Intravenous Therapy Basics

Objective: Intravenous Therapy is frequent in many Addiction and Mental Health settings. This module provides nurses with a quick review of the basics of monitoring, assessing for local and systemic complications, practicing aseptic technique, and dealing with agitated clients.

The first known attempt at IV therapy was in 1658 when Sir Christopher Wren designed an IV administration set with a quill and a pig's bladder to instill wine, ale, and opium into a dog's veins (Millam, 1996). About six years later, J.D. Major attempted to inject impure compounds into human veins with devastating results. By the 18th century, O'Shaughnessy and Latta were credited for treating cholera patients with intravenous fluids. In order to accomplish this, Latta used a small silver tube attached to a syringe filled with a hypertonic solution of sodium, chloride and bicarbonate (Millam).

Intravenous fluid therapy is essential when clients are unable to take sufficient food, medications and fluids orally. Intravenous therapy is an efficient and effective method of supplying fluids directly into the intravascular fluid compartment and replacing electrolyte losses (Berman & Snyder, 2012). IV solutions can be classified as isotonic, hypotonic and hypertonic depending on their purpose. Table 1 illustrates different types of IV fluids, and outlines nursing implications for each category of IV solution.

Table 1: Intravenous Solutions

Types of Solution	Nursing Implications
Isotonic Solutions 0.9% NaCl (normal saline - NS) Lactated Ringer's 5% dextrose in water (D5W)	Isotonic solutions such as NS and lactated Ringer's initially remain in the vascular compartment, expanding vascular volume. Assess clients carefully for signs of hypervolemia such as ascites, high blood pressure, bounding pulse, jugular vein distension, crackles and shortness of breath. D5W is isotonic on initial administration but provides free water when dextrose is metabolized, expanding intracellular and extracellular fluid volumes. D5W is avoided in clients at risk for increased intracranial pressure (IICP) because it can increase cerebral edema.
Hypotonic Solutions 0.45% NaCl (1/2 NS) 0.33%NaCl (1/3 NS)	Hypotonic solutions are used to provide Na+, Cl-, and free water and treat cellular dehydration. These solutions promote waste elimination by the kidneys. Do not administer to clients at risk for IICP or third space fluid shift.
Hypertonic Solutions 5% dextrose in NS (D5NS) 5% dextrose in 0.45% NaCl (D1/2NS) 5% dextrose in lactated Ringer's (D5LR) 10% dextrose in Water (D10W)	Hypertonic solutions draw fluid out of the intracellular and interstitial compartments into the vascular compartment, expanding vascular volume. Do not administer to clients with kidney or heart disease or clients who are dehydrated. Watch for signs of hypervolemia.

Adapted from: Berman, A. & Snyder. S. (2012). Fluid, electrolyte and acid-base balance. In Kozier & Erb's (Eds.), *Fundamentals of Nursing: Concepts, process, and practice* 9th edition (p. 1480). Upper Saddle River, NJ: Pearson Education Inc.

The goal of all IV therapy is to maintain fluid and electrolyte balance and/or the delivery of IV medication (Burke, 2005).Table 2 describes the steps involved in monitoring a gravity-drip IV infusion, and discusses rationale. ***Intravenous pumps provide more accuracy and safety and should be used whenever possible.***

Table 2: Monitoring a Gravity-Drip Intravenous Infusion

Purpose • To maintain the prescribed flow rate • To prevent complications associated with IV therapy
Assessment • Appearance of infusion site; patency of system • Type of fluid being infused and rate of flow • Response of the client
Planning • Review the client record regarding previous infusions and use of infusion devices. Note any complications and how they were managed. Gather pertinent data. • From the order, determine the type and sequence of solutions to be infused. • Determine the rate of flow and infusion schedule.
Implementation • Prior to performing the procedure, introduce self and verify the client's identity using agency protocol. Explain to the client what you are going to do, why it is necessary, and how she or he can participate. • Perform hand hygiene and observe other appropriate infection control procedures. • Provide for client privacy and assist the client to a comfortable position and expose the IV site. • Ensure that the correct solution is being infused: Compare the label on the IV container (including added medications) to the order. If the solution is incorrect, slow the rate of flow to a minimum to maintain the patency of the catheter. If the infusing solution is contraindicated for the client, stop the infusion and saline-lock the catheter. *Rationale: Just stopping the infusion may allow a thrombus to form on the end of the IV catheter.* Change the solution to the correct one, using new tubing. Document and report the error according to agency protocol. • Calculate desired flow rate (hourly volume) and drop rate of prescribed infusion depending on macro drip or micro drip infusion set, and open rate-controlling clamp to calculated drop rate: Flow rate (mL/hr) = $\frac{\text{Total infusion (mL)}}{\text{Hours of infusion (hr)}}$ Drop rate (gtts/min) = $\frac{\text{gtts factor}}{60} \times \frac{\text{flow rate}}{1}$

- Observe the rate of flow every hour and compare against infusion schedule.
  Rationale: Infusions that are off schedule can be harmful to a client.
  To read the volume in an IV bag, pull the edges of the bag apart at the level of the fluid and read the volume remaining.
  Rationale: Stretching the bag allows the fluid meniscus to fall to the proper level.
  Observe the position of the solution container. If it is less than 3 feet above the IV site, readjust it to the correct height of the pole.
  Rationale: If the container is too low, the solution may not flow into the vein because there is insufficient gravitational pressure to counter the pressure of the blood within the vein.
  If too much fluid has infused in the time interval, check agency policy. The primary care provider may need to be notified. In some agencies, you will slow the infusion to less than the ordered rate so that it will be completed at the planned time.
  Rationale: Solution administered too quickly may cause a significant increase in circulating blood volume. Hypervolemia may result in pulmonary edema and cardiac failure.
  In other agencies, if the order is for a specified amount of fluid per hour, the IV may be adjusted to the correct rate and the client monitored for signs of fluid overload. In this case, make the appropriate revisions on the container time strip. If the rate is too slow, adjust the IV to the prescribed rate. Also, check agency policy. Some agencies permit nursing personnel to adjust an IV that is behind time by a specified percent. Adjustments above this amount may require a primary care provider's order.
  Rationale: Solution that is administered too slowly can supply insufficient fluid, electrolytes, or medication for the client's needs.
  If the prescribed rate of flow is 150mL/hr or more check the flow rate more frequently, for example every 15-30 minutes.

- Observe for complications, and if detected take action as appropriate.

- Inspect the patency of the IV tubing and catheter. Observe the drip chamber. If it is less than half full, squeeze the chamber to allow the correct amount of fluid to flow in. Inspect the tubing for kinks or obstructions to flow. Arrange the tubing so that it is lightly coiled and under no pressure. Sometimes the tubing becomes caught under the client's body and the weight blocks the flow. Observe the position of the tubing. If it is dangling below the venipuncture, coil it carefully on the surface of the bed.
  Rationale: The solution may not flow upward into the vein against the force of gravity.
  Determine catheter position. Some methods include:
  1. Aspirate the catheter for a blood return. Do this slowly and gently.
  2. Apply a tourniquet several inches above the venipuncture site (for a gravity drip).
  Rationale: Compression from the tourniquet should stop or slow the flow of fluid. If it doesn't, the fluid could be leaking into the tissue.
  3. Lower the solution container below the level of the infusion site and observe for a return flow of blood from the vein.
  Rationale: A return flow of blood indicates that the needle is patent and in the vein. Blood returns in this instance because venous pressure is greater than the fluid pressure in the IV tubing. Absence of blood return may indicate that the needle is no longer in the vein or that the tip of the catheter is partially obstructed by a thrombus, the vein wall, or a valve in the vein. (Note: With some catheters, no blood may appear even with patency because the soft catheter walls collapse during siphoning).
  If there is leakage, locate the source. If the leak is at the catheter connection, tighten the tubing into the catheter. If the leak is elsewhere in the tubing, slow the infusion and replace the tubing. Estimate the amount of solution lost, if it was substantial. If the IV insertion site is leaking, the catheter will have to be removed and IV access reestablished at a new site.

- Teach the client ways to maintain the infusion system, for example, inform of any limitations on movement or mobility, instruct to notify nurse if the flow rate suddenly

changes or the solution stops dripping, if the solution container is nearly empty, if there is blood in the IV tubing, if discomfort or swelling is experienced at the IV site, and inform that you will be checking the venipuncture site periodically.

- Document relevant information. Record the status of the IV insertion site and any adverse responses of the client. Document the client's IV fluid intake at least every 8 hours according to agency policy. Include the date and time; amount and type of solution used, flow rate, and the client's general response. In most agencies, the amount remaining in each IV container is also recorded at the end of the shift.

Evaluation

- Perform follow-up based on findings or outcomes that deviated from expected or normal for the client. Consider urinary output compared to intake, tissue turgor, specific gravity of urine, vital signs, and lung sounds compared to baseline data.

- Regularly check the client for intended and adverse effects of the infusion. Report significant deviations from normal to the primary care provider.

Documentation

- Document the type of IV solution as well as the infusion rate. Note the insertion site location and site assessment. Document the client's reaction to the IV therapy as well as the absence of subjective reports that she/he is not experiencing any pain or other discomfort, such as coolness or heat associated with the infusion. Additionally, record that the client is not demonstrating any other IV complications, such as signs or symptoms of fluid overload. Record on an intake and output document as needed.

Sample Documentation
17/01/12 1022h: IV with D5 ½ NS infusing at 100mL/hr into right forearm/cephalic vein; site remains asymptomatic; denies pain; tolerating well; no adventitious sounds auscultated in lungs bilaterally; instructed to notify nurse with any swelling or pain at or around IV insertion site. *Your Signature*

Adapted from:

Berman, A. & Snyder. S. (2012). Fluid, electrolyte and acid-base balance. In Kozier & Erb's (Eds.), *Fundamentals of nursing: Concepts, process, and practice 9th edition* (p. 1494-1496). Upper Saddle River, NJ: Pearson Education Inc.,

Lynn, P. (2011). Fluid, electrolyte and acid-base balance. In *Taylor's Clinical nursing skills: A nursing process approach 3rd edition* (p. 781). Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Otto, S.E. (2007). Intravenous therapy. In Elkin, Perry, and Potter's (Eds.) *Nursing interventions & clinical skill* 4th edition (p. 608). St. Louis, Missouri: Mosby Elsevier.

Complications

When a patient has an intravenous, the nurse caring for that patient needs to assess the patency of the IV and potential complications. Complications may present as being either local or systemic. Local complications may be more frequent and less severe than systemic complications. The following table defines potential complications, and signs, symptoms and nursing considerations for each local complication.

Table 3: Local complications associated with intravenous infusions

Complication/Cause	Signs and symptoms	Nursing Considerations
Infiltration: the escape of fluid into the subcutaneous tissue.	Swelling, pallor, coldness, or pain around the infusion site; decrease in flow rate; unable to palpate tip.	Check the infusion site every hour for signs/symptoms. Discontinue the infusion if symptoms occur. Remove catheter

Dislodged catheter Penetrated vessel wall		Restart the infusion at a different site. Elevate affected limb. Use warm or cold compresses depending on the IV fluid (eg. hypertonic solution use cold compress, isotonic/hypotonic use warm or cold compress). Limit the movement of the extremity with the IV.
Extravasation: the inadvertent administration of a vesicant substance into the tissue surrounding the vein. Dislodged catheter Penetrated vessel wall	Pain, burning, feeling of tightness, tingling, numbness.	***This is considered an emergency.*** Stop the infusion immediately. Remove the dressing and withdraw the peripheral catheter. Use dry gauze to control bleeding. Assess color, sensation, motion, temperature and capillary refill distal to the injury. Measure circumference of affected extremity and compare with other extremity. Apply a new dry dressing. Do not apply excessive pressure to the area. Elevate affected arm. Apply heat or cold depending on the drug. Notify primary care provider STAT.
Infection: when insertion site is invaded by bacteria and has the potential to spread.	Redness, pain, warmth, discharge, fever	Discontinue infusion and remove catheter. Swab site for culture and sensitivity. Cleanse infected site using medical asepsis. Apply dry dressing. Use warm compresses if necessary. Restart IV in alternate location away from infection site Change dressing as per agency protocol.
Phlebitis: an inflammation of a vein. Mechanical trauma from needle or catheter Chemical trauma from solution Septic (contamination)	Acute tenderness; redness and pain along vein pathway, warmth, palpable cord vein, and slight edema of the vein above the insertion site.	Discontinue infusion and remove catheter. Apply warm, moist compresses to the affected site Avoid further use of the vein Restart the infusion in another vein
Thrombus: a blood clot on the tip of the catheter inside the vessel that blocks blood flow. Tissue trauma from needle or catheter	Symptoms similar to phlebitis IV fluid may cease if clot obstructs needle	Stop infusion immediately Remove catheter Apply warm compresses Restart the IV at another site Do not rub or massage the affected area

Hematoma: blood leaking into the tissue causes bruising which may occur at any time during treatment. Poor IV insertion technique Injury to vessel	Discoloration, swelling, tenderness.	Remove intravenous catheter. Apply pressure over insertion site. Elevate arm while applying pressure. Apply dry gauze dressing.

Adapted from: Lynn, P. (2011). Fluid, electrolyte and acid-base balance. In *Taylor's clinical nursing skills: A nursing process approach* 3rd edition (p. 782). Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins.

In order to assess the severity of infiltration and phlebitis, the following grading scales are useful.

Table 4: Infiltration Scale

Grade	Clinical criteria
0	No symptoms
1	Skin blanched, edema less than 1 inch in any direction, cool to touch, with or without pain.
2	Skin blanched, edema 1 to 6 inches in any direction, cool to touch, with or without pain.
3	Skin blanched, translucent, gross edema greater than 6 inches in any direction, cool to touch, mild-moderate pain, possible numbness.
4	Skin blanched, translucent, skin tight, leaking, skin discolored, bruised, swollen, gross edema greater than 6 inches in any direction, deep pitting tissue edema, circulatory impairment, moderate to severe pain, infiltration of any amount of blood product, irritant or vesicant.

Note. Adapted from Infusion Nurses Society. (2006). Infusion nursing standards of practice. Journal of Infusion Nursing, 29(1S), S60.

Table 5: Phlebitis Scale

Grade	Clinical Criteria
0	No symptoms
1	Erythema at access site with or without pain.
2	Pain at access site with erythema and/or edema.
3	Pain at access site with erythema and/or edema, streak formation, palpable venous cord.
4	Pain at access site with erythema and/or edema, streak formation, palpable venous cord greater than 1 inch in length, purulent drainage.

Note. Adapted from Infusion Nurses Society. (2006). Infusion nursing standards of practice. Journal of Infusion Nursing, 29(1S), S59.

When monitoring IV therapy, it is important to be aware of possible systemic complications and know how to assess and respond in the event of occurrence. Table 4 defines systemic complications, outlines specific signs and symptoms to assess for, and presents nursing considerations in the event of a complication.

Table 6: Systemic complications of intravenous therapy

Complication/Cause	Signs and symptoms	Nursing Considerations
Speed shock: the body's reaction to a substance that is injected into the circulatory system to rapidly	Pounding headache, fainting, rapid pulse rate, apprehension, chills, back pains, dyspnea	If symptoms develop, discontinue the infusion immediately Report symptoms of speed shock to primary care provider immediately Monitor vital signs if symptoms develop Use the proper IV tubing Carefully monitor the rate of flow Check the rate frequently for accuracy. A time tape is useful.
Fluid Overload: the condition caused when too large a volume of fluid infuses into the circulatory system which may lead to excess fluid in the lungs (pulmonary edema).	Engorged neck veins, anxiety, restlessness, increased blood pressure and pulse, cyanosis, dyspnea, cough, crackles, bounding pulse.	If symptoms develop, slow the rate of infusion Place in semi-Fowler's position Administer oxygen Notify the physician immediately Monitor vital signs Carefully monitor the rate of fluid flow Monitor intake and output Check the rate frequently for accuracy
Air embolism: air in the circulatory system Break in the IV system allowing air in the circulatory system as a bolus	Respiratory distress Increased heart rate Chest pain Cyanosis Decreased blood pressure Change in level of consciousness Shock	Pinch off catheter or secure system to prevent entry of air Place client on left side in Trendelenburg position to trap air in right atrium Inform physician Monitor vital signs and pulse oximetry Administer oxygen
Pulmonary Embolism: occurs when a thrombus blocks completely or partially blocks the pulmonary artery Thrombus becomes dislodged from IV catheter	Anxiety, chest pain, cyanosis, diaphoresis, hemoptysis, increased respiratory rate, shortness of breath, tachycardia	Place in semi-fowler's position Administer oxygen Notify physician
Sepsis: microorganisms invade the blood stream through the catheter insertion site Poor aseptic technique Multi-lumen catheters Long-term catheter insertion Frequent dressing changes	Red and tender insertion site Fever, chills, malaise, headache, disorientation, hypotension, tachycardia, shortness of breath, cyanosis, nausea and vomiting	Assess catheter site daily. Notify physician immediately if any signs of sepsis. Follow agency policy for taking a specimen for culture and sensitivity of IV site and catheter tip. Remove IV Obtain blood cultures as ordered Administer antibiotics as ordered. Use scrupulous aseptic technique

Adapted from: Lynn, P. (2011). Fluid, electrolyte and acid-base balance. In Taylor's clinical nursing skills: A nursing process approach 3rd edition (p. 782). Philadelphia, PA: Wolters Kluwer Health/Lippincott Williams & Wilkins.

Infection control is integral to all client care and professional practice (Lavery, 2010). When caring for an IV, it is important for all staff to maintain aseptic technique in order to decrease the chance of an infection developing. Table 5 outlines recommended practice to reduce the incidence of infection when a client in receiving IV therapy.

Table 7: Good practice to reduce infection in intravenous therapy

- Wash hands, wear a new pair of non-sterile disposable gloves and use an aseptic, non-touch technique for all aspects of IV therapy, including preparation, administration, and site care.
- Prepare IV fluids and drugs in designated clean area.
- Use pre-mixed solutions and avoid additives to fluid bags if possible.
- Ensure all IV administration sets are labeled with the date and time and change them appropriately: solution sets – change every 72 hours; blood sets – change every 12 hours; lipid containing solutions – change every 24 hours.
- Administration sets that are disconnected should be discarded.
- Add-on devices should be kept to a minimum and changed as recommended by the manufacturer. In general, 3 way taps should be changed every 72 hours, and needleless devices should be changed according to the manufacturer's instructions.
- All administration ports should be thoroughly decontaminated before and after use.
- IV dressings should be replaced when loose, wet or soiled.
- Venous access devices should be removed when no longer in use.

Adapted from: Scales, K. (2008). Intravenous therapy: A guide to good practice. *British Journal of Nursing, 17*(19), S4-S12.

Dealing with an agitated client

Due to the nature of their illness, clients may be confused, combative, suicidal, or psychotic during intravenous therapy. Nursing interventions that decrease agitation and promote safety will assist in keeping agitated clients and health care professionals free from harm.

Case Example

Mr. M., 65 years old, has been admitted to a psychiatric unit for an attempted overdose on acetaminophen. Mr M. has an IV with N-acetylcysteine infusing. The admitting nurse assesses Mr. M.'s mental status and finds that Mr. M. responds to simple questions inappropriately, is restless, disoriented and pulling at his IV. When the nurse tries to dissuade Mr. M from pulling his IV by repositioning his arm, Mr. M. becomes combative, striking out at the nurse. Knowing that the IV infusion is an important part of Mr. M.'s treatment at this time, what interventions could the nurse take to maintain the patency of the IV, and promote comfort for the client?

After having suffered a needle stick injury as a result of a combative client, Burkhart shares the following considerations on handling an agitated client safely (Perry & Jagger, 2003) while performing IV care:

- Assess to determine if the client is able to tolerate the procedure.
- Consider safety issues (IV lines, needles, potential for injury, self-harm or blood and body fluid exposure, presence of hallucinations/delusions) in your assessment.
- Use safety-engineered sharp devices.

- Always use personal protective equipment, including goggles and face shields when appropriate. Almost 90% of bites and scratches affect the arms or hands, gloves and long sleeved gowns are particularly important.
- In order to help the client regain a sense of control over the situation, approach the client in a gentle, calm and non-threatening manner, use a quiet voice while giving clear, concise information in simple sentences about what you are going to do and the expected outcome. It is also important to maintain a quiet and non-stimulating environment.
- Before you perform any procedure, tell the client what you'll be doing and why, and ask her to hold still. If she refuses the procedure, don't insist.
- If the client becomes verbally aggressive, identify and acknowledge feelings and shift the topic to a safer, more familiar one.
- If the client becomes delusional, acknowledge feelings and reinforce reality. Do not attempt to challenge the content of the delusion.
- If you're starting an IV line and the client becomes agitated or hostile, immediately back the needle out of the vein and activate the safety mechanism. Then get assistance before starting any other procedures.
- If a patient is suicidal or under the influence of drugs or alcohol, be sure to have at least two health care workers at the bedside for any procedures.
- When you feel like you are losing control of a situation or your presence is upsetting the client, ask for assistance or have someone else take over.
- Don't get caught up in the mechanics of care that you forget to pay attention to the client's body language. Signs of high anxiety include darting eyes, staccato speech, and jerky body movements.
- Utilize an IV house protective device if necessary.
- If arm restraints are required, use with caution.
- If hypodermoclysis is indicated, choose a site that the client would have difficulty reaching, such as the mid-back.
- Use the techniques of non-violent crisis intervention.

Conclusion

Intravenous Therapy is within the nursing scope of practice but should not be performed without an understanding of asepsis and how to safely do the procedures. Nurses have a key role in the prevention of complications associated with IV therapy and helping the client in return to a healthy state (Scales, 2008). Special considerations in addiction and mental health areas include safety issues for clients in a confused, combative, suicidal, or psychotic state. All nurses must deliver IV care based on the best available evidence. Knowledge and skills for safe and effective practice must be kept up-to-date throughout each practitioners working life (Nursing and Midwifery Council, 2008). This module is intended to be part of that ongoing review of the basic knowledge about intravenous therapy.

References

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Ready for Review

Administering IV therapy to pediatric and geriatric patients requires special care. Both populations are at a higher risk for certain medical conditions that can affect both the patient's need for IV therapy and the effectiveness of the therapy. By understanding the risks and concerns of these populations, you will be better equipped to properly administer IV therapy. Finally, in any medical situation involving pediatric or geriatric patients, remember to be sensitive to the patient's personal issues.

Quick Quiz

Answer each question below in your own words.

1. Discuss the problem associated with blunt chest trauma in children.
2. Discuss the fluid replacement rule for pediatric patients.
3. What is one type of IV set used to regulate fluid delivery in pediatric patients?
4. How can prescription drugs affect an elderly patient who is hemorrhaging?
5. Discuss the possible problems associated with inserting IV lines and securing the IV lines in elderly patients.

Test Your Knowledge

Select the best answer for each of the following.

1. You are assessing a 4-year-old child who has fallen and hurt his arm. Which of the following is applicable to patients of this age?
   A. Tolerate separation from parents
   B. Tend to take statements literally
   C. Just beginning to develop independence
   D. View themselves as invincible

2. Which of the following is the leading cause of death in children age 1 to 19 years?
   A. Unintentional injury
   B. Malignant neoplasm
   C. Congenital anomalies
   D. Suicide

3. Which of the following statements regarding assessment of the pediatric patient is FALSE?
   A. You should ask yourself if the child is responding normally for his or her age.
   B. When going through the ABCs, you should assess and fix the problems as you encounter them.
   C. Assessment of skin color, temperature, and capillary refill is part of the assessment for circulation.
   D. Critical illness in pediatric patients typically manifests in either respiratory failure or dysrhythmia.

4. You need to deliver D_{25} to your pediatric patient. How do you mix the solution?
   A. Mix four parts of D_{50} with one part of sterile water.
   B. Mix one part of D_{50} with one part of normal saline.
   C. Mix four parts of normal saline with one part of D_{50}.
   D. You should not mix drugs in the field.

5. You are preparing to start an IV line on an 85-year-old patient who had fallen and injured his hip. Which of the following statements regarding geriatric patients is FALSE?
   A. The geriatric patient is often under the care of several doctors.
   B. The mortality rate in the geriatric trauma patient is low.
   C. Geriatric patients may have underlying medical conditions that are less tolerant of the possibility of shock.
   D. Minor infections can potentially lead to septic shock.

WRAP UP

Ready for Review

Successful IV technique takes time to perfect. Several factors, from the patient's condition to the available IV equipment, influence every IV start. Mastery of IV skills comes when you understand and can overcome all the variables. Take your time when practicing IV starts and gain a solid understanding of what you are doing. This understanding will be useful when you need to perform a quick and flawless IV start in less than optimum conditions.

Quick Quiz

Answer each question below in your own words.

1. Summarize the process of inserting a catheter into a vein.
2. Describe how you would correctly assemble the bag and blood tubing.
3. Calculate the drip rate for administering 500 mL of normal saline through a macrodrip set over 45 minutes.
4. Perform the following calculations:
   A. Order: Morphine sulfate (MSO_4) 2 mg IV push
      On hand: 10 mg/mL morphine sulfate in prefilled syringe
      How many mL should you administer?
   B. Order: Bretylium tosylate 5 mg/kg
      On hand: Bretylium tosylate 500 mg/10 mL
      Patient's weight: 242 lb
      How many mL should you administer?
   C. Order: Lactated Ringer's solution 300 mL over 30 minutes
      On hand: Lactated Ringer's solution 1,000 mL
      Administration set: 10 gtt/mL
      How many gtt/min will you administer?
   D. Order: Normal saline 1,000 mL over 4 hours
      On hand: Normal saline 1,000 mL
      Administration set: 15 gtt/mL
      How many gtt/min will you administer?
5. The patient is receiving MSO_4 via IV infusion. The concentration of the solution is 100 mg MSO_4 in 500 mL IV fluid. It is infusing at a rate of 30 mL/h. How many mg/h is the patient receiving?

Test Your Knowledge

Select the best answer for each of the following:

1. Which of the following is NOT a reason to follow a system for IV administration?
   A. Health care-associated infections
   B. To ensure that steps are completed in the proper order
   C. Ensure sterile technique
   D. A system is required by OSHA

2. Which of the following items is NOT necessary to start an IV line?
   A. Tape
   B. BP cuff
   C. IV tubing
   D. IV catheter

3. Which of the following steps in assembling IV supplies should take place EARLIEST?
   A. Select appropriately sized catheter
   B. Open alcohol wipe
   C. Select the solution
   D. Connect the IV tubing to the catheter hub

4. Which action should be taken immediately prior to venipuncture?
   A. Draw blood
   B. Tear tape
   C. Apply constricting band
   D. Select appropriately sized catheter

5. Which of the following is NOT a key factor in selecting an IV site for a patient who needs a line to keep the vein open?
   A. Select a vein as close to the body's central circulation as possible.

B. Avoid areas where the vein crosses over joints.
C. Select a vein that has a firm, round feel when palpated.
D. Select a vein that is straight.

6. An 18-year-old man has been involved in a motorcycle crash. He has bilateral femur fractures. What size IV catheter is best?
A. 18-gauge over-the-needle catheter
B. 16-gauge over-the-needle catheter
C. 25-gauge butterfly needle
D. 19-gauge butterfly needle

7. Which of the following is NOT one of the five rights of medication administration?
A. Right patient
B. Right route
C. Right medication
D. Right attitude

8. Which of the following actions should be taken first when preparing to discontinue an IV line?
A. Remove the tape.
B. Remove the IV tubing from the catheter hub.
C. Stop the flow of fluids.
D. Place a piece of gauze over the site.

9. You are asked to start an IV line of normal saline and infuse 500 mL over 2½ hours. How many drops per minute will you infuse using a 15 drop/mL set?
A. 30
B. 50
C. 75
D. 100

10. The physician asks you to administer 0.5 mg of atropine. It is packaged as 1 mg in 10 mL. How many mL will you deliver?
A. 2.5
B. 5
C. 50
D. 15

11. You are to deliver 1.5 mg/kg of succinylcholine to your patient, who weighs 70 kg. It is packaged in a concentration of 1,000 mg in 10 mL. How many mL will you deliver?
A. 1
B. 2
C. 10
D. 20

12. Which of the following is defined as the escape of fluid into the surrounding tissue?
A. Phlebitis
B. Hematoma
C. Infiltration
D. Occlusion

13. Your patient's IV line of normal saline is running very slow. You are using a macrodrip set with an 18-gauge catheter. The bag is on an IV pole. Which of the following is NOT a likely cause of the slow flow?
A. The IV fluid is too thick.
B. The administration set is the wrong type.
C. The catheter is too small.
D. The pole is too low.

Glossary

access port A sealed hub on an administration set designed for sterile access to the IV fluid.

administration set Tubing that connects to the IV bag access port and the catheter in order to deliver the IV fluid.

air embolus The presence of air in the veins, which can lead to cardiac arrest if a large enough bolus were to enter the lungs.

allergic reaction The body's exaggerated immune response to an internal or a surface antigen.

blood tubing A special type of macrodrip IV set intended for rapid blood and/or fluid resuscitation of a patient.

butterfly needle A rigid, hollow, venous cannulation device identified by its plastic "wings" that act as anchoring points for securing the catheter.

catheter shear The cutting of the catheter by the laser sharpened needle during improper cannulation technique; the severed piece can then enter the circulatory system.