Implanted Vascular Access Ports: Complication Management

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- A special thanks to all the patients who share their dreams and battle scars with the rest of us via the world wide web.

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Objectives

- Participants will be able to discuss patient assessment for the management of implanted vascular access devices
- Participants will be able to discuss identification, intervention, and management of adverse events associated with the implanted vascular access device

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Definition

- An implanted port is a medical device consisting of a housed reservoir which is accessed through a septum that is connected to a catheter

- The housed reservoir is located under the skin and the catheter is surgically placed into a vessel, body cavity, or organ for the purpose of infusate and/or transfusate delivery

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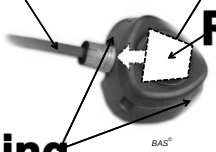
Port Terminology

Catheter

Septum

- General:
  - ✓ Implanted Venous Access Port
  - ✓ Port
  - ✓ TIVAS



Reservoir

- Brands:
  - Infusaport
  - Port-a-cath
  - Medi-port
  - Power Port

Housing

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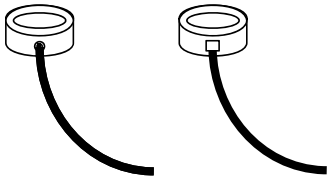
Port Configurations

- Some port reservoirs are implanted prior to attaching the catheter; others are all-in-one from the manufacturer.



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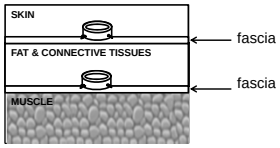
Port Pocket & Securement

- The surgeon creates a snug pocket, inserts the port, and may secure the implanted port to one of the fascia layers.



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Port Insertion Sites: Chest

- The Right Internal Jugular is the preferred vessel for catheterization:
  - Straight path to the SVC
  - Avoids vessel space between first rib and clavicle (catheter can catch and lead to pinch-off syndrome)
- The Left IJ is the next choice
  - Still avoids area of pinch-off syndrome
- The Right Subclavian (straight path) is third choice
- The Left SC is the least preferred chest site

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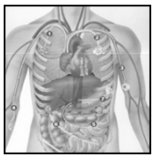
Alternate Port Sites

- Reservoir may be placed on arm (catheter tunnels to basilic or axilla vein)
- Reservoir also may be placed in the abdominal region
- Reservoir may even be placed on top of thigh (when iliac/femoral access only remaining option or for hepatic-arterial chemotherapy)



COURTESY SMITH MEDICAL 2003
http://www.quia.com/pages/portaccesscoursesurg.html

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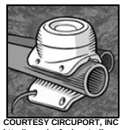
Alternate Port Purposes

- Dialysis access
- Peritoneal access
- Hepatic-Arterial access

COURTESY MEDTRONICS
http://www.medtronic.com/SE/physician/p_pump_index.html



COURTESY CIRCUPORT, INC
http://www.innfusionstudios.com/circuport/contact.html

COURTESY CIRCUPORT, INC
http://www.kidney.org.uk/conf02/steele-detail.html

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Other Implanted Devices

- Pain management devices
  - Intrathecal
  - Neurostimulator/modulation

COURTESY MEDTRONICS
http://professional.medtronic.com/pt/neuro/scs/prod/index.htm

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http://professional.medtronic.com/pt/neuro/idd/prod/index.htm

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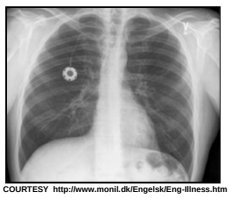
Assessment: Radiograph

- A radiograph of tip location (or L.I.P. reading thereof) must be reviewed prior to accessing or using any C.V.C., including an implanted port
  - If not available, please obtain a Chest X-ray



COURTESY http://www.monil.dk/Engelsk/Eng-illness.htm

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Assessment: Pressure Inject-Ability

- **Must be identifiable:**
  - **A radiograph may reveal that the implanted port may be used for pressure (power) injection**
  - **Patient presents information card/booklet provided by surgical staff at time of port placement**
  - **Port has palpable bumps on septum**

COURTESY http://jmmultiplemyeloma.blogspot.com/2011/07/bard-power-port-day-39-july-22-2011.html

- **If unable to verify as pressure injectable, must not be used for such; catheter fracture or embolus may result**

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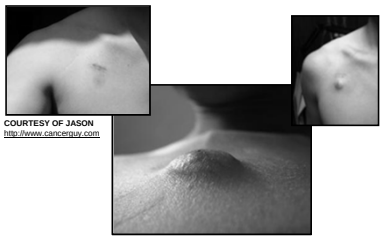
Port Site Assessment

- **Port site assessment is both visual and palpable**



COURTESY OF JASON
http://www.cancerguy.com

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Assessment continued

COURTESY OF SCHULICH SCHOOL OF MEDICINE AND DENTISTRY
http://web.schulich.uwo.ca/Students/medicine/year3/radiology/tubeslinesdrains/portacaths.html

COURTESY OF / RETRIEVED FROM
http://uiebaqugun.500mb.net/

COURTESY OF BASIL WILLIS III
http://basilwillis.com/?p=73

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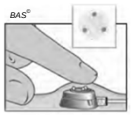
Assessment continued

- Patient should be as supine as possible
- Palpate directly above port
  - Helps estimate depth to port and thus length of access needle needed



- Palpate edges of port
  - Gives an idea of general port shape location of septum(s)

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Assessment: Access

- Insert only a non-coring "Huber" needle in to the septum of an implanted venous port
  - Any other type of needle may core the port; at best, the port would be compromised, at worst, the patient would suffer a foreign body embolism
- Access pressure injectable ports with pressure injectable non-coring needles and all other ports with standard non-coring needles (avoids error of assumption)

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Access continued

- Sterile procedure
  - Dressing supplies, flush, & cap
  - Secure port with non-dominant hand while inserting non-coring needle

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Access continued

- Aspirate for blood return and discard, rather than re-inject blood, then flush with 20 mL normal saline.

Recommendations

While a more thorough investigation of this situation continues, FDA continues to recommend that health care professionals consider taking the following precautions:

- Avoid flushing the syringe when initially confirming needle patency upon accessing the port. If the needle has cored the port, flushing may introduce the core into the patient's body, and could lead to serious adverse events.
- When possible, upon accessing the port, consider aspirating a small amount of blood from the port after septum puncture, then discard the syringe with its contents. This step may recapture the silicone sliver. If the needle becomes clogged when attempting to aspirate, remove the needle, discard it and select a new one.
- Watch for signs and/or symptoms that may indicate damage to the port's septum, such as medication leakage resulting in inadequate therapy delivery, along with tissue, nerve and/or muscle damage; and redness of the surrounding area.
- Patients should continue to follow their doctor's recommendations for receiving treatment.

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Access RED flags

- Can not insert non-coring needle
  - Reassess port position, secure with non-dominant hand and try again.
- Can not aspirate
  - Do not flush, remove needle, reassess and re-access
  - Obtain CXR and anticipate Alteplase administration
  - Consider flushing if known port condition
- Can not flush or resistance with flushing
  - Obtain CXR and anticipate Alteplase administration
- Patient "hears" flush
  - Obtain CXR
  - Patient feels swelling near port with flush or flush tracks back up needle
  - Consider needle malposition, remove and re-access
  - Obtain CXR and notify physician if reoccurs

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Maintenance points

- Change dressing and non-coring needle at least every 7 days, and as needed
- Assess patency (blood return and flushing) and site appearance with each patient assessment and as needed (or as per institutional/employer policy)
- Pay attention to patient tolerance of infusion
- Potentially adverse events may happen at any point; recognition and intervention are key to patient well being

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Adverse Events

- **Whew! Might make you wonder why anyone would want an implanted venous port**

• Air Embolism	• Device Rotation or Extrusion	• Perforation of Vessels or Viscus
• Bleeding	• Endocarditis	• Pneumothorax
• Brachial Plexus Injury	• Extravasation	• Spontaneous Catheter Tip Malposition or Retraction
• Cardiac Arrhythmia	• Fibrin Sheath Formation	• Thoracic Duct Injury
• Cardiac Tamponade	• Hematoma	• Thromboembolism
• Catheter or Port Erosion Through the Skin	• Hemothorax	• Vascular Thrombosis
• Catheter Embolism	• Hydrothorax	• Vessel Erosion
• Catheter Occlusion	• Intolerance Reaction to Implanted Device	• Risks Normally Associated with Local or General Anesthesia, Surgery, and Post-Operative Recovery
• Catheter Occlusion, Damage or Breakage due to Compression between the Clavicle and First Rib	• Inflammation, Necrosis, or Scarring of Skin Over Implant Area	
• Catheter or Port related Sepsis	• Laceration of Vessels or Viscus	

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http://www.bardaccess.com/powerPort/assets/pdfs/MC-0475-01_PowerPort_Nursing_Guide_web.pdf

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Adverse Events:
Primarily related to insertion

- **Pneumothorax, Hemothorax, or Hydrothorax**
  - ***Diagnosis: Respiratory signs and symptoms***
    - **Shortness of breath**
    - **Decreased pulse ox or spO_2**
    - **Absent or muffled breath sounds**
  - ***Treatment***
    - **Mild: may require increased monitoring only**
    - **Moderate-Severe or persistent: chest tube insertion**

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Adverse Events:
Primarily related to insertion

- **Thoracic duct injury: Main lymphatic duct**
  - ***Diagnosis: Chylothorax (lymph in the pleural cavity)***
    - **Shortness of breath**
    - **Decreased pulse ox or spO_2**
    - **Absent or muffled breath sounds**
  - ***Treatment***
    - **Intra-thoracic surgical repair of main duct**
    - **Also, measures to re-inflate the lung as necessary**

GRAY, HENRY. 1918.
Anatomy of the Human Body

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Adverse Events:
Primarily related to insertion

- **Laceration or perforation of blood vessel**
  - ***Diagnosis: if missed during insertion***
    - **May include signs/symptoms of hemothorax**
    - **Hematoma**
    - **Hypotension / hypovolemia**
  - ***Treatment***
    - **Surgical intervention if patient symptomatic or vessel injury does not self resolve**
    - **Hemodynamic stability**

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Image COURTESY OF http://wellnessadvocate.com/Anatomy/img/500px-Circulatory_System_no_tags.svg.png

Adverse Events:
Primarily related to insertion

- **Laceration or perforation of viscus**
  - Probable organ involved lung or heart
    - **Lung insult = pneumothorax**
  - *Cardiocentesis Diagnosis: if persists*
    - **Cardiac Tamponade**
      - **Retrosternal pain**
      - **Tachycardia**
      - **Muffled heart tones**
      - **Jugular Vein Distension**
      - **Hypotension / Paradoxical pulse**
  - *Treatment*
    - **Placement of septal occlusion device**
    - **Pericardiocentesis**
    - **Supportive care**

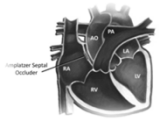

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IMAGE RETRIEVED FROM http://www.pediatricheartspecialists.com/articles/detail/atrial_septal_defect

Adverse Events:
Primarily related to insertion

- **Brachial Plexus Injury**
  - *Diagnosis*
    - **Mild: numbness, tingling, and / or weakness in arm**
    - **Moderate: shooting or shocking and burning arm pain**
    - **Severe:**
      - **Loss of finger, elbow, and / or shoulder motion**
      - **Severe pain**
  - *Treatment*
    - **Time and pain management**
    - **Surgical intervention for scar tissue, cut, or torn nerves**
      - **Nerve graft or nerve transfer**
      - **Muscle graft**
- **Anesthetic related complications**

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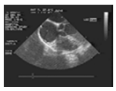
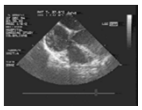
Adverse Events:
Occurring at insertion or later

- **Air embolism**

  - *Diagnosis*
    - **Witnessed event – patient inhales while introducer, catheter, or tubing from non-coring needle is open to air or unclamped**
    - **Signs / symptoms – depend on the location of the blockage**
      - **Pulmonary most likely: chest pain, short, dyspneic breath**
      - **Also, could be cardiac or brain embolic**

Images COURTESY OF http://anestit.unipa.it/gta/vae.html

Adverse Events:
Occurring at insertion or later

- **Air Embolism continued**
  - *Treatment*
    - **Immediately place in left lateral decubitus Trendelenburg (to keep air trapped in the apex of the heart)**
    - **Aspiration of the air via a C.V.C. placed in the atrium may be attempted**
    - **100% oxygen and endotracheal intubation may be required**
    - **Hyperbaric oxygen therapy may be required**
    - **C.P.R. may be necessary**
      - **Compressions may actually breakup the air bubbles, improving cardiac output**
      - **Position patient supine and head down**

Adverse Events:
Occurring at insertion or later

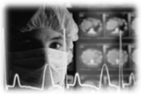
- **Cardiac Arrhythmia**
  - Related to catheter tip position
    - **At insertion: Catheter too long, extends into atrium or ventricle**
    - **Later: Internal migration of catheter, due to fracture or dislodgment**


  - *Diagnosis*
    - **EKG shows PAC, PVC, or V-tach**
      - Patients with premature beats may report palpitations, often described as 'missed,' 'skipped,' or 'flip-flop' beats
        - » May also be asymptomatic per patient reporting
      - Patients with ventricular tachycardia report 'rapid' palpitations, angina, and/or syncope; they also may have rapid or absent pulses, may lose consciousness or be hypotensive

Images COURTESY OF http://itsjesryl.blogspot.com/2010/10/electrocardiogram-ecg.html

Adverse Events:
Occurring at insertion or later

- **Arrhythmia continued**



  - *Treatment*
    - **Requires repositioning of catheter tip (surgical or radiological intervention)**
    - **Urgent - in cases of ventricular tachycardia where patient is asymptomatic**
    - **Emergent - in cases of symptomatic v-tach or as a result of catheter dislodgment**

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Adverse Events:
Occurring at insertion or later

- **Hematoma and Bleeding**

  - *Diagnosis*
    - **Superficial: visible and or palpable**
    - **Internal: hypovolemia or anemia**
  - *Treatment*
    - **Superficial: direct pressure to slow or stop bleeding**
    - **Internal: supportive care while self resolves or surgical intervention**
    - **Application of recumbinant thrombin may aid in sealing capillary or small venule leaks**
    - **Correction of underlying coagulopathies**
    - **Rarely requires evacuation of hematoma**

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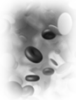
Adverse Events:
Occurring at insertion or later

- **Bacteremia – invasion of the blood by pathogenic microorganisms**
- **Sepsis – suspected infection with 2 or more: T>38.3°C, HR>90, RR>20, BG>140 in absence of diabetes, WBC>12k or >10% immature forms, and acutely altered mental status**
- **Severe sepsis – Acute organ dysfunction, hypoperfusion, or hypotension prior to fluid challenge**
  - *Differential Diagnosis*

    - **Signs and symptoms of infection without any other identified source**
      - **Positive blood cultures**
    - **May be insertion, care, or contamination related**
    - **May also be result of colonized port catheter / reservoir**
      - **Patient exhibits fever and chills synchronized with port irrigation**



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Adverse Events:
Occurring at insertion or later

- *Treatment*
  - IV anti-microbial ASAP
  - Maintain or regain hemodynamic stability
    - » Fluid therapy
    - » Vasopressors
    - » Inotropic therapy
    - » Steroids, Activated Protein C, Blood products, Glucose control, and lactate clearance (severe sepsis/septic shock)
  - Device removal
    - » Pocket inspection and swab culture
    - » Reservoir culture
  - Device preservation
    - » In cases of coagulase negative staphylococcal infection (most common), may try
      - » Antibiotic therapy through catheter
      - » Antibiotic lock

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Adverse Events:
Occurring at insertion or later

- **Other infection**
  - **Reservoir Pocket Infection**
    - ***Diagnosis***
      - Redness, swelling, sero-purulent drainage around port site
      - Positive cultures of pocket surrounding the port
      - Often progressed to bacteremia or port colonization
      - Definitive diagnosis by culture of pocket surrounding port during device removal
    - ***Treatment***
      - Anti-microbial specific to causative organism
      - Device removal
      - May require additional wound care if severe abscess or port extrusion

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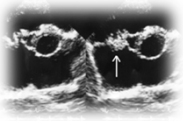
Adverse Events:
Occurring at insertion or later

- **Endocarditis**
  - ***Diagnosis***
    - Signs and symptoms of infection
    - Positive blood cultures
    - Heart murmur
    - Echocardiogram: detects vegetation on heart valves



  - ***Treatment***
    - Device removal
    - IV anti-microbial for at least 6 weeks
    - Heart surgery for valve repair or replacement if necessary

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Image COURTESY OF The Full Wiki: http://www.thefullwiki.org/Infective_endocarditis

Adverse Events:

Primarily apparent some time after insertion

- **Skin erosion / reservoir extrusion**
  - *Diagnosis*
    - **Visually apparent**
    - **Rule out local infection – often associated with pocket infection**
  - *Treatment*
    - **Device removal, wound care, possible skin grafting**
    - **Device preservation and wound care**

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Adverse Events:

Primarily apparent some time after insertion

- **Fibrin Sheath**
  - *Diagnosis*
    - **Chest radiograph shows catheter in SVC**
    - **Partial occlusion**
      - **Unable to obtain blood return**
      - **Some resistance "sluggish" to flush**
    - **Complete occlusion**
      - **Unable to withdraw or flush**

  - *Treatment*
    - **Alteplase 2 mg in 2.2 mL preservative free sterile water**
    - **May repeat dose, may require overnight dwell**

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Images COURTESY OF http://www.cathflo.com/catheter/occlusions.jsp

Adverse Events:

Primarily apparent some time after insertion

- **Occlusions unrelated to clotting**
  - *Treatment*
    - **Lipids → 70% Ethanol**
    - **Mineral precipitates → 0.1-N hydrochloric acid**
    - **Acidic infusates → 0.1-N hydrochloric acid**
    - **Basic infusates → Sodium bicarbonate or 0.1-N sodium hydroxide (NaOH)**
    - **Contrast media → Sodium bicarbonate**
    - **Unknown/other → consider one dose of Alteplase**

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Adverse Events:

Primarily apparent some time after insertion

- **Lack of recoverable blood return**
  - ***Tissue around catheter inside the vein***
    - Days 1-7 some fibrin
    - Days 7-14 endothelial and smooth muscle cells
    - Over 21 days collagen
    - Tissue may encase catheter in such a way as to allow infusion, but eliminate blood return
    - Also, may be due to SVC stenosis or thrombosis
  - ***Diagnosis***
    - Catheter dye study
  - ***Treatment***
    - Continue catheter use and obtain blood peripherally
    - Remove and replace catheter
  - ***Prevention***
    - Place tip at cavoatrial junction upon insertion of port access

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Adverse Events:

Primarily apparent some time after insertion

- **Thromboembolism**
  - ***Diagnosis***
    - Subclavian or SVC thrombus – SVC syndrome
      - Periorbital, facial, arm, and chest wall edema
      - Jugular vein distention
      - Hemoptysis
      - Headache and chest pain
      - Bluish upper body and face
    - Embolism
      - Chest pain
      - Cough, wheeze, blood-streaked sputum
      - Increased, irregular pulse
      - Syncope
    - Imaging studies
      - Venography
      - Magnetic resonance venography

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Adverse Events:

Primarily apparent some time after insertion

- **Thromboembolism continued**
  - *Treatment*
    - Fibrinolytics
      - May be through catheter
      - Example: 3 mg Alteplase per hour and 1000u heparin
    - Interventional radiology to snare and remove clot
    - Surgery to remove clot
    - Stent vessel open
    - Respiratory support
      - Maintain airway
      - Oxygen therapy

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Adverse Events:

Primarily apparent some time after insertion

- **Scarring and SVC stenosis**
  - ***Diagnosis***
    - **Catheter malfunction**
    - **SVC syndrome symptoms**
  - ***Treatment***
    - **Elimination of any associated thrombus**
    - **Surgical or IR**
      - **Retraction of catheter (to pull back out of the way)**
      - **Stent placement in affected area of SVC**
      - **Return of catheter to position in SVC**

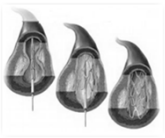

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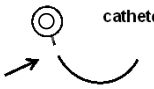
Image COURTESY of http://cyt-ar.com.ar/cyt-ar/index.php/Archivo:Stent_Palmaz.jpg

Adverse Events:

Primarily apparent some time after insertion

- **Catheter fracture, separation, or embolism**
  - ***Causation***
    - **Port design: reservoir and catheter were not manufactured as one piece**
    - **Pinch-off syndrome: when catheter is compressed between the clavicle and first rib**
    - **Pressure injection: through catheter not designed for such**



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Adverse Events:

Primarily apparent some time after insertion

- **Catheter fracture / embolism continued**
  - ***Diagnosis***
    - **Rapid swelling around reservoir pocket due to infusate infiltration – may be only symptom**
    - **Signs of pulmonary embolism: Dyspnea, Chest pain, Cough, Wheeze, Rapid and irregular pulse, Syncope**
  - ***Treatment: Urgent if not Emergent***
    - **LIFE SUPPORT MEASURES**
    - **May require positioning to keep catheter in heart**
    - **Immediate fluoroscopically guided catheter retrieval**
    - **Replacement of implanted port**

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Adverse Events:

Primarily apparent some time after insertion

- **Catheter fracture, separation, or embolism continued**
  - ***Prevention***
    - **At insertion**
      - **Place implanted port manufactured as one piece or place suture at reservoir / catheter junction**
      - **Insert catheter into venous anatomy from an internal jugular approach**
    - **During use**
      - **Place only pressure injectable implanted ports**
      - **If unable to verify pressure tolerance, do not pressure inject through an implanted port**

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Adverse Events:

Primarily apparent some time after insertion

- **Pinch off syndrome – a few more points**
  - ***Diagnosis***
    - **Only occurs when port implanted from the Subclavian approach**
    - **Suspect when catheter intermittently occludes completely and clearance is not related to Alteplase administration**
  - ***Treatment***
    - **Catheter removal and replacement, preferably from an internal jugular approach**

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Adverse Events:

Primarily apparent some time after insertion

- **Vessel erosion – uncommon**
  - ***Diagnosis***
    - **Presents with chest pain, dyspnea**
    - **Widened mediastinum and pleural effusion per radiograph**
    - **Contrast study shows extravasation into mediastinum rather than SVC**
  - ***Treatment***
    - **Catheter removal**
    - **Thoracentesis, thoracostomy, pericardocentesis**
  - ***Preventive measures***
    - **Place catheter well into the SVC at the cavoatrial junction to decrease mechanical erosion of vessel due to tip abutment**

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Adverse Events:

Primarily apparent some time after insertion

- **Reservoir rotation or inversion**

  - ***Diagnosis***
    - **Visualization or Palpation: may not look or feel as it should**
    - **Inability to access: Unable to pierce septum with non-coring needle or must approach at awkward angle or patient position to access**
    - **May also be detectable per two view chest radiographs**
  - ***Treatment***
    - **Correct or replace surgically**
    - **May continue to use if possible and short term**
    - **Remove**

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Adverse Events:

Primarily apparent some time after insertion

- **Device intolerance RARE**
  - **Sensitivity to poly-urethane or silicone**
    - ***Diagnosis***
      - **Inflammatory response, likely localized, without presence of micro-organisms**
      - **Usually diagnosed by ruling out more likely scenarios**
    - ***Treatment***
      - **Device removal**

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Adverse Events:

Primarily apparent some time after insertion

- **Non-coring needle dislodgment**

  - ***Diagnosis***
    - **Swelling around port reservoir that appears during infusion**
    - **Lack of blood return with aspiration**
    - **Removal and replacement of non-coring needle regains blood return**
  - ***Treatment***
    - **Benign infusate: removal and replacement of access**
    - **Vesicant therapy: consult with pharmacist and administer antidote if available**
      - **May also aspirate through access prior to removal**
      - **May require wound care and grafting**
  - ***Prevention***
    - **Access reservoir with non-coring needle of appropriate size**
    - **Secure port with non-dominant hand during access**

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Advanced Assessment:
Problem Identification

- Assess patient
  - Vital signs
  - Lung sounds
  - Heart tones
  - Presence/absence of edema
- Visualize and palpate port site and catheter track
  - Presence/absence of bruising
  - Skin appearance
  - Port position
- Ask patient about health status and device tolerance, and investigate
  - New onset palpations
  - New onset upper extremity neuropathy
  - Chest pain and/or dyspnea
  - Any pain associated with implanted port

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Advanced Assessment:
Problem Identification

- Know where catheter tip is located
  - Radiograph on file, or obtain
- Assess port function with access
  - Patency: blood return and ability to flush device
  - Obtain chest radiograph for any discrepancies
- Monitor patient and port site appearance during infusion therapy
  - Stop infusion and investigate further any changes in port site or patient

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Summary

- Implanted ports are intended to provide long term access for therapeutic intervention to improve a person's health or well being
  - Often referred to as "permanent"
- A consistent and responsible approach to the use and care of these devices will often accomplish this intention
  - Diagnosis and treatment of complications associated with the device include
    - Knowledge of expected device function
    - Early identification of device disruption and failure
    - Appropriate corrective intervention

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