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.

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
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.

Port Terminology

Catheter

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

Septum

Reservoir

Housing

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

Port Configurations

• Some port reservoirs are implanted prior to attaching the catheter; others are all-in-one from the manufacturer.
Port Pocket & Securement

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

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

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)
**Alternate Port Purposes**

- Dialysis access
- Peritoneal access
- Hepatic-Arterial access

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

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

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

**Other Implanted Devices**

- Pain management devices  
  - Intrathecal  
  - Neurostimulator/modulation

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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

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http://www.monil.dk/Engelsk/Eng-Illness.htm
**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.
- 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.

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**Assessment continued**

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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 into 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
Access continued

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

Recommendations
With increased throughput and office settings, UPS continues to recommend that healthcare professionals consider using through-needle aspiration.
- Work to identify the needle when adding medication to the patient's port, and considering alternate venous access sites.
- Take meticulous care when inserting the needle and consider using a needle with an entry needle designed for this purpose. Please consider using a needle that is specifically designed for this purpose in patients who have been previously accessed).
- The needle be aspirated and then re-injected. This may prevent any potential entrapment of medication and/or air into the venous system, such as a medication bag or venous access site.
- When considering whether to inject or aspirate, the needle in the patient's port, and consider using a needle that is specifically designed for this purpose in patients who have been previously accessed.

References: 12-19-2012 FROM
http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm198766.htm

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

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
Adverse Events

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

Adverse Events:

- Primarily related to insertion
  
  - Pneumothorax, Hemothorax, or Hydrothorax
    - Diagnosis: Respiratory signs and symptoms
      - Shortness of breath
      - Decreased pulse ox or spO₂
      - Absent or muffled breath sounds
    - Treatment
      - Mild: may require increased monitoring only
      - Moderate-Severe or persistent: chest tube insertion

- Thoracic duct injury: Main lymphatic duct
  
  - Diagnosis: Chylothorax (lymph in the pleural cavity)
    - Shortness of breath
    - Decreased pulse ox or spO₂
    - Absent or muffled breath sounds
  - Treatment
    - Intra-thoracic surgical repair of main duct
    - Also, measures to re-inflate the lung as necessary
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

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

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

Leadership, Education, Accountability, Development
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

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
**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

**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 recombinant thrombin may aid in sealing capillary or small venule leaks
    - Correction of underlying coagulopathies
    - Rarely requires evacuation of hematoma

**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
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
  - Device removal
    - Pocket inspection and swab culture
    - Reservoir culture

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

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
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

- 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

- 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

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

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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

**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
    - Blush upper body and face
  - Embolism
    - Chest pain
    - Cough, wheeze, blood-streaked sputum
    - Increased, irregular pulse
    - Syncope
  - Imaging studies
    - Venography
    - Magnetic resonance venography

**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
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

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

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
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

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

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
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

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

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
Advanced Assessment: Problem Identification

- Assess patient
  - Vital signs
  - Lung sounds
  - Heart sounds
  - 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 palpitations
  - New onset upper extremity neuropathy
  - Chest pain and/or dyspnea
  - Any pain associated with implanted port

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

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
References