CHAPTER 10

Introduction to IV Therapy

OBJECTIVES

The learner will:

1. Differentiate primary, secondary, peripheral, and central intravenous (IV) lines.
2. Explain the function of IV drip chambers, roller clamps, slide clamps, and intermittent injection ports.
3. Define and identify the dosage for an IV heparin port flush.
4. Discuss the use of electronic/volumetric pumps
5. Identify abbreviations in IV solutions.

Introduction

It is **impossible to imagine a functioning modern medical system without intravenous therapy**. Nor would we have **as many exciting TV and film scenes where the emergency starting of an IV is pivotal to life**!

But that's just the **dramatic side** of IV therapy. In uncountable areas of medical care, IVs are essential for **short- and long-term nutrient therapy** for patients unable to eat; **replacement of body fluids and electrolytes**; **administration of blood and plasma**; **antibiotic therapy**; **infusion of chemotherapeutic drugs** in the treatment of malignances; **administration of surgical anesthetics**; and **life-sustaining care in dialysis**.

IV fluid and medication administrations are some of **the most challenging** of nursing responsibilities. There are currently estimated to be **hundreds** of manufactured **IV fluids**, **administration sets and components**, and **dozens of different models of electronic/volumetric infusion devices (EIDs)**.

This would appear to make the entire subject of IV therapy overwhelming, **but it isn't**. This chapter presents a **basic introduction to IV equipment and solutions** in understandable, small segments. It will provide an **excellent base of instruction** on which you can build your IV knowledge and skills.

Let's start by looking at basic IV setups, equipment, and terminology related to IV infusions.

Primary Line

Refer to **Figure 10-1**, which shows a primary IV setup. Concentrate on the **close-up** of this IV setup **on the top right**, in which the IV tubing is already connected to the solution bag.

All IV tubing is connected to a solution bag using sterile techniques.

All IV solution and tubing lines are set up **before needle or cannula insertion** in a vein. Next, look closely at A in Figure 10-1: the **drip chamber** is only **half full**. The **drip chamber** is squeezed to only **half fill** so that the drips can be counted to set the ordered flow rates.

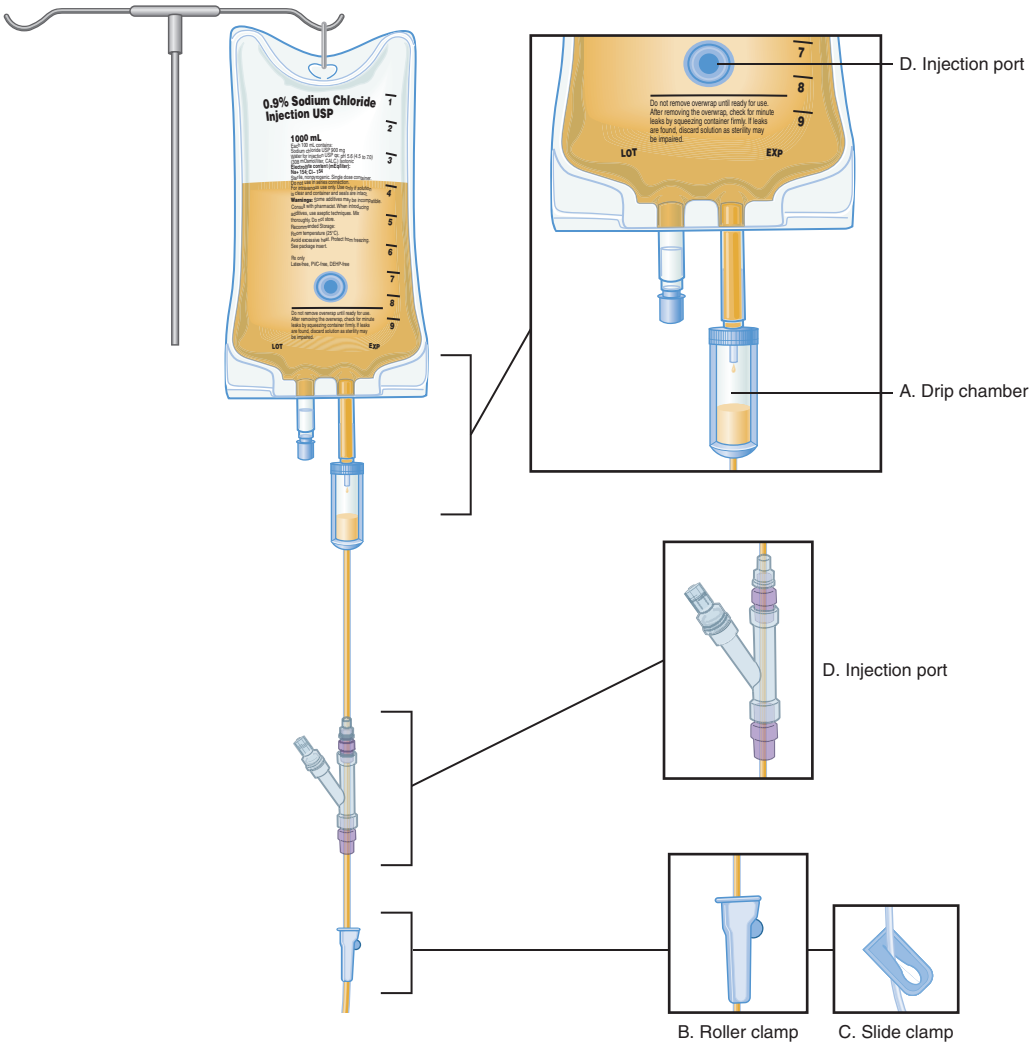

Figure 10-1 Primary IV setup

The half-full level of fluid in the drip chamber is critically important to allow the falling drops to be counted and the flow rate set.

Additional **ports** are located in several locations on the tubing, typically near the drip chamber, middle of the line, and cannula end. **Ports allow the injection of medication directly into the bag or line** (see D in Figure 10-1), or for the **attachment of a secondary IV line** containing compatible IV fluids or medications.

Next, look at B in Figure 10-1: the **roller clamp** used to **set the flow rate**. This is done by holding **a watch containing a second hand next to the drip chamber and counting the drips for 15 seconds**. Multiplied by **four**, this gives you the **flow rate per minute**. Finally, locate C in Figure 10-1, the **slide clamp**. Slide clamps are used to **shut off the IV temporarily without changing the flow rate**. These would be used, for example, to add a new solution bottle to the line.

There are two additional terms relating to primary lines that you must know. If an arm or hand (or, less commonly, leg) vein is used for an infusion, it is referred to as a **peripheral line**. This is to distinguish it from a **central line**, in which **an infusion cannula is surgically inserted into the vena cava in the chest**.

Secondary IV Line

Uncomplicated infusions are delivered by **gravity flow**, which requires that the **infusion bag be hung well above the patient's heart level**. **Secondary lines are used to infuse medications on an intermittent basis**, such as every 6–8 hours, or to infuse **a second IV solution**.

Look next at the diagram of a **secondary IV setup** in **Figure 10-2.**

Secondary lines connect to the primary line at a port below the primary line drip chamber.

Notice that the **primary IV bag** on the left **is hanging lower than a second, smaller bag on the top right**, colored yellow for identification. This represents **a secondary IV setup**.

Because IVs **infuse by gravity flow**, the higher **secondary solution has a greater pressure, and it will infuse first**. When the secondary IV has completely infused, **the primary line will automatically resume infusion**.

Peripheral Infusion Ports

Peripheral ports are most often located in an arm or hand. These require a **special IV needle infusion device**. **Inserted to lie flush to the skin**, the port is **secured by taping down its special side wings**. **Once** the port is secured, the **needle is withdrawn**, **leaving a comfortable flexible plastic cannula in the vein for repeat infusions**.

Central infusion ports are an alternative port for many medical conditions and are provided by the **insertion of a central venous catheter (CVC)**. Central ports deliver medications and/or IV fluids **directly into the circulatory system, and then immediately throughout the body**.

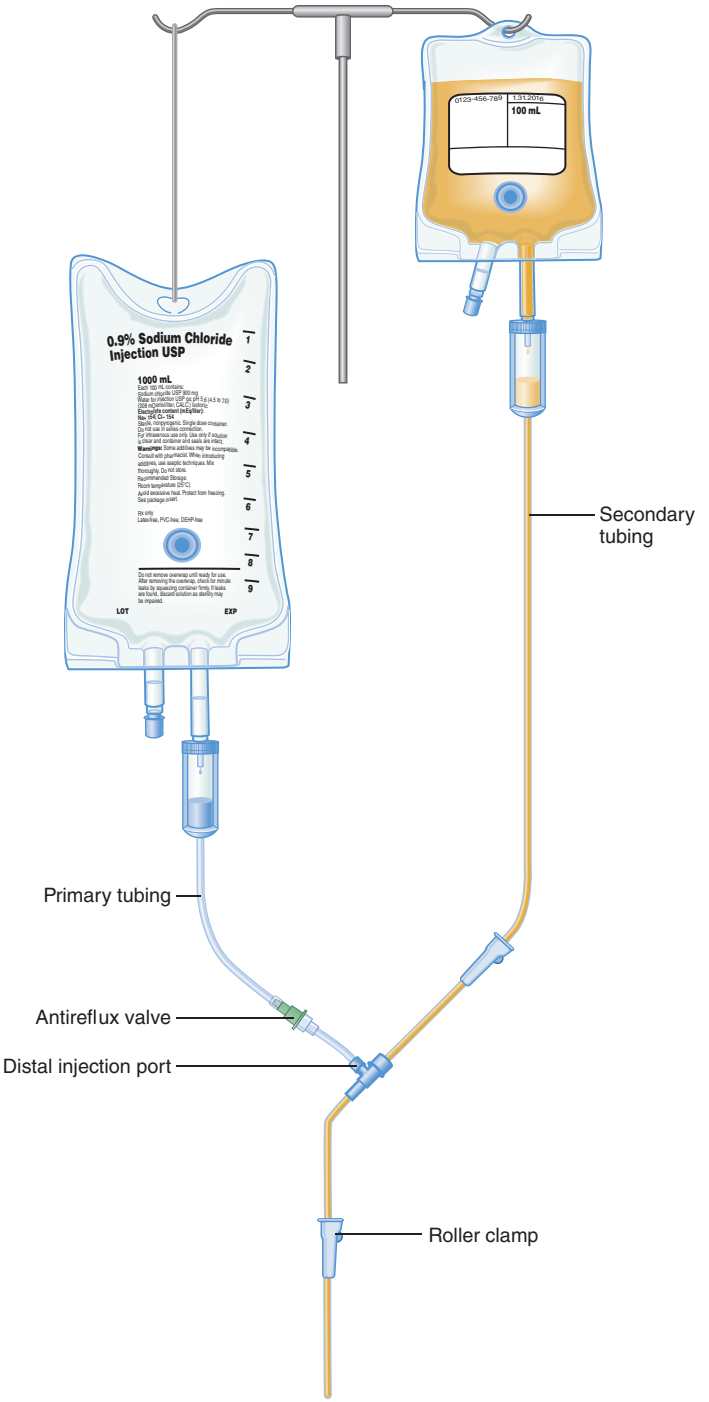

Figure 10-2 Secondary IV setup

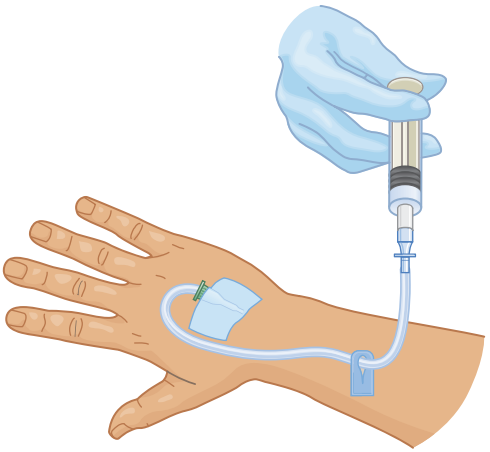

Figure 10-3 Port flushing

IV Port Flushes

Both peripheral and central ports require regular flushes to keep their cannulas open, termed **patent** (see **Figure 10-3**). The choice of **which type, how much, and how often to flush a port** depends on **physician orders**.

Flush solution choices are **sterile normal saline** or **heparin**, and these alternatives have led to ports sometimes being referred to as **Saline-Locks** or **Heplocks**.

Ports must be cleansed with an alcohol swab before a flush is initiated.

Sterile normal saline of 0.9% is readily available in the clinical setting for saline flushes. Two flush strengths are available: **10 units/mL and 100 units/mL**.

The 100-unit flush must never be exceeded.

Local response to the **port itself is also monitored** because adults' and children's **local reaction to ports** differ significantly.

One other IV term that applies to IV therapy that you will hear is **bolus**. This identifies the **rapid administration of a medication or solution, usually in an emergency situation**.

Problems 10-1

You are now ready to answer some basic questions from your introduction to IV administration. Answer the questions as briefly as possible.

1. What is the correct fluid level for an IV drip chamber? _____
2. Which clamp is used to regulate the IV flow rate? _____
3. When might a slide clamp be used? _____

4. What is a peripheral line? _____
5. What is a central line? _____
6. What must the height of a primary solution bag be when a secondary bag is infusing? _____
7. What is the first step in port flushing? _____
8. What are the two strengths of heparin flush solutions available? _____

Answers 1. Middle of chamber **2.** Roller clamp **3.** To stop the IV temporarily **4.** An IV in an arm or leg vein **5.** An IV catheter surgically inserted into the vena cava **6.** Lower than the secondary line **7.** Cleanse the port with alcohol swab **8.** 10 units/mL and 100 units/mL

Electronic/Volumetric Infusion Pumps

Refer now to **Figure 10-4**, which shows an electronic infusion pump. Electronic pumps are attached to IV stands, and the **infusion line is positioned through the pump**. The device is then **programmed to deliver the ordered flow rate**.

Because of the wide variation in pump models and their functions, caution is mandatory when they are used. It is estimated that a significant number of IV medication errors result from pump programming.

Hospital or clinical in-service education is required for the use of all infusion devices.

It is beyond the scope of this text to do more than mention pumps at this time. But, be curious, check them out when clinical opportunities arise.

Patient-Controlled Analgesia (PCA) Devices

Finally, there is one more variety of electronic pump called a **patient-controlled analgesia (PCA)** device. These allow a patient to **self-administer medication to control pain**. A **prefilled syringe or medication bag containing pain medication** is inserted into the device and the **dosage rate is set**. The **patient presses the control button** as pain medication is needed, and **the administration is recorded** by the PCA.

This device also **keeps a record** of the number of times a patient **attempts to use it** and provides a record of the **effectiveness of the dosage prescribed**. If a patient's pain is not being relieved, new orders must be obtained and the PCA reset to administer the new dosage.

Figure 10-4 Electronic infusion pump

Problems 10-2

Answer the questions about the infusion devices you were just introduced to as briefly as possible.

1. What is the function of an electronic/volumetric pump? _____
2. List the major precautions in the use of volumetric pumps. _____
3. What is the full form of PCA? _____

Answers 1. To administer IVs at a controlled rate **2.** Accurate programming; rate and site monitoring **3.** Patient-controlled analgesia

All electronic devices must be closely monitored to be sure they are functioning properly.

Electronic devices have been in use for many years and are relatively trouble-free, but if the desired goal is not being obtained, in the absence of other obvious reasons, **the possibility of pump failure must be considered**.

Introduction to Percentages in IV Solutions

While it may seem like an oversimplification, it helps to keep in mind **the role that our own body fluids and chemicals** play in IV therapy. When the body is under attack for any medical reason, both body fluids and chemicals can go seriously out of balance.

In its simplest sense, IV solutions are produced **to match our body's own physiological chemistry**, and that starts with our **own physiological interstitial tissue balance of 0.9%**.

Let's start with the basic fact that **IV fluids are sterile**. They are prepared in plastic solution bags in volumes ranging from 250 mL to 1000 mL, and administering them is an **aseptic/sterile procedure**.

Solutions are clearly labeled with their **name and percentage strengths**, but **orders and charting** are often done **using abbreviations**.

In IV fluid abbreviations, D identifies dextrose; W identifies water; S identifies saline; NS identifies normal saline; and numbers identify percentage (%) strengths.

Abbreviations may differ, but they are easily identifiable; for example, D5W, 5% D/W, and D5%W. The **initials and percentages have the identical meaning, regardless of the way they are written or expressed**.

Saline IV solutions are prepared in **several percentage strengths**. They are frequently written with the **0.9 and %** included, but different percentage saline strengths are also available: **0.45%** (0.45% is half of 0.9%) and **0.225%** (one-quarter of 0.9%).

Another commonly used solution is **Ringer's lactate**, a **balanced electrolyte solution**, which is also called **Lactated Ringer's Solution**. This solution is used to control chemical imbalances. As you would now expect, Ringer's may be abbreviated **RL or LR**.

Electrolytes may also be added to some of the basic fluids just discussed. One electrolyte so commonly added that it deserves mention is **potassium chloride**, which is abbreviated **KCl**. It is measured in milliequivalents (**mEq**).

This brief introduction to IV solutions has been included to take some of the mystery out of these fluids when you first see them. Familiarity with **everything related to IV therapy is a lifelong focus in nursing care**, and this brief introduction is **all you need to know at this point of your education**.

Problems 10-3

Use the abbreviations just discussed to write the components and percentage strengths of the IV solutions.

1. D10NS _____
2. D5S _____
3. D5S _____
4. D5 1/4S _____

5. D20W _____
6. D5NS 20 mEq KCl _____
7. D5RL _____

Answers 1. 10% dextrose in normal saline **2.** 5% dextrose in saline **3.** 5% dextrose in saline **4.** 5% dextrose in 0.225% saline **5.** 20% dextrose in water **6.** 5% dextrose in normal saline with 20 mEq potassium chloride **7.** 5% dextrose in Ringer's lactate solution

What Percentages Really Mean

You may recall that **percent means grams of drug per 100 mL of fluid**. This means that a 5% dextrose solution will have **5 g of dextrose in each 100 mL**. A 500-mL bag of a 5% solution will contain 5 g × 5, or 25 g of dextrose, whereas 500 mL of a 10% solution contains 10 g × 5, or 50 g of dextrose.

The point being made here is that **percentages make IV fluids significantly different from each other**. As with drugs, reading labels and making sure that IVs are administered as ordered are critically important.

Parenteral Nutrition

One of the options available for providing long-term nutrition when a patient is unable to eat is to **administer a nutrient solution via a central vein**. The solutions infused are generally of a high caloric content containing varying percentages of glucose, amino acids, and/or fat emulsions.

A number of abbreviations/descriptions are used for parenteral nutrients. Some of the more common are **total parenteral nutrition (TPN)**, **partial parenteral nutrition (PPN)**, and **hyperalimentation (nutrition in excess of maintenance needs)**.

There is a noticeable difference in fluids that contain lipids (fat, intralipids), in that they are **opaque-white** in appearance, not unlike milk. These fluids are normally **infused slowly**, but **not usually over a period of more than 24 hours because they can spoil and support bacterial growth**.

All precautions applicable to IVs in general apply equally to parenteral nutrients, with **more care necessary for the IV site** to prevent infection. Flow rate and infusion time calculations covered in subsequent chapters are also applicable to parenteral nutrition solutions.

Summary

This concludes your introduction to IV therapy. The important points to remember from this chapter are:

- Sterile technique is used to set up all IV solutions, tubing, and devices.
- The correct fluid level for an IV drip chamber is half full.
- Injection ports on an IV line are used to connect secondary lines and to infuse medications.
- A peripheral line refers to an IV infusing in a hand, arm, or leg vein.

- A central line refers to an IV infusing into the deep chest vena cava.
- IVs flow by gravity pressure.
- Secondary solution bags must hang higher than the primary bag to infuse first.
- Infusion ports are used to infuse medications on an intermittent basis when a continuous IV is not present.
- Infusion ports may require irrigation with sterile normal saline or heparin flush solution, not to exceed 100 units/mL.
- Electronic/volumetric pumps are devices that force fluids into a vein under pressure at a controlled rate.
- Patient-controlled analgesia (PCA) devices allow a patient to self-administer pain medication.
- In IV fluid abbreviations, D identifies dextrose, W identifies water, S identifies saline, NS identifies normal saline, RL or LR identify Ringer's lactated solution, and numbers identify percentage (%) strengths.

Summary Self-Test

You are to assist with some IV procedures. Answer the situational questions concerning these procedures.

1. A patient is admitted and an IV of 1000 mL D5RL is started. What do these initials identify? What is this IV line called? _____
2. Why is the roller clamp on the IV tubing line closed before connection to the solution bag? _____
3. An IV is started in the back of a patient's left hand. This makes it what type of line? _____
4. You are asked to check the fluid level in the drip chamber, and you observe it is at the correct level, which is? _____
5. You are then asked to adjust the flow rate. What clamp will you use? _____
6. In order for an antibiotic to infuse first when a secondary set is used, how must it be hung in relation to the primary bag? _____
7. Some days later, the patient's IV is to be discontinued, but he is to continue to receive IV antibiotics. What is the site for this intermittent administration called? _____
8. The patient had a PCA in use for one day. What do these initials mean? What does this device control? _____

Answer the following as briefly as possible.

9. What heparin dosage strengths are used for an IV port flush? _____

10. In IV fluid abbreviations, D5NS identifies what IV fluid? _____

Answers

1. 5% dextrose in Ringer's lactate; primary **2.** To prevent air from entering the tubing **3.** Peripheral **4.** Half full **5.** Roller **6.** Volumetric pump **7.** Intermittent infusion port; saline or heparin lock **8.** Patient-controlled analgesia; administration of pain medication **9.** 10 units/mL or 100 units/mL **10.** 5% dextrose in normal saline