Long-Term Central Venous Access in the Oncology Patient

Diane G. Cope, PhD, ARNP, BC, AOCNP
Oncology Nurse Practitioner
Florida Cancer Specialists and Research Institute
Fort Myers, Florida
Objectives

• Identify factors that increase risk of infusion therapy complications for oncology patients

• Describe two strategies to maintain LTCVA for oncology patients
Central Venous Access Devices in Oncology
Indications for LTCVA in Oncology

- Medications and Oncologic Treatments
- Frequency, delivery, and duration
- Vein status
- Contrast media
- Transfusional needs
- Blood specimens
- Transplant candidate
- Patient preference

Povoski, 2014
Device and Patient Selection

• Treatment Regimen
  – Agent
  – Cancer diagnosis
  – Schedule
  – Patient
  – Social support
# Vesicants and Irritants

<table>
<thead>
<tr>
<th>Vesicants</th>
<th>Irritants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amascrine</td>
<td>Bendamustine</td>
</tr>
<tr>
<td>Carmustine</td>
<td>Bleomycin</td>
</tr>
<tr>
<td>Cisplatin</td>
<td>Bortezemab</td>
</tr>
<tr>
<td>Dactinomycin</td>
<td>Carboplatin</td>
</tr>
<tr>
<td>Daunorubicin</td>
<td>Cyclophosphamide</td>
</tr>
<tr>
<td>Docetaxel</td>
<td>Fluouracil</td>
</tr>
<tr>
<td>Doxurubicin</td>
<td>Etoposide</td>
</tr>
<tr>
<td>Epirubicin</td>
<td>Gemcitabine</td>
</tr>
<tr>
<td>Idarubicin</td>
<td>Irinotecan</td>
</tr>
<tr>
<td>Mitomycin</td>
<td>Mitoxantrone</td>
</tr>
<tr>
<td>Oxaliplatin</td>
<td>Topotecan</td>
</tr>
<tr>
<td>Paclitaxel</td>
<td></td>
</tr>
<tr>
<td>Vinblastine</td>
<td></td>
</tr>
<tr>
<td>Vincristine</td>
<td></td>
</tr>
<tr>
<td>Vinorelbine</td>
<td></td>
</tr>
</tbody>
</table>
Chemotherapy Agent
Vein Status
Age and Cancer
Catheter and Infusion Complications in the Oncology Patient

Pneumothorax
Hemothorax
SQ hematomas
Catheter tip malposition
Catheter fracture

Drug extravasation
Venous thrombosis
Infection
Central Line-Associated Blood Stream Infections

- Costly
- Potentially life threatening
- Extended hospital stays
- Treatment delays

O’Grady et al., 2011; Shah et al., 2013
Common Definitions

• Systemic:
  – Catheter-related bloodstream infection CRBSI
  – Central line associated bloodstream infection CLRBSI

• Local:
  – Insertion site
  – Port pocket
  – Tunnel

O’Grady, 2011; Shah, 2013
Etiology of CLABSI

- Contamination on insertion
- Contamination of hub or catheter by hands, fluids, devices
- Hematogenous seeding
- Contamination of infusate
- Catheter material

DeLa Cruz et al., 2012; INS, 2010; O’Grady, 2013; ONS, 2011
Oncologic Risk Factors for CLABSI

• Patient status
  – Neutropenic
  – Immunocompromised
  – Poor wound healing

• Fibrin sheath or thrombus formation
VAD Infections and Symptoms

• Local/Tunnel/Port Pocket:
  – swelling, tenderness, erythema, drainage
Treatment of VAD Infection

• Daily documentation of site assessment
• Local:
  – Clean area chlorhexidine
  – Apply sterile gauze and tape dressing daily
  – Warm compresses
  – PO/ IV antibiotics 10 to 14 days

Shah et al., 2013
VAD Infections and Symptoms

• Tunnel and port pocket infection
  – IV antibiotics
  – Usually removal of device
VAD Infection
Symptoms and Diagnosis

• Systemic: fever, chills, diaphoresis, hypotension, mental status change

• Cultures:
  – VAD and percutaneous
  – Catheter tip

• Same organism from percutaneous and catheter tip

• Same organism from percutaneous and catheter blood culture

Shah et al., 2013
Common Organisms

- Coagulase-negative staphylococci
- Staphylococcus aureus
- Candida species
- Enterococci species

O’Grady et al, 2011; Mermel, et al., 2009
Treatment of VAD Infection

- **Systemic Infection**
  - Administer IV antibiotics
  - Rotate lumens for multi-lumen catheters
  - Antibiotic lock technique
  - Thrombolytic therapy

Schiffer et al., 2013; Shah et al., 2013
VAD Removal for Infection

• Persistent or recurrent tunnel infection
• Fungus, gram-negative bacilli, *S aureus*, enterococcus, yeast
• Persistent symptoms of infection after antibiotics
• Confirmed VAD sepsis

Schiffer et al., 2013; Shah et al., 2013
Prevention of Central Line-Associated BSI

• Incorporate central line insertion bundle
  – Hand washing before and after care
  – Maximal barrier precautions upon insertion
  – Optimal catheter site selection
  – Chlorhexidine skin antisepsis
  – Removal of line if not needed

O’Grady et al., 2011; Mermel, et al., 2009; Shah et al., 2013
Prevention of Central Line-Associated BSI

- Consistent maintenance procedures
- Strict sterile/aseptic technique
- Alcohol decontamination prior to hub access
- Routine surveillance for infection rates
- Patient and caregiver education
- Monitor patients with co-morbid diseases closely

INS, 2010; ONS, 2011
VAD Infection Summary

• Variability exists in VAD practice
• Standardized evidence based interventions are needed
• Meticulous aseptic/sterile technique vital
Catheter Occlusion

- Incidence: 41% of central venous catheters
- Interruption of therapy
- Infiltration or extravasation
- Infection
- Increased cost of treatment
- Patient trauma, emotional distress

(Camp-Sorrell, 2010)
Types of Catheter Occlusions

• Thrombotic (58%)
  – Clot or thrombus within or around device or in surrounding vessel

• Multi-factorial

(Gorski et al., 2010)
## Patient-related Risk Factors for Thrombus

<table>
<thead>
<tr>
<th>Category</th>
<th>Risk Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change or trauma to vessel wall</td>
<td>Traumatic insertion/catheter malposition</td>
</tr>
<tr>
<td></td>
<td>Long duration of catheter use</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
</tr>
<tr>
<td>Change in blood flow</td>
<td>Dehydration</td>
</tr>
<tr>
<td></td>
<td>Diminished activity/bed rest</td>
</tr>
<tr>
<td></td>
<td>Hypotension</td>
</tr>
<tr>
<td></td>
<td>Atrial fibrillation</td>
</tr>
<tr>
<td></td>
<td>Tumor</td>
</tr>
<tr>
<td>Increased blood coagulability</td>
<td>Inflammatory disease</td>
</tr>
<tr>
<td></td>
<td>Chronic renal failure</td>
</tr>
<tr>
<td></td>
<td>Sepsis</td>
</tr>
<tr>
<td></td>
<td>Malignancy</td>
</tr>
</tbody>
</table>

Falanga, 2011
Catheter-related Risk Factors for Thrombus

- Catheter size
- Catheter tip malposition
- Left-sided insertion
- Duration of catheter use
- Improper maintenance

Schiffer et al., 2013
Catheter-related Thrombus Formation

- Catheter insertion
  - Initiates biofilm/fibrin layer formation
  - Blood on catheter surface forms fibrin layer
  - Catheter colonized by pathogens in biofilm
  - Bacteria produce barrier to normal defenses

Image courtesy of Genentech, Inc, used with permission
Types of Thrombotic Occlusions

- Fibrin tail
- Fibrin sheath
- Mural thrombus
- Intraluminal thrombus
Types of Thrombotic Occlusions

- **Fibrin Tail**
  - Formed on every catheter at time of insertion

- **Fibrin Sheath**
  - Fibrin covers catheter like a “sock” and may extend back to the point where the catheter enters the vein
  - May or may not function
Types of Thrombotic Occlusions

- **Mural Thrombus**
- Fibrin from vessel wall injury binds to fibrin covering catheter surface
- **Contributing factors**
- Endothelial injury:
  - Catheter tip causes injury: insertion or malpositioned tip
- Altered blood flow:
  - Presence of catheter in vein
Types of Thrombotic Occlusions

- Intraluminal Thrombus
  - Thrombi form within the catheter lumen

- Causes:
  - Pump malfunction
  - Inadequate flushing
  - Withdrawing blood
  - Inadvertent line disconnection
  - Retrograde blood flow due to increased intrathoracic pressure
Port Thrombus

Buildup of blood in port chamber/catheter
Catheter Related Thrombosis

- Thrombotic
  - Lack of free-flowing blood return
  - Inability to infuse
  - Increased resistance
  - Sluggish flow
  - Early signs and symptoms: swelling, pain, discoloration, distended veins
Catheter-related Thrombosis Treatment

- Catheter removal?
- Symptomatic
  - Length of treatment
  - Treatment options

Debourdeau et al., 2013; Schiffer et al., 2013;
Types of Occlusions

- Thrombotic
- Non-Thrombotic/Mechanical
- Partial:
  - Can infuse
cannot
- Complete/Total:
  - unable to
aspirate
Types of Catheter Occlusions

• Non-thrombotic (42%)
  – Malpositioned tip
  – Pinch-off Syndrome
  – Other Mechanical
  – Infusate precipitate or residue

(INS, 2011)
Catheter Lumen Occlusion

- Biofilm
- Drug precipitate
Catheter Lumen Occlusion

- Biofilm
  - Starts at time of catheter insertion
  - Formed by organisms remaining on skin after antisepsis
  - During infusions
  - Tubing or cap changes
  - Medication administration
  - Flushing

Donlan, 2011
Catheter Lumen Occlusion
Biofilm
Biofilm

- Less than 10 days: outer surface
- More than 30 days: inner surface
- Fibrin/thrombosis/biofilm $\rightarrow$ Increased occlusion
- Aggressive flushing $\rightarrow$ sepsis

Donlan, 2011
Drug Precipitate

- Incompatible medications or solutions infused into same catheter
- Risk for Precipitate
  - Acidic drugs: if pH increases
  - Alkaline drugs: if pH decreases
  - Lipid emulsions infusion

Nakazawa, 2010
# Common Drug Precipitates in Oncology

<table>
<thead>
<tr>
<th>Drug</th>
<th>Cause</th>
<th>Precaution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphotericin B</td>
<td>Incompatible with saline</td>
<td>Flush before and after with dextrose</td>
</tr>
<tr>
<td>Diazepam</td>
<td>Poorly water soluble</td>
<td>Do not dilute; Consider lorazepam</td>
</tr>
<tr>
<td>Fluorouracil</td>
<td>Droperidol</td>
<td>Flush before and after</td>
</tr>
<tr>
<td>Furosemide</td>
<td>Frequently incompatible</td>
<td>Flush before and after</td>
</tr>
<tr>
<td>Heparin</td>
<td>Meperidine</td>
<td>Flush residual drug with saline prior to heparin lock</td>
</tr>
<tr>
<td></td>
<td>Promethazine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gentamicin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tobramycin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Amikacin</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vancomycin</td>
<td></td>
</tr>
<tr>
<td>VP-16</td>
<td>Weakly soluble</td>
<td>Flush before and after</td>
</tr>
</tbody>
</table>

Trissel, 2011
Nursing Interventions: Drug Precipitate

- Watch for change in appearance
- Keep compatibility chart
- Check for incompatibilities with additives
- Don’t piggyback into parenteral nutrition lines

Rosenthal, 2007
Best Practice: Drug Precipitate

In the absence of data confirming that two drugs are compatible, one must always assume “Incompatibility”
Catheter Occlusion Management

• t-PA (alteplase) therapy
• 2 mg/ml, wait 30 minutes, aspirate;
  – may repeat (additional 90 minutes)
• 85% cases restored within hour
• Ideal concentration, volume, administration, dwell time, frequency without evidence base

• Radiographic imaging
## Flushing Protocol Overview

<table>
<thead>
<tr>
<th>Access Device</th>
<th>Flushing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-tunneled peripheral</td>
<td>NS 1-3ml q 8, 12, or 24 hours</td>
</tr>
<tr>
<td>Central</td>
<td>Heparin 100 units/ml, 3 ml/day or 2ml/day per each lumen</td>
</tr>
<tr>
<td>PICC</td>
<td>Heparin 10-100 units/ml, 3 ml/day or 3 ml/day three times/week</td>
</tr>
<tr>
<td>Tunneled</td>
<td>Heparin 10-100 units/ml, 3 ml/day; 3 ml qod; 5ml three times /week; or 5 ml weekly</td>
</tr>
<tr>
<td>Implanted port</td>
<td>Heparin 100 units/ml, 5 ml q 4-6 weeks and after use</td>
</tr>
<tr>
<td>Groshong</td>
<td>NS 5-10 ml weekly or after use</td>
</tr>
</tbody>
</table>

INS, 2010; ONS, 2011
Summary: Catheter Flushing

- Flushing protocols
  - Heparinized versus normal saline
  - Volume and frequency
  - Heparin use with risk of coagulopathies and HIT
Summary: Catheter Occlusion

• Be Safe!
  – Listen to the patient! Stop for any problems!

• Controversial issues:
  – t-PA therapy: ideal concentration, volume, administration, dwell time, frequency
  – Frequency of radiographic imaging
  – Infusion with no blood return
  – When to remove
LEFT IJV
Summary: LTCVA in the Patient with Cancer

Challenge, Complex, Caution

• Individualize to situation
• Proceed with safety
• Respond to every symptom and sign