Al-Zahraa University for women
Health and Medical Technology College
Department of Anesthesiology

Nursing Science

Intravenous Infusion

Learning objectives

After completing this lecture, the students will be able to:

- **Describe three methods for maintaining or restoring fluid volume.**
- **Explain the terms isotonic, hypotonic, and hypertonic when used in reference to IV solutions.**
- **List four factors that affect the choice of tubing used to administer IV solutions.**
- **Identify techniques for infusing IV solutions.**
- **Discuss at least criteria for selecting a vein when administering IV fluid.**
- **List complications associated with IV fluid administration.**

Intravenous Infusion:

Policies and practices vary concerning how much responsibility practical/vocational nurses assume with IV fluid therapy.

❖ **Administered of IV fluid into circulatory system in the following situation:**

- It is an efficient and effective method of supplying fluids directly into the intravascular fluid compartment and replacing electrolyte losses.
- Iv fluid therapy is essential when clients are unable to take sufficient food and fluids orally
- Fluid restrictions vary from "nothing by mouth" to a precise amount ordered by a primary care provider and postoperatively.
- Administer drugs and replace blood and blood products

Solutions: Liquids (solvent) that contain a dissolved substance (solute).

Parenteral Nutrition (PN): is a nutritionally adequate a solution consisting of glucose, other nutrients, and electrolytes administered through a central venous catheter

❖ **Nurses roles in IV infusion:**

- The nurse is responsible for Confirming the type and dosage of IV solution.
- Administering and maintaining the therapy
- Teaching the client and significant others how to continue the therapy at home if necessary

Classification (Types) of IV solutions

1. According to Osmotic Pressure:

A. Hypotonic solutions:

1. Hypotonic solutions have a lesser concentration of solutes.
2. Lowers osmotic pressure and causes fluid to move into the cells (treat cellular dehydration).
3. If infused beyond the client's tolerance water intoxication may result.

4. Do not administer to clients at risk for IICP because it can increase cerebral edema or third-space fluid shift.

E.g.,

- **Sodium chloride 0.45% (half NS).**
- **Sodium chloride 33% (one-third NS).**

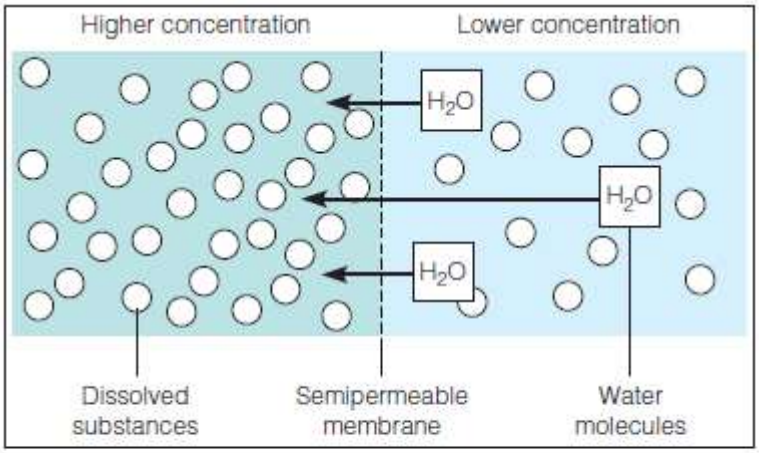
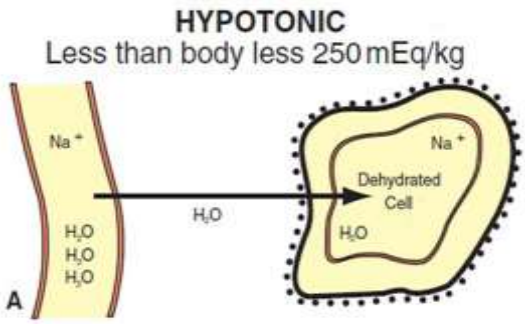


FIGURE 44.4 Osmosis: Water molecules move from the less concentrated area to the more concentrated area in an attempt to equalize the concentration of solutions on two sides of a membrane.



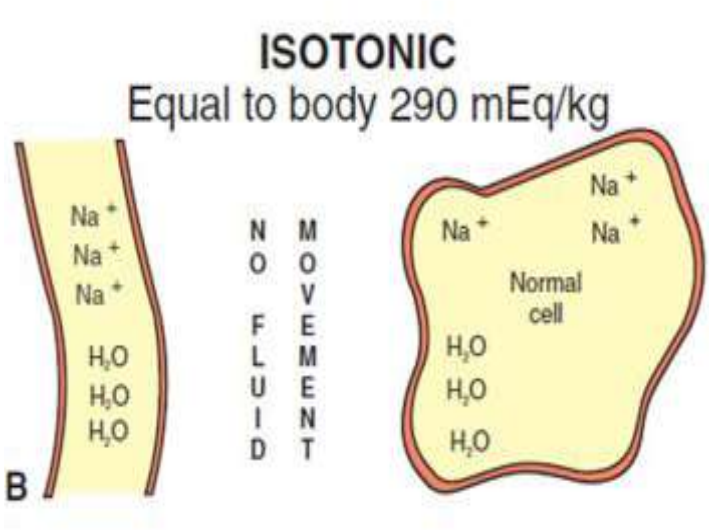
B. Isotonic solutions:

1. Solutions are isotonic, having the same concentration of solutes as blood plasma
2. When infused, remains inside the intravascular compartment.
3. Used to restore vascular volume.
4. If infused beyond the client's tolerance, cardiac overload may result.
5. Because this solution expands vascular volume, clients should be assessed carefully for signs of hypervolemia, such as bounding pulse and shortness of breath.

6. **E.g.,**

- Dextrose 5 % in water (D 5 W)-,
- Ringer s lactate
- Normal saline (NS) 0.9,%

- Dextrose 2.5 % in 0.45 % saline,
- Dextrose 5 % in 0.2 % saline.
- D5 W is isotonic on initial administration but provides free water when dextrose is metabolized, expanding intracellular and extracellular fluid volumes.
- D5 W is avoided in clients at risk for IICP because it can increase cerebral edema.



C. Hypertonic Solutions:

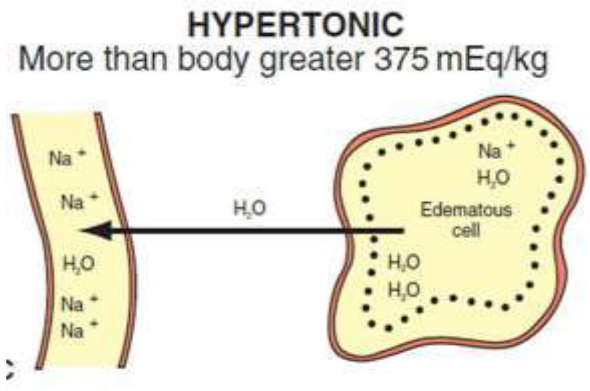
1. The concentration of solutes is greater than plasma.

2. Increases the osmotic pressure of the blood plasma, drawing fluid out of the intracellular and interstitial compartments into the vascular compartment, expanding vascular volume.

3. Do not administer to clients with kidney or heart disease or clients who are dehydrated. Watch for signs of hypervolemia.

4. Cellular dehydration may result if infused beyond the client's tolerance.

5. **E.g.,**
   - Dextrose 5% in 0.45% saline (D5 1/2NS),
   - Dextrose 5% in saline 0.9% (D5NS),
   - Dextrose 5% in lactated Ringer's (D5LR).



2. According to Their Purpose:

A. Nutrient Solutions

- Contain some form of carbohydrate (e.g., dextrose, glucose, or levulose) and water.
- Water is supplied for fluid requirements and carbohydrate for calories and energy.
- Nutrient solutions are useful in preventing dehydration and ketosis

- Do not provide sufficient calories to promote wound healing, weight gain, or normal growth in children.
- Common nutrient solutions are 5% dextrose in water (d5w) and 5% dextrose in 0.45% sodium chloride (dextrose in half normal saline).

B. Electrolyte Solutions

- Contain varying amounts of cations and anions. Commonly used solutions are
- Normal saline (0.9% sodium chloride solution),
- Ringer's solution (which contains sodium, chloride, potassium, and calcium), and
- Lactated ringer's solution (which contains sodium, chloride, potassium, calcium, and lactate).
- **Lactated ringer's is an alkalizing solution that may be given to treat metabolic acidosis (lactate is metabolized in the liver to form bicarbonate).**
- Saline and balanced electrolyte solutions are commonly used to restore vascular volume, particularly after trauma or surgery. They also may be used to replace fluid and electrolytes for clients with continuing losses, for example, those experiencing gastric suction or wound drainage.

C. Acidifying Solutions

- In contrast, are administered to counteract metabolic alkalosis. Examples of acidifying solutions are 5% dextrose in 0.45% sodium chloride and 0.9% sodium chloride solution.

D. Volume Expanders

- Used to increase the blood volume following severe loss of blood (e.g., from hemorrhage) or loss of plasma (e.g., from severe burns). Examples of volume expanders are dextran, plasma, albumin

Starting an IV Infusion:

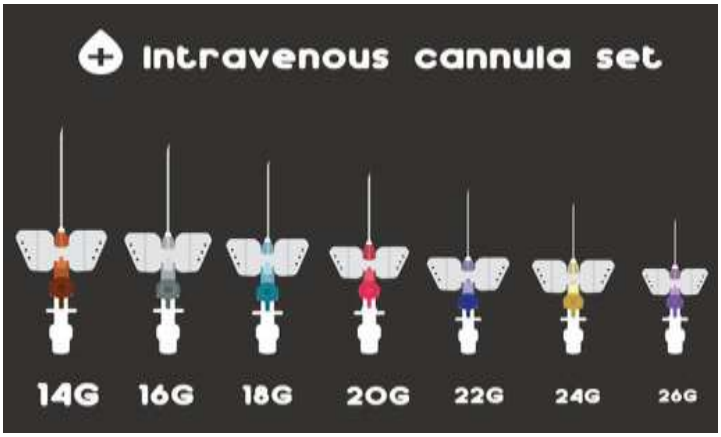
When selecting the vein for IV access (Venipuncture, or Cannula) you should Avoid using veins that are:

- In areas of flexion (e.g., the antecubital fossa)
- Highly visible, because they tend to roll away from the needle

- Damaged by previous use, phlebitis, infiltration, or sclerosis
- Continually distended with blood or knotted or tortuous
- In a surgically compromised or injured extremity (e.g., following a mastectomy), because of possible impaired circulation and discomfort for the client.
- In arm with a functioning arteriovenous fistula.
- In an arm that has circulatory or neurologic impairments.

❖ Intravenous Infusion Equipment

- IV catheters
- Catheter stabilization devices
- Solution containers
- Infusion administration sets
- IV filters
- IV poles



❖ Intravenous Equipment:

- IV equipment is sterile, disposable.
- Using aseptic technique and standard precautions when assembling and changing IV equipment.

- IV equipment must be inspected to determine integrity and expiration date (Product integrity refers to the sterility of the equipment).
- Solution should be clear, cloudiness indicates previously container opened, leaks indicates possible contamination.
- It is essential that the solution be sterile and in good condition, that is, clear. Cloudiness, evidence that the container has been opened previously, or leaks indicate possible contamination
- Do not write directly on a plastic IV bag with a ballpoint pen (may puncture the bag) or indelible marker (may absorb through the bag into the solution).
- When preparing the client's skin for a venipuncture, cleanse the skin with betadine and wait for it to dry. Do not apply alcohol after the skin has been prepped with betadine. If these substances are combined, they form a toxic material that may be absorbed through the skin.

Before starting an infusion, the nurse determines the following:

- The type and amount of solution to be infused
- The exact amount (dose) of any medications to be added to a compatible solution
- The rate of flow or the time over which the infusion is to be completed.
- Understanding the purpose for the infusion

Regulating Intravenous Infusions

- The number of drops delivered per milliliter of solution varies with different brands and types of infusion sets. This rate, called the drop factor, is printed on the package of the infusion set.
- Macrodrops commonly have drop factors of 10, 12, 15, or 20 drops/ml;
- The drop factor for microdrip sets is always 60 drops/ml

$$\text{Drops per minute} = \frac{\text{Total infusion volume} \times \text{drop factor}}{\text{Total time of infusion in minutes}}$$

If the requirements are 1,000 mL in 8 hours and the drip factor is 20 drops/mL, the drops per minute should be

$$\frac{1{,}000 \text{ mL} \times 20}{8 \times 60 \text{ min (480 min)}} = 41 \text{ drops/min}$$



❖ **Electronic infusion device (EID):**

1. Use when a patient is fragile or a solution must be strictly controlled.
2. Delivers fluids intravenously by exerting positive pressure on the tubing or the fluid.
3. Has alarms that can detect factors such as an empty solution container, tube obstruction, air in the tubing, infiltration, or low battery.

3. Using the following formula:

When using an infusion device:

$$\frac{\text{Total volume in mL}}{\text{Total hours}} = \text{mL/hr}$$

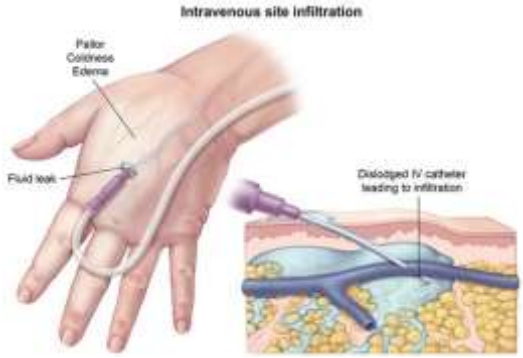
Changing Intravenous Containers and Tubing

- IV solution containers are changed when only a small amount of fluid remains in the neck of the container and fluid still remains in the drip chamber
- All IV bags should be changed every 24 hours, regardless of how much solution remains, to minimize the risk of contamination
- "Routine site care and dressing changes are not performed on short peripheral catheters unless the dressing is soiled or no longer intact"
- Peripheral IV catheters are removed every 48 hours or may stay in a vein for up to 72 hours maximum.
- A midline catheter can last from 1 to 4 weeks.
- The butterfly needle is most frequently used for short-term therapy (e.g., less than 24 hours) such as with single-dose therapy, IV push medications, or blood sample.
- Change infusion sets every 24 hours or whenever their sterility is in question.
- Pressure and a dry sterile dressing are applied to the site upon removal of the catheter**.**
- Clinical assessment of the site is ongoing, and the IV site should be changed earlier than these guidelines in cases of infiltration, signs of infection, or severe discomfort.

Complications of Infusion Therapy

1. Infiltration

- **Infiltration**: is the unintended administration of a *nonvesicant* drug or fluid into the subcutaneous tissue. **Infiltration can be caused by:**
  - ✓ Puncture of the vein during venipuncture,
  - ✓ Dislodgement of the catheter,
  - ✓ Or a poorly secured infusion device



- **Signs and symptoms:**
  - ✓ Coolness of skin around site
  - ✓ Skin blanching(pallor), tautness (i.e., a client states it feels "tight")
  - ✓ Edema at, above, or below the insertion site
  - ✓ Leakage at insertion site
  - ✓ Absence of or "pinkish" blood return
  - ✓ Difference in size of opposite hand or arm

2. Extravasation:

Extravasation: is the unintended administration of *vesicant* drugs or fluids into the subcutaneous tissue.

- **Signs and symptoms:**

Same as infiltration and can also include:

- ✓ Burning, stinging pain
- ✓ Redness followed by blistering, tissue necrosis, and ulceration.

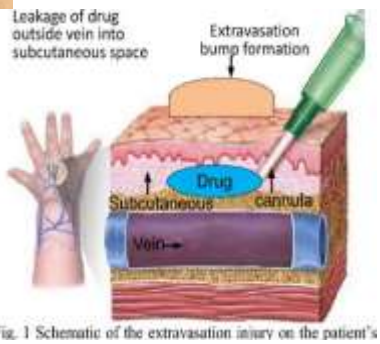


Fig. 1 Schematic of the extravasation injury on the patient's

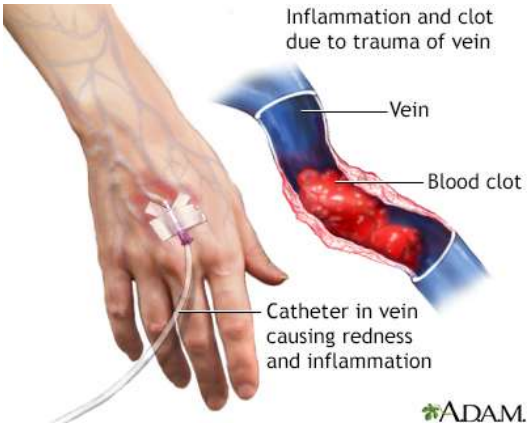
❖ Prevention of Infiltration and Extravasation:

1. Avoid areas of joint flexion in the selection of the venipuncture site
2. The gauge of the catheter should be the smallest in an appropriate vein.
3. Using a manufactured catheter stabilization device prevents unnecessary movement of the catheter.
4. Assessing patency of the catheter and vein frequently.
5. Knowing the osmolality and pH of medications and fluids.

3. Phlebitis

Phlebitis: is an inflammation of the vein of which there are three types:

- ***Mechanical phlebitis***: is caused by too large of a catheter in a small vein causing irritation of the vein.
- ***Chemical phlebitis*:** occurs when a vein becomes inflamed by irritating or vesicant solutions or medications.
- ***Bacterial phlebitis***: is inflammation of the vein and a bacterial infection, which can be caused by poor aseptic technique during insertion of the IV catheter and/or breaks in the integrity of the IV equipment
- **Signs and symptoms of Phlebitis:**
  - ✓ Erythema at access site with or without pain
  - ✓ Pain at the access site, with erythema and/or edema
  - ✓ Palpable venous cord
  - ✓ Purulent drainage
  - ✓ Increase in body temperature.



- **Prevention strategies for phlebitis**
- Practicing good hand hygiene, assessing the length of time needed for the infusion therapy
- Peripheral
- IV catheters be replaced when clinically indicated (rather than the previous recommendation of every 72 or 96 hours).

4. **Air Embolism**: a bubble of air traveling within the vascular system.
5. **Thrombus Formation:** a stationary blood clot
6. **Pulmonary Embolus**: a blood clot that travels to the lung

References

1. Berman, A., Snyder, SH., & Frandsen, G. (2022). Kozier and Erb's Fundamentals of Nursing: concepts; 12 process; and practices. Ninth edition. Pearson Education, Inc. United States of America: 1450-1507.

2. Kozier, B., Erb, G., Berman, A., Snyder, SH., & Frandsen, G., Buck, M., Ferguson, L., Yiu, L., and Stamler, L. (2018). Fundamentals of Canadian Nursing: Concepts, Process, and Practice. 4th edition. Pearson Canada Inc., Pp. 1326-1387