Peripheral vein	Umbilical artery
Peripheral vein	Peripheral artery

Umbilical Venous Catheter

- Inserted via the umbilical vein in the umbilical cord
- Catheter tip position - junction of the ductus venosus and the inferior vena cava just above the diaphragm and outside the heart - T9 - T10
- 3-7 days
- Length, Umbilical stump, xiphisternum on weight

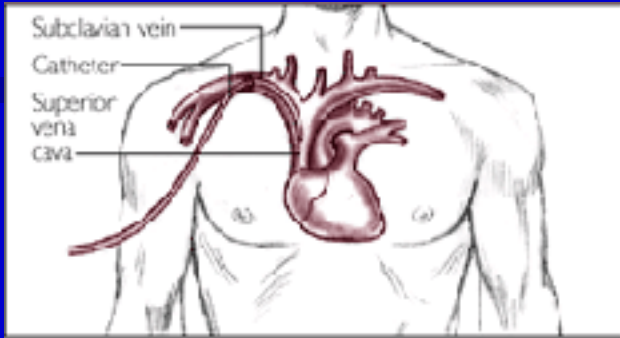
Weight	Catheter size
<1500g	3.5 Fr
1500-3500g	5.0 Fr
>3500g	8.0 Fr

Choosing a Catheter

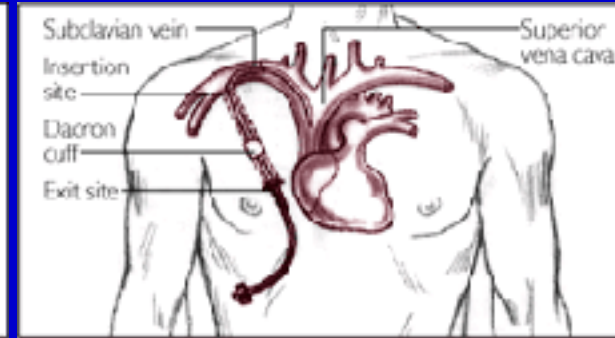
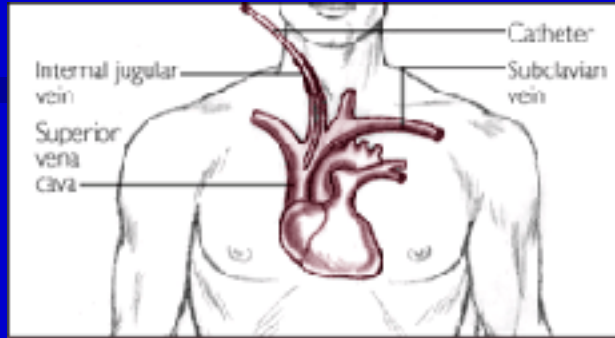
- Size?
- Length?
- Number of lumens?
- Patient
 - Weight/size
 - Size of vessel
 - Indications

PATIENT SIZE	CATHETER SIZE & SOURCE	SITE OF INSERTION
NEONATE	Single-lumen 5 Fr (COOK)	Femoral artery or vein
	Dual-Lumen 7.0 French (COOK/MEDCOMP)	Femoral vein
3-6 KG	Dual-Lumen 7.0 French (COOK/MEDCOMP)	Internal/External-Jugular, Subclavian or Femoral vein
	Triple-Lumen 7.0 Fr (MEDCOMP)	Internal/External-Jugular, Subclavian or Femoral vein
6-30 KG	Dual-Lumen 8.0 French (KENDALL, ARROW)	Internal/External-Jugular, Subclavian or Femoral vein
>15-KG	Dual-Lumen 9.0 French (MEDCOMP)	Internal/External-Jugular, Subclavian or Femoral vein
>30 KG	Dual-Lumen 10.0 French (ARROW, KENDALL)	Internal/External-Jugular, Subclavian or Femoral vein
>30 KG	Triple-Lumen 12.5 French (ARROW, KENDALL)	Internal/External-Jugular, Subclavian or Femoral vein

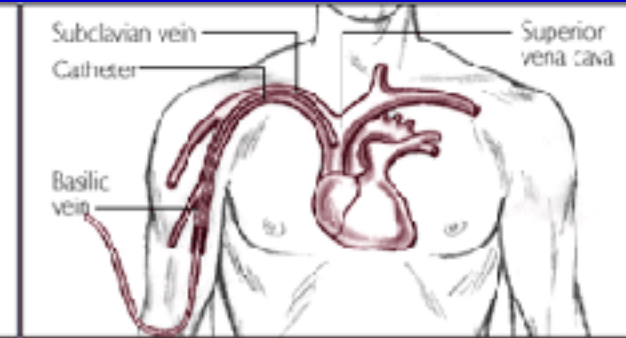
CVC Care/Maintenance



Percutaneous



Tunneled

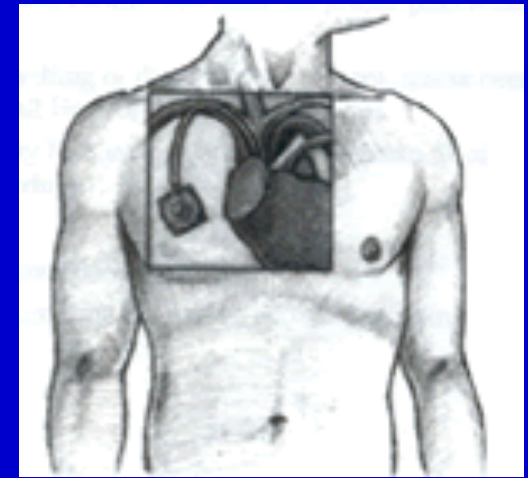


PICC

- Flush after each access or daily for catheters $>21\text{ G}$ q 6 hrs $<21\text{ G}$
- Adults: 10ml saline, peds/neonates: 5ml saline
- Tunneled - End of therapy/discharged/weekly- heparin 3 ml
- Transparent dressing change q 7 days & prn, Gauze - every 48 hours

CVC Care/Maintenance

- Flush after each use and weekly while accessed; monthly when not accessed
 - - 10ml saline
 - - Followed by 4.5ml-5ml heparinized saline,
 - ✓ 100units/ml for adults
 - ✓ 10units/ml for peds
 - ✓ After each access or monthly
- Transparent dressing/ access needle change q 7days



Implanted Port

Vascular Access for Pediatric Apheresis: Some Final Thoughts

- Catheters with poor function will function poorly... over and over and over and over
- Balance between surgical expertise (preference?) and the necessary evils dictated by the patient
 - high PEEP... femoral catheter?
 - massive ascites... IJ catheter?

Take Home Message

- Obtaining vascular access in children - challenging
- Good prospective vascular access management essential
- Choice of long-term vascular access device in children is guided by duration and frequency of therapy
- Condition & preferences of the patient and care givers
- Knowledge about correct usage of vascular access devices is fundamental for safe transfusion and apheresis practice

