

Title	Central & Peripheral Venous Catheters: Guide to Placement and Care
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Purpose

The purpose of this course is do describe proper placement of central and peripheral venous catheters, and the proper care required to prevent potential infection and problems associated with the use of central and peripheral venous catheters. At the conclusion of this course the health care professional should be able to meet the following objectives.

Objectives

1. Demonstrate the knowledge and skills needed for IV insertion by the nurse.
 2. Discuss two issues that have been discussed in recent years regarding use of IVs.
 3. Explain three problems associated with use of IV access for patient care.
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Introduction

Starting a peripheral intravenous catheter is one of the most important and fundamental, albeit least practiced and perfected, skills most new RN graduates possess. Intravenous catheters are used to deliver fluids, medications, and nutrition to patients. When the newly licensed RN attempts to place a peripheral intravenous catheter into a patient he or she is faced with several issues that must be taken into consideration. Such issues include the patient's anatomy (size of available veins) type of medications being delivered to the patient, and length of time the intravenous catheter is intended to serve the patient. Choosing the correct size of cannula and correct location of cannula with the type of fluid to be infused, the new RN graduate places the intravenous catheter according to protocol and maintains the intravenous catheter site until desired infusion has been achieved. While most people think in terms of peripheral intravenous catheters in relationship to patient care, the use of central lines is becoming more widespread. Central venous catheters are requisite for the patient with multiple medication drips, fluids, and nutrition; the patient who will need intravenous therapy for an extended period of time benefits greatly from the use of central venous catheters.

Peripherally inserted catheters

The registered nurse is responsible for insertion of the peripheral intravenous catheter. Knowledge of human anatomy helps the nurse determine the best site suited for intravenous catheter insertion, the most suitable sites tend to be veins of the hands and the antecubital area. Of course, patient education is important at this time to help the patient becomes prepared for the insertion. The nurse provides education about use of the tourniquet to allow venous distention making the vein appear more visible, application of aseptic technique which could include use of alcohol wipes to sanitize the area and education about what the patient can expect from the intravenous catheter, including any problems associated with the use of intravenous therapy.

Local anesthetics

Many patients have a fear of needles. Use of a local anesthetic can make the process of peripheral intravenous insertion into the patient's vein more tolerable. Lidocaine injection is one available option to use. Many patients complain about the burning sensation associated with lidocaine. As a matter of fact, some patients claim they would rather feel the pain of the intravenous catheter insertion than have the burn from lidocaine. Another option for anesthetizing the intravenous catheter insertion site is with the use of EMLA cream. This cream is used more widely with pediatric patients due to the length of time needed for maximum effect to occur, 45 minutes to 1 hour. One research study found that EMLA cream provided more effective pain relief, but that lidocaine was more useful in the adult population due to its immediate anesthetic effect acting within 30 to 60 seconds of time. When time is an issue, EMLA cream is not recommended. Another study found that lack of pain relief associated with intravenous catheter insertion was a source of patient dissatisfaction, ranking intravenous catheter insertion as highly stressful. Lack of a local anesthetic such as lidocaine, results in a significant pressor response for the patient, causing increased blood pressure and heart rate. This study further states that patients who received lidocaine prior to intravenous catheter insertion were more satisfied and would ask to use the medication in the future. The patients felt that the pain associated with lidocaine was far less than the actual intravenous catheter insertion. Nurses equipped with the knowledge that lidocaine and EMLA cream both are effective, should weigh the benefits of offering either of these anesthetics to the patient prior to insertion of an intravenous catheter, thus creating better patient satisfaction and outcome.

Extending the life of peripherally inserted intravenous catheters

One study researched the effects of extending the use of a peripheral intravenous catheter from the commonly accepted time period of 72 hours to 96 hours to determine if intravenous catheters left longer than 72 hours contributed to phlebitis. The Center for Disease Control and Prevention originally set criteria for changing the peripheral intravenous catheter and administration sets at 72 hours. This study found that patients who used their peripheral lines for 96 hours had no more ill effects from their intravenous catheters than patients who used them for 72 hours. Extension of the intravenous catheter life from 72 to 96 hours leads to greater patient satisfaction, since intravenous catheter insertion is painful; and the cost savings to the health organization with regard to fewer charges for supplies and less personnel time used for these changes by physicians and nurses is greater. Now, the CDC has made the recommendation that peripheral venous catheters are changed no more often than 72 to 96 hours. Close assessment of intravenous catheter insertion site for thrombophlebitis and infection should be conducted when 72 hours has elapsed. One important note is that studies indicate increases in incidence of thrombophlebitis and bacterial colonization when intravenous catheters are left in place more than 72 hours. However, rates of phlebitis are no different in peripheral intravenous catheters left in place for 72 hours as compared to 96 hours. Any signs of phlebitis should trigger the nurse to change the intravenous catheter site. Non-peripheral intravenous catheter sets remain intact much longer, and so do have different considerations. There are no recommendations for optimal dwell time for central vascular devices.

Central venous catheters

Central lines, including PICCs and deep lines, are inserted by physicians or registered nurses who are certified to insert these vascular lines. These lines are much more invasive and can have more complications than peripheral intravenous catheters. There are several reasons a patient may need a central line. For example, long-term intravenous catheter use, such as chemotherapy or antibiotic use warrants a longer term access than a peripherally-inserted intravenous catheter. A patient who has several drips, or who has medications as well as intravenous nutrition needs more intravenous access than a peripheral intravenous catheter can offer. The staff nurse's role is assist the physician or registered nurse who is certified in central catheter placement. Assistance may include gathering the necessary materials, holding the patient's head, arm, etc., dressing the site once the catheter is inserted, and educating the patient as well as family members regarding

the necessity and use of the central line.

Patency assurance

Patency of the intravenous catheter is of great concern to the nurse. Routine assessments must be made in order to ensure the IV is still usable. Several things can happen to an intravenous catheter that impedes its ability to deliver fluids, medications, or nutrition. Dislodgment can be a problem. The nurse must ensure the intravenous catheter is stabilized with tape or some other device such as Tegaderm that provides safe, aseptic placement of the catheter, but does not interfere with visualization of the intravenous catheter insertion site or impedance of circulation or infusion through the infusion device. Dressing changes at central lines sites should be done according to set protocol, which is generally at least every seven days for central lines. Dressings applied to peripheral intravenous catheter sites should only be changed when the site is changed, unless the site has large amounts of drainage or the dressing is no longer providing protection. The site should then be cleaned and re-dressed. Maintaining patency of the intravenous catheter is of particular concern to the nurse. If the catheter's patency is compromised, the patient will not receive the prescribed fluids or medications, and the nurse will have to invest more time trying to find another intravenous access. Small blood clots may form at the end of catheters, impeding or even occluding infusion of the intravenous fluid. Routine flushing of the intravenous catheters helps prevent this problem. Intravenous catheters should be flushed with normal saline, while central venous catheters should be flushed with an anticoagulant when not in regular use.

Phlebitis, infiltration, and extravasation

Phlebitis is the most common adverse reaction to peripherally inserted intravenous catheters. Phlebitis is the inflammation of the vein. Presentation of phlebitis can range from slight pain and redness to pain, erythema, palpable venous cord, and pyrexia. The intravenous catheter site should be changed if pain, erythema, and swelling develop. Some medications, including intravenously infused potassium, can cause phlebitis to occur very quickly. Infiltration is another problem that can occur with intravenous catheter infusion, in which the non-vesicant medication is inadvertently administered to the tissue surrounding the intravenous catheter insertion site rather than in the vascular pathway. Extravasation is the same as infiltration except that the medication involved is a vesicant (an additive such as potassium chloride, calcium chloride, magnesium or one of the many agents used to treat cancer) which causes injury to the surrounding tissue when it escapes from the vascular pathway as intended. When infiltration or extravasation occurs, the medication is immediately stopped with removal of the intravenous catheter. Extravasation requires immediate intervention depending on the medication administered. For instance, Dopamine requires administration of Regitine for treatment to prevent further, permanent damage to tissues.

Hematoma

Hematoma is another problem that can occur with intravenous catheter use. It is defined as uncontrolled bleeding at the venipuncture site resulting in hard painful swelling filled with infiltrated blood. The nurse must remove the problematic intravenous catheter and provide intervention with elevation of the limb and application of ice.

Air embolus

Air embolus is a life-threatening problem associated with central intravenous catheter insertion and maintenance. Nurses must take care to avoid pushing air through the central intravenous catheter tubing and must guard against allowing intravenous fluid bags to run dry. Intravenous catheter tubing must be primed before attachment to the central intravenous catheter, and the intravenous catheter site should be below heart level upon insertion of the catheter.

Catheter-related infections

Catheter-related infections have received much scrutiny due to additional expense and extended hospital stays associated with the infectious process. One report states that hospital-acquired bloodstream infections contribute to morbidity and mortality rates in the United States each year; and that the primary cause for these infections, estimated to be around 250,000 in number, is with intravascular catheters. Bloodstream infections considered to be primary bloodstream infections are mainly due to intravascular catheters, usually central venous catheters. With the increased use of central venous catheters, catheter-related bloodstream infections caused by central venous catheters is now at about 90%. Of great importance and interest is the central venous catheters placed in an intensive care unit contribute greatly to these bloodstream infections. Sources considered to be the greatest contributing factors to bloodstream infections while receiving therapy via a central venous catheter include the following sources:

- Bacterial colonization from the client or health care worker's skin.
- Contamination of the hub or intraluminal.
- Bloodstream infection seeding from another source.
- Contamination of the infusing fluid.

The Centers for Disease and Prevention have established guidelines for the prevention of intravenous catheter-related infections. The CDC has put emphasis on the education and training of providers who insert and maintain intravenous catheters, the use of sterile precautions during central line placement, skin preparations for antisepsis, avoidance of routine replacement of central line catheters, and using antibiotic-impregnated short-term central venous catheters. The CDC maintains that use of intravenous catheters, while necessary, carries the risk of local site infections, bloodstream infections, septic thrombophlebitis, endocarditis, lung abscess, brain abscess, osteomyelitis, and endophthalmitis. It should be noted that the daily infection risk with central lines is approximately 20 times that of peripheral catheters. Infection is, by far, the most prevalent and destructive result of problematic intravenous catheters.

Staph bacteria are the most common culprit of infection, with E.coli, Pseudomonas, Klebsiella, and Candida being involved also. It has been observed that many times intravenous catheters are left in place in case they are needed later. According to one author, the best prevention for catheter-related infection is to remove the intravenous catheter line when it is no longer necessary.

Reports over the last 20 years have consistently shown risk for infections decreases as aseptic standards are used. It has been said that special IV teams have shown effectiveness in reducing the incidence of IV-related infection. Also, it has been noted that as nursing staff falls below a critical level, infection risk increases.

The most important action taken by the nurse when inserting and caring for the intravenous catheter site is, say it together now, HANDWASHING. This simple procedure when practiced frequently and properly is the most important factor in the war against harmful microbes, and disease prevention. Other practices also help with prevention including use of skin antisepsis with alcohol wipes and iodine. Use of transparent dressings is comparable to gauze and tape dressing in rate of bacterial colonization at around 5%. Transparent dressings, however, allow visualization of the intravenous catheter insertion site and can be left intact for the duration of the catheter use without increasing risk of thrombophlebitis or infection from contamination of hospital staff changing dressings. Stopcocks are a potential portal of entry for bacteria, occurring in 45-50% of cases. Wiping the stopcock with alcohol wipes and use of piggyback systems rather than stopcocks have shown some improvement in risk of infection.

Other prevention measures employed to reduce intravenous catheter-related infections include the following:

1. Do not insert an intravenous catheter when oral therapy is an option.
2. Use a peripheral line intravenous catheter rather than a central line if possible.
3. Use PICC lines rather than subclavian/jugular/femoral lines if possible.
4. Use as few lumens on central lines as possible.

Remember that of the central venous lines, jugular and femoral insertion sites carry greater risk of infection than does the subclavian site.

According to one study, prevention of intravenous catheter-related infections may not decrease mortality ICU patients, but among surviving patients, there is significant increase in hospital stay regardless of age, diagnosis, or severity. Economic considerations must be examined since many insurances and Medicare pay only a set amount for diagnoses leaving very little room for payment of complications resulting from nosocomial infections.

Summary

Intravenous catheter insertion is half-skill, half-luck on behalf of the nurse starting the intravenous catheter. There are certain issues that the nurse must consider when performing this most common procedure during patient care. The nurse must exercise best judgment when selecting the site for the intravenous catheter, and selecting the type of intravenous catheter to insert; and if planning to insert a peripheral intravenous catheter, the size of the intravenous catheter to use with regard to the type of fluid to be infused. Utilization of aseptic technique, especially that of observing proper hand washing, and maintaining sterile technique, when placing a central line demonstrates evidence that the nurse is practicing critical thinking skills. Information regarding intravenous catheter insertion and the discomfort associated with it has improved in recent years and will most likely improve in the years to come. One of the most recent studies has enabled patients to avoid peripheral intravenous catheter changes every 72 hours by extending peripheral intravenous catheter sites to 96 hours when patency is established and signs of phlebitis or infection are absent. Remembering a few rules of thumb, such as the following go a long way toward assuring a patient does not acquire an infection or suffer any other life-threatening experience during intravenous therapy:

- Maintaining sterile technique with intravenous catheter insertion.
- Avoiding routine replacement of central intravenous catheters.
- Removing intravenous catheters when no longer in use.
- Maintaining nursing staff at an acceptable level.
- Using skin antisepsis (alcohol and iodine) when placing an intravenous catheter line.
- Wiping stopcocks with alcohol wipes prior to use or using a piggyback system.
- Using PICC lines rather than subclavian/jugular/femoral lines.
- Using peripheral rather than central intravenous catheters.
- Using the least possible number of lumens on central lines as necessary.
- Washing **hands** frequently and thoroughly.

Assessing the intravenous catheter insertion site routinely for pain, redness, swelling, and drainage to determine patency is of utmost importance when caring for a patient receiving intravenous therapy. Flushing the intravenous catheter with normal saline is a way to maintain patency; and flushing a central catheter with an anticoagulant when not in use also assures patency.

Several potential problems associated with intravenous access sites have been discussed. Responsibility for collecting information during patient assessment and recognizing that a problem may be developing resides with the nurse caring for the patient. Communicating any concerns with regard to patient care must then be brought to the attention of the physician who intervenes on the patient's behalf. Potential problems associated with intravenous catheter access sites such as hematoma and phlebitis may or may not be preventable, but there is much the nursing staff

can do to prevent other potential problems associated with placing an intravenous catheter and maintaining an intravenous catheter insertion site.

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Course Exam

1. Preferably the most suitable sites for peripheral IV insertion are the veins of the hands and antecubital area.

- True False
2. Lidocaine requires a minimum of 45 minutes to reach its maximum effectiveness.
 True False
3. 72 is the maximum number of hours an intravenous catheter can remain in place at the same site.
 True False
4. Gathering materials necessary for central venous catheter insertion is the staff nurse's role.
 True False
5. Central venous catheter dressing changes are done at least every ten days.
 True False
6. Phlebitis is the most common adverse reaction to peripheral IVs.
 True False
7. Extravasation occurs when a vesicant medication enters the tissues surrounding the IV site.
 True False
8. Peripheral intravenous catheters present a daily infection risk that is twenty times greater than that of a central line.
 True False
9. Removing an intravenous catheter which is no longer required, is the best prevention against catheter-related infection.
 True False
10. Handwashing is the most important action taken by the nurse upon insertion and care of an intravenous catheter.
 True False
11. Four major sources contribute to bloodstream infections, but the most common source can be traced to microorganisms from the patient's skin and from the skin of health care workers.
 True False
12. Every intravenous catheter has the potential to cause an infection.
 True False
13. Leaving a centrally-inserted central venous catheter in place for more than two weeks increases the potential for a bloodstream infection.
 True False
14. Secondary to thorough and frequent hand hygiene, employing aseptic technique at time of insertion and dressing changes decreases the risk of infections associated with catheter use.
 True False

15. Bloodstream infections resulting from central venous catheter use mimic those clinical features associated with other infectious processes, and CVCs should be suspect when no other source of infection is apparent.
- True False
16. Nosocomial or hospital-acquired infections due to CVC use increases a hospital stay by another week and medical costs by more than \$10,000.00
- True False
17. The utilization of jugular/femoral/subclavian lines rather than PICC lines demonstrates critical thinking skill with respect to prevention of infection or other potential catheter-related life-threatening incidents.
- True False
18. An unacceptable level of nursing staff assigned to a unit with a large number of patients receiving intravenous therapy has no direct bearing on the potential problems associated with intravenous catheterization.
- True False
19. An area at the site of an intravenous catheter that is hard, painful, swollen and filled with infiltrated blood is a condition known as phlebitis.
- True False
20. Infiltration and extravasation are the same condition, except infiltration is the result of a vesicant, such as potassium chloride, entering the tissue surrounding the catheter insertion site instead of the intended vascular pathway.
- True False