Lecture-8

Intravenous Admixture

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Intravenous Admixture

- The preparation of intravenous admixtures involves the addition of one or more drugs to large volume sterile fluids such as sodium chloride injection, dextrose injection, lactated Ringer’s injection, and others.
- The additives are generally in the form of small-volume sterile solutions packaged in ampuls, vials, small-volume minibags for use as piggybacks, or sterile solids, some requiring constitution with a sterile solvent before transfer.

- Although a wide variety of drugs and drug combinations are used in preparing dilute infusions for intravenous therapy, some of the more common additives include electrolytes, antibiotics, vitamins, trace minerals, heparin, and, in some instances, insulin.
- Figure 13.4 shows the aseptic addition of an additive to a large-volume solution. In any properly administered intravenous admixture program, all basic fluids (large-volume solutions), additives (already in solution or extemporaneously constituted), and calculations must be carefully checked against the medication orders.

FIGURE 13.4 Aseptic addition of an additive to a large-volume parenteral solution. *(Courtesy of Millipore Corporation.)*

- Patient care facilities often adopt standard concentrations of intravenous solutions of commonly used drugs to provide uniformity within the institution.
- Common examples are dopamine 400 mg in 250 mL of D5W, insulin 25 units in 250 mL of NS, and nitroglycerin 50 mg in 250 mL D5W.
- In preparing these standard concentrations, the pharmacist withdraws the determined volume from an ampul or vial containing the concentrated drug solution and transfers it to the specified volume of D5W, NS, or other intravenous fluid.

- Table 13.2 shows various infusion concentrations that may be conveniently prepared from 40mg/mL and 80mg/mL concentrations of dopamine injection.
- It is important to recognize that drug dosing by infusion is varied by the drug concentration in the infusion, the volume of infusion administered, the infusion set used, and the rate of flow of the infusion (e.g., mL/min, mg/min).
- Rate of infusion calculations are presented in the next section.

TABLE 13.2 OPTIONS TO PREPARE INFUSIONS OF DIFFERENT CONCENTRATIONS

VOLUME USED			CONCENTRATION OF DOPAMINE HCl[a]	
IV FLUID	INJECTION	INJECTION:	40 mg/mL	80 mg/mL
250 mL	5 mL		800 mcg/mL	1.6 mg/mL
	10 mL		1.6 mg/mL	3.2 mg/mL
500 mL	5 mL		400 mcg/mL	800 mcg/mL
	10 mL		800 mcg/mL	1.6 mg/mL
1000 mL	5 mL		200 mcg/mL	400 mcg/mL
	10 mL		400 mcg/mL	800 mcg/mL

[a] Note: In practice, the volume of the added injection is generally disregarded in expressing the drug concentration of the resultant infusion solution.

Example Calculations of Additives to Intravenous Infusion Solutions

- A medication order for a patient weighing 154 lb. calls for 0.25 mg of amphotericin B per kilogram of body weight to be added to 500 mL of 5% dextrose injection.
- If the amphotericin B is to be obtained from a constituted injection that contains 50 mg/10 mL, how many milliliters should be added to the dextrose injection?

$$1 \text{ kg} = 2.2 \text{ lb.}$$
$$\frac{154 \text{ (lb.)}}{2.2 \text{ (lb.)}} = 70 \text{ kg}$$
$$0.25 \text{ mg} \times 70 = 17.5 \text{ mg}$$

Constituted solution contains 50 mg/10 mL:

$$\frac{50 \text{ (mg)}}{17.5 \text{ (mg)}} = \frac{10 \text{ (mL)}}{x \text{ (mL)}}$$
$$x = 3.5 \text{ mL, } \textit{answer.}$$

Or, solving by dimensional analysis:

$$154 \text{ lb.} \times \frac{1 \text{ kg}}{2.2 \text{ lb.}} \times \frac{0.25 \text{ mg}}{1 \text{ kg}} \times \frac{10 \text{ mL}}{50 \text{ mg}} = 3.5 \text{ mL, } \textit{answer.}$$

- An intravenous infusion is to contain 15 mEq of potassium ion and 20 mEq of sodium ion in 500 mL of 5% dextrose injection.
- Using potassium chloride injection containing 6 g/30 mL and 0.9% sodium chloride injection, how many milliliters of each should be used to supply the required ions?
- 15 mEq of K^- ion will be supplied by 15 mEq of KCl, and 20 mEq of Na+ ion will be supplied by 20 mEq of NaCl

$$\begin{aligned}
1 \text{ mEq of KCl} &= 74.5 \text{ mg} \\
15 \text{ mEq of KCl} &= 1117.5 \text{ mg or } 1.118 \text{ g} \\
\frac{6 \text{ (g)}}{1.118 \text{ (g)}} &= \frac{30 \text{ (mL)}}{x \text{ (mL)}} \\
x &= 5.59 \text{ or } 5.6 \text{ mL, } \textit{and}
\end{aligned}$$

$$\begin{aligned}
1 \text{ mEq of NaCl} &= 58.5 \text{ mg} \\
20 \text{ mEq of NaCl} &= 1170 \text{ mg or } 1.170 \text{ g} \\
\frac{0.9 \text{ (g)}}{1.17 \text{ (g)}} &= \frac{100 \text{ (mL)}}{x \text{ (mL)}} \\
x &= 130 \text{ mL, } \textit{answers.}
\end{aligned}$$

Or, solving by dimensional analysis:

$$15 \text{ mEq} \times \frac{74.5 \text{ mg}}{1 \text{ mEq}} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{30 \text{ mL}}{6 \text{ g}} = 5.59 \text{ or } 5.6 \text{ mL, and}$$

$$20 \text{ mEq} \times \frac{58.5 \text{ mg}}{1 \text{ mEq}} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{100 \text{ mL}}{0.9 \text{ g}} = 130 \text{ mL, } \textit{answers.}$$

- A medication order for a child weighing 44 lb. calls for polymyxin B sulfate to be administered by the intravenous drip method in a dosage of 7500 units/kg of body weight in 500 mL of 5% dextrose injection.
- Using a vial containing 500,000 units of polymyxin B sulfate and sodium chloride injection as the solvent, explain how you would obtain the polymyxin B sulfate needed in preparing the infusion.

$$1 \text{ kg} = 2.2 \text{ lb.}$$

$$\frac{44}{2.2} = 20 \text{ kg}$$

$$7500 \text{ units} \times 20 = 150{,}000 \text{ units}$$

Step 1. Dissolve contents of vial (500,000 units) in 10 mL of sodium chloride injection.

Step 2. Add 3 mL of constituted solution to 500 mL of 5% dextrose injection, *answer*.

Rate of flow of intravenous fluids

- On medication orders, the physician specifies the rate of flow of intravenous fluids in milliliters per minute, drops per minute, amount of drug (as milligrams per hour), or, more frequently, as the approximate duration of time of administration of the total volume of the infusion.
- Pharmacists may be called on to perform or check rate-of-flow calculations as those described in the following example problems in this section.
- Often times, the following equation finds use in rate-of-flow calculations:

$$\text{Rate of flow (drops/minute)} = \frac{\text{Volume infusion (mL)} \times \text{Drip set (drops/mL)}}{\text{Time (minutes)}}$$

In common usage are *macro sets* that deliver 10, 15, or 20 drops per milliliter and mi*crodrip* or *minidrip sets* that deliver 60 drops per milliliter.

Examples of Rate-of-Flow Calculations

- A medication order calls for 1000 mL of D5W to be administered over an 8-hour period. Using an IV administration set that delivers 10 drops/mL, how many drops per minute should be delivered to the patient

$$\text{Volume of fluid} = 1000 \text{ mL}$$
$$8 \text{ hours} = 480 \text{ minutes}$$

$$\frac{1000 \text{ (mL)}}{480 \text{ (minutes)}} = 2.08 \text{ mL per minute}$$

$$2.08 \text{ mL/min} \times 10 \text{ (drops/mL)} = 20.8 \text{ or } 21 \text{ drops per minute, } \textit{answer.}$$

Or, solving by dimensional analysis:

$$\frac{10 \text{ drops}}{1 \text{ mL}} \times \frac{1000 \text{ mL}}{8 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 20.8, \text{ or } 21 \text{ drops per minute, } \textit{answer.}$$

Or, solving by the equation:

$$\text{Rate of flow (drops/minute)} = \frac{\text{Volume infused (mL)} \times \text{Drip set (drops/mL)}}{\text{Time (minutes)}}$$
$$= \frac{1000 \text{ mL} \times 10 \text{ drops/mL}}{480 \text{ minutes}}$$
$$= 20.8 \text{ or } 21 \text{ drops per minute, } \textit{answer.}$$

- Ten (10) milliliters of 10% calcium gluconate injection and 10 mL of multivitamin infusion are mixed with 500 mL of a 5% dextrose injection.
- The infusion is to be administered over 5 hours. If the dropper in the venoclysis set calibrates 15 drops/mL, at what rate, in drops per minute, should the flow be adjusted to administer the infusion over the desired time interval?

$$\text{Total volume of infusion} =$$
$$10\text{ mL} + 10\text{ mL} + 500\text{ ml} = 520\text{ mL}$$

Dropper calibrates 15 drops/mL

$$520 \times 15\text{ drops} = 7800\text{ drops}$$

$$\frac{7800\text{ (drops)}}{300\text{ (minutes)}} = 26\text{ drops per minute, } \textit{answer}.$$

Or, solving by dimensional analysis:

$$\frac{15\text{ drops}}{1\text{ mL}} \times \frac{520\text{ mL}}{5\text{ hours}} \times \frac{1\text{ hr}}{60\text{ min}} = 26\text{ drops per minute, } \textit{answer}.$$

Or, solving by the equation:

$$\text{Rate of flow (drops/minute)} = \frac{\text{Volume infused (mL)} \times \text{Drip set (drops/mL)}}{\text{Time (minutes)}}$$
$$= \frac{520\text{ mL} \times 15\text{ drops/mL}}{300\text{ minutes}}$$
$$= 26\text{ drops per minute, } \textit{answer}.$$

- An intravenous infusion contains 10 mL of a 1: 5000 solution of isoproterenol hydrochloride and 500 mL of a 5% dextrose injection.
- At what flow rate should the infusion be administered to provide 5 µg of isoproterenol hydrochloride per minute, and what time interval will be necessary for the administration of the entire infusion?

10 mL of a 1:5000 solution contain 2 mg

2 mg or 2000 μg are contained in a volume of 510 mL

$$\frac{2000\ (\mu g)}{5\ (\mu g)} = \frac{510\ (mL)}{x\ (mL)}$$

$$x = 1.275 \text{ or } 1.28 \text{ mL per minute, } \textit{and}$$

$$\frac{1.28\ (mL)}{510\ (mL)} = \frac{1\ (minute)}{x\ (minutes)}$$

$$x = 398 \text{ minutes or approx. } 6\tfrac{1}{2} \text{ hours, } \textit{answers.}$$

Or, solving by dimensional analysis:

$$\frac{1\ min}{5\ \mu g} \times \frac{0.002\ g}{510\ mL} \times \frac{1{,}000{,}000\ \mu g}{1\ g} \times 510\ mL = 400 \text{ minutes} \approx 6\tfrac{1}{2} \text{ hours, } \textit{answer}$$

- If 10 mg of a drug are added to a 500-mL large-volume parenteral fluid:

(a) what should be the rate of flow, in milliliters per hour, to deliver 1 mg of drug per hour?

(b) If the infusion set delivers 15 drops/mL, what should be the rate of flow in drops per minute?

(c) How many hours should the total infusion last?

(a) what should be the rate of flow, in milliliters per hour, to deliver 1 mg of drug per hour?

$$\frac{10\ (\text{mg})}{1\ (\text{mg})} = \frac{500\ (\text{mL})}{x\ (\text{mL})}$$

$$x = 50 \text{ mL per hour, } \textit{answer.}$$

(b) If the infusion set delivers 15 drops/mL, what should be the rate of flow in drops per minute?

$$15 \text{ drops/mL} \times 50 \text{ mL/hr} = 750 \text{ drops per hour}$$

$$\frac{750\ (\text{drops})}{x\ (\text{drops})} = \frac{60\ (\text{minutes})}{1\ (\text{minute})}$$

$$x = 12.5 \text{ drops/minute, } \textit{answer.}$$

Or, solving by dimensional analysis:

$$\frac{15 \text{ drops}}{1 \text{ mL}} \times \frac{50 \text{ mL}}{1 \text{ hr}} \times \frac{1 \text{ hr}}{60 \text{ min}} = 12.5 \text{ drops per minute, } \textit{answer}.$$

(c) How many hours should the total infusion last?

$$\frac{50 \text{ (mL)}}{500 \text{ (mL)}} = \frac{1 \text{ (hour)}}{x \text{ (hour)}}$$

$$x = 10 \text{ hours, } \textit{answer}.$$