Central Venous Access Device Care

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

Session Overview
- Overview of access devices
- Routine care
- Catheter complications
  - Catheter complications
    - Catheter occlusions
    - Extravasation
    - Catheter infections
- Vigilant, knowledgeable nursing care

VAD Overview
- Increased placement and use of VADs
  - > 5 million VADs each year
  - Fluids
  - Medications
  - Contrast media/radiographic studies
  - Blood products
  - Blood specimens
  - Increased need for infusion therapy with aging population
  - Increased age with diminished vascular integrity

VAD Overview
- Three decades of use with advances in technology
  Power systems:
  - Contrast media injections

VAD Overview
- Three decades of use with advances in technology
  Power systems:
  - Contrast media injections

Techniques for placement
- Venous anatomy

- Subclavian
- Internal jugular
- Basilic
- Brachial
- Cephalic
- Intercostal
- Ulnar
- Femoral
VAD Selection and Patient Perceptions
- Questionnaire given to clinic oncology patients
- Top 3 reported benefits of having a port
  - no more peripheral venipunctures
  - greater convenience
  - arms left free for ADLs
- Patients disliked the visibility of ports and complained about site soreness

Conclusions: “Good nursing care includes the ability to provide optimal care and maintenance of the VAD, but understanding the patients’ point of view is an added value.”

Choosing VADs by Oncology Nurses
- Survey design
- Purpose: To determine the differences between issues related to choosing a VAD for a patient vs. choosing one for him or herself.
- Top 3 characteristics that nurses thought patients should value:
  - How long the VAD would be needed
  - Which medications would the VAD be used for
  - Which insertion site would be used
Choosing VAD con’t

- When considering a VAD for him or herself, the nurses ranked
  - #1 SAFETY
  - #2 How independent the VAD will let them be
  - #3 How easy the VAD will be to care for and maintain
  - Do we teach the patient what they need or what we think they need?

- Chernecky C. et al. Spring 2003 JVAD

PICC line

- IR or Bedside
- Ultrasound guided
- 1 week to 1 year dwell
- Sutured, secured with special anchor tape, or stat-lock
- Easy to insert, easy to remove
- Newer power PICCs and triple lumen PICCs
- Tip in SVC

Hickman Tunneled

- 1, 2 or 3 lumens
- Silicone material
- Use large lumen for blood draws
- Clamp on reinforced area
- Temporary stitches
- Broviac is smaller for peds
- May be repaired
- Do not force flush, easy to rupture

Groshong Tunneled

- Special valve at tip
- No clamp
- NS flushes
- If valve malfunctions, may need to switch to heparin flushes

Implanted Venous Ports

- Placed in IR or OR
- May be used for chemo same day it is inserted
- Need “huber” non-coring needle to access
- Sterile procedure for access
- 2,000 punctures
- VAD: low care and maintenance, low infection rate
- Needs a flush once a month when not in use

Power Ports

- May be used for CT scans and power injectors
- Need to use special power huber needle for CT scan
- Otherwise regular huber needle can be used for routine IVs/chemo/blood
Referral Guidelines for Power Port
- Adequate soft tissue chest, 60 kg. or over
- Need for CT scans with IV contrast
- Patient able to communicate special power port procedures to others

Cleansing Agent Overview

<table>
<thead>
<tr>
<th>Agent</th>
<th>Action</th>
<th>Coverage</th>
<th>Residual Activity</th>
<th>Application</th>
<th>Duration of Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol</td>
<td>70% and 92%</td>
<td>Bacteriocidal (denaturation of proteins)</td>
<td>Gram (+)-, TB, fungi, viral</td>
<td>None</td>
<td>Circular; Dry time: 2-3 minutes</td>
</tr>
<tr>
<td>Povidone-iodine</td>
<td>Antimicrobial (replaces cell contents with iodine)</td>
<td>Gram (+)-, TB, fungi, viral</td>
<td>Minimal</td>
<td>Circular; Dry time: 2-3 minutes</td>
<td>Two hours</td>
</tr>
<tr>
<td>2% Chlorhexidine gluconate</td>
<td>Antimicrobial (breakdown cell contents)</td>
<td>Gram (+)-, TB, fungi, viral</td>
<td>Excellent</td>
<td>Scrubbing: Back and forth; Dry time: At least 30 seconds</td>
<td>Four to six hours</td>
</tr>
</tbody>
</table>

Chloraprep
- Replaced iodine based products due to proven improved efficacy in preventing infection
- Also recommended by national standards like CDC
- 2% Chlorhexidine Gluconate mixed with 70% Isopropyl Alcohol

Dressing Change Overview

<table>
<thead>
<tr>
<th>VAD</th>
<th>Dressing</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-tunneled peripheral</td>
<td>Transparent Gauze</td>
<td>5-7 Days QOD or pm</td>
</tr>
<tr>
<td>Central</td>
<td>Transparent Gauze</td>
<td>5-7 Days QOD or pm</td>
</tr>
<tr>
<td>PICC</td>
<td>Transparent Gauze</td>
<td>5-7 Days QOD or pm</td>
</tr>
<tr>
<td>Tunneled</td>
<td>Transparent Gauze</td>
<td>5-7 Days QOD or pm</td>
</tr>
<tr>
<td>Implant port</td>
<td>Transparent Gauze</td>
<td>7 Days QOD or pm</td>
</tr>
<tr>
<td>Groshong</td>
<td>Transparent Gauze</td>
<td>7 Days QOD or pm</td>
</tr>
</tbody>
</table>

Biopatch
- CHG imbedded in foam placed around exit site
- Maki and Mermel demonstrated a 60% reduction in infection with Biopatch
- Easy to use, placed at time of insertion
- Not needed with healed tunneled catheters and optional with ports

Biopatch and Securement
- Biopatch can be used on catheters that are secured with:
  - Statlock
  - Stitches
  - Hubguards or other sterile anchor tape
**Dressing Integrity**

- New VADs often cause bleeding
- CDC recommends sterile gauze under dressing until bleeding stops
- Biopatch works in presence of blood

**Exit Site Drainage**

- Patients with third spacing, edema, liver involvement might have trouble keeping dressing dry and intact
- Use alternative dressing materials and site care to prevent skin breakdown
- Will need to do more frequent dressing changes

**Flushing Protocol Overview**

<table>
<thead>
<tr>
<th>VAD</th>
<th>Flushing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-tunneled peripheral</td>
<td>NS 3-5ml 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 qd, 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>

(ONS Acumen Database, 2011)
Summary: Catheter Flushing

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

Case study for VAD selection

What would you choose?

- Patient has poor peripheral veins, needs frequent CT scans, and will be on intermittent chemotherapy for at least 6 months
- Patient weighs 50 kg
- Best VAD option would be…..and why……..
  - PICC line
  - Power Port
  - Regular Port
  - Peripherals
  - Tunneled
  - Midline

Catheter Occlusion

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

Types of Occlusions

- Partial:
  - Can infuse but cannot aspirate
- Complete/Total:
  - unable to infuse or aspirate

Types of Catheter Occlusions

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

(Infusion Nursing Society, 2010)
Catheter Tip Placement

- Optimal Tip Placement
  - Lower 1/3 of the superior vena cava
  - Free-floating
  - Rapid blood flow: SVC
  - 2 liters /minute

(Catheter Tip Placement, Infusion Nursing Society, 2010)

Catheter Occlusion: Malpositioned Tip

- Alterations in Tip Position
  - Placement
  - Jugular: more arterial punctures vs subclavian access; fewer malpositions with jugular
  - Experienced operators should perform catheter insertions
    - Ultrasound guidance is recommended for all central venous access insertions
    - pneumothorax, hemothorax, hemorrhage, carotid puncture, air embolism and infection

(Catheter Occlusion: Malpositioned Tip, Infusion Nursing Society, 2010; Reusch, Walder, & Tramer, 2000)

Catheter Occlusion: Malpositioned Tip

- Alterations in Tip Position
  - Migration
    - Internal jugular vein
    - Inominate or brachiocephalic veins
    - Subclavian veins
    - Axillary veins
    - Azygos vein
    - Right atrium

(Catheter Occlusion: Malpositioned Tip, Infusion Nursing Society, 2010)

Catheter Tip Migration

- Can occur anytime
- Can be spontaneous
- Sporadic changes in intrathoracic pressure
  - Coughing
  - Sneezing
  - Heart failure
  - Excessive neck movement
  - Excessive arm movement
- Inadequate VAD stabilization

(Signs and Symptoms of Malposition, Infusion Nursing Society, 2010)

Signs and Symptoms of Malposition

- Lack of a blood return
- Resistance to flushing
- Shoulder, chest, back pain
- Swelling
- “Hearing” flow or gurgling sounds with flushing
- Dysrhythmias, palpitations
- Possible seizures or other neurologic problems

(Hadaway, 2009)

Tip Malposition

Chest x-ray shows tip in internal jugular vein
Usually requires port removal
**Nursing Interventions**

- STOP!
- Report to physician
- Anticipate radiographic study
- Patient education
- Patient reassurance

**Medical/Surgical Management**

- Interventions
  - attempt rapid fluid infusions
  - guide wire or snare manipulation
  - remove and replace catheter
- Prevention
  - insertion by experienced personnel
  - chest X-ray for tip location immediately after insertion and periodically while catheter is indwelling

**Types of Catheter Occlusions**

- Non-thrombotic
  - Pinch-Off Syndrome:

  Occurs when catheter is “pinched” or compressed between clavicle and first rib

  (ONS, 2011)

**Pinch-Off Syndrome**

- Rare
- Estimated 0.5-3%
- Only catheters inserted in the subclavian vein

  (Hadaway, 2011; Infusion Nursing Society, 2010)

**Signs and Symptoms of Pinch-Off Syndrome**

- Infraclavicular pain and/or swelling
- Clinically
  - Positional aspiration
  - Positional infusion
  - Catheter fracture/hole
  - Extravasation
  - Embolism

  (Hadaway, 2009; Infusion Nursing Society, 2010)
Pinch-off syndrome

Unable to flush/aspirate
Raise arm or shoulders back
Assess periclavicular area
Patient education/support
Chest x-ray

Medical/Surgical Management

- Intervention
  - Chest X-ray
  - Catheter removal
- Prevention
  - Catheter insertion from jugular vein or subclavian vein lateral to the midclavicular line

Catheter fracture

- Prevent tugging on lines
- Pull PICCs out slowly
- Do not force PICCs out if they become stuck

Non-thrombotic/Mechanical Occlusions

- Catheter clamp
- Catheter dressing
- Kinked intravenous tubing
- Kinked catheter

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

  Hadaway, 2005

Biofilm

- Less than 10 days: outer surface
- More than 30 days: inner surface
- Fibrin/thrombosis/biofilm → Increased occlusion
- Aggressive flushing → sepsis
- Fibrinolytic therapy

  Hadaway, 2005

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>Fluouracil</td>
<td>Doxorubicin</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/Promethazine/Gentamicin/Tobramycin/Amikacin/Vancomycin</td>
<td>Flush residual drug with saline prior to heparin lock</td>
</tr>
<tr>
<td>VP-16</td>
<td>Weakly soluble</td>
<td></td>
</tr>
</tbody>
</table>

  Trissel, 2010

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”

Types of Catheter Occlusions

- Thrombotic (58%)
  - Clot or thrombus within or around device or in surrounding vessel
- Multi-factorial

(Infusion Nursing Society, 2010)

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

- 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

Patient-related Risk Factors for Thrombus

<table>
<thead>
<tr>
<th>Change or trauma to vessel wall</th>
<th>Traumatic insertion/catheter malposition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Long duration of catheter use</td>
</tr>
<tr>
<td></td>
<td>Hypertension</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Change in blood flow</th>
<th>Dehydration</th>
</tr>
</thead>
<tbody>
<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>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Increased blood coagulability</th>
<th>Inflammatory disease</th>
</tr>
</thead>
<tbody>
<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>

(ONS Access Device Guidelines, 2011; Timoney et al., 2002)

Fibrin Clot

- Fibrin is a normal physiological response
- If fibrin clot is large enough it can interfere with blood return
- Small clots can be treated with alteplase
- Studies show that new clots are easier to resolve than older ones
- INS/ONS standards require blood return

(INS/ONS standards require blood return)

Lee, 2006

Catheter-Related Risk Factors for Thrombus

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

Lee, 2006

Image courtesy of Genentech, Inc, used with permission.
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

- **Fibrin Sheath-Retrograde flow**
  - Fibrin sleeve can cause retrograde flow and potential extravasation
  - Patient c/o pain and pressure with flushing and there was no blood return

- **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
  - Precursor to central vein thrombosis

- **Intraluminal Thrombus**
  - Thrombi form within the catheter lumen
  - Causes:
    - Pump malfunction
    - Inadvertent line disconnection
    - Inadequate flushing
    - Withdrawing blood into catheter to check patency or collect laboratory specimens
  - Blood reflux
  - Retrograde blood flow due to increased intrathoracic pressure

- **Port Thrombus**
  - Buildup of blood in port chamber/catheter
Catheter Function Assessment

- Thrombotic
  - Lack of free-flowing blood return
  - Inability to infuse fluids
  - Increased resistance when flushing
  - Sluggish flow
  - Early signs: swelling, pain, discoloration, distended veins

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

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

Extravasation

- Defined as: Inadvertent administration of a vesicant solution into the surrounding tissue
- Vesicant: Agent capable of causing blistering, skin sloughing, or necrosis
- DNA-binding vesicants: bind to nucleic acids in DNA of healthy cells in the tissue, are retained in the tissue
- Non-DNA-binding vesicants: do not bind to DNA, are more easily metabolized

Extravasation

- Defined as: Inadvertent administration of a vesicant solution into the surrounding tissue
- Vesicant: Agent capable of causing blistering, skin sloughing, or necrosis
- DNA-binding vesicants: bind to nucleic acids in DNA of healthy cells in the tissue, are retained in the tissue
- Non-DNA-binding vesicants: do not bind to DNA, are more easily metabolized

Extravasations

- Extravasation is relatively rare
- Estimates range from 0.1% to 6% of anthracycline treatments
- Under-reported
- Risk higher using peripheral access versus implanted VAD

Ener et al, 2004

Vesicant Potential of Antineoplastic Agents

<table>
<thead>
<tr>
<th>Vesicant Agents</th>
<th>Irritant Agents</th>
<th>Nonvesicant Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asparaginase</td>
<td>Carmustine</td>
<td>Captopril</td>
</tr>
<tr>
<td>Bleomycin</td>
<td>Dacarbazine</td>
<td>Daunorubicin</td>
</tr>
<tr>
<td>Chlorambucil</td>
<td>Daunorubicin liposomal</td>
<td>Daunorubicin</td>
</tr>
<tr>
<td>Cyclophosphamide</td>
<td>Daunorubicin</td>
<td>Doxorubicin</td>
</tr>
<tr>
<td>Cytarabine</td>
<td>Doxorubicin</td>
<td>Epirubicin</td>
</tr>
<tr>
<td>Fludarabine</td>
<td>Etoposide</td>
<td>Melphalan</td>
</tr>
<tr>
<td>Gemcitabine</td>
<td>Irinotecan</td>
<td>Mitomycin</td>
</tr>
<tr>
<td>Ifosfamide</td>
<td>Oxaliplatin</td>
<td>Mitoxantrone*</td>
</tr>
<tr>
<td>Methotrexate</td>
<td>Topotecan</td>
<td>Paclitaxel</td>
</tr>
<tr>
<td>Pentostatin</td>
<td>Vinblastine</td>
<td></td>
</tr>
<tr>
<td>Rituximab</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thiotepa</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trastuzumab</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Vesicant Classifications

DNA Binding
- Anthracyclines
  - Doxorubicin
  - Daunorubicin
  - Idarubicin
  - mitoxantrone
- Antitumor antibiotics
  - Mitomycin

Non-DNA Binding
- Vinca alkaloids
  - Vincristine
  - Vinblastine
  - Vinorelbine
- Taxane
  - Paclitaxel
  - Docetaxel
- Topoisomerase inhibitors
  - Etoposide
  - Irinotecan
  - Topotecan

Risk Factors for Extravasation

Device
- Insertion-related complications
- Inadvertent catheter damage during insertion
- Surgical site challenges
- Presence of fibrin or thrombus at catheter tip
- Catheter migration
- Long device dwell time
- Deeply implanted ports

Sauerland, Engelking, Wickham, & Corbi (2006)

Risk Factors for Extravasation

Drug
- Vesicant classification
- Site of infiltration
- Volume infiltrated
- Drug concentration

Sauerland, Engelking, Wickham, & Corbi (2006)
### Risk Factors for Extravasation

<table>
<thead>
<tr>
<th>Patient</th>
<th>Clinician</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Lack of knowledge</td>
</tr>
<tr>
<td>Impaired communication</td>
<td>Lack of IV skills</td>
</tr>
<tr>
<td>Compromised circulation</td>
<td>Unfamiliar with VADs</td>
</tr>
<tr>
<td>Altered sensory perception</td>
<td>Distractions/Overload</td>
</tr>
<tr>
<td>Poor understanding of risk</td>
<td></td>
</tr>
<tr>
<td>History of multiple courses of chemotherapy</td>
<td></td>
</tr>
<tr>
<td>Concurrent medications</td>
<td></td>
</tr>
</tbody>
</table>

Sauerland, Engelking, Wickham, & Corbi, 2006

### Potential Consequences of Vesicant Chemotherapy Extravasation
- Blistering, peeling, sloughing, tissue necrosis
- Damage to underlying structures (tendons, nerves)
- Damage to vascular system (impaired venous return)
- Functional and sensory impairment
- Permanent disfigurement
- Delay or discontinuation of cancer treatment

Schulmeister (2009)

### Extravasation Signs & Symptoms
- Redness
- Swelling
- Stinging, burning, pain (may or may not be present)
- Loss of blood return from VAD
- IV flow rate that slows/stops
- Leakage around non-coring needles

Polovich, Whitford, & Olsen, 2009; Sauerland, Engelking, Wickham, & Corbi, 2006

### Extravasation Clinical Course
- Immediate pain, edema, erythema, and blistering
- Induration with skin atrophy
- Invasive ulceration after 1–4 weeks that progressively enlarges over months with no tendency for spontaneous healing, extending to deep tissue structures
- Long-term pain, contractures, dystrophy, and potential loss of function of the affected limb

### General Instructions
- Stop infusion immediately. DO NOT remove the cannula
- Disconnect the infusion (not the cannula/needle)
- Leave the cannula/needle in place and try to aspirate as much of the drug as possible from the cannula with a 10 ml syringe.
- Mark the affected area and take digital images of the site
- Remove the cannula/needle
- Collect the extravasation kit, notify the physician and seek advice from the chemotherapy team
- Elevate limb and administer pain relief if required
- Give patient information sheet and arrange follow up and documentation

### Current Extravasation Treatment Approaches
- Conservative observation alone
- Non-pharmacological
- Pharmacological methods
- Surgery
Extravasation Treatment
- Extravasations cannot always be prevented.
- Early detection is key to minimizing tissue damage.
- Prompt and appropriate treatment is critical.
- Use a collaborative approach (nurse, MD, patient)

Conservative Treatment
- Clinical evidence shows that even a small extravasation can lead to ulceration
- More aggressive therapy necessary
- Only biopsy-negative cases can be managed conservatively

Non-pharmacologic Methods
- Heat vs Cooling
  - Most commonly used is cooling
- Flushing
  - Tedious and time consuming
  - Several incisions necessary
  - Drug will undoubtedly remain
  - Not applicable to extravasations from central catheters

Pharmacological Treatment
- FDA approved
- Sodium thiosulfate
  - Antidote to mechlorethamine extravasation
- Hyaluronidase
  - Antidote to plant alkaloid extravasation
- Dexrazoxane (Totect/USA; Savene/European)
  - Antidote to vesicant extravasation

Conservative Treatment
- Clinical evidence shows that even a small extravasation can lead to ulceration
- More aggressive therapy necessary
- Only biopsy-negative cases can be managed conservatively

Topical Heat vs Cold

<table>
<thead>
<tr>
<th>Agent</th>
<th>Drug</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkylating Agents</td>
<td>mechlorethamine</td>
<td>Ice compresses for 6-12 hours</td>
</tr>
<tr>
<td>Anthracyclines</td>
<td>daunorubicin</td>
<td>Ice pack for 15-20 minutes</td>
</tr>
<tr>
<td></td>
<td>doxorubicin</td>
<td>four times/day; remove 15 minutes prior to and during Totect administration</td>
</tr>
<tr>
<td>Antitumor antibiotics</td>
<td>mitomycin</td>
<td>Ice pack</td>
</tr>
<tr>
<td></td>
<td>dacarbazine</td>
<td>Ice pack</td>
</tr>
<tr>
<td>Plant alkaloids</td>
<td>vinblastine</td>
<td>Warm pack for 15-20 minutes</td>
</tr>
<tr>
<td></td>
<td>vincristine</td>
<td>four times/day</td>
</tr>
<tr>
<td>Taxanes</td>
<td>docetaxel</td>
<td>Ice pack for 15-20 minutes</td>
</tr>
<tr>
<td></td>
<td>paclitaxel</td>
<td>four times/day</td>
</tr>
<tr>
<td></td>
<td>oxaliplatin</td>
<td>Warm pack</td>
</tr>
<tr>
<td></td>
<td>melphalan</td>
<td>Ice pack</td>
</tr>
</tbody>
</table>

National and International Oncology Guidelines
- No guidelines or recommendations
  - American Society of Clinical Oncology
  - Hematology/Oncology Pharmacy Association
  - International Society of Oncology Pharmacy Practitioners
  - Multinational Association of Supportive Care in Cancer
  - National Comprehensive Cancer Network

Polovich, Whitford, & Olsen (2009); Schulmeister (2009)
Langer, 2006
Polovich, Whitford, & Olsen, 2009; Schulmeister, 2009
Schulmeister, 2009
Morganstern & Held-Warmkessel, 2008; Schulmeister, 2009
National and International Oncology Guidelines

- Oncology Nursing Society
  - Anthracycline extravasation – Totect
  - Mechlorethamine extravasation – Sodium thiosulfate
  - Plant alkaloid extravasation – Hyaluronidase

- European Oncology Nursing Society
  - Anthracycline extravasation – Savene
  - Sodium thiosulfate – not recommended
  - Hyaluronidase – possible antidote

- United Kingdom ONS
  - Anthracycline extravasation – Savene for extravasation exceeding 1.5 ml

Polovich, Whitford, & Olsen, 2009; Schulmeister, 2009

### Use of Antidotes

<table>
<thead>
<tr>
<th>Antidote</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium thiosulfate</td>
<td>Used as an antidote for mechlorethamine and anthracycline extravasation.</td>
<td>Reaction rate may be increased by prompt use.</td>
</tr>
<tr>
<td>Hyaluronidase</td>
<td>Used to break down hyaluronic acid and disperse the drug, promoting absorption.</td>
<td></td>
</tr>
</tbody>
</table>

**Alkylating Agent Extravasation Antidote** (mechlorethamine)

- Antidote: sodium thiosulfate (available 10%, 25%)
- Neutralizes drug to form nontoxic thioesters that are excreted in urine and reduces the production of hydroxyl radicals that cause tissue injury
- Preparation: 1/6 molar solution (mix 4 mL of 10% solution with 6 mL sterile water)
- Store at room temperature
- Inject 2 mL of solution for each milligram of mechlorethamine suspected to have extravasated
- Use 25-gauge needle, change with each injection

Polovich, Whitford, & Olsen 2009; Schulmeister, 2009

**Plant Alkaloid Extravasation Antidote**

- Antidote: hyaluronidase
- Breakdown of hyaluronic acid and disperses drug, promoting absorption
- Inject 1 mL in five separate injections (25-gauge needle, change needle with each injection)
- Store in refrigerator

Polovich, Whitford, & Olsen (2009); Schulmeister (2009)

**Anthracycline Extravasation Treatment**

- Totect (dexrazoxane for injection)
- Unknown mechanism of action
- Dose on days one and two: 1000 mg/m², day three: 500 mg/m²
- Max dose 2000 mg on days one and two, 1000 mg on day three
- Decrease dose 50% in patients with creatinine clearance < 40 mL/minute

Schulmeister, 2009

**Anthracycline Extravasation Treatment (cont.)**

- Totect 500 mg vial mixed in 50 ml diluent then added and administered in 1,000 mL normal saline over 1-2 hours
- Give in large vein in area away from site of extravasation
- Initiate first dose ASAP and within 6 hrs of extravasation
- Monitor CBC and liver enzymes
- Side effects: myelosuppression, gastrointestinal
Key Elements of Extravasation Documentation

- Vesicant administration technique
- Concentration and estimated amount of extravasated drug
- Patient’s symptoms, clinical signs
- Measurement of affected area (with photographs if permitted by policy)
- Immediate interventions (e.g. heating/cooling)
- Administration of antidote/treatment
- Patient teaching & follow-up

Polovich, Whitford, & Olsen (2009)

Potentially Devastating Consequences

Anthracycline Extravasation

Chemo Extravasation

Doxirubicin Extravasation

Day 1 redness, pain
Doxirubicin Extravasation
Day 4 Redness, Swelling

Doxirubicin Extravasation
Day 8 Blistering

Doxirubicin Extravasation
Day 10 Blistering, Peeling

Doxirubicin Extravasation
Day 12 induration, necrosis

Radiographic Imaging

Fluorescence microscopy of biopsied tissue

Surgical Intervention
- Early case studies showed that surgical debridement with wide margins necessary to prevent deep ulcerations
- All anthracycline-containing tissue must be removed
- Surgical intervention may be guided by fluorescence microscopy
- Skin flaps may be necessary
**Surgical debridement**

- Removal of extravasated tissue
- Wide surgical margins

**Postoperative Results**

- Aesthetic defects; limb damage

**Extravasation Kit**

- Cold pack (instant or reusable)
- Hot pack (instant or reusable)
- Antidotes according to local procedures
- 2 ml syringes
- 25 G needles
- Skin disinfectant as per local guidelines
- Indelible pen for marking the affected area
- Documentation forms
- Copy of extravasation management procedure
- Patient information leaflet

Polovich, Whitford, & Olsen (2009)

**Prevention of Extravasation via VADs**

- Assure placement and patency of VADs (blood return)
- Engage patients in extravasation prevention/detection
- Monitor patients closely
- Use infusion pumps with care
- Educated/certified clinicians
- Vesicant identification

Polovich, Whitford, & Olsen (2009)
Prevention of Extravasation via Peripheral Lines
- Verify the patency of the intravenous site, check for blood return.
- Inform the patient to report any sensation of burning or pain at the infusion site.
- Vesicant drugs should be given first and by slow IV push via the side-arm port of a fast running infusion.
- Irritant drugs should be sufficiently diluted.

Polovich, Whitford, & Olsen (2009)

Summary: Extravasation
- The prevalence of chemotherapy extravasation is not high, however the consequences can be serious, cause the patient pain and discomfort and possibly cause delay in treatment and in some cases hospitalization.
- The avoidance and prevention of chemotherapy extravasation is the primary goal.
- Be on guard; Stop and seek assistance.
- Maintaining high standard of care in the delivery of IV chemotherapy and management of the extravasation incidences is critical.

Infections

VAD Infections
- Costly
- Potentially life threatening
- Lack of standardization: definition, pathophysiology, diagnosis, treatment

Bishop, 2007; Camp-Sorrel, 2007

Common Definitions
- Systemic (CRBSI): most serious type
- Local:
  - Exit site
  - Port pocket
  - Tunnel

(Pratt, et al., 2007; Vescia, et al., 2008)

<table>
<thead>
<tr>
<th>Type of Infection</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colonized Catheter</td>
<td>Significant growth from the catheter tip, subcutaneous segment of the catheter or catheter hub</td>
</tr>
<tr>
<td>Phlebitis</td>
<td>Erythema, induration, warmth, and tenderness or pain near catheter exit site</td>
</tr>
<tr>
<td>Exit-site infection</td>
<td>Erythema, induration or tenderness within 2 cm of the catheter exit site with or without CRBSI with or without pus</td>
</tr>
<tr>
<td>Clinical Microbiological</td>
<td>Exudate (and associated positive exudate culture) at catheter exit site</td>
</tr>
<tr>
<td>Tunnel infection</td>
<td>Erythema, induration, or tenderness &gt;2 cm from the exit site along the subcutaneous tract of a tunneled catheter with or without CRBSI</td>
</tr>
<tr>
<td>Pocket infection</td>
<td>Infection in the subcutaneous pocket of an implantable port with or without related bloodstream infection</td>
</tr>
<tr>
<td>CRBSI</td>
<td>Bloodstream infection with at least one positive blood culture from the peripheral vein, clinical signs of infection and no alternative source.</td>
</tr>
</tbody>
</table>
Etiology of VAD Infections
- Contamination on insertion
- Catheter hub contamination
- Biofilm formation
- Neutropenic patient
- Contamination of infusate
- Hematogenous seeding
- Catheter material type

(Frasca et al., 2010; Pratt, et al., 2007; Worthington & Elliott, 2005)

VAD Infection Etiology
- Physical condition of patient
- Fibrin sheath or thrombus formation
- Inappropriate use of needleless system
- Cutaneous infection

(Frost, et al., 2007; Worthington & Elliott, 2005)

Common Organisms
- Coagulase-negative staphylococci
- Staphylococcus aureus
- Candida species
- Gram negative bacilli
- Pseudomonas aeruginosa

(Camp-Sorrell, 2007; Mermel, et al., 2000)

Sources of Infection Entry

Exit Site Infection
- Diabetic with PICC, doing own dressings at home
- Purulent drainage, cultured positive for yeast
- Blood cultures negative, patient asymptomatic
- Line pulled and replaced other arm
- Importance of patient and family education and re-education
Port Pocket Infections
Chest Port
- Warm, red, tender port site
- Possible elevated WBC, fever
- Prevent by using sterile technique to access ports
- Treat with antibiotics, might require port removal

PICC Bleeding and Infection
- Bleeding into arm after PICC placed
- Patient with low platelet count, did not receive platelets before procedure
- Bleeding into tissue resulted in infection
- PICC removed

Port Erosion through skin
- Can be a result of infection, repeated punctures in the same area of port or loss of skin integrity
- Next patient had breast cancer that eventually caused skin metastasis
- Port was removed and a PICC line placed for supportive care
VAD Infection Symptoms
- Local: swelling, tenderness, erythema, drainage
- Systemic: fever, chills, diaphoresis, hypotension, mental status change

Diagnosis of VAD Infection
- Exit site infection: culture of exudate at site
- Blood cultures: VAD and peripherally
  - Paired: positive vs negative
  - Quantitative: number of organisms found in each culture
  - Positive culture with no other source positive
  - Culture of infused
  - Culture catheter tip

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

VAD Removal for Infection
- Persistent or recurrent tunnel infection
- Fungus, gram-negative bacilli, enterococcus, yeast
- Persistent symptoms of infection after antibiotics
- Confirmed VAD sepsis
Prevention of VAD Infection

- Incorporate central line bundle
  - Frequent hand washing before and after care
  - Maximal barrier precautions upon insertion
  - Chlorhexidine skin antisepsis
  - Optimal catheter site selection
  - Daily review of line necessity and remove if not needed
  - Alcohol decontamination prior to hub access

- Marschall, et al., 2009; Mermel, et al., 2009; Pratt, et al., 2007

Consistent maintenance procedures
- Strict aseptic technique
- Routine surveillance for infection rates
- Patient and caregiver education
- Monitor patients with co-morbid diseases closely

- Marschall, et al., 2009; Mermel, et al., 2009; Pratt, et al., 2007

Oncology Nursing Interventions

- Patient education
- Things to report to healthcare provider
- Detailed documentation
- VAD nursing care

VAD Infection Controversies

- Use of ointments
  - Local infections
  - Neutropenic patients

- Obtaining blood cultures
  - Accessing ports
  - Discard first blood draw
  - Preparing access site

- Camp-Sorrell, 2007

VAD Infection Controversies

- Anticoagulation vs fibrinolytic therapy
  - Amount
  - Type
  - Duration

- Antibiotic lock technique
  - Appropriate antibiotic concentration
  - Duration of treatment
  - Instillation time

- Camp-Sorrell, 2007
VAD Infection Summary

- Variability exists in VAD practice
- Standardized evidence based interventions are needed
- Meticulous aseptic technique vital
- Prospective multi-site research is needed

Case Study #1

Case Study #2
Case Study #3

Case Study #4

Would you access this port?
Summary: VAD Maintenance and Management of Complications

- Knowledgeable nursing care
- Thorough, ongoing assessment
- Patient education
- Controversial issues
  - Dressing material/frequency
  - Flushing protocol
  - Catheter with no blood return
  - Catheter removal: thrombosis; infection

THANK YOU