Advanced VA-IV course

Session 3: Complications

Catheter migration, Occlusion and rare events

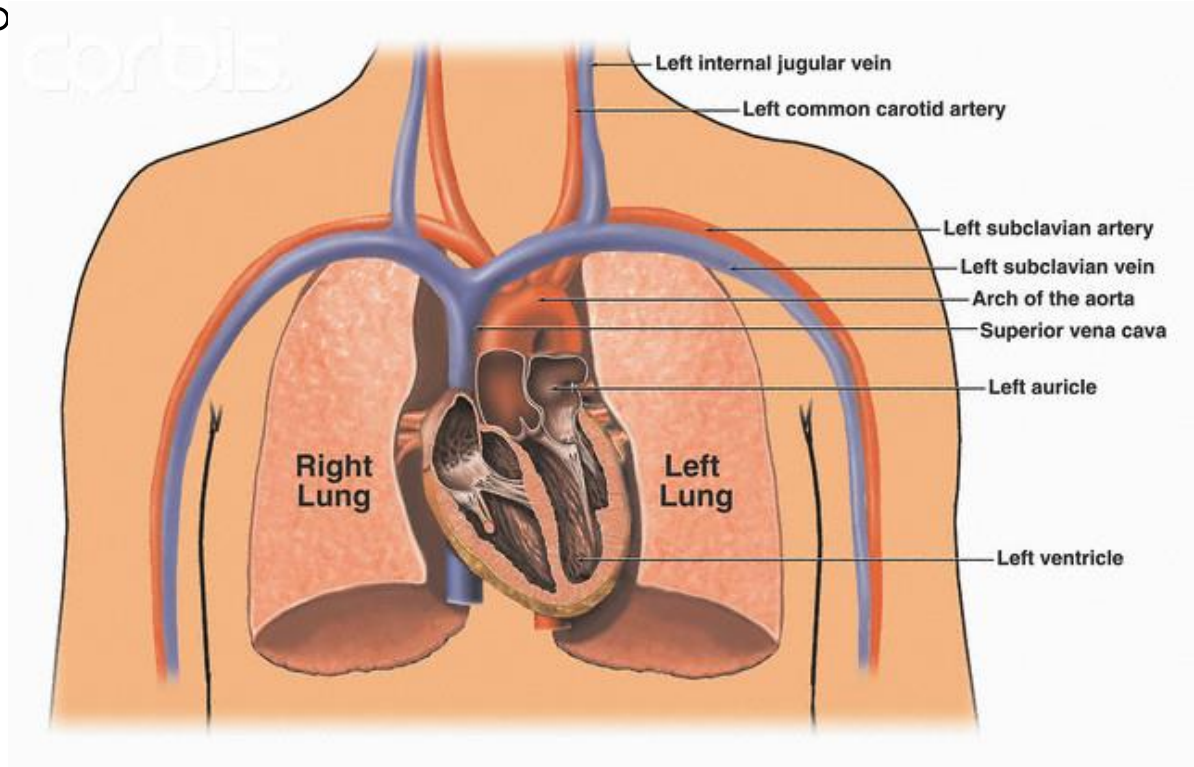
Patient presents with one or more of the following…

- Difficulty flushing–feeling more resistance
- Inability to withdraw (no blood return)
- Incomplete infusion (residual volume left)
- Complaints of hearing gurgling or rushing noise when infusion running
- Complaints neck/shoulder pain
- Leaking at insertion site when attempting to flush or during infusion

Rule out catheter migration or occlusion

Catheter tip migration from SVC

- Internal Jugular (most often: ~40% of the time
- Axillary vein
- Contralateral innominate or subclavian
- R atrium
- Causes:
  - Tip not in lower 1/3 SVC
  - ↑ intrathoracic pressure (cough, vomiting
  - Rigorous upper arm movements
  - Inadequate VAD securement



In addition to inability to infuse or withdraw…

- Other signs to watch for specific to catheter tip migration:
  - Change in external length of catheter
  - Hearing a rushing or gurgling sound during infusion
  - Neck sensation (“ something feels funny in my neck”)
  - Arm or shoulder discomfort
  - Palpitations with or without SOB
  - Arrhythmias (with or without symptoms)

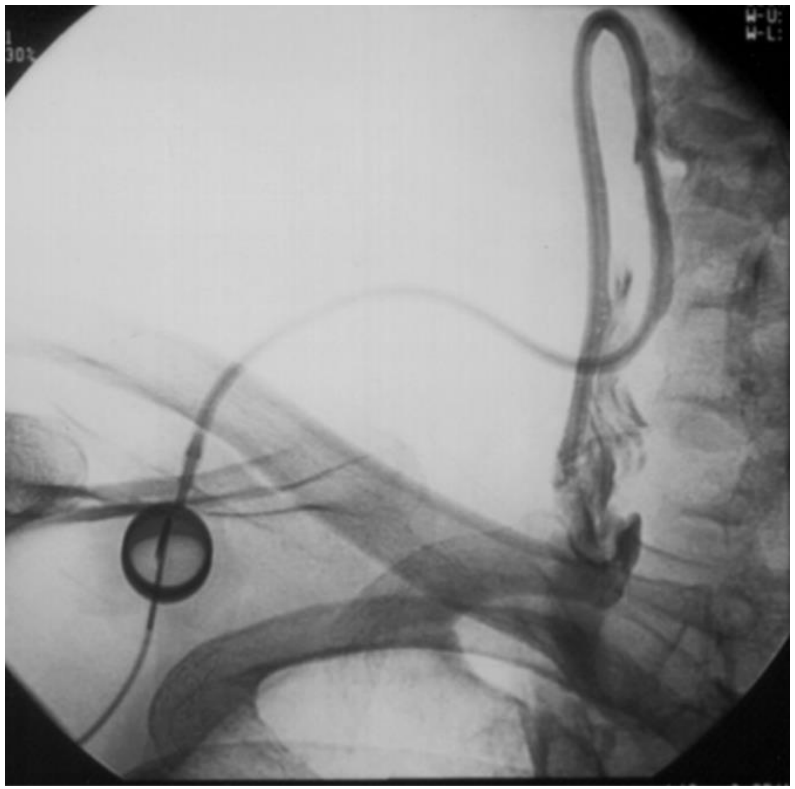
Suspected malposition management

- Assess for positional CVAD:
- First attempt non-invasive techniques:
  - Change position: stand, lie down, Trendelenburg (if tolerated), move around the room, raise or move arm
  - Cough, deep breaths, Valsalva manoeuvre
  - Roll shoulders backward and forward
- Gently flush using push-pull method (flush with 1 – 2 mL then attempt to aspirate)
  - May need to remove any add-on devices (e.g. needle-free connector) and using ANTT, attempt to flush and aspirate.
- IVAD: change the needed
- DO NOT force flush or ever use a syringe smaller than 10mL

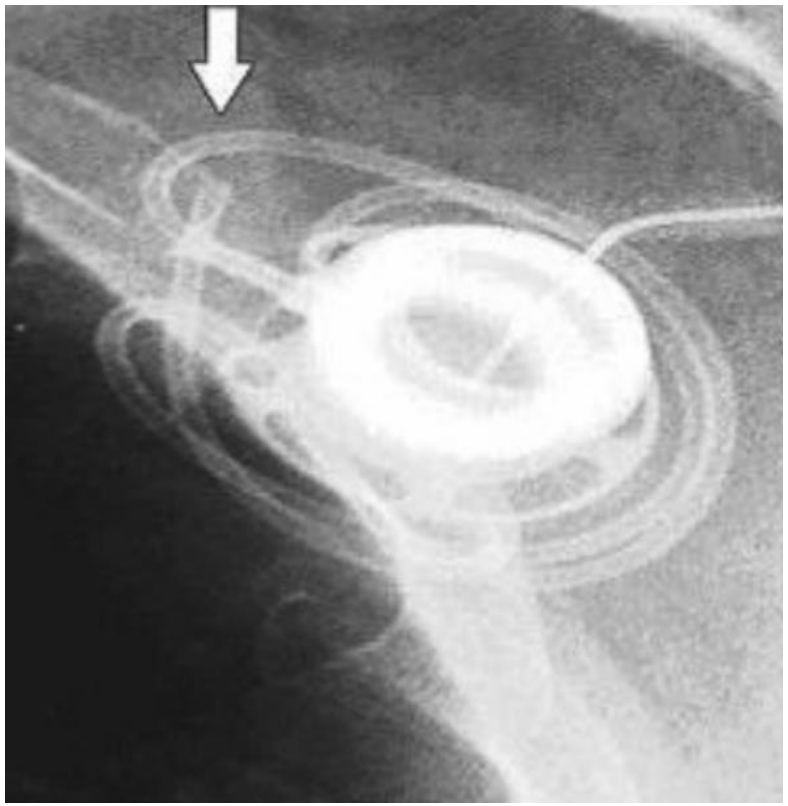
Suspected malposition or occlusion

- Use the physical force of gravity, patient positioning, upper extremity manipulation, hemodynamic flow and the effect of flushing the catheter
- Use alone or in concert

Catheter tip in R IJ



Catheter tip migrated & flipped in IJ

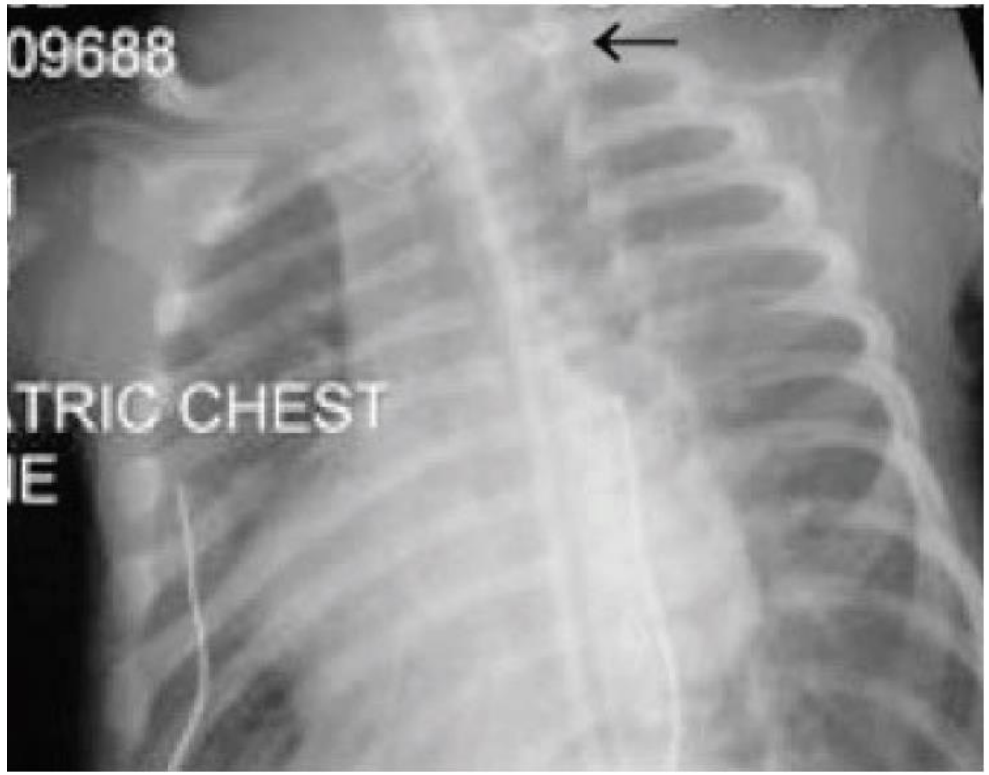


Catheter has backed out of the vein and now coiled in sub/Q tissue

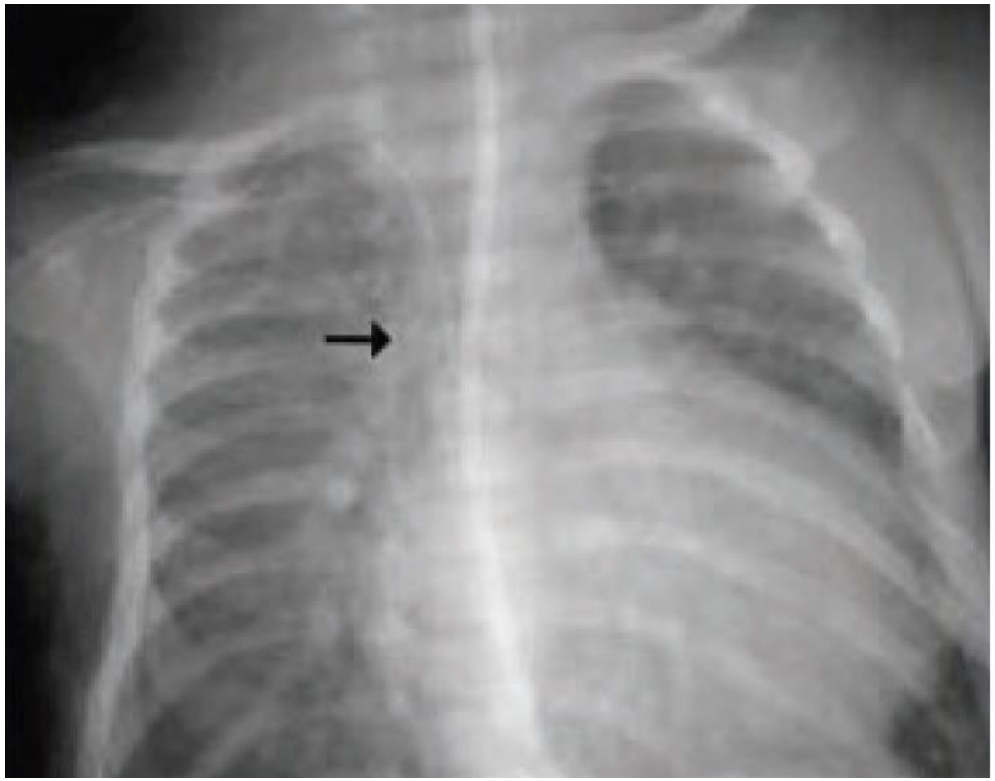
Photos: L Schulmeister RN

PICC troubleshooting

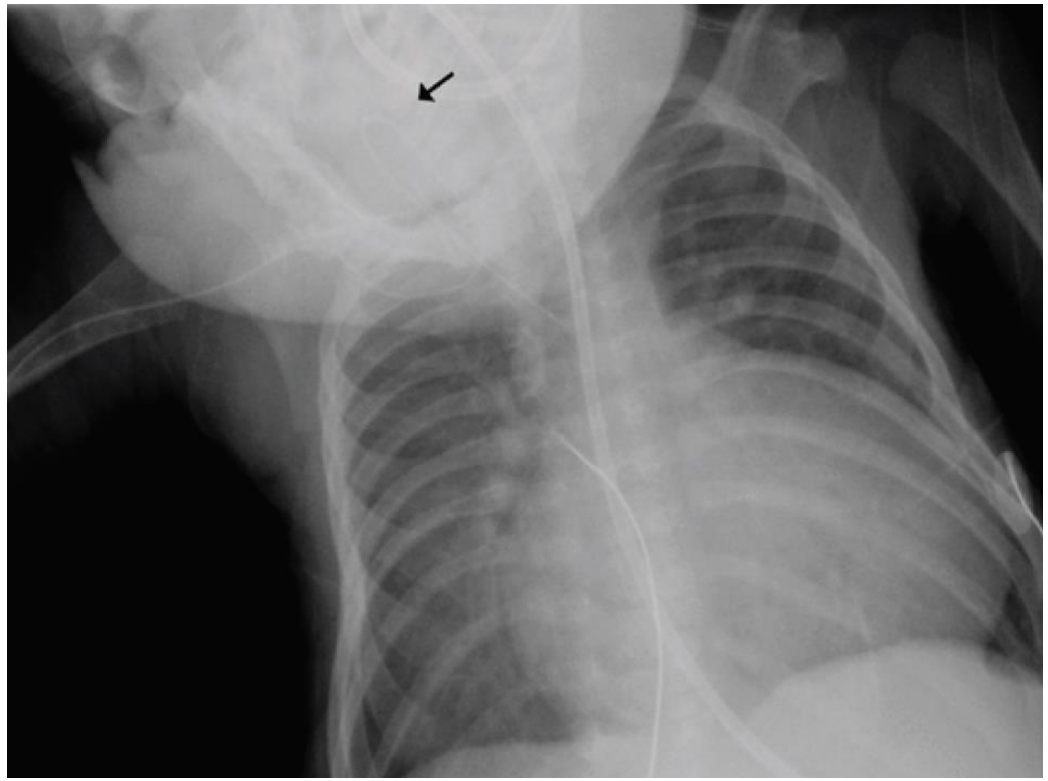
Initial CXR post insertion: migrated to contralateral subclavian vein



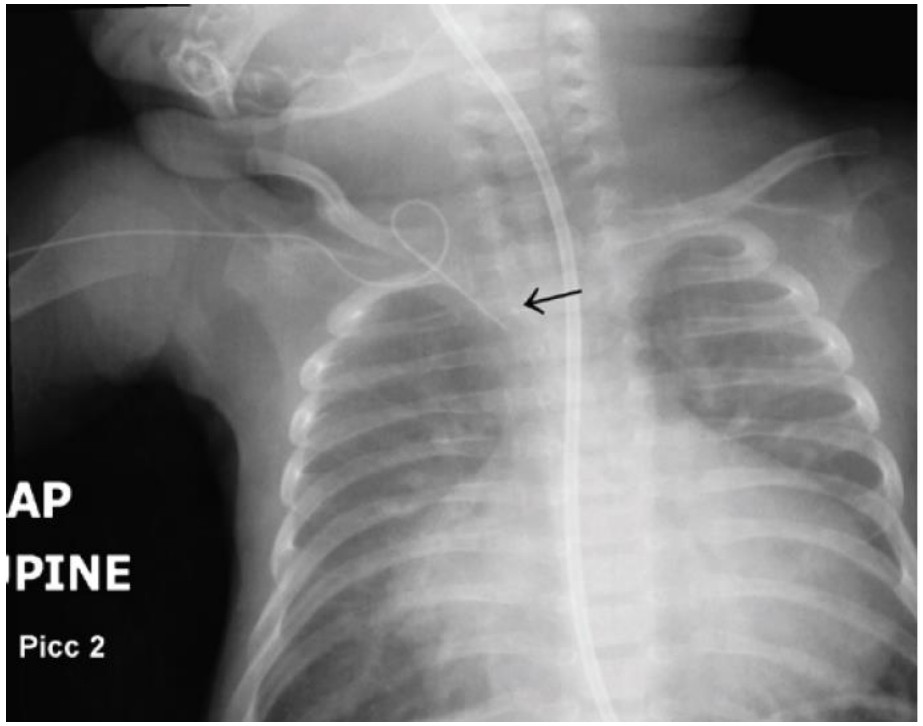
Repositioned using sterile technique: now at Cavo-atrial junction (SVC/RA)



2 days later, external length ↓ 1.5 cm, X-ray shows catheter coiled into the neck



Catheter pulled back 1.5 cm, remained coiled in the jugular vein



If catheter malposition suspected

- Stop infusion until tip placement verified

Infusate / Medication Risk Assessment[8]

High-risk medications for PVAD:

- Continuous vesicant chemotherapy or intermittent/irritant cyclicals
- Osmolarity > 600 Osm/L (exception immunoglobulin)
- pH extremes (e.g. pH <5 or > 9)
- Duration of therapy > 7 days
- Speed of infusion
- Medication dilution
- Viscosity

Catheter occlusions

- In addition to care provided immediately following CVAD placement, care is required to sustain CVAD function over time.
- Ongoing care includes prevention and assessment of complications associated with device maintenance and use.
- Catheter occlusions are the most common noninfective complication associated with long-term CVADs ~1/3 of all lines (Hamilton, 2006; Miller, 2006) caused by:
- Medication and lipid precipitation,
- fibrin sheaths,
- catheter tip positioning

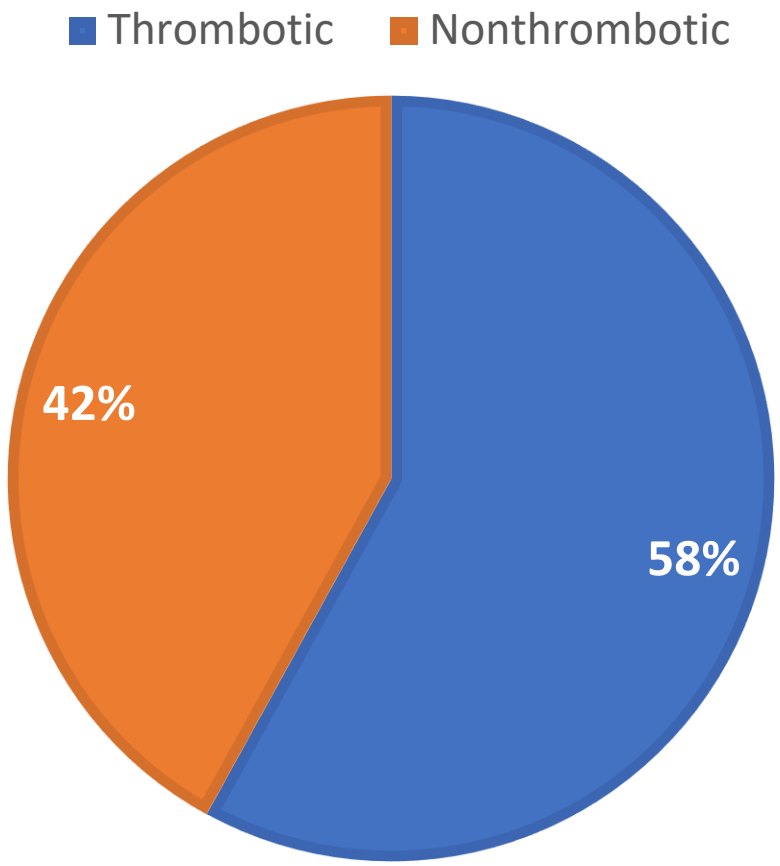
Catheter Occlusion

- An obstruction of a VAD lumen that prevents or limits the ability to flush, withdraw blood or administer solutions or medications.

Type of Occlusion	Causes
Mechanical	• Internal or external problems with catheter • Tubing kings, clamps closed or clogged connectors • VAD dislodgement or tip migration • Incorrect placement of non-coring needle • Incorrect length of non-coring needed • Pinch-off syndrome
Chemical	• Medication type • Medication precipitate (residue or mixing of incompatible meds)
Thrombotic	• Intraluminal thrombus, fibrin tail or flap • Fibrin sheath or sleeve • Mural thrombus

CVAA, OMG Guideline, 2019

Types of Occlusions



NOTE: occlusions may have more than one cause

Degree/Type of occlusion

Degree/Type of Occlusion	Symptoms/Signs	Causes
Partial	↓ Ability to infuse fluids; resistance with flushing &/or aspiration Sluggish flow ↑ Pressure during infusion (EID alarms)	Mechanical, chemical or thrombotic
Withdrawal	Inability to aspirate blood with ability to infuse without resistance Lack of free-flowing blood return	Mechanical or thrombotic
Complete	Inability to infuse or withdraw blood or fluid	Mechanical, chemical or thrombotic

CVAA, OMG Guideline, 2019

How to know it's occluded

- Signs & symptoms:
  - Increased residual volume (or delayed completion of infusion)
  - Frequent occlusion or high pressure alarms on infusion pump
  - Leaking, swelling at insertion site (signs of infiltration or extravasation)
  - Resistance when flushing
  - Sluggish flow
  - Inability to withdraw blood
  - Sluggish blood return

First step when catheter appears to be occluded:

Rule out mechanical obstruction!

Unable to obtain blood return

- Place patient supine (if able to tolerate)
- Use 10 mL syringe with 0.9%NaCl to gently “push-pull”
- 53% success rate (N = 8685 IVADs: Goossens et al, 2007)

Resolve mechanical obstruction

- Check for kinks, clamps, or twists in the administration set, dressing
- Consider changing dressing
- Verify correct placement of non-coring needle
- Replace clogged filter
- Non-invasive troubleshooting as mentioned for catheter migration
- Check for catheter damage
- CXR for proper tip placement

Incorrect placement of non-coring needle

- Remember, if unable to flush or aspirate blood with an IVAD, re-access (with a new needle)
- This will rule-out needle malposition
  - Feel the back of the reservoir
  - Smooth entry of needle

IVAD needle misplacement

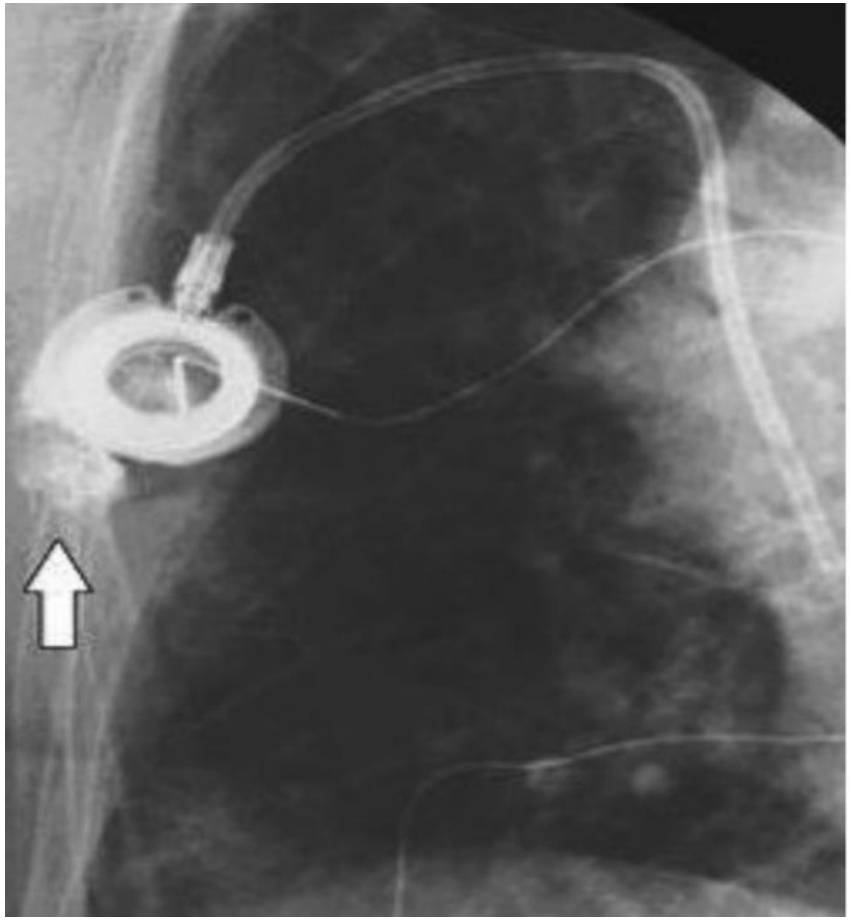
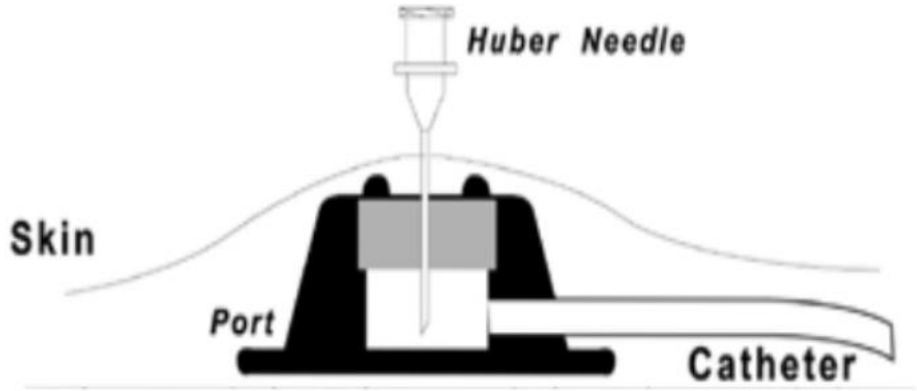


Photo: L Schulmeister RN



Pinch-Off syndrome

- Catheter inserted into the subclavian vein is 'pinched' between the clavicle & first rib
- Rare occurrence with CVADs (PICC excluded)
- Risk: catheter fragmentation with embolization
- CVAD Will need to be removed if

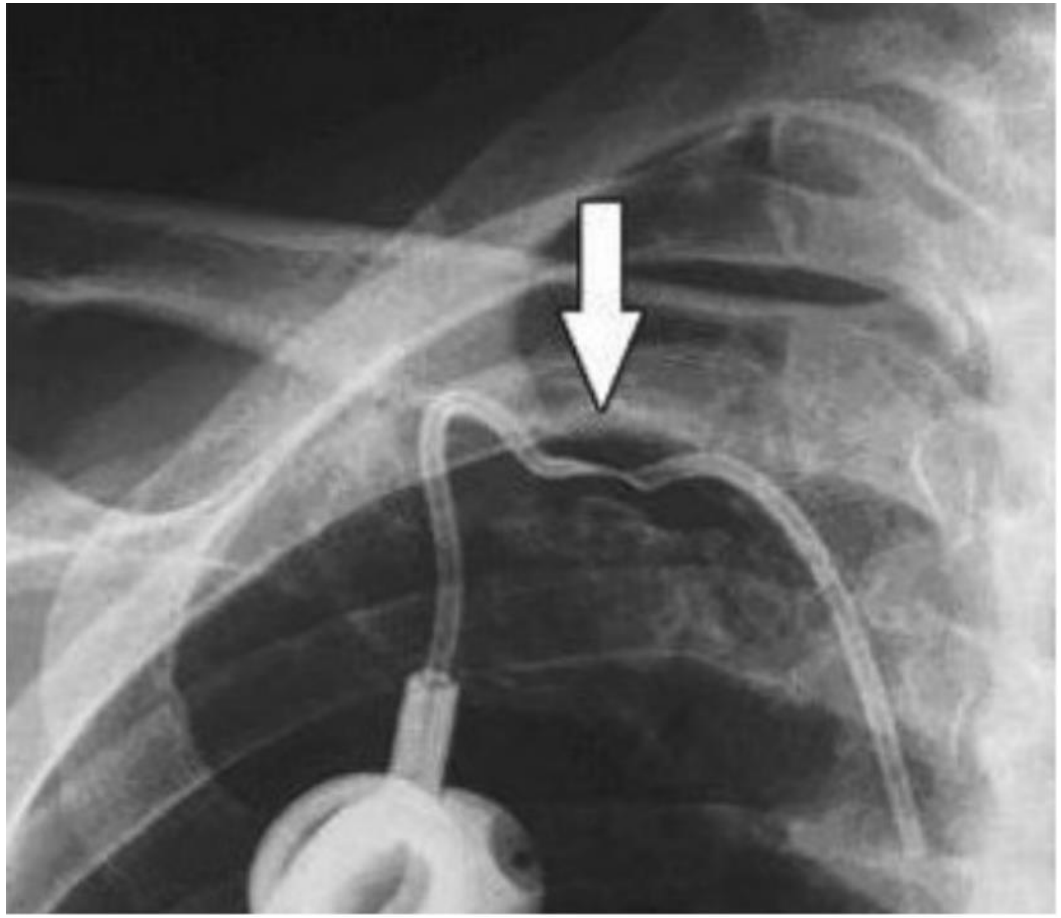


Photo: L Schulmeister RN

Precipitate causes

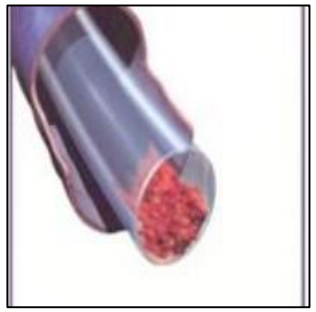
- Drug crystallization
- Drug-drug incompatibility
- Drug-solution incompatibility

- Well known culprits
  - Phenytoin
  - Heparin (given after a drug w/o first flushing with 0.9% NaCl
  - Calcium, phosphate
  - Penicillin, Cipro/Tazo, Cloxacillin (sticky build-up intraluminal)

pH of common drugs

	Medication	pH	Unblocking agent
Alkaline	Ampicillin	8-10	Sodium Bicarbonate
	Dilantin	10-12	
	Acyclovir	10-12	
	Gancyclovir	11	
Acidic	Vancomycin	2.5 - 4.5	Hydrochloric Acid
	Ciprofloxin	3.5 - 4.6	
	Dopamine	3.3 - 3.6	
	Gentamycin	3.0 - 5.5	
	Morphine	2.5 - 6.5	
	Amikacin	3.5 - 5.5	
	Pipercillin/Taxobatam	4.5 -6.9	

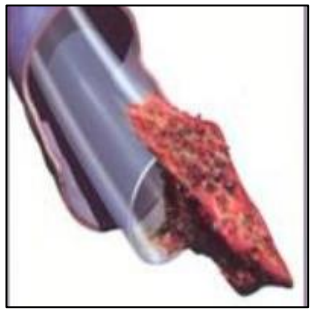
Types of Thrombotic Occlusions



Intraluminal Thrombus

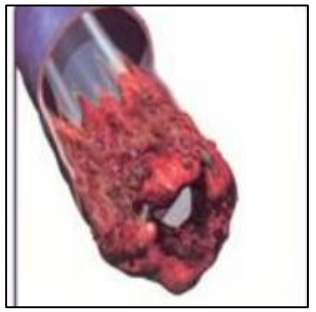
Forms inside the lumen

May cause partial or complete occlusion



Fibrin Tail

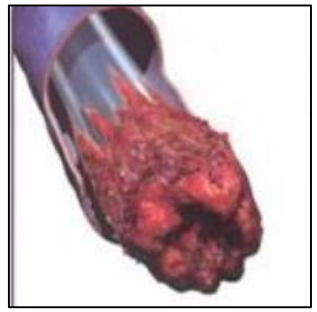
Extends from the end of the catheter & can act like a one way valve



Mural Thrombus

Fibrin from vessel wall damage binds to fibrin on catheter surface.

May cause venous thrombus & catheter obstruction



Fibrin Sheath/Sleeve

Fibrin adhered to outside the catheter and encases it like a sleeve, covering the catheter tip.

Fibrin sleeve Extravasation

Thrombotic Occlusion Questions: True or False

1. According to the Infusion Nurses Society (INS) Standards of Practice a nurse should always aspirate the catheter for positive blood return to confirm patency prior to administering medications and solutions.
2. Three risk factors for thrombus formation are: venous stasis, enhanced blood coagulation, trauma to the vein wall.
3. Thrombotic occlusion of only one lumen of a catheter does not put the patient at risk for a catheter related blood stream infection.
4. Catheter salvage is the preferred approach for managing catheter. thrombosis.
5. There may be a potential risk of a bleed due to systemic exposure with the instillation of Cathflo used to treat an occluded catheter lumen.

Thrombotic Occlusion Multiple Choice

1. Catheter occlusions can be:
   a. Complete and prevent aspirations or infusions
   b. Partial which allows infusions but prevents aspirations
   c. Be a cause frequent infusion pump alarms
   d. All of the above
2. Intermittent catheter malfunction, difficulty drawing blood, and frequent pump alarms, in conjunction with radiologic evidence of catheter compression, defines:
   a. catheter malposition
   b. catheter fracture
   c. pinch-off sign
   d. pinch-off syndrome

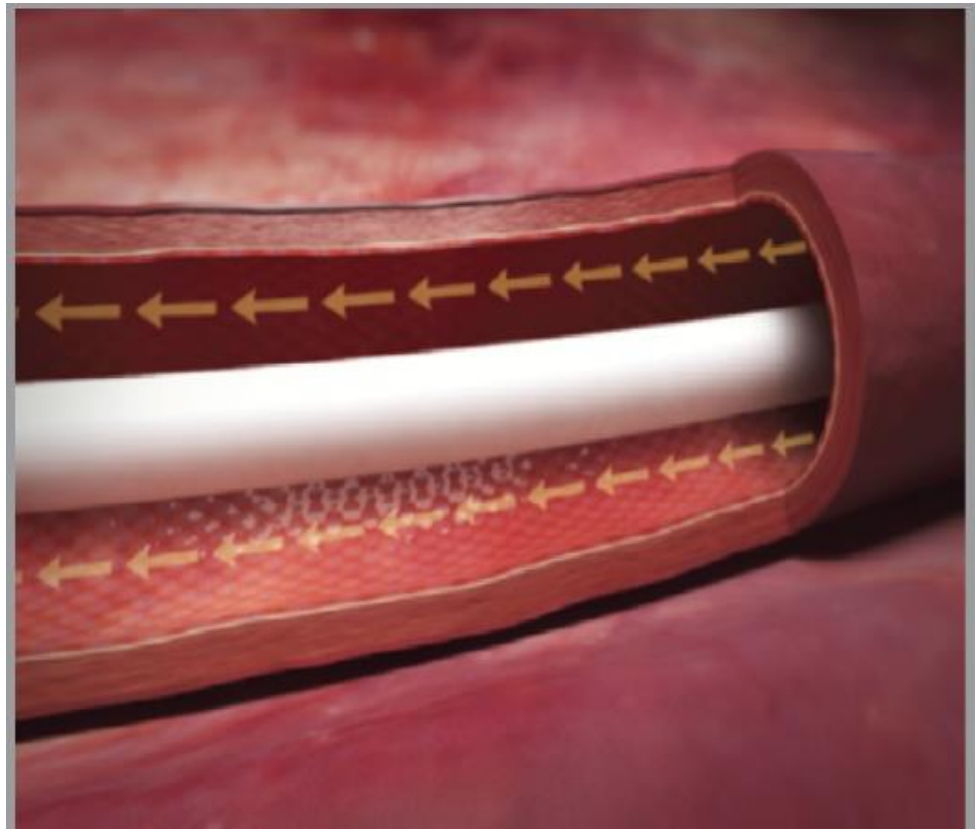
Thrombotic Occlusion Multiple Choice

1. The manufacturer's instructions state that Cathflo may be allowed to dwell in the catheter lumen:
   a. Up to 24 hours
   b. From 30 – 120 minutes
   c. For as long as it takes to lyse the thrombus

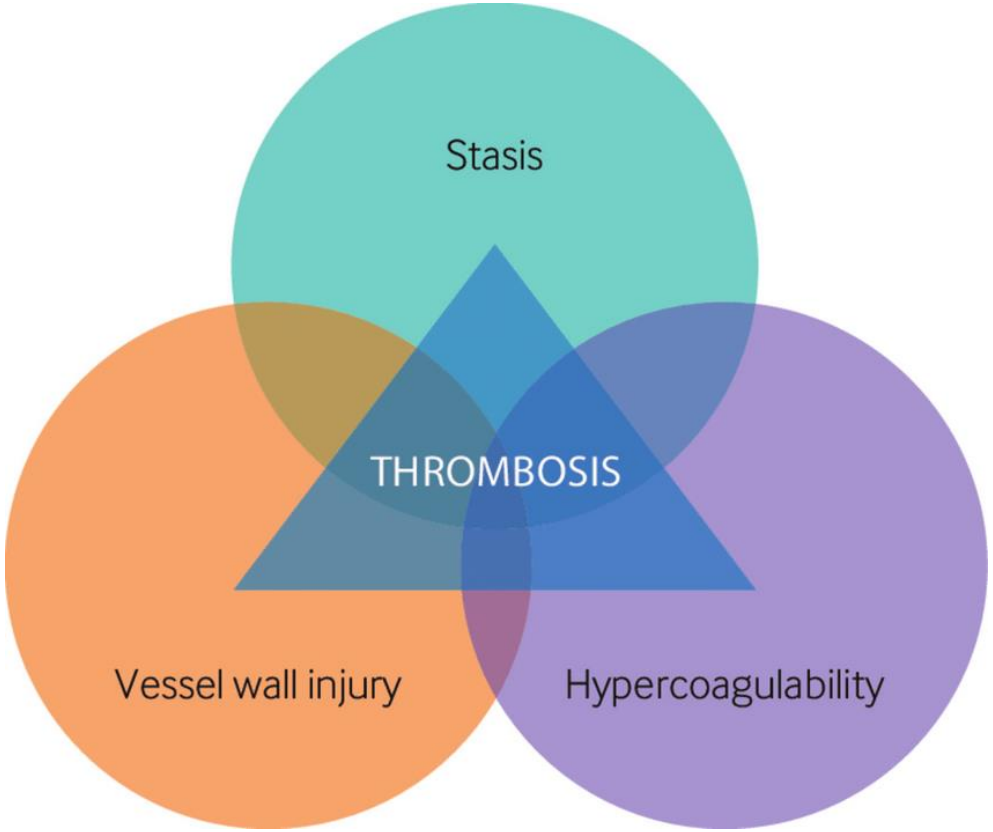
2. Cathflo is to be reconstituted using:
   a. Sterile Normal Saline 0.9% - 10 mL
   b. Sterile Water – 5 mL
   c. Sterile Water 2 mL
   d. any of the above

3. A complete assessment of the patient and the catheter to determine the cause of a malfunctioning lumen includes:
   a. A physical assessment of the patient and the catheter including a check of all lumen for patency
   b. A check for mechanical occlusion
   c. A review of recent catheter use including infusate/drug properties
   d. d. all of the above

Vessel Preservation / Reducing Vessel Depletion



Spencer, T. & Mahoney, K., 2017[11]



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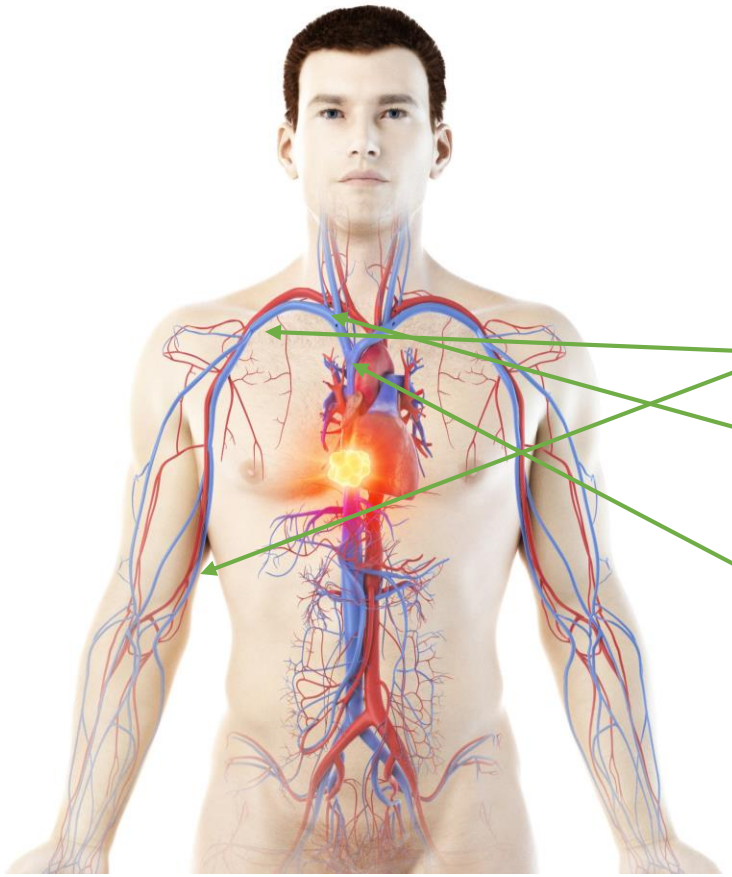
Vein Diameters and Vessel Flow Rates



Vein diameters & Vessel Flow Rates

2mm – 5mm
Metacarpal
Flow rate – 10ml/min

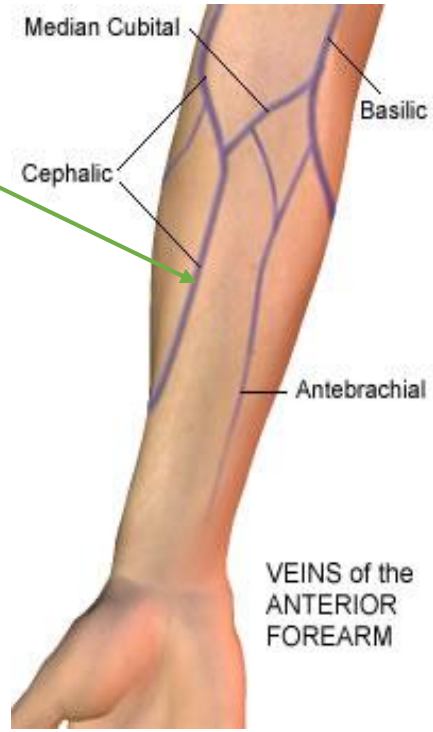
6mm
Forearm
Flow rate - 20-40 ml/min

8mm
Basilic Upper Arm Vein
Flow rate – 90- 150 ml/min

16mm
Axillary Vein
Flow rate – 150-350 ml/min

6mm- 19 mm
Subclavian
Flow rate – 350-1500 ml/min

20mm – 30 mm
Superior Vena Cava
Flow rate – 2000 ml/min



Graphics F. Kleinsteuber

Risk vs Benefit

- Benefits
  - Clearing the line
  - Resuming therapy in a timely manner
- Risks:
  - Releasing bacteria/biofilm into the venous system
  - Adverse reaction to catheter clearing agent
  - Catheter damage
  - Embolization of clot, precipitate or catheter

Question: does the need to salvage the catheter outweigh risks of treatment?

Assessment

- Confirm
  - Type of catheter
  - Occlusion exists and the most likely cause.
  - Qualified nurse must review patient's physical status, allergies, and Cis to catheter clearing agent.

Catheter Clearing Agents

Indication	Clearance Agent
Thrombotic Occlusions	Alteplase (Cathflo)
Lipid Occlusions	Ethyl Alcohol
Precipitates (acidic) medications or calcium phosphorus precipitates	Hydrochloric Acid
Precipitates (alkaline) medications: e.g. gancycolovir, acyclovir, ampicillin, phenytoin, septra	Sodium bicarbonate

Alteplase (Cathflo)

- How it works:
  - Converts plasminogen to plasmin initiating local fibrinolysis
- Indications
  - Restoration of function for CVADs—ability to withdraw blood

  - Cathflo MOA

Alteplase preparation

- 2 mg vial = 1mg/mL (must be refrigerated)
- Add 2.2 mL sterile water (non-bacteriostatic)
- Swirl or gently invert vial to mix—do NOT shake
- Attach a 5 micron filter needle to 10mL syringe
- Withdraw 2mL (2 mg) of solution from the reconstituted vial
- Remove filter needle
- Will remain stable for 8 hours once mixed if stored b/w 2 – 30°C

Alteplase preparation continued

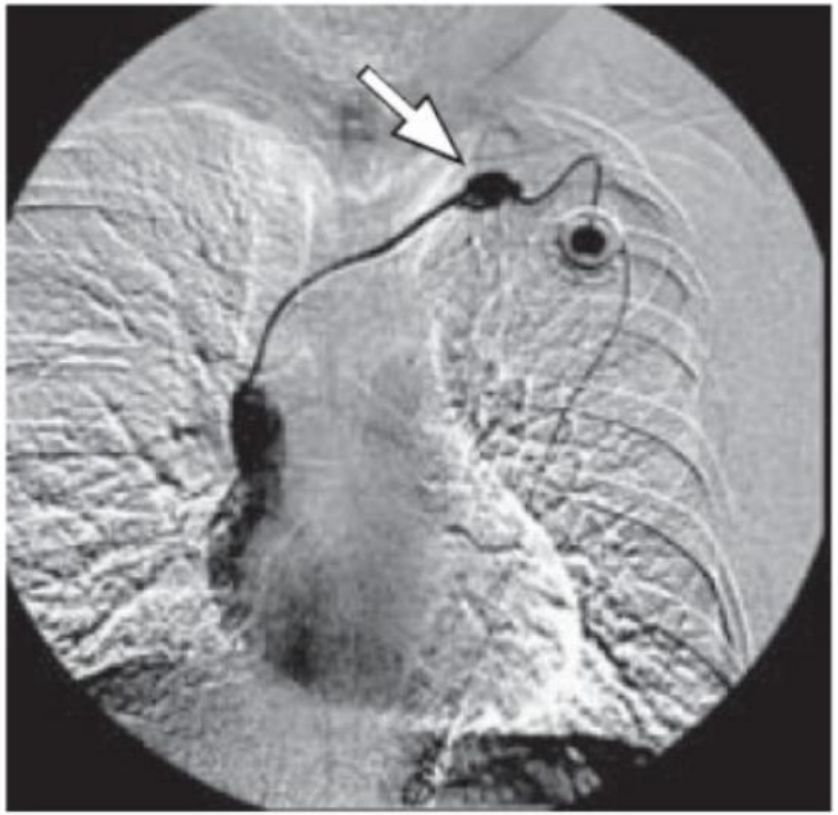
- Instillation volume
  - 2 mL or equal to volume of catheter lumen (ad indicated)
- Dwell time
  - 30 – 120 min
  - May be left overnight if needed
  - Once dwell time is completed, aspirate 4 – 5 mL and discard.
- May repeat dose X1
- Monitoring
  - Vitals baseline and as per organizational policy

Alteplase Contraindications & Precautions

- Contraindications:
  - Anyone with known hypersensitivity to Alteplase or any component of the formulation

- Precautions
  - Caution with patients with active internal bleeding or who have had the following within the last 48 hrs.:
    - Surgery
    - Obstetrical delivery
    - Percutaneous biopsy
  - Patients with thrombocytopenia, hemostatic defects or any condition where bleeding is a significant risk or wound be difficult to manage (e.g. venous thrombosis in region of catheter
  - Use in pregnancy only if potential benefit justifies potential risk to fetus
  - In the presences of known or suspected infection in the CVAD

Accidental nicking of tubing on insertion



Photos L Schulmeister RN

IVAD complication: Erosion

- IVAD erosion occurs when a portion or all of the port chamber or indwelling venous tubing protrudes through the skin. Occurs in ~1% (Zawacki et al., 2009).
- Potential causes:
  - Bevacizumab (Avastin) administration may cause delayed or incomplete wound healing (Genentech, Inc., 2013)
  - Angiogenesis triggered by inflammatory response by repetitive trauma from puncture site wound
  - Long-term corticosteroid use is known to cause thin skin and slower wound healing (Vallerand & Sanoski, 2012).
  - Repeated access at the same location (Almhanna et al., 2008; Camp-Sorrell, 2004).
  - Inadequate securement of IVAD access needles and tubing
  - Needle size (too large); 20 or 22 ga sufficient
- According to manufacturer recommendations, the depth of VAP placement should be from 0.5-2 cm. If the port is placed too shallow or if the tissue layer over the VAP is too thin, it may lead to tissue erosion (Bard Access Systems, 2014).
- Port pocket site selection needs to provide good port stability,, doesn't create pressure points and doesn't interfere with mobility or clothing

Twiddler's syndrome

- Port itself 'loses' anchor and moves within pocket

Photo: L Schulmeister RN