

PIV315: Complications with Vascular Access Devices – Part 1

Study Guide

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Completion education. No accredited nursing contact hours awarded.

Course Description

Recognize, assess, and manage infiltration, extravasation, phlebitis, and occlusion complications. Learn grading scales, antidotes for vesicant injuries, and immediate intervention strategies to protect patient safety.

How to Use This Guide

This is a condensed, high-yield reference. Skim the key terms and the quick-reference tables, confirm you can explain each high-yield point, then read the section summaries to spot any gap. Return to the on-site lesson for full detail, and attempt the post-test cold. Passing score: 90%.

Key Terms at a Glance

Term	What it means
Chemical phlebitis	results from the irritant properties of the infusate — low or high pH, high osmolarity, or specific irritant drugs such as potassium chloride — and can develop within hours.
Bacterial phlebitis	reflects contamination and biofilm, progresses over days, and carries the highest risk of systemic infection.
Chemical Cause	Irritant medications (K+, hypertonic)
Onset: Within hours Signs	Pain, swelling, erythema
Prevention	Appropriate vessel, dilute infusate
Bacterial Cause	Poor asepsis, biofilm
Onset	Progressive over days
Signs	Purulent drainage, systemic signs
Treatment	Remove, culture, antibiotics

High-Yield Points

- Learning Objectives After completing this module the learner will be able to: Differentiate infiltration from extravasation and grade infiltration using the Infusion Nurses Society (INS) scale. Initiate the correct emergency response to a suspected vesicant extravasation and identify the antidote classes and their mechanisms. Distinguish mechanical, chemical, and bacterial phlebitis by cause, onset, and presentation,

and grade severity with a standardized scale. Troubleshoot an occluded catheter safely and explain why forced flushing is contraindicated. Recognize air embolism and take the correct emergency positioning and escalation steps. Apply a prevention-first framework that stops complications before they progress.

- Categories of VAD Complications

- Infiltration Grading Scale Grade Characteristics Clinical action 1 Mild swelling, no pain Monitor closely 2 Moderate swelling, blanching, slight discomfort Remove catheter 3 Significant swelling beyond the area, pain, coolness Remove immediately, notify provider 4 Severe swelling, blistering, tissue breakdown Remove, notify provider, photo-document

- Key Action Remove the catheter at Grade 2 or higher to prevent progression. After removal, elevate the limb and apply warm compresses to promote reabsorption of the infiltrated fluid.

- Infiltration versus Extravasation Infiltration Leakage of a non-vesicant fluid Usually reversible Managed with rest and elevation Prognosis: full recovery expected

- Critical: Extravasation is a medical emergency . Stop the infusion immediately, leave the catheter in place if possible for aspiration and antidote delivery, apply thermal therapy per protocol, and notify the provider and pharmacy STAT . Time to treatment is the strongest predictor of whether permanent damage is prevented.

- Vesicant Antidotes and Mechanisms Vesicant type Antidote Mechanism Most chemotherapy Hyaluronidase Breaks down hyaluronic acid; improves drug diffusion and dispersal Vasoconstrictors (epinephrine, norepinephrine) Phentolamine Local vasodilation; restores perfusion and flushes the vesicant Doxorubicin (anthracycline) Dexrazoxane Iron chelator; reduces free-radical tissue toxicity Nitrogen mustard Sodium thiosulfate Inactivates the alkylating agent

- Key Principle Antidote effectiveness depends on time to administration . Vesicant antidotes are given locally around the extravasation site, and the accompanying thermal therapy must follow the drug-specific protocol.

- Phlebitis Type Comparison Mechanical Cause: Catheter movement or trauma Onset: 24–48 hours post-insertion Signs: Redness, warmth, palpable cord Treatment: Stabilize or remove catheter

- VIP Grading Scale Grade Clinical findings Action 0 No symptoms Monitor; continue IV 1 Erythema at the insertion site only Monitor; document 2 Erythema and/or edema; one sign of inflammation Remove catheter 3 Erythema, edema, warmth, pain/cord/streak Remove, culture tip, consider antibiotics 4 Grade 3 signs plus fever, malaise, lymphadenopathy Remove, blood cultures, antibiotics, provider 5 Advanced: spreading cellulitis, systemic toxicity Emergent removal, IV antibiotics, imaging

- Standard Practice Assess with the VIP scale at every evaluation. Remove the catheter at Grade 2 or higher , and document the grade and the actions taken for continuity of care.

- Occlusion: Causes and Progressive Management Common causes Fibrin deposits (most common) Clot formation (thrombosis) Catheter kinked or coiled Catheter tip against the vein wall Hub or connector malfunction

- Never: Force a flush against an occluded line. This risks catheter fracture and fragment embolization. Use gentle pressure only, and escalate rather than push through resistance.

- Air Embolism Sources

- Life-Threatening: Air embolism requires immediate positioning (left lateral Trendelenburg) and provider notification . Meticulous air elimination during setup and infusion is the essential preventive measure.

- Prevention Framework (8 Key Elements) Regular assessment: Identify early signs before progression to severe grades. Proper insertion: Minimize mechanical trauma; use ultrasound guidance where indicated. Appropriate vessel and catheter selection: Match device to vessel and therapy; reduce chemical phlebitis by choosing a suitable route for irritants. Aseptic technique: Meticulous asepsis at insertion and every hub

access, with disinfection of the connector. Stabilization: Secure the catheter to prevent movement and dislodgement. Regular flushing: Maintain patency and prevent occlusion on a defined schedule. Prompt removal: Remove unnecessary lines immediately to shorten the window of risk. Patient education: Teach patients to report pain, swelling, and warmth to enable early intervention.

- **Clinical Pearl** When a patient reports that a well-functioning line suddenly "burns" or aches during infusion, believe the symptom and stop the infusion to assess. Early chemical phlebitis and early extravasation both announce themselves through the patient's sensation before the site looks abnormal.

- **Atypical Presentations:** Major catheter-related complications can present atypically. Reference: Variability in the Clinical Presentation of Major Catheter-Related Complications: A Case Report. JIN 49(2), 2026. Teaching implication — maintain a high index of suspicion even when classic signs (erythema, tenderness, fever) are absent or subtle.

Quick-Reference Tables

Grade	Characteristics	Clinical action
1	Mild swelling, no pain	Monitor closely
2	Moderate swelling, blanching, slight discomfort	Remove catheter
3	Significant swelling beyond the area, pain, coolness	Remove immediately, notify provider
4	Severe swelling, blistering, tissue breakdown	Remove, notify provider, photo-document

Vesicant type	Antidote	Mechanism
Most chemotherapy	Hyaluronidase	Breaks down hyaluronic acid; improves drug diffusion and dispersal
Vasoconstrictors (epinephrine, norepinephrine)	Phentolamine	Local vasodilation; restores perfusion and flushes the vesicant
Doxorubicin (anthracycline)	Dexrazoxane	Iron chelator; reduces free-radical tissue toxicity
Nitrogen mustard	Sodium thiosulfate	Inactivates the alkylating agent

Grade	Clinical findings	Action
0	No symptoms	Monitor; continue IV
1	Erythema at the insertion site only	Monitor; document
2	Erythema and/or edema; one sign of inflammation	Remove catheter
3	Erythema, edema, warmth, pain/cord/streak	Remove, culture tip, consider antibiotics
4	Grade 3 signs plus fever, malaise, lymphadenopathy	Remove, blood cultures, antibiotics, provider
5	Advanced: spreading cellulitis, systemic toxicity	Emergent removal, IV antibiotics, imaging

Section-by-Section Summary

The key idea of each lesson section, condensed to the essentials. Use it to review fast and spot any gap before the post-test.

PIV315: Complications with VAD – Part 1

Mastering the recognition, grading, and immediate management of the local complications of peripheral vascular access — infiltration, extravasation, phlebitis, and occlusion.

Local complications of peripheral vascular access are common, and most are preventable or reversible when recognized early. The difference between a minor, self-limiting event and permanent tissue loss is frequently measured in minutes and in whether the clinician graded the finding correctly and acted on it.

1. Infiltration: Definition and Grading

Infiltration occurs when a non-vesicant intravenous solution leaks out of the vein and into the surrounding subcutaneous tissue, typically because the catheter tip has moved out of the lumen, punctured the vessel wall, or become dislodged. It is the most common peripheral IV complication.

Consistent grading is what turns a subjective impression into an actionable finding. The INS classifies infiltration into grades that escalate from a barely perceptible change to frank tissue breakdown, and each grade carries a defined clinical response.

2. Extravasation: Vesicant Injury and Management

Extravasation is the escape of a vesicant — a solution or medication capable of causing tissue destruction — into the tissue surrounding the vein. Common vesicants include many chemotherapy agents, concentrated electrolytes such as potassium chloride and calcium chloride, vasopressors, and hyperosmolar solutions.

Because the consequences are severe and can be delayed, any suspicion of extravasation is treated as an emergency. The single most important determinant of outcome is time to intervention.

- Leakage of a vesicant medication
- Tissue-destructive potential
- May require antidote administration
- Risk: permanent scarring or loss of function

3. Antidotes for Vesicant Extravasation

Specific antidotes can limit or reverse vesicant injury when they are administered promptly and matched to the extravasated agent. The choice of antidote depends entirely on the drug involved, so verification with pharmacy is mandatory before administration.

4. Phlebitis: Mechanical, Chemical, and Bacterial

Phlebitis is inflammation of the vein wall, and it is classified by its underlying mechanism because cause dictates both prevention and treatment. Mechanical phlebitis arises from movement or trauma of the catheter within the vein, often related to an oversized catheter, an unstable dressing, or placement near a joint; it typically appears in the first 24 to 48 hours.

Matching the mechanism to the response is what makes management effective: stabilizing or resizing the catheter addresses mechanical phlebitis, diluting or slowing an irritant and selecting an appropriate vessel addresses chemical phlebitis, and removal with culture and possible antibiotics addresses bacterial phlebitis. In all cases, catheter removal is the mainstay once phlebitis reaches a grade that warrants it.

- Cause: Irritant medications (K+, hypertonic)
- Onset: Within hours
- Signs: Pain, swelling, erythema
- Prevention: Appropriate vessel, dilute infusate
- Cause: Poor asepsis, biofilm
- Onset: Progressive over days
- Signs: Purulent drainage, systemic signs
- Treatment: Remove, culture, antibiotics

5. VIP Scale for Phlebitis Assessment

A standardized phlebitis scale gives the whole care team a shared language, so a finding graded on one shift means the same thing on the next. The Visual Infusion Phlebitis (VIP) scale grades severity from an asymptomatic site through early erythema to systemic involvement, and each grade is tied to a specific action.

6. Occlusion: Prevention and Troubleshooting

Occlusion is a blockage that prevents flushing, infusion, or aspiration. It may be thrombotic (a clot or fibrin), mechanical (a kink, clamp, or malpositioned tip), or drug-precipitate (an incompatibility that forms a solid within the lumen).

- 1. Gentle saline flush (10 mL barrel)
- 2. Reposition the limb (elevate or flex)
- 3. Apply a warm compress (about 15 minutes)
- 4. Notify provider for a thrombolytic if indicated
- 5. Remove the device if it cannot be cleared

7. Air Embolism: Recognition and Emergency Response

Air embolism occurs when air enters the vascular system and forms a gas bubble that obstructs blood flow. Small amounts may be asymptomatic, but a large bolus can be rapidly fatal, most commonly through obstruction of the right ventricular outflow or the pulmonary circulation.

The emergency response is to occlude the source, place the patient in the left lateral decubitus (Trendelenburg) position to trap air in the right atrium and prevent it from entering the pulmonary artery, administer high-flow oxygen, and summon the provider and rapid-response support immediately. Prevention is the priority: prime all tubing to eliminate air, keep connections Luer-locked, and use correct positioning and technique during central line insertion and removal.

8. Complication Prevention Strategies

A prevention-first approach is more effective and less costly than managing complications after they develop. The following eight elements form a practical framework that addresses the mechanical, chemical, and infectious pathways together, and each element interrupts a specific route to harm before it can progress.

Key Take-aways

- Infiltration is non-vesicant leakage and is usually reversible; grade it and remove the catheter at Grade 2 or higher.
- Extravasation is a vesicant emergency — stop the infusion, leave the catheter in place for aspiration and antidote, and escalate STAT; time to treatment drives outcome.

- Match the antidote and thermal therapy to the specific drug and verify with pharmacy.
- Phlebitis is classified as mechanical, chemical, or bacterial; grade with the VIP scale and remove at Grade 2 or higher.
- Determine the type of occlusion before intervening, and never force a flush against resistance.
- Air embolism calls for immediate source occlusion, left lateral Trendelenburg positioning, oxygen, and provider notification.
- Prevention through assessment, asepsis, stabilization, flushing, and prompt removal is the most effective strategy.

Concepts Tested on the Post-Test

Each item is a topic the post-test probes. Exact wording may differ; the underlying concept is what you must be able to reason through. If any feels unfamiliar, revisit that section above.

1. What is the most common peripheral IV complication?
2. Which infiltration grade requires immediate catheter removal?
3. What defines Grade 2 infiltration?
4. What is the primary concern with extravasation of vesicant medications?
5. What is the first action to take if vesicant extravasation is suspected?
6. Which antidote is used for most chemotherapy vesicant extravasation?
7. What is the antidote for vasoconstrictive medication extravasation?
8. Which type of phlebitis occurs 24-48 hours after insertion?
9. What grade on the VIP scale requires catheter removal?
10. What does VIP scale Grade 3 include?
11. What is the primary prevention strategy for occlusion?
12. What should you do if gentle flushing fails to clear an occlusion?
13. What is the immediate position for suspected air embolism?
14. Why is left lateral Trendelenburg position effective for air embolism?
15. What is a common source of air embolism in IV therapy?
16. How should ice be applied in vesicant extravasation?
17. What is the most critical factor in preventing vesicant extravasation complications?
18. Which medication is known to cause chemical phlebitis quickly?
19. What sign is NOT included in VIP Grade 2 phlebitis?
20. How should infiltration be managed after catheter removal?
21. What is the relationship between catheter gauge and phlebitis risk?
22. What should be documented when phlebitis is assessed?
23. Why is prompt action important for extravasation?
24. What does forcing a flush in an occluded line risk?
25. How can patients help prevent VAD complications?
26. A PICC becomes occluded in a patient receiving parenteral nutrition. According to a 2026 JIN case report, the pattern most consistent with...
27. An institutional algorithm for managing a suddenly occluded PICC should FIRST:

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