CVAD Standards of Care for Pharmacists and Nurses

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Speaker Disclosures

• The speakers for this presentation have no conflicts of interest to disclose.
• Off-label and/or investigational drug uses will not be discussed during this presentation.

Objectives

After attending this presentation, the learner will be able to:
• Provide a brief overview of the published standards and guidelines for evidence-based VAD care in the home
• Describe the drug characteristics that must be considered when selecting the vascular access device and method of drug administration
• Explain the rationale and available evidence for filtering infused drugs during administration
• Describe the purpose and structure of the NHIA VAD Care and Maintenance Resource Tool for adult and pediatric patients
Published Guidelines and Standards

- Infusion Nursing Society - Infusion Therapy Standards of Practice (revised 2016)
- SCORCH Guidelines – Nebraska Medical Center (2012)
- CDC Guidelines for the Prevention of Intravascular Catheter-Related Infection (2011)
- SHEA Compendium Strategies to Prevent Central-line Associated Bloodstream Infections in Acute Care Hospitals (2014)

INS Revisions – New Name

- Standards were previously named the Infusion Nursing Standards of Practice
- Because nurses are not the only clinicians responsible for the safe and effective practice of infusion therapy, the name was changed to Infusion Therapy Standards of Practice
- The INS has published a crosswalk document comparing the changes from the 2011 standards to the 2016 standards on their website in the INS Learning Center

INS Revisions

- Standards are divided into nine sections
- Each section includes:
  - Standards
  - Practice Standards
  - Sections 4-9 include Section Standards
- Standards are not rated, but practice standards are given ratings based on evidence. Rating scale ranges from I, or the highest rating to V, or the lowest rating
- References are provided at the end of each section to substantiate the ratings
INS Revisions – New Standards

• Section One: Infusion Therapy Practice
  • Standard 4 Infusion Team – “4.1 The infusion team is structured through its scope of service to meet patient and organizational needs for safe, effective, and high-quality infusion therapy” (INS, 2016)

• Section Three: Infection Prevention and Control
  • Standard 19 Standard Precautions – “19.1 Standard Precautions are used during all infusion procedures that potentially expose the clinician to blood and body fluids, secretions, excretions except sweat, nonintact skin, and mucous membranes and may contain transmissible infectious agents.” (INS, 2016)

• Section Four: Infusion Equipment
  • Standard 22 Vascular Visualization – “22.1 To ensure patient safety, the clinician is competent in the use of vascular visualization technology for vascular access device (VAD) insertion. This knowledge includes, but is not limited to appropriate vessels, size, depth, location, and potential complications. 22.2 Vascular visualization technology is used in patients with difficult venous access and/or after failed venipuncture attempts. 22.3 Vascular visualization technology is employed to increase the success with peripheral cannulation and decrease the need for central vascular access device (CVAD) insertion, when other factors do not require CVAD.” (INS, 2016)

• Standard 23 CVAD Tip Location – “23.1 Tip location of a central vascular access device (CVAD) is determined radiographically or by other imaging technologies prior to initiation of infusion therapy or when clinical signs and symptoms suggest tip malposition. 23.2 The original to location is documented in the patient’s medical record and made available to other organizations involved in the patient’s care. 23.3 The CVAD tip location with the greatest safety profile in adults and children is the cavoatrial junction (CAJ).” (INS, 2016)
INS Revisions – New Standards

• Section Seven: VAD-Related Complications
  • Standard 47 Nerve Injuries – “47.1 During peripheral venipuncture and catheter dwell time, reports of paresthesia-type pain require immediate removal of the vascular access device (VAD). 47.2 During the insertion or dwell of central vascular access devices (CVADs), clinicians will maintain a high index of suspicion for nerve injuries when the patient complains of respiratory difficulty or unusual presentations of pain or discomfort.” (INS, 2016)

INS Revisions – Existing Standard Changes of Interest

• Standard 11 Patient Education
  • Mention of instructing patients to verify that web sites are reputable
  • Advise patients about the use of social media outlets to obtain medical information and/or advice

• Standard 23 Central Vascular Access Device (CVAD) Tip Location
  • Addition of reference to the use of ECG technology for CVAD tip verification
  • Optimum tip placement verbiage change from lower third of the SVC to the cavoatrial junction
  • Mention of avoidance of tip location in veins distal to the SVC or IVC i.e. subclavian, innominate common iliac veins, etc.)

• Standard 26 VAD Planning Short Peripheral/Midline Catheters
  • Recommendations for use of vascular visualization devices for increased success with placement of catheters
  • Removal of all references to pH of infusates
  • Recommended maximum osmolarity for peripheral catheters increased from 600 mOsm/L to 900 mOsm/L.

• Standard 27 Site Selection
  • Recommendation to use the site that is most likely to last the full length of the prescribed therapy as opposed to starting at the most distal location i.e. the hand
INS Revisions—Existing Standard Changes of Interest
- Standard 34 Needleless Connectors Practice Criteria
  - Discussion of the use of disinfection caps
- Standard 37 VAD Stabilization Practice Criteria
  - Recommendations regarding removal of stabilization devices and the risk of medical adhesive related skin injury (MARSi)

Standard 36. Filtration
1. Parenteral nutrition solutions/blood & blood components are filtered using an in-line or add-on filter appropriate to the type of solution
2. Intraspinal infusion solutions are filtered using a surfactant-free, particulate-retentive, and air-eliminating filter
3. Medications withdrawn from glass ampoules are filtered using a filter needle or filter straw

Practice Criteria
A. Use filters adhering to manufacturers', directions for use and filtration requirements of the infusion therapy solution or medication
   1. Filters are contraindicated when medications are retained on the filter material
   2. Avoid filters for small drug volumes retained by the filter
   3. Filtering out particulate matter may limit capillary endothelium damage and removing microbubbles may reduce cerebral and pulmonary ischemia
   4. In-line air-eliminating filters are required for adults with Eisenmenger syndrome (heart defect that causes right to left shunting)
   5. When required by the package insert
Practice Criteria
B. Change add-on filters to coincide with administration set changes; use a primary administration set with an in-line filter whenever possible
C. Locate filters close to vascular access device hub
D. Verify pump pressure doesn’t exceed filter pressure rating
E. Filter parenteral nutrition. 0.2 μ without fat emulsion; 1.2 μ with fat emulsion. Change filter every 24 hours
B. Separate fat emulsion infusion may not require a filter. Nutrilipid® 20% requires a 1.2 micron in-line filter

Practice Criteria
F. Intraspinal infusion through an epidural filter
  • Epidural Filter is 0.2 micron, 100% bacterial retentive, usually flat with male/female luer lock hubs. A common flow rate is >200ml/Min @ 45 psi and a maximum pressure around 115 psi. The filter bubble point is >46psi.
G. Filter solutions removed from ampules

Practice Criteria
F. Filter use reduces complications in pediatric ICUs, including SIRS
  1. Jack T, Bombe M, Brent RL, et al. In-line filtration reduces severe complications and length of stay in pediatric intensive care unit; a prospective, randomized, controlled trial. Intensive Care Med. 2012;38(12):2058-66. CONCLUSION: The overall complication rate during the PICU stay was signficantly lower for those patients admitted to the ICU and treated with an in-line filter (12.8% vs. 15.9%).
  3. Sasa M, Dickula J, Jack T. In-line Filtration Decreases Systemic Inflammatory Response Syndrome, Renal and Hematologic Dysfunction in Pediatric Cardiac Intensive Care Patients. Pediatr Cardiol 2012;33:1270–1278. CONCLUSION: Risk of SIRS, renal, and hematologic dysfunction were significantly decreased within the filter. No risk differences were demonstrated for occurrence of sepsis; any other organ failure or dysfunctions between both groups.
Practice Criteria

F. Filters don’t prevent infusion phlebitis
   CONCLUSION: In-line filters in peripheral IV catheters cannot be recommended routinely because evidence of their benefit is uncertain

When to filter

• During compounding or administration?
  • In situations where filters are known to be beneficial, the filtration occurs during administration as a last safety feature
  • Filtration in the pharmacy of parenteral nutrition would not capture precipitants or fat droplet flocculation that occurred during storage
  • Where sterilization from nonsterile ingredients is the purpose of filtration, it is completed in the pharmacy in accord with USP Chapter 797 requirements, but final filtration during high risk intraspinal infusion is required

When are filters required?

• Compounding:
  • Sterilization by filtration
• By drug
  • Parenteral nutrition
  • By package insert: Filtered Medications Guidelines http://www.utmb.edu/rxhome/FilteredMeds/
• By situation – critical care, multiple line entry versus limited entry, areas of know infectious contamination risk
• By severity of disease – immunosuppressed patients
Standard 45. Phlebitis

45.1 The clinician assesses the vascular access site for phlebitis; determines the need for and type of intervention; educates the patient and/or caregiver about phlebitis, the intervention, and any follow up; and assesses patient response to treatment.

A. Assess regularly...the vascular access site. Instruct the patient to report pain or discomfort at the access site. Signs and symptoms of phlebitis include pain/tenderness, erythema, warmth, swelling, induration, purulence, or palpable venous cord. The number or severity of symptoms that indicate phlebitis differs...

Practice Criteria

B. Recognize risk factors that can be addressed:
   1. Chemical phlebitis may be related to infusates with dextrose >10% or high osmolarity (>900 mOsm/L); certain medications (depending on dosage and length of infusion), such as potassium chloride; amiodarone, and some antibiotics; particulates in the infusate; too large a catheter for the vasculature with inadequate hemodilution; and skin antiseptic solution that is not fully dried and pulled into the vein during catheter insertion. Consider using a midline catheter or PICC for infusates listed above or identified as causing phlebitis, depending on length of infusion time and anticipated duration of therapy. Allow skin to dry after application of antiseptic.

C. Recognize risk factors that can be addressed:
   2. Mechanical phlebitis may be related to vein wall irritation from catheter, catheter movement, insertion trauma, catheter material
   3. Bacterial phlebitis may be related to emergent VAD insertions and poor aseptic technique
   4. Patient-related factors include current infection, immunodeficiency, and diabetes, insertion in lower extremity except for infants; and age ≥ 60
   5. Post infusion phlebitis, although rare, occurs post catheter removal through 48 hours due to any of the factors above
Standard 45. Phlebitis - comments

• pH removed as a cause of chemical phlebitis
• Osmolarity risk increased to ≥ 900 mOsm/L
• Dextrose >10% named, as well as certain medications such as potassium chloride; amiodarone, and some antibiotics
• Depending on dosage and length of infusion

pH as a cause of phlebitis

• There are not enough data to implicate pH, osmolarity, or direct cellular toxicity as the sole cause of drug-induced phlebitis
• Isolated science has shown endothelial damage from these factors, but that’s a clue, not proof
• Phlebitis is a convergence of factors such as gender, catheter insertion site, catheter materials, catheter tip location, vascular blood flow, drug infusion rate, frequency and duration of therapy, drug characteristics, and perhaps predominantly, variance in patient tolerance due to underlying disease, pregnancy, and other factors

pH as a cause of phlebitis

  • pH alone is not a predictor of phlebitis, the risk cannot be quantified.
  • Does that mean that non-physiologic pH should not be considered among the factors that may cause phlebitis? The data are inconclusive, the recent analyses retrospective or look at therapy of less than 6 days. The focus seems to be on vancomycin, but it does not have the most extreme drug pH.
pH and phlebitis

At its extremes, pH may have a larger role in the development of phlebitis. pH alone does not correlate well with the frequency of phlebitis.

<table>
<thead>
<tr>
<th>pH</th>
<th>Phlebitis %</th>
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<tbody>
<tr>
<td>1.5</td>
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<tr>
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<tr>
<td>11</td>
<td>9</td>
</tr>
<tr>
<td>10.12</td>
<td>50</td>
</tr>
</tbody>
</table>

Osmolarity and phlebitis

- The new standard adopts the ASPEN definition of osmolarity that can be tolerated for parenteral nutrition: 900 mOsm/L, up from the previous 600 mOsm/L
- Question 2. What is the maximum safe osmolarity of PN admixtures intended for peripheral vein administration?
- Recommendation: We suggest that PN with an osmolarity of up to 900 mOsm/L can be safely infused peripherally.
- Higher osmolarity limits, especially when peripheral PN is prepared as a total nutrient admixture (TNA), may also be tolerated, but the evidence to support a safe limit is lacking.

Osmolarity and phlebitis

- **GRADE: Weak**
- **Rationale:** The coinfusion of intravenous fat emulsion (IVFE) has not been shown to reduce phlebitis. All available studies that have evaluated peripheral vein thrombophlebitis with infusion of PPN are limited by small sample size. Most are observational in study design. The osmolarity content of PPN regimens evaluated ranged from low (400 mOsm/L) to high (1700 mOsm/L). The rate of infusion was often not controlled or described in the methods or in the results. Osmolarity rates <100 mOsm/L improve patient tolerance. There is no consensus on what is considered a "tolerable" rate of thrombophlebitis or an acceptable duration of infusion before phlebitis occurs. Kane et al (1700 mOsm/L) accepted a thrombophlebitis rate of 30% and found that peripheral intravenous (IV) cannulas remained patent for an average of 6.3 days in patients receiving a high osmolarity (1700 mOsm/L) PPN. The high osmolarity PPN formula evaluated in this study contained IVFE prepared as a TNA. Older studies that did not incorporate IVFE with the PPN regimen or included the coinfusion of IVFE found that peripheral infusion was generally well tolerated with osmolarity limited to approximately 900 mOsm/L.
Osmolarity and phlebitis

• 31. Isaacs JW, Millikan WJ, Stackhouse J, Hersh T, Rudman D. Parenteral nutrition of adults with a 900 milliosmolar solution via peripheral veins. Am J Clin Nutr. 1977;30(4):552-559. CONCLUSIONS: infusion of P900 is feasible if heparin and cortisol are added to the solution. The incidence of thrombosis without cortisol was about 50%.


• 37. Bayer-Berger M, Chiolero R, Freeman J, Hirschi B. Incidence of phlebitis in peripheral parenteral nutrition: effect of the different nutrient solutions. Clin Nutr. 1989;8(4):181-186. Phlebitis rates were 22% in Group 1 (712 mOsm/L), 48% in Group 2 (802.5 mOsm/L), 44% in Group 3 (920 mOsm/L) and 26% in Group 4 (260-314 mOsm/L).


Endothelial cell toxicity and phlebitis

• One proposed solution to determination of endothelial cell toxicity is isolation of the cells in vitro so that the factors are controlled. The availability of human umbilical vein endothelial cells (HUVEC) makes that research possible and its use increasing.

• A number of drugs have been tested in the in vitro setting. Endothelial cells have been challenged with clinical drug doses (comparable drug concentrations) and the concentrations that cause cell damage and death documented. This is still research, but those data are identifying tolerable drug concentrations.

• In time, researchers may be able to replicate more of the environment in which phlebitis actually occurs.

Endothelial cell toxicity

• The most recent publication (2015) on endothelial cell toxicity looks at vancomycin

• The article is Influence of Vancomycin Infusion Methods on Endothelial Cell Toxicity and the lead author is Maryline Drouet

• The findings are interesting...
Endothelial cell toxicity

- First, compared to saline of the same neutral pH, saline with vancomycin caused cell death so the drug has activity against endothelial cells.

Endothelial cell toxicity

- The results showed a significant increase in endothelial cell death from a vancomycin concentration of 2.5 mg/ml on

Endothelial cell toxicity

- With continuous exposure, vancomycin 5 mg/ml produces 50% cell death after 24 hours of exposure and almost complete cell death after 48 hours. A concentration of 2.5mg/ml shows about 25% cell death after 24 hours and more than 50% after 72 hours.
Endothelial cell toxicity

- Lastly, this looks at grams/day vancomycin therapy – and the equivalent of 2 gm/day intermittently produces nominal cell loss, while the same 2gms/day by continuous infusion causes a 50% cell death.

![Graph showing cell toxicity](image)

Endothelial cell toxicity

- Other antibiotics are known to cause endothelial cell toxicity. The clinical application of the data has not been established.

<table>
<thead>
<tr>
<th>Factors influencing phlebitis</th>
<th>Endothelial Cell Toxicity (mg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>pH</td>
</tr>
<tr>
<td>Azithromycin</td>
<td>6.5</td>
</tr>
<tr>
<td>Ciprofloxacin</td>
<td>3.3-3.9</td>
</tr>
<tr>
<td>Clarithromycin</td>
<td>5-6</td>
</tr>
<tr>
<td>Erythromycin</td>
<td>7</td>
</tr>
<tr>
<td>Levofloxacin</td>
<td>4.6</td>
</tr>
<tr>
<td>Vancomycin</td>
<td>2.5-4.5</td>
</tr>
</tbody>
</table>

Assessing Individual Patient Risk for Phlebitis

- All factors must be considered when deciding the likelihood of phlebitis during intravenous therapy
- See the Dynamic Handout

<table>
<thead>
<tr>
<th>Factor</th>
<th>Weight</th>
</tr>
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<tbody>
<tr>
<td>Disease state</td>
<td>cumulative</td>
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<tr>
<td>Pregnancy</td>
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</tr>
<tr>
<td>Catheter insertion site</td>
<td>by site</td>
</tr>
<tr>
<td>Catheter tip location</td>
<td>by type</td>
</tr>
<tr>
<td>Catheter materials</td>
<td>by type</td>
</tr>
<tr>
<td>Drug infusion rate</td>
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</tr>
<tr>
<td>Frequency of dosing</td>
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<tr>
<td>Duration of therapy</td>
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</tr>
<tr>
<td>Drug characteristics</td>
<td>1/0</td>
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<tr>
<td>Score</td>
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</tr>
</tbody>
</table>
NHIA VAD Care and Maintenance Resource Tool

- Created as a succinct education resource and quick reference guide to promote continuity of VAD care practices among home health and home infusion providers
- Consistency in VAD practices can reduce overuse of supplies and resultant impact (unscheduled deliveries, lack of needed supplies)
- Being revised to reflect standards and guidelines published since last revision in 2012
- Organized as a table displaying care and maintenance policies in the left column and VAD types across the top row with specific information provided at each intersection

Questions?

References