

# Administering Intravenous Solutions and Medications

# Learning Objectives

## Theory

- 1) List four purposes for administering intravenous (IV) therapy.
- 2) Evaluate the advantages and potential problems of using an infusion pump to deliver fluids or medications.
- 3) Summarize the possible complications that can arise from the use of the IV route and the corrective actions you should take for each one.

# Learning Objectives

## Clinical Practice

- 1) Prepare to give medications using each of the following methods:
  - a. Using an infusion pump
  - b. Using a second IV line as a piggyback
  - c. Using a controlled-volume device
  - d. Using an intermittent IV or a PRN (as-needed) lock
  - e. IV Push
  - f. Giving the medication as a bolus

# Intravenous Therapy

90-95% of patients in the hospital  
receive some type of IV Therapy

Nurses initiate, maintain, troubleshoot  
and discontinue IVs



# IV Therapy

? IVs are given to supply the body with:

- Drugs or substances that cannot be supplied by other means (orally/rectally) or medications maybe more effective when given this route.
- Fluids and electrolytes—for patients who do not have adequate oral intake
- Blood, plasma, and other blood components
- Nutritional formulas containing glucose, amino acids, and lipids

# Intravenous solution containers



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# Papoose Board



Papoose Board is used when a child cannot be still for IV placement

# IV Therapy (cont'd)

? The average adult needs 2000 to 3000 mL of fluids in each 24-hour period to replace those eliminated by the body and to maintain hydrolysis for chemical/metabolic reactions.

? Fluids are lost by:

- Hemorrhage
- Severe or prolonged vomiting or diarrhea
- Excessive wound drainage
- Wounds (especially burn wounds)
- Profuse perspiration

# IV Therapy Guidelines and Considerations

## Clinical Practice

- 1) Devise a care plan with patient-specific data for a patient who needs IV fluid therapy.
- 2) Calculate the IV fluid flow rate from various IV orders.
- 3) Initiate IV therapy by performing venipuncture with an IV cannula (catheter over the stylet) using **aseptic** technique and starting the ordered infusion. Maintain **sterility** of IV catheter.
- 4) Add a new bag of fluid to replace one from which the solution has infused (if ordered).

# IV Therapy Guidelines and Considerations

## Clinical Practice

- 5) Discontinue an IV infusion and evaluate the site and surrounding tissue. Examine catheter closely to *ensure catheter is completely intact.*
- 6) Safely monitor a patient receiving a blood transfusion; document your actions and the patient's response to therapy.
- 7) Collect data on a patient who is receiving total parenteral nutrition; document your findings and the patient's response to therapy.

# Types of IV Solutions

? Solutions most frequently used contain:

- Glucose
- Saline
- Electrolytes
- Vitamins
- Amino acids
- Blood and blood products

# Types of IV Solutions (cont'd)

**Isotonic solutions**

**Hypotonic solutions**

**Hypertonic solutions**



# Types of IV Solutions (cont'd)

## Isotonic solutions

- Have the same concentration (or osmolality) as cells
- Used to ↑ the fluid volume in the vessels
- Does NOT cause shifting of fluids in body
- NS (0.9% NaCl), D5W, LR, D5 in 0.225 NS

# Types of IV Solutions (cont'd)

## Hypotonic solutions

- Contain less solute (particles) than extravascular fluid
- Contain less particles than cells (cytoplasm)
- More dilute (contains more water) than in cells
- Will cause fluid to shift out of vessels into cells
- Used for dehydrated patients
- 0.45% NS, 0.225% NS

# Types of IV Solutions (cont'd)

## Hypertonic solutions

- Contain more solutes than cells (cytoplasm)
- Contains more particles than cells (cytoplasm)
- More concentrated (contains more H<sub>2</sub>O) than cells
- Will cause fluid to shift out of cells into vessels
- Used for patients with edema
- D10W, D5NS, D5 ½ NS, D5LR

# Administration Sets

## ? Primary intravenous set

- Consists of bag of solution, regular tubing set, needleless connector, and IV stand

## ? Secondary or piggyback intravenous set

- Medications to be given intravenously often added to an existing IV line by using the piggyback method

## ? Y-Type intravenous set

- Used to infuse certain blood products
- Blood products **MUST** infuse with **NORMAL SALINE**

# Intravenous fluid and medication administration sets



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# Luer-Lok needleless intravenous syringe and port



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# Y-type blood administration setup



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# Administration Sets (cont'd)

## ? Controlled-volume set

- Infusion pump administers small volumes of fluid or medication

## ? Intermittent IV device (saline or PRN lock)

- Established by applying Luer-lock cap or an extension set to the IV cannula

## ? Filters

- Trap small particles such as undissolved medication or salts that have precipitated from solution



# Controlled-volume set



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# Intermittent intravenous device



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# Infusion Pumps

- ? An added safety measure are more accurate in regulating the flow of routine IV fluids
- ? Use is **mandatory** when patients receiving TPN
- ? Use is **mandatory** for medications that require critical accuracy (Dopamine, Dobutamine, Heparin, etc...)
- ? Controllers reduce risk of infusing fluid too quickly
- ? Patient-controlled analgesia (PCA) pumps are used in most hospitals and in the home setting

# Intravenous infusion pump



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# PCA Pumps

? Used to administer pain medication

- PCA pumps: used in hospitals to allow patient to regulate administration of IV analgesics

? Patient receives a preset bolus of medication when the button is pushed and/or a base amount of medication each hour

? A “lock-out” default prevents overdose

? Nurse must assess regularly

# Venous Access Devices

## ? Intravenous needles and catheters

- Winged-tip or butterfly needle
  - ? Meant for short-term therapy
  - ? Supplied in odd-numbered gauges (17, 19, 23, and 25)
- Over-the-needle catheters
  - ? Consist of a needle with a catheter sheath over it
  - ? The needle is removed, leaving the flexible catheter in the vein
  - ? 18-, 19-, 20- to 22-gauge needles
- Through-the-needle catheter
  - ? Used for midline catheter insertion for long-term peripheral use

# Who Can Start a Peripheral IV?

RN

LVN

Physician

Nurse Practitioner

Dentist

Paramedic



# Some General Rules for IVs

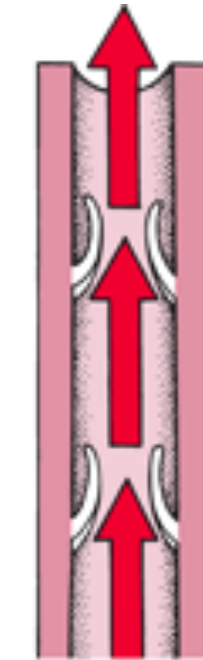
- ❓ Tip of IV catheter should point towards heart
- ❓ Peripheral IV need to be changed q48-72h
- ❓ Intermittent PRN devices should be flushed every 8 hours
- ❓ IV tubing needs to be changed q24h
- ❓ PICC can last 12 months if cared for properly
- ❓ PICC lumens should be flushed q6-8h



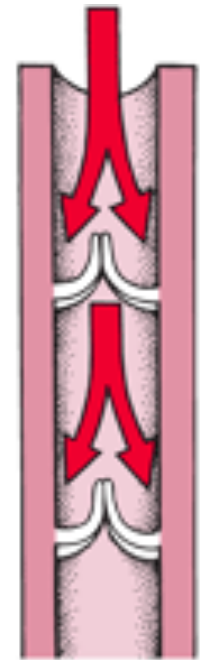
# Valves

Present in MOST Veins

- ? Prevent backflow and pooling of blood
- ? More valves in lower extremities and longer vessels
- ? Vein dilates at valve attachment



Valves Open



Valves Closed

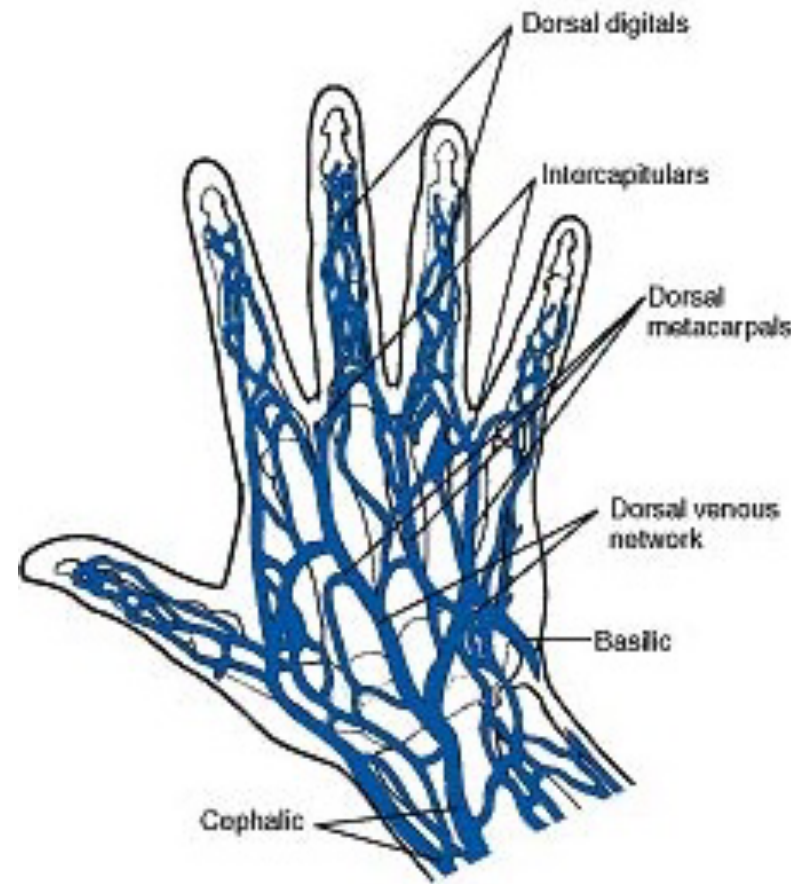
# Veins of the Upper Extremities

## ? Digital Vessels

- Along lateral aspects of fingers, infiltrate easily, painful, difficult to immobilize and should be LAST RESORT

## ? Metacarpal Vessels

- Located between joints and metacarpal bones (act as natural splint)
- Formed by union of digital veins
- Geriatric patients often lack enough connective/adipose tissue and skin turgor to use this area successfully



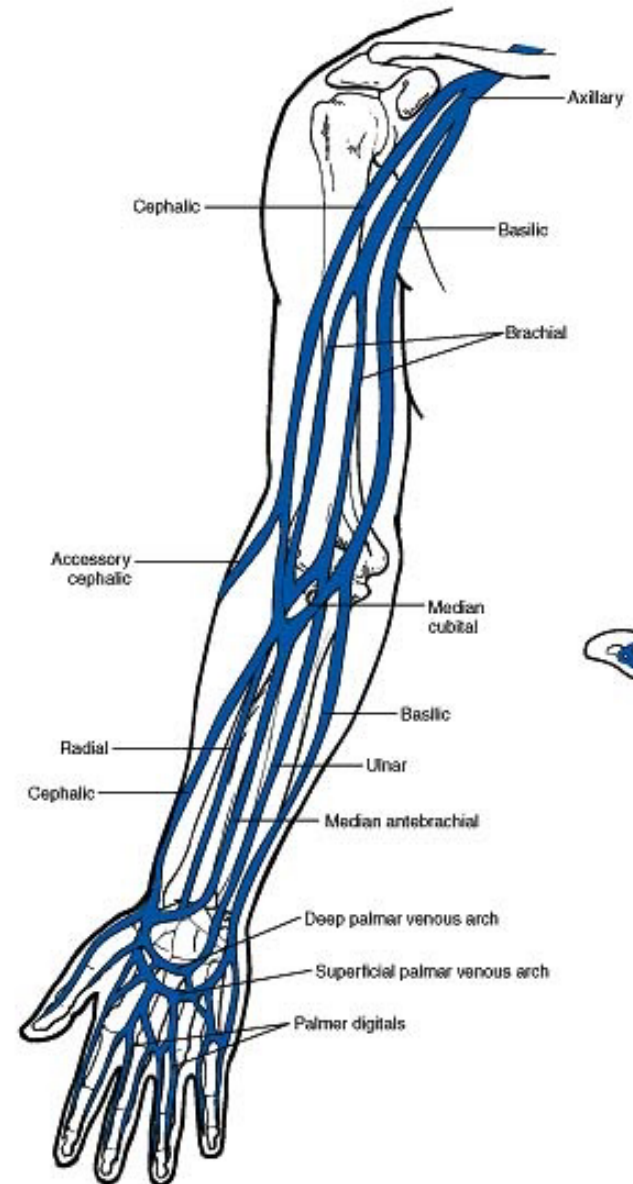
# Veins of the Upper Extremities

## ? Cephalic Vein

- Starts at radial aspect of wrist
- Access anywhere along entire length (BEWARE of radial artery/nerve)

## ? Accessory Cephalic Vein

- Joins the Cephalic below the elbow bend
- Accepts larger gauge catheters, but may be a difficult angle to his and maintain



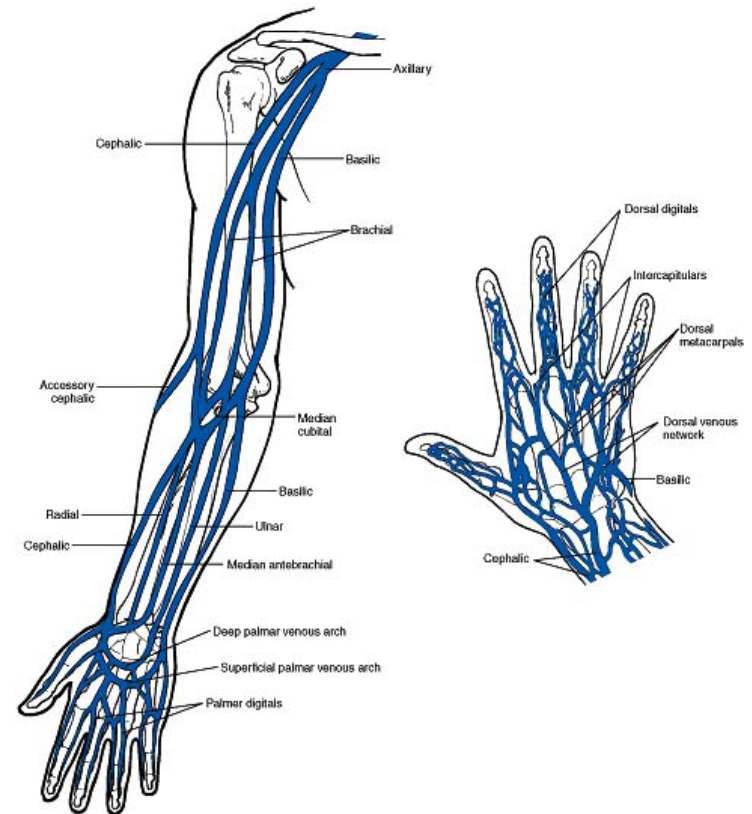
# Veins of the Upper Extremities

## ? Basilic Vein

- Originates from the ulna side of the metacarpal veins and runs along the medial aspect of arm. It is often overlooked because of its location on the “back” of the arm, but flexing the elbow/bending the arm this vein into view.

## ? Medial Antebrachial Basilic Vein

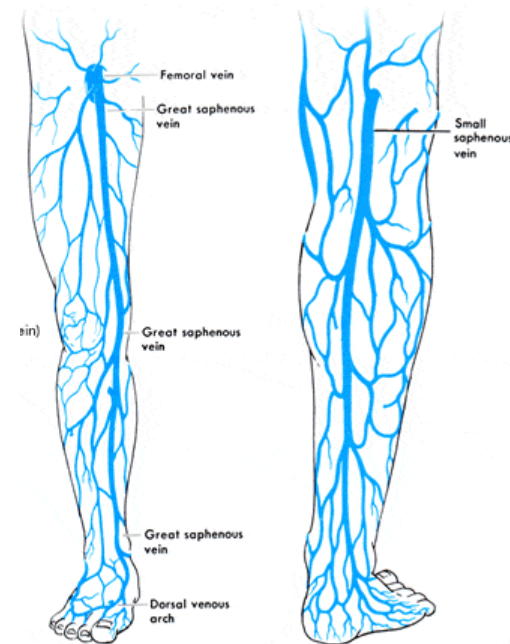
- Empties in the Basilic vein running parallel to tendons, so it is not always well defined.
- Accepts larger gauge cath.
- BEWARE of Brachial Artery and Brachial Nerve



# Veins of the Lower Extremities

Veins in Lower extremities are typically not used for intravenous infusions because these sites are more likely to develop

- Phlebitis
- Thrombus
- Infection



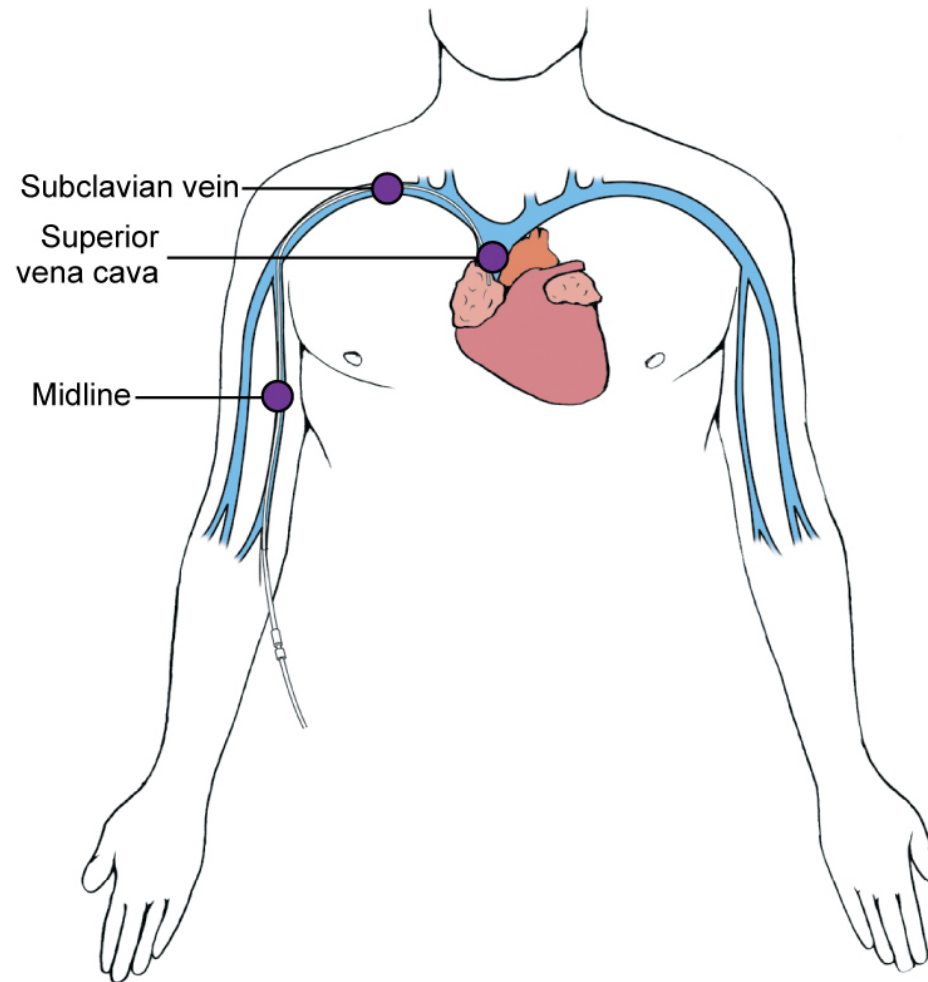
# Total Parenteral Nutrition (TPN)

- ❓ Nothing except lipids can infuse with TPN
- ❓ Must be infused via central line
  - ❓ NEVER peripheral IV
- ❓ BS must be checked q6h on pts receiving TPN
- ❓ TPN must be checked by 2 licensed nurses BEFORE hanging
- ❓ If TPN runs-out w/o replacement bag ready, hang D10W at same rate until pharmacy provides next TPN bag

# Rules for Blood Products

- ❓ In Texas, **only** RNs can hang blood transfusions
- ❓ LVNs **can** be responsible for patient **AFTER** the blood is initially hung by RN
- ❓ Blood can only infuse for 4 hrs (infection)
- ❓ STOP transfusion for any adverse reactions and infuse NS wide-open to dilute
  - Send remaining blood to lab for analysis

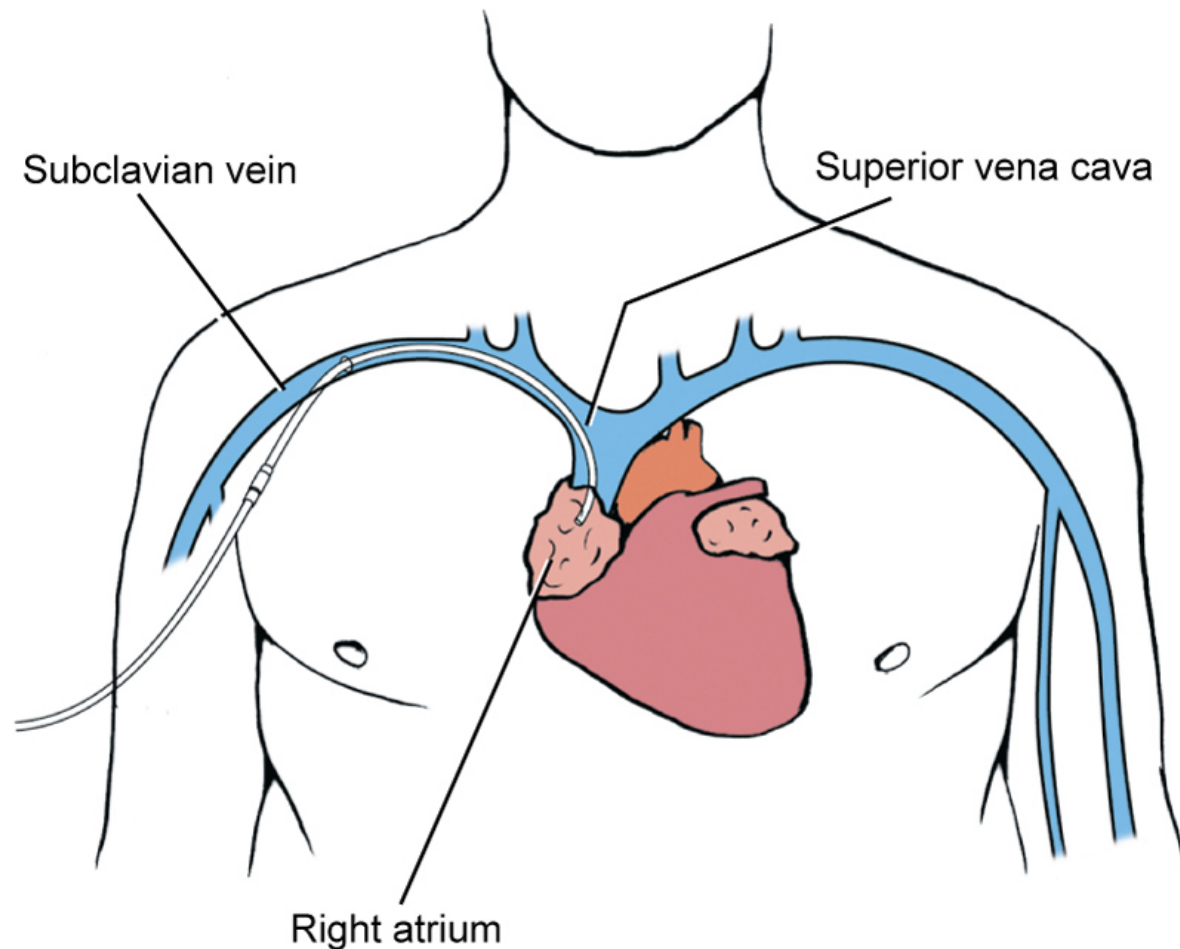
# Placement of a PICC line



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# Placement of a subclavian central line



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# Central Venous Catheters

- ? PICC should be positioned in right atrium or superior vena cava
- ? Must confirm with CXR before using PICC
- ? Some are tunneled long-term catheters such as a Hickman or Broviac catheter
- ? Any unused port must be flushed q6-8h to maintain patency

# When Giving IV Meds

- ❑ Review drug's action before administration and know possible side effects and nursing implications
- ❑ Assess for allergies and drug incompatibilities
- ❑ Ensure IV line is patent before attempting to administer med, and verify IV flow rate
- ❑ Use port closest to insertion site (while clamping tubing above port when injecting)

# When Giving IV Meds (cont'd)

## ? Adhere to Seven Rights of Medication Administration

Right patient

Right medication

Right dosage

Right route

Right time

Right indication

Right documentation

# When Giving IV Meds (cont'd)

- ❓ IV fluids, electrolytes and medications will reach the patients heart within 20 seconds of injection
- ❓ Always know which meds need to be diluted (or given as IVPB)
- ❓ ALL ELECTROLYTES MUST BE DILUTED (IVPB)

# Rates for Common IV Drugs

? **Morphine** = 1 mg per minute (max)

? **Demerol** = 10 mg per minute (max)

? **Dilaudid** = 3 mg per minute (max)

? **Lasix** or **Bumex** may be given quickly

? Must assess potassium level

? **Digoxin** can be given IVP or IVPB

- Use extreme caution with pt on telemetry
- IVP given slowly over 5 minutes
- IVPB given over 5-30 minutes



# Intravenous Access: When Things Go Wrong...



## Intravenous Access: *When Things Go Wrong...*



Bruising



Infection



Extravasation



Infiltration



Phlebitis



Extravasation  
+ 10 days

# Infiltration vs. Extravasation

## ? Infiltration

- Catheter tip slips out of vein
- Catheter tip punctures through vein wall
- Infused fluid flows into surrounding tissues



## ? Extravasation

- IV Chemicals/medication erode the vessel wall causing hole
- Infused fluid flows into surrounding tissues.





# Complications of IV Therapy: Infiltration

- ? Occurs when fluid or medication leaks out of the vein into the tissue
- ? Edema around the site
- ? Tissue will feel cool to touch
- ? D/C IV and restart IV at another site
  - Proximal or another limb
- ? Elevate extremity
  - Edema will usually reabsorb within 24 hours

# Infiltration / Extravasation

## **TREATMENT: STOP INFUSION**

Remove IV

Elevate extremity to inhibit further edema

Notify charge RN and Physician

Treat as ordered

**Document accurately**

# Phlebitis/Thrombophlebitis

## **Chemical**

Caused by IV drug irritation to tunica intima. Warm compresses may help while IV is stopped/changed. Anti-inflammatory and analgesic medications are often used no matter what the cause.

## **Mechanical**

Caused by irritation to internal lumen of vein during insertion of IV and usually appears shortly after insertion. The device may need to be removed and warm compresses applied



## **Bacterial**

Caused by introduction of bacteria into the vein. Remove the device immediately and treat with antibiotics. The arm will be painful, red and warm; edema may accompany

# Complications of IV Therapy: Phlebitis

- ❑ Caused by irritation of the vein by the needle, catheter, medications, or IV solution additives
- ❑ S+S: erythema, warmth, swelling, tenderness
- ❑ IV must be D/C'd and another site found
- ❑ Apply warm compresses to the inflamed site to decrease discomfort

# Signs and Symptoms of Infiltration vs. Phlebitis

## ? Infiltration

- Edematous
- Pale
- Cool to touch
- Painful

## ? Phlebitis/Thrombophlebitis

- Reddened
- Warm (or hot) to touch
- Painful
- Possible edematous

# Other Complications of IV Therapy

## ? Catheter embolus

- Occurs when a piece of the catheter breaks off and travels in the vein until it lodges

## ? Air embolus

- Can occur when changing bags, or when opening the line of a subclavian catheter

## ? Speed shock (Fluid Overload)

- ? Occurs when fluids or medications given by bolus are administered too rapidly

# Air Embolism

? Caused by large amount of air injected into the IV system.

? **Patient will immediately go into cardiac and respiratory distress**

## ? **TREATMENT**

- Place patient in **LEFT TRANDELENBURG POSITION.**
- Consult Cardiovascular Surgeon stat.

# Septicemia

- ❓ Severe bloodstream infection that occurs to a system or entire body.
- ❓ Most often caused by poor insertion technique, contaminated IV medication, or poor site care.
- ❓ Signs and Symptoms: fever, chills, pain, headache, nausea, vomiting, extreme fatigue
- ❓ Treatment:
  - Discontinue device immediately
  - Notify charge RN and Physician
  - Draw 2 sets of Blood Culture and Sensitivity (C&S x2)
  - Administer antimicrobials as ordered



Any medication or  
fluid infused into  
an IV will **hit** the  
**HEART** and **BRAIN**  
in **20 seconds**

# Initiating IV Therapy

 See Check-off Sheet for Step-by-Step Procedure

# IV Catheter Selection

- ❓ Select the appropriate site catheter for the condition.
  - The smaller the gauge, the larger the cannula.
    - ❓ 16g is larger than a 22g
  - Blood must infuse through at least a 20g catheter to prevent break down of blood cells.
  - Trauma cases require a large bore catheter to quickly delivery infusions.

# Starting a Peripheral IV

1. Follow instructions on check-off sheet.
2. Always go by “**FEEL**”, not by sight.  
(good veins are bouncy to the touch but not always visible.)
3. Apply tourniquet tight enough to stop venous flow; but not so tight that it obstructs arterial flow.
4. If difficult to locate vein: Gently tap the flesh to encourage a vein to surface, use warm compresses, ask the patient to open and close their hand to encourage circulation, and allow the arm to hang dependently (below heart level) to fill veins.

# Starting a Peripheral IV

5. Avoid areas of joint flexion
6. Start distally and use the shortest length/smallest gauge access device that will properly allow prescribed therapy
7. Release tourniquet after inserting the catheter but before infusing IV solutions

# Calculation of Flow Rate

? To calculate ml/hour:

- $$\frac{\text{Volume in mL}}{\text{Time in hours}} = \text{mL/hour}$$

? To calculate drops/minute:

- $$\frac{(\text{Volume in mL}) \times (\# \text{ of drops/mL})}{\text{time (in minutes)}} = \text{gtts/min}$$

? Note: The larger the drip factor the smaller the volume. Drip factor of 60 gtts/min is smaller than 15 gtts/min

# Calculation of Flow Rate

- ? MD orders: Infuse 500 mL of NS over 4 hrs
- ? Pharmacy sends: 500 mL bag of NS
- ? At what rate (mL/hr), will you infuse the IV?

# Calculation of Flow Rate

- ? MD orders: Infuse 500 mL of NS over 4 hrs
- ? Pharmacy sends: 500 mL bag of NS
- ? There are no IV pumps available. You must infuse the solution using tubing with a drip factor of 15 drops (gtts) per mL/
- ? At what rate (gtts/min), will you infuse the IV?



# Calculation of Flow Rate

- ? MD orders: Infuse Heparin gtt @ 1200 units/hr
- ? Pharmacy sends: 20,000 units of heparin in a 500mL bag of NS
- ? At what rate (mL/hr), will you infuse the IV?

# Medication Calculation

- ? MD orders: 20 MEq KCl in 100 mL NS to infuse over 2 hours
- ? Pharmacy sends: KCl vial 5 MEQ/mL (and) 100 mL bag of NS
- ? How many mL's of KCl should the nurse add to the IVPB bag?
- ? At what rate (mL/hr), should the nurse infuse the IVPB solution?

# Time tape label for an IV fluid container



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# Time tape label for an IV fluid container

- Calculate the rate of infusion:
  - In mL/hr for pump infusion
  - In gtts/min for gravity infusion
- Label the solution container,
  - including patient's name, room number
  - Date**
  - Rate of infusion**
  - Time infusion started**
  - Initials.**

# Managing IV Therapy

## ? Keeping the IV solution running

- Assess:

- ? The IV flow: the solution should drip into the chamber at regular intervals
- ? The rate of the infusion
- ? If a pump is used, check the programmed rate and volume; the dripping in the chamber will occur intermittently
- ? The insertion site
- ? Complaints from the patient
- ? The level of the fluid remaining in the bag

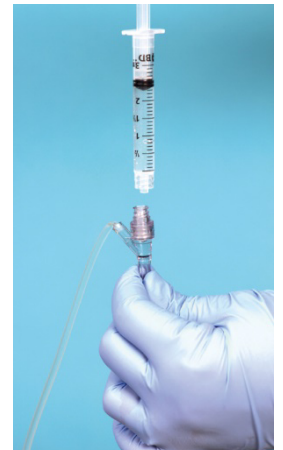
# Medication Considerations

## ? Primary IV fluids infusing without medication

- Cleanse port closest to insertion site
- Clamp tubing between port and IV solution

## ? Primary IV fluids infusing with medications

- Cleanse port closest to insertion site
- Clamp tubing between port and IV solution
- Flush tubing via closest port to site
- Inject medication using appropriate timing
- Flush tubing via closest port to site



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# Medication Considerations

## ? Saline lock, Heparin lock, INT (Intermittent Needle Therapy)

- Cleanse port cap
- Flush lock/INT (assess for infiltration)
- Inject medication using appropriate timing
- Flush lock/INT

# IVPB Administration

(IV Piggyback)

The smaller IVPB bag  
**MUST** hang **HIGHER** than  
the primary IV bag.



# IV Push Administration

If using the primary IV line

- Cleanse port nearest the injection site.
- Flush with 1-10 mL NS
- Administer IV push medications in the port
- Clamp the IV tubing between the drip chamber and the port.
- Flush port with 1-10mL NS
- Unclamp and resume infusion.

If using a Saline lock, Heparin lock, INT (Intermittent Needle Therapy)

- Cleanse port cap
- Attach syringe with 1-3 mL NS. Aspirate to verify blood return.
- Flush lock/INT with 1-3 mL NS and assess for infiltration
- Inject medication using appropriate timing
- Flush lock/INT with 1-3 mL NS

# Medication Considerations

## ? IV Potassium

- Know K<sup>+</sup> level before administering
- Must be diluted in IVPB and infused into primary IV Line
- Always infuse over 1 hr, 2 hrs, or 4 hrs depending on concentration
- If burning sensation, slow IV rate
- Be vigilant for cardiac arrhythmias
- Recheck serum K<sup>+</sup> level after administration

# Medication Considerations

## ? Demerol (Meperidine)

- Never administer faster than 10mg per minute

## ? Morphine (Morphine Sulfate)

- Never administer faster than 1mg per minute

## ? IV Heparin

- Know the patient's INR, PT or PTT

## ? IV Lasix (furosemide)

- Monitor Potassium electrolyte level.

# Medication Reactions

? A patient has an IVPB antibiotic infusing into a peripheral IV line starts to develop symptoms:

- Shortness of Breath
- Skin Rash

? Treatment:

- Stop Antibiotic
- Infuse NS wide-open
- Notify physician

# Medication Clarification

- ❓ When two IVBP Medications (antibiotics) are scheduled to be administered at the same time, adjust administration times.
- ❓ Antibiotics cannot be administered at the same time.
- ❓ Adhere to facility policy on medication administration:
  - 1 hour before scheduled time
  - 1 hour after scheduled time

# Chemotherapy

- ❓ Administering antineoplastic medications
  - Must be specially certified RN to administer
  - Many are very irritating to tissue
  - Special precautions are used in preparing and administering these drugs

# Phlebotomy

 See check-off sheet for procedure

**The END!**