Advanced Oncology Certified Nurse Practitioner

REVIEW COURSE 2024

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THE UNIVERSITY OF TEXAS
MD Anderson Cancer Center
Making Cancer History®

Vascular Access Devices

Objectives

Distinguish types of vascular access devices (VADs), indications, contraindications, and care and maintenance.

Examine commonly encountered complications of VADs and necessary interventions.

Demonstrate knowledge of the VADs to provide comprehensive patient education and support at the bedside.

Content Outline

- Vascular Access devices
  - A. Anatomy (common veins accessed)
  - B. Types of VADs
    - 1. Peripherally inserted central catheter (PICC)
    - 2. Centrally inserted central catheter (CICC)
    - 3. Tunneled and non-tunneled
  - C. Indications
  - D. Care and maintenance
  - E. Removal
- Complications of Use
  - A. Infection
  - B. Thrombosis
  - C. Skin Problems
    - Infiltration versus extravasation

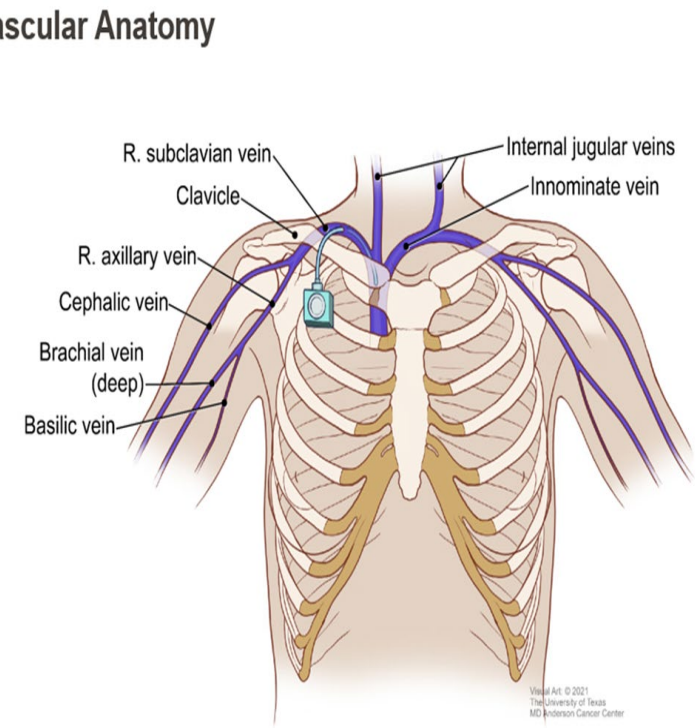
Vascular Anatomy

Peripheral veins

1. basilic
2. brachial
3. cephalic
4. external jugular
5. median cubital
6. metacarpal and digital

Central veins

1. axillary
2. subclavian
3. internal jugular
4. femoral



(Resource Guide for Vascular Access, 2019)

Indications

- Chemotherapy
- Intravenous fluids and medications
- Parenteral nutrition
- Blood and blood components
- Hemodynamic monitoring
- Plasmapheresis/apheresis
- Hemodialysis

(Resource Guide for Vascular Access, 2019)

General Considerations

- prescribed therapy
- duration of use
- indication of use
- least invasive VAD
- smallest outer diameter
- fewest number of lumens
- vessel health preservation

(INS, 2021; Gorski et al., 2021)

General Considerations for assessment

- vascular characteristics
- patient's age
- comorbidities
- history of infusion therapy
- patient’s preference for VAD location
- ability and resources available to care for the device
- vesicant drugs/ role of pH
- exposure to radiation and chemotherapy
- skin condition

(Gorski et al.,2021; Resource for Vascular Access, 2019)

Special considerations for oncology patients

Diagnostics – chest x-ray, vascular studies, CT or PET scan

Vascular history – mediastinal mass

Laboratory results – platelets (15 to 20K) and INR (2.0)

Duration

Vascular Access Devices

Non-tunneled

- Peripheral intravenous catheter
- Midline catheter
- PICC (peripherally inserted central catheters)
- CICC (centrally inserted central catheters) like apheresis

Tunneled

- implanted vascular port
- tunneled cuffed catheter

Ommaya reservoir

(Resource Guide for Vascular Access, 2019)

Non-tunneled catheters

Indications

- Short to long term central venous access
- Hydration
- Total parenteral nutrition
- Chemotherapy
- Vesicant drugs
- Blood and blood components
- Difficult intravenous access (DIVA)
- Apheresis
- Placement: bedside, ambulatory clinic, IR

(Resource Guide for Vascular Access, 2019)

Peripheral intravenous catheter

- Veins accessed: basilic, cephalic, median, and accessory veins
- Indications: infusion projected for 5 days or less non-irritant medications and solutions
- Contraindications: placement into an arm with venous thrombosis, fracture, trauma, infection or poor circulation, mastectomy, axillary lymph dissection, AVF fistula or graft
- Use of ultrasound – evidence-based practice

(Resource Guide for Vascular Access, 2019)

Midline catheter

- Veins used: basilic, brachial or cephalic veins. Accessed with US
- Indications: infusion for 6 days or up to 4 weeks, non-infiltrating solutions and non-vesicant
- Contraindications: arm with fracture, trauma, thrombosis, infection, poor circulation, AVF or graft, CKD patients
- Tip location: at the proximal region of the axillary line or distal shoulder

(Resource Guide for Vascular Access, 2019)

Peripherally inserted central catheters

- Vein accessed: basilic, brachial and cephalic veins
- Advantages:
  - ease of insertion
  - less risks and complications
  - patient's comfort
- Disadvantages
  - High risk of thrombosis
  - Adverse vascular consequences if placed for CKD patients

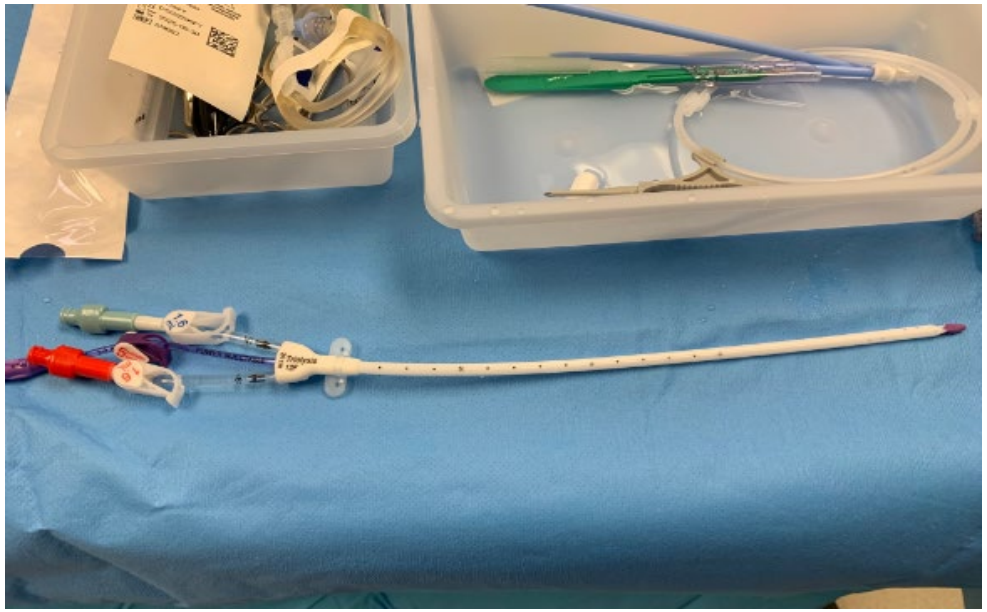
(Resource Guide for Vascular Access, 2019)

Centrally inserted central catheters

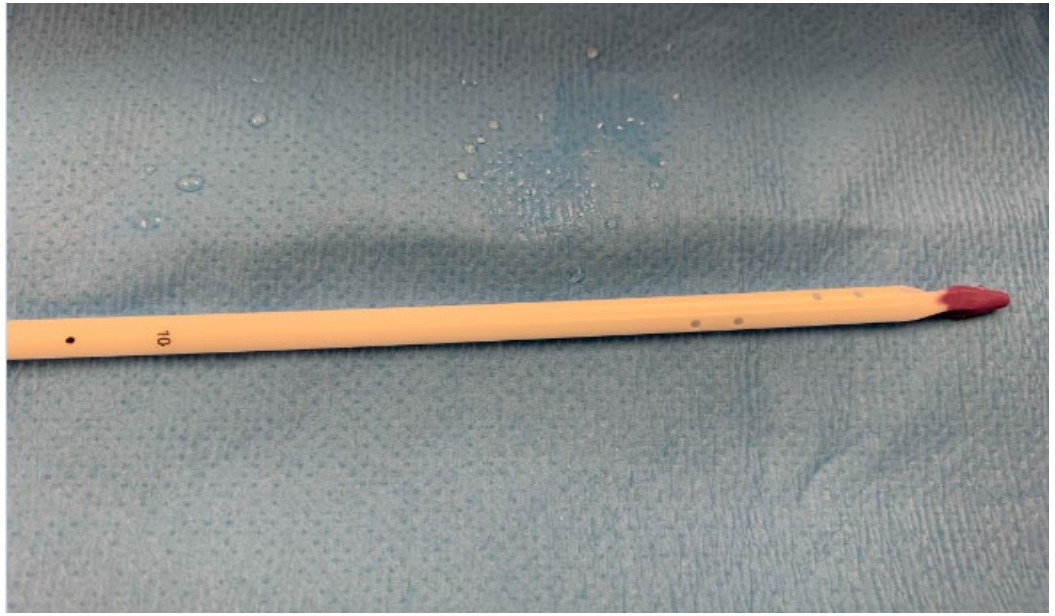
- Veins accessed
  - axillary, subclavian, internal jugular, and femoral vein
  - Use of ultrasound
  - Apheresis catheter – large bore catheter

    -stiffer material allows for rapid withdrawal of blood for autologous stem cell transplant collection
- Laboratory considerations
  - Platelets and INR
- Anticoagulants

Apheresis catheter



(Dalusung, J. “Apheresis catheter “. 2021. jpeg)



Contraindications

- Existing tracheostomies, history of radical neck dissection, cervical fracture instability, or unstable airway is not appropriate for neck or chest sites insertions
- For PICC placement
  - Do not place into an arm with fracture, trauma, infection, amputation or poor circulation, history of mastectomy with axillary lymph node dissection
  - Avoid placement into a paralyzed arm and history of DVT
  - Chronic kidney disease patients

(Resource Guide for Vascular Access, 2019)

CICC optimal tip location

- Cavoatrial junction/upper right atrium/ distal SVC
- Chest radiography
- Femoral approach tip location is the inferior vena cava above the level of the diaphragm

(Resource Guide for Vascular Access, 2019)

Complications and interventions post insertion

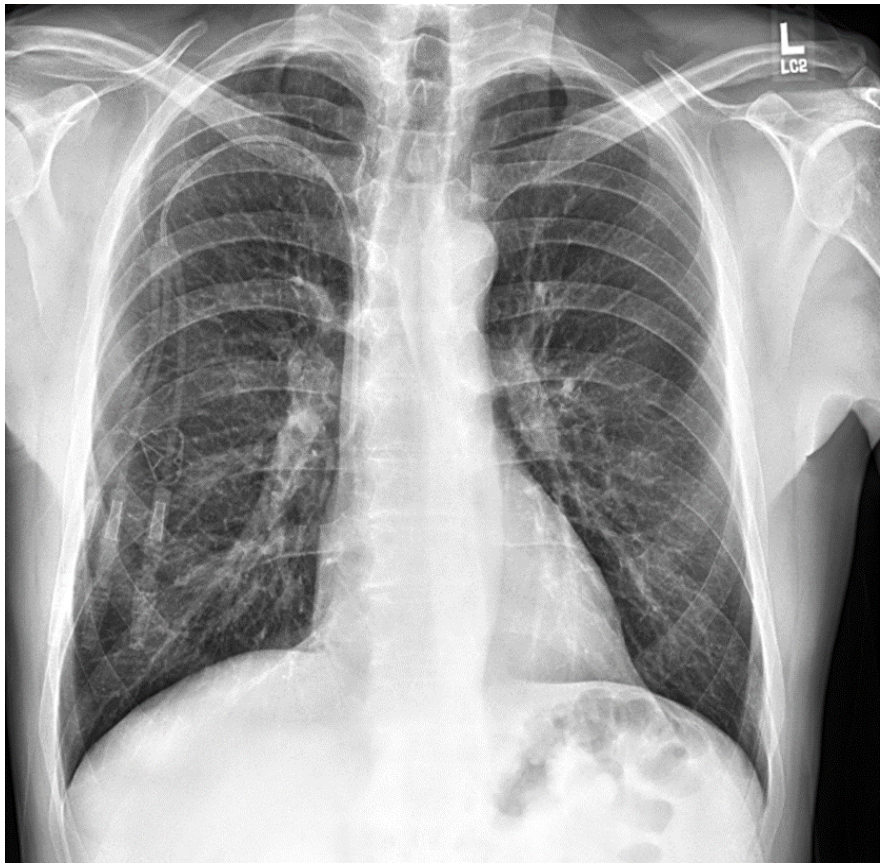
Malpositioned CVC Tip

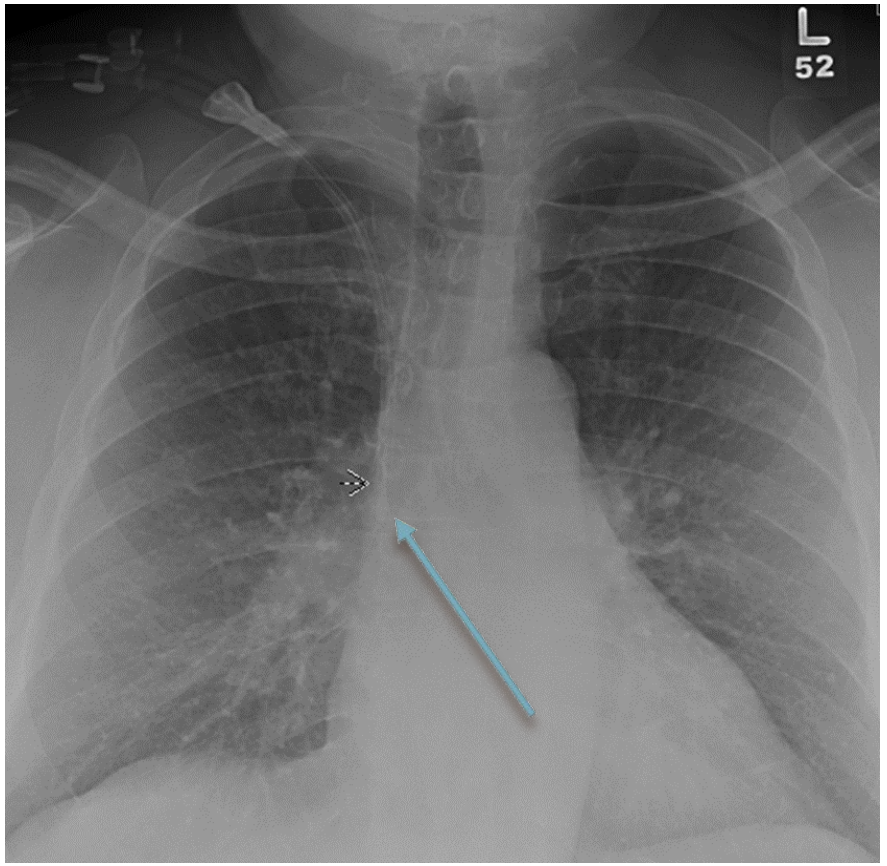
- CVC tip not in the optimal position of SVC
  - Malpositioned on insertion
  - Brachiocephalic
  - Contralateral vein
  - Mammary vein
  - Azygous vein

- Important: DO NOT use the catheter!

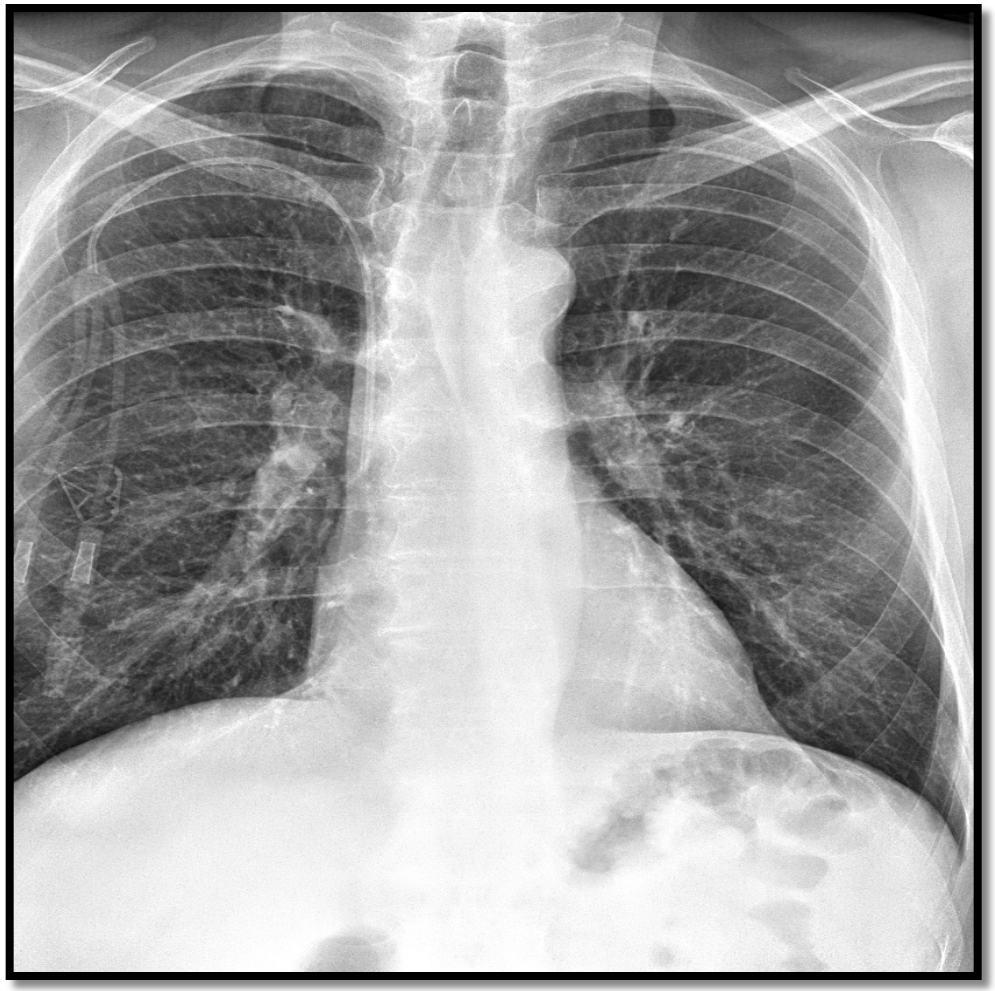
- Management
  - Over wire exchange
  - Power flush

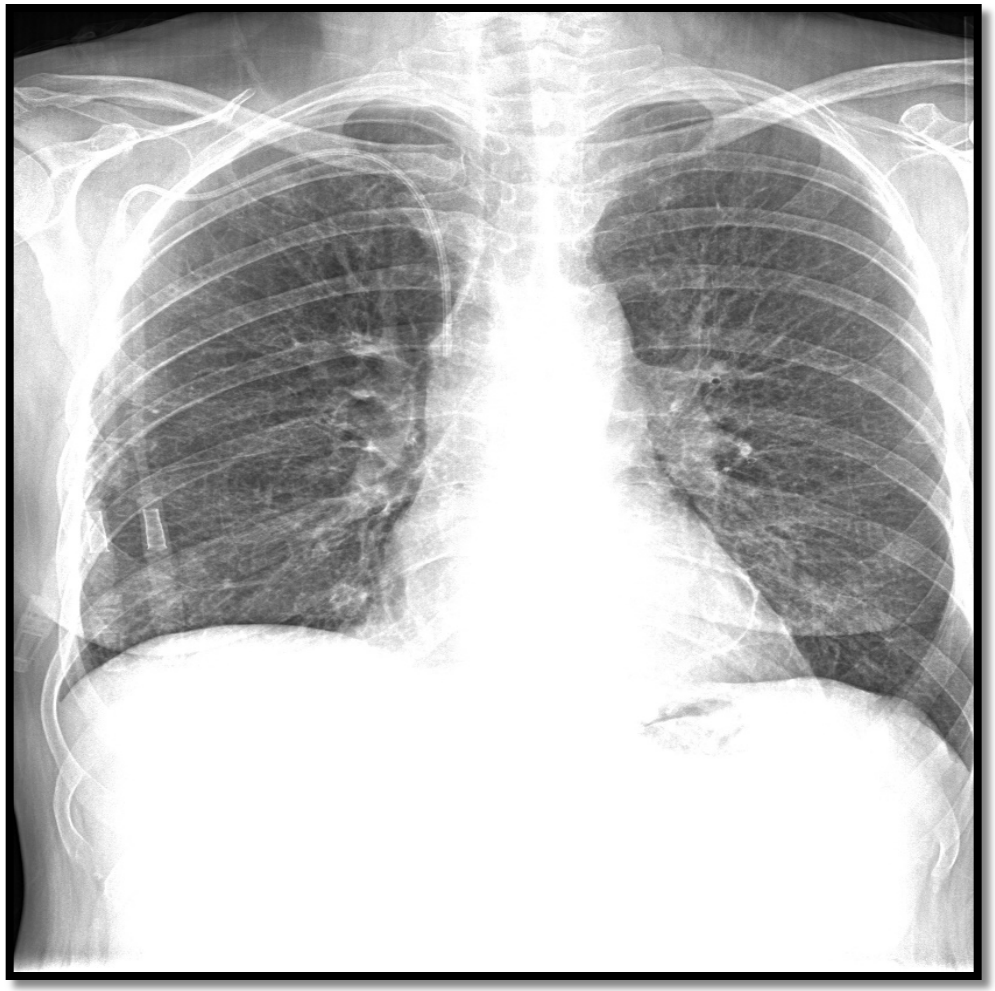
CVC tip optimal position

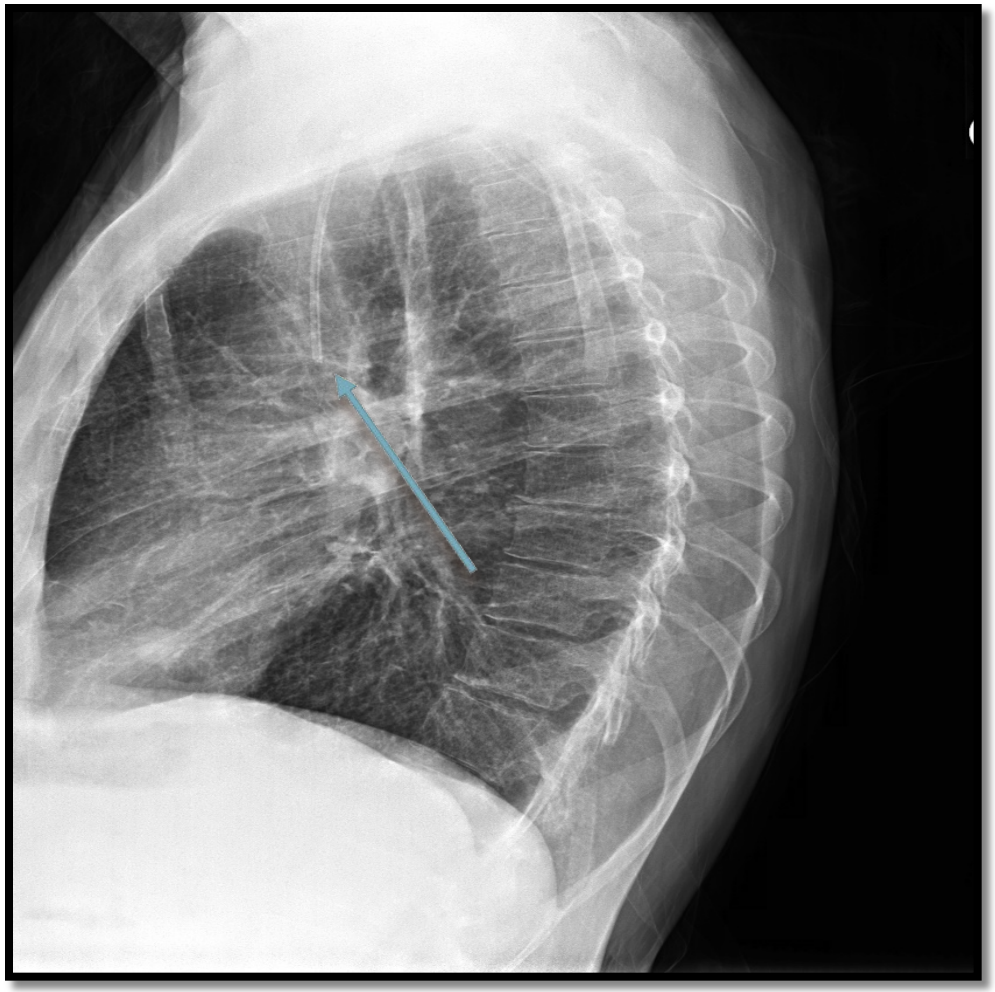


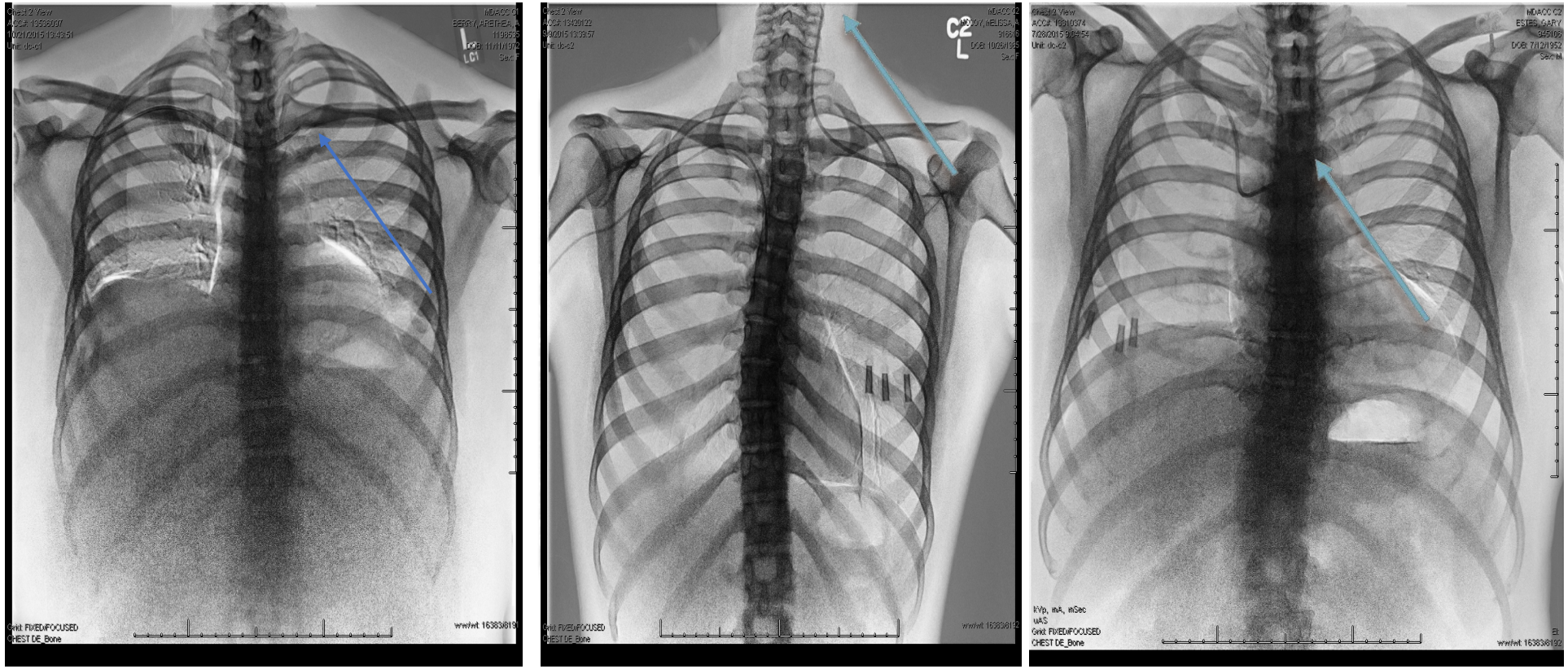


- (Dalusung, J. Figures adapted from Electronic medical record (2020))

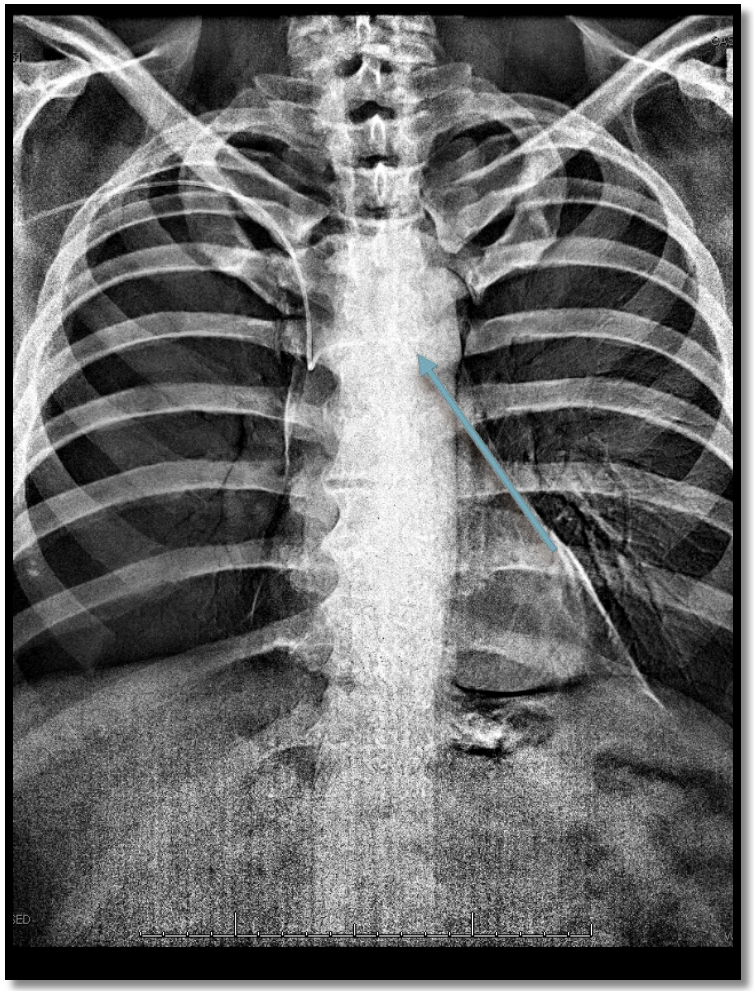






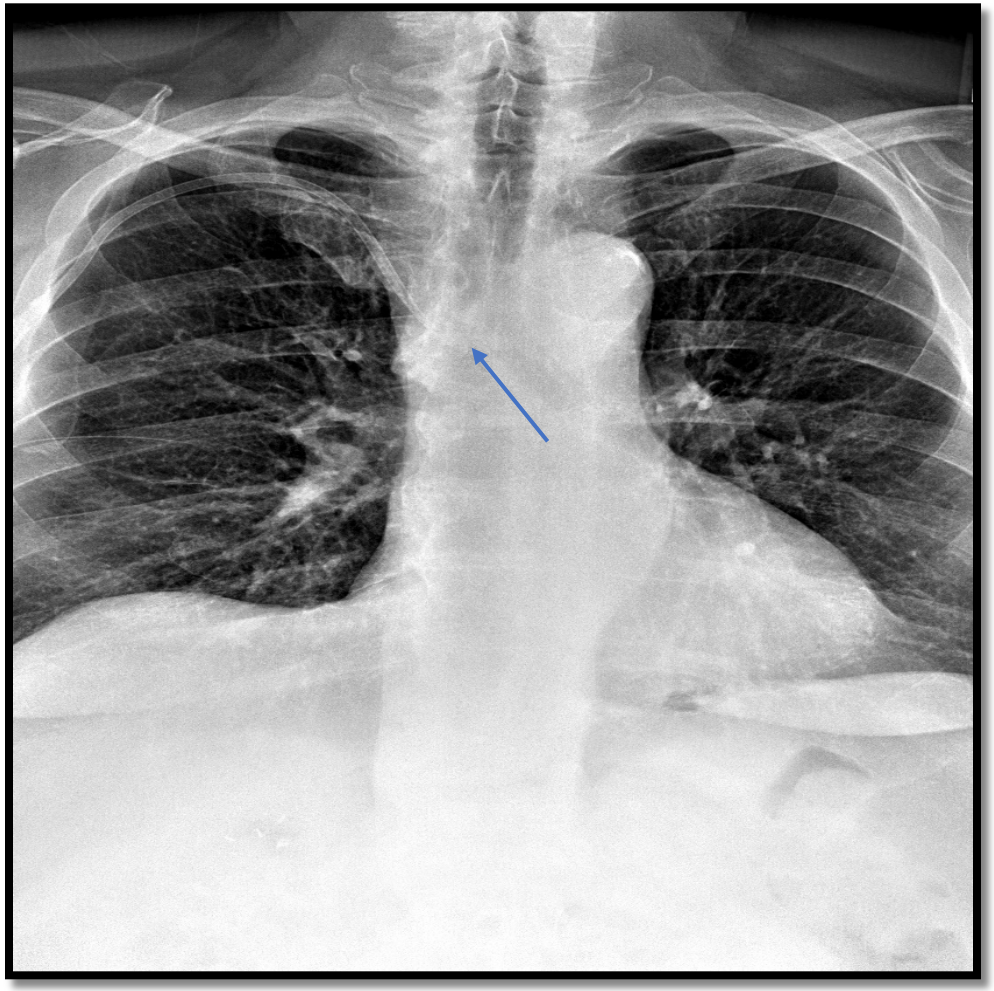


Different tip placement of catheter (AP view)

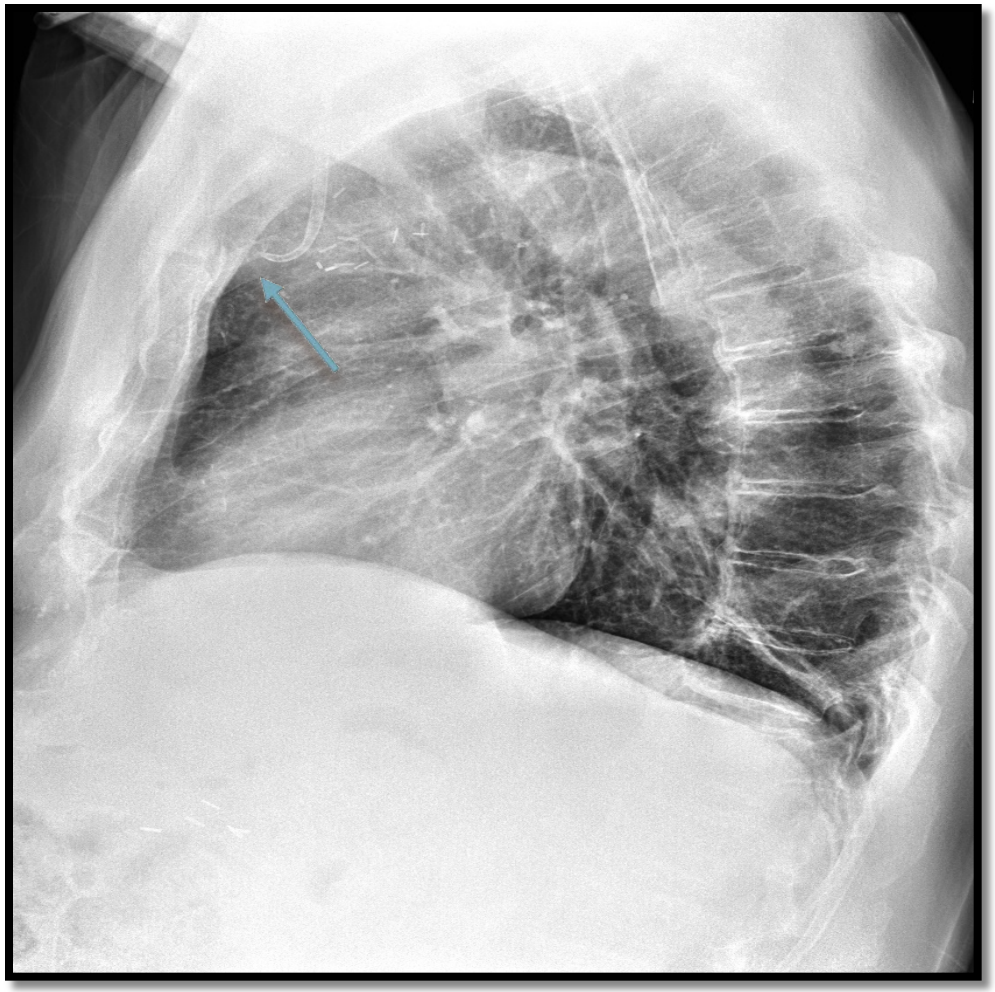


PA View

Lateral view



PA View



Lateral view

Complications and interventions post insertion

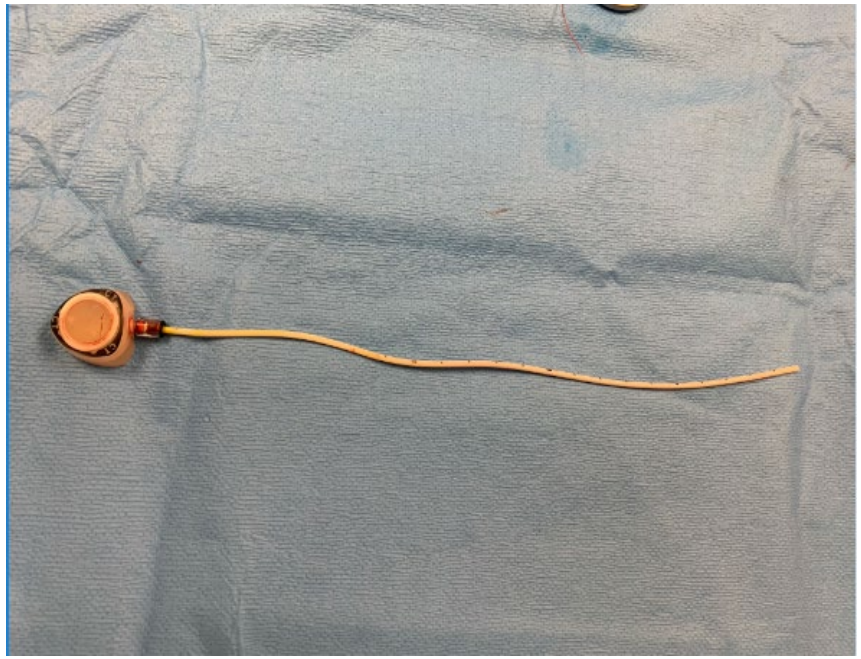
- Pneumothorax
  - Overnight observation
  - Denver catheter placement
- Retention of guide wires
  - Retrieval per IR
- Air embolism
  - Positioning, oxygen supplement
- Cardiac arrythmias
  - Pull back guidewire/catheter
- Arterial puncture/cannulation
  - IR consult
- Nerve injury
  - Removal

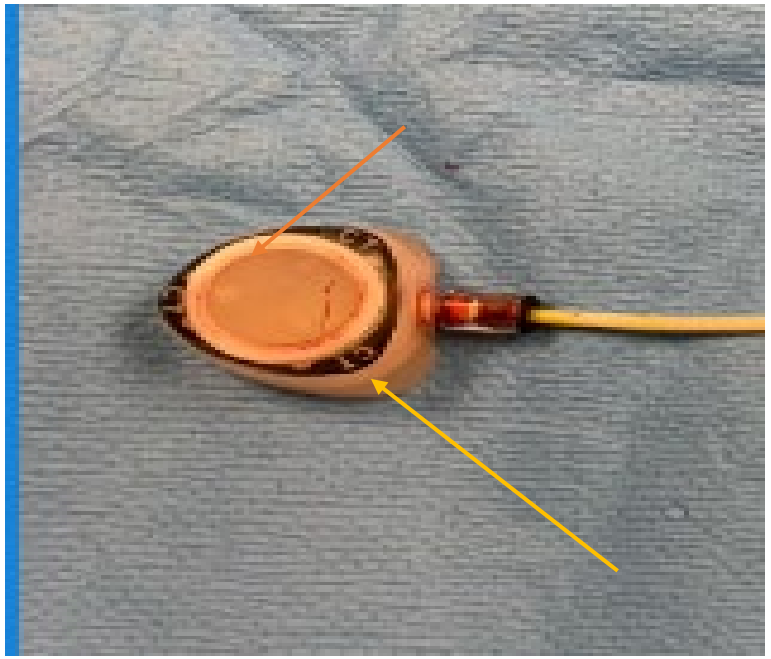
(Resource Guide for Vascular Access, 2019)

Implanted tunneled port

- Vein accessed: subclavian, internal jugular, femoral vein
- Placement: OR versus IR
- Indications:
  - months to years dwelling time, apheresis, hemodialysis
- Contraindications:
  - bloodstream infection, severe coagulopathy, cellulitis at insertion site
- Considerations:
  - Scheduled in operating room or interventional radiology
  - Anesthesia or sedation
  - Every 4 to 6 weeks flushing if not used

Power implanted port





(Dalusung, J. “Types of central venous catheters “. 2021. jpeg)

Port flushing

- least 10 mL of 0.9% sodium chloride
- adult oncology patients, it was found safe to extend maintenance flushing and locking to every 3 months with 10 mL saline followed by 3 to 5 mL heparin (100 units/mL).
- consider an annual chest x-ray to assess port position and integrity for long term use

(Diaz et al., 2017; Gorski et al., 2021; Odabas et al., 2014; Solinas et al., 2017).

Tunneled cuffed catheter

- Cuff attached to the proximal end of the catheter for securement
- Exit site heals within 2 to 3 weeks
- Removal require dissection of tissues around the exit site

Power/pressure injectable VAD

- Withstands >300 pounds per square inch (psi)
- Can be used for power injection of IV contrast for CT or MRI scan
- Use only power needle or non-coring needles for power injection per manufacturer recommendation for implanted port

Complications of Use

- Thrombosis – common in PICCs
  - the formation, development, or existence of a blood clot within the vascular system (INS., 2021)
  - Signs and symptoms: pain, edema or erythema, acute onset, collateral veins
  - Doppler ultrasound
  - Positive result is not indication for removal
- Phlebitis is the inflammation of a vein.
  - Signs and symptoms: pain or tenderness, erythema, edema, purulence, and or palpable venous cord (INS., 2021)
- Thrombophlebitis is phlebitis with formation of blood clot (INS., 2021)

DVT related to CVC management

- CVC associated thrombosis can be prevented with optimal CVC tip placement
- Anticoagulants are not recommended as prophylactic
- Treatment of CVC associated thrombosis should be based on the prolonged use of low-molecular weight heparin
- Maintenance of the catheter is justified if it is mandatory, functional, in the right position and in the absence of infection, with a favorable evolution under close monitoring
- anticoagulant treatment should then be continued as long as the catheter is present

- P. Debourdeau, D. Kassab Chahmi, G. Le Gal, I. Kriegel, E. Desruennes, M.-C. Douard, I. Elalamy, G. Meyer, P. Mismetti, M. Pavic, M.-L. Scrobohaci, H. Lévesque, J. M. Renaudin, D. Farge, on behalf of the working group of the SOR; 2008 SOR guidelines for the prevention and treatment of thrombosis associated with central venous catheters in patients with cancer: report from the working group, Annals of Oncology, Volume 20, Issue 9, 1 September 2009, Pages 1459–1471, https://doi.org/10.1093/annonc/mdp052

Deep vein thrombosis

- a common risk of insertion of central venous access
- incidence (5- 52%)
- catheter material, catheter type, catheter size versus vein diameter catheter tip placement

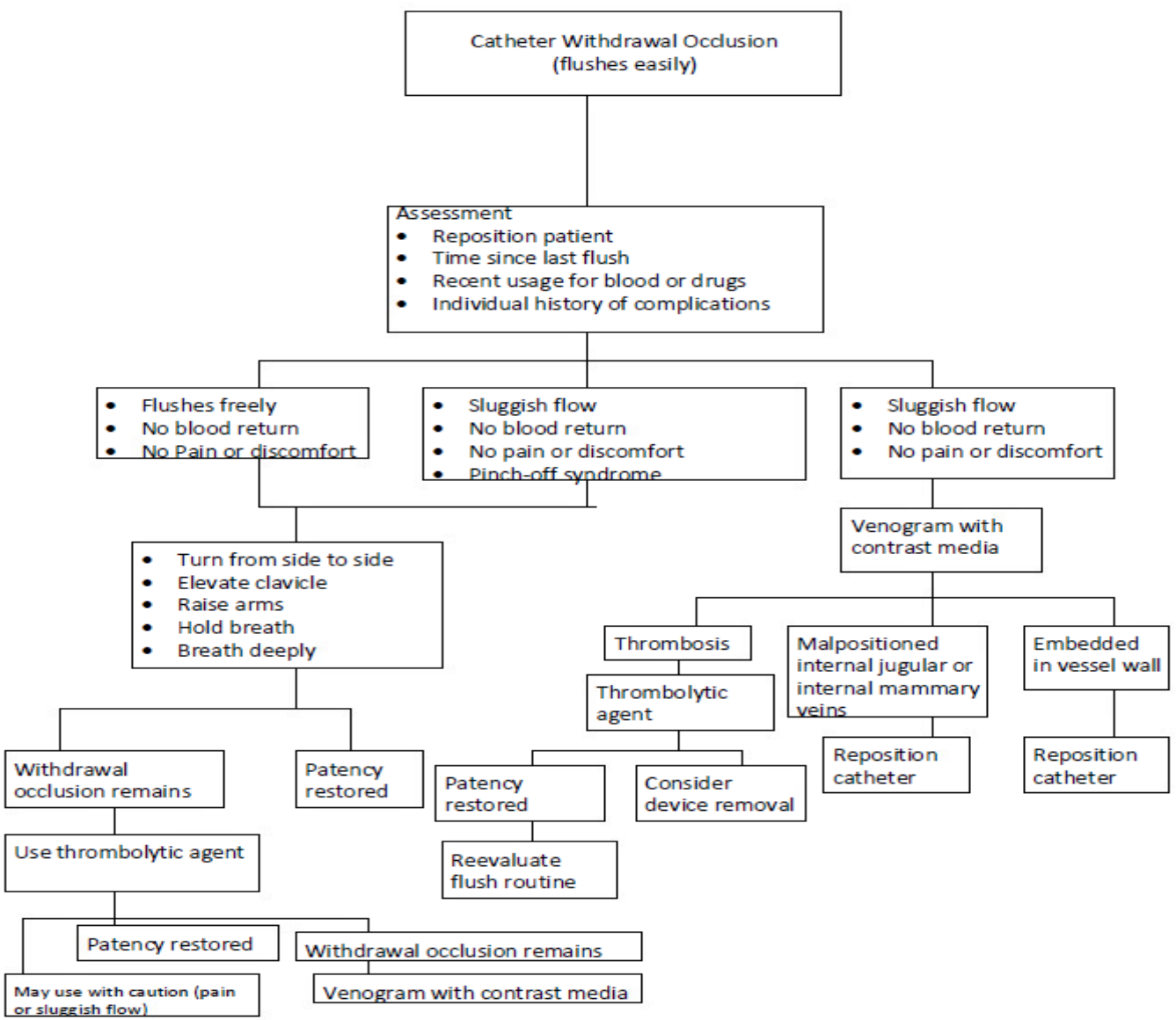
❖ Things to consider before removing the catheter

✓Is the catheter still in good condition?

✓Will the patient still need it?

✓Are there alternative sites for insertion?

✓Can the patient be anticoagulated?



(Yarbro et al., 2016)

Infection

CRBSI: Catheter Related Bloodstream Infection

- used when diagnosing and treating patients
- catheter is the source of the BSI

CLABSI: Central Line Associated Bloodstream Infection

- Surveillance definition used by CDC's National Healthcare Safety Network (NHSN)
- central line placed within the 48-hour period before the development of the BSI

O'grady, N. P., Alexander, M., Burns, L. A., Dellinger, E. P., Garland, J., Heard, S. O., ... & Healthcare Infection Control Practices Advisory Committee (HICPAC)(Appendix 1). (2011). Guidelines for the prevention of intravascular catheter-related infections. Clinical infectious diseases, 52(9), e162 e193.https://www.cdc.gov/infectioncontrol/guidelines/bsi/background/terminology.html

CLABSI incidence

- 250,000 BSIs annually

  30,100 CLABSIs occur in US acute care facilities each year
- 46% decrease in CLABSIs has occurred in hospitals across the U.S. from 2008-2013
- CLABSIs serious infections typically causing a prolongation of hospital stay;
- increased cost & mortality risk

CDC's National Healthcare Safety Network (NHSN). Bloodstream infection event (central-line–associated bloodstream infection and non–centralline–associated bloodstream infection) NHSN protocol. Available at: https://www.cdc.gov/nhsn/psc/bsi/index.html
Rupp ME, Karnatak R. Intravascular Catheter-Related Bloodstream Infections. Infect Dis Clin North Am. 2018 Dec;32(4):765-787. doi: 10.1016/j.idc.2018.06.002. Epub 2018 Sep 18. PMID: 30241718

Catheter related bloodstream infection

- Decrease in incidence by 50% from 2008 to 2014
- Risks increases with number of catheter lumens, immunocompromised patients
- Maximum sterile barrier
- Care and maintenance
- Chlorhexidine use
- Diagnosed with 2 sets of blood culture

(Grady, et al, 2011; Resource Guide for Vascular Access, 2019)

Cultures

- Catheter tip cultures are not routinely done at catheter removal unless any or all of the following circumstances exist:
- A. Fever (>101 Fahrenheit), not related to therapy
- B. Hypotension related to suspected sepsis
- C. Site inflammation
- D. Positive blood cultures within last 7 days
- E. Suspected catheter-related infection
- F. Endocarditis

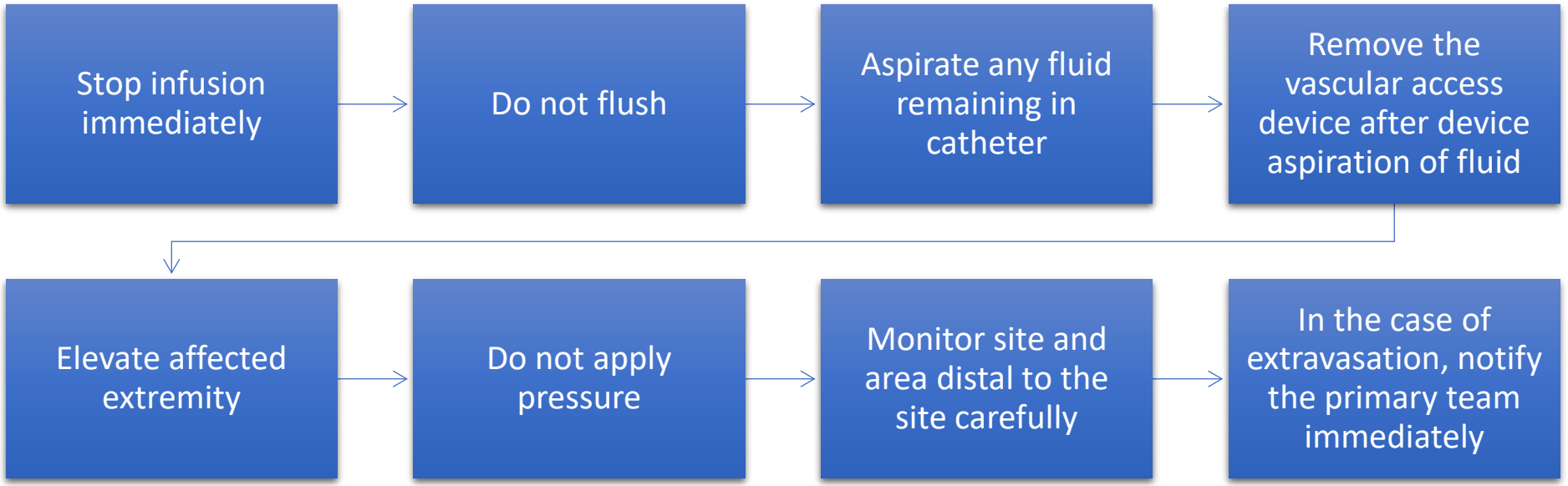
(Grady, et al, 2011; Resource Guide for Vascular Access, 2019)

Skin problems

- Figure adapted from Resource Guide for vascular access (2019)

- Infiltration – inadvertent administration of medication into the tissue
- Extravasation – administration of vesicant or large volume of solution into the tissue
- s/sx - fluid leakage around the insertion site, swelling, pain, induration, erythema, warm, or tissue necrosis
- Important: STOP the infusion

Treatment



(Resource guide for vascular access, 2019)

Care and Maintenance

- Dressing change once a week
- Monitor and maintenance
- Patient education
- Routine flushing

Removal

- Indication
- Apply pressure dressing and keep for 24 hours

(Resource Guide for Vascular Access, 2019)

Device maintenance

FLUSHING

Figures adapted from Resource guide for vascular access

ASSESSMENT

VISUAL INSPECTION

DRESSING CONDITION

SKIN CONDITION

DOCUMENTATION

Ommaya reservoir

- Surgically inserted by neurosurgeon
- Ventricular access device with an intraventricular catheter system
- Long-term access to the intrathecal space
- CSF long-term access
- Administration of medications directly into the brain
- At risk for neurological complications, non-functioning reservoirs, and the need for reoperation
- Risk for post-op infection, typically with gram-positive skin organisms, occurs in 5-8% of patients
- Growing use with evidence of increased patient survival with late-stage LMD due to immunotherapy and small molecule

Ommaya reservoir

Contraindications

- scalp infection
- Brain abscess
- Previously known allergy to silicone

- Identify signs of increased intracranial pressure
- Strict aseptic technique with access

Conclusion

- VADs place an integral part in the management and treatment of our oncology patients
- Type of VADs and insertion should ideally depend on the clinician, patient's preference and the treatment plan
- Knowledge of the catheters is important for providers to know as we collaborate care of our cancer patients

References

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Thank you!

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