IV THERAPY

Julie Ross, BSN, RN

Course Overview

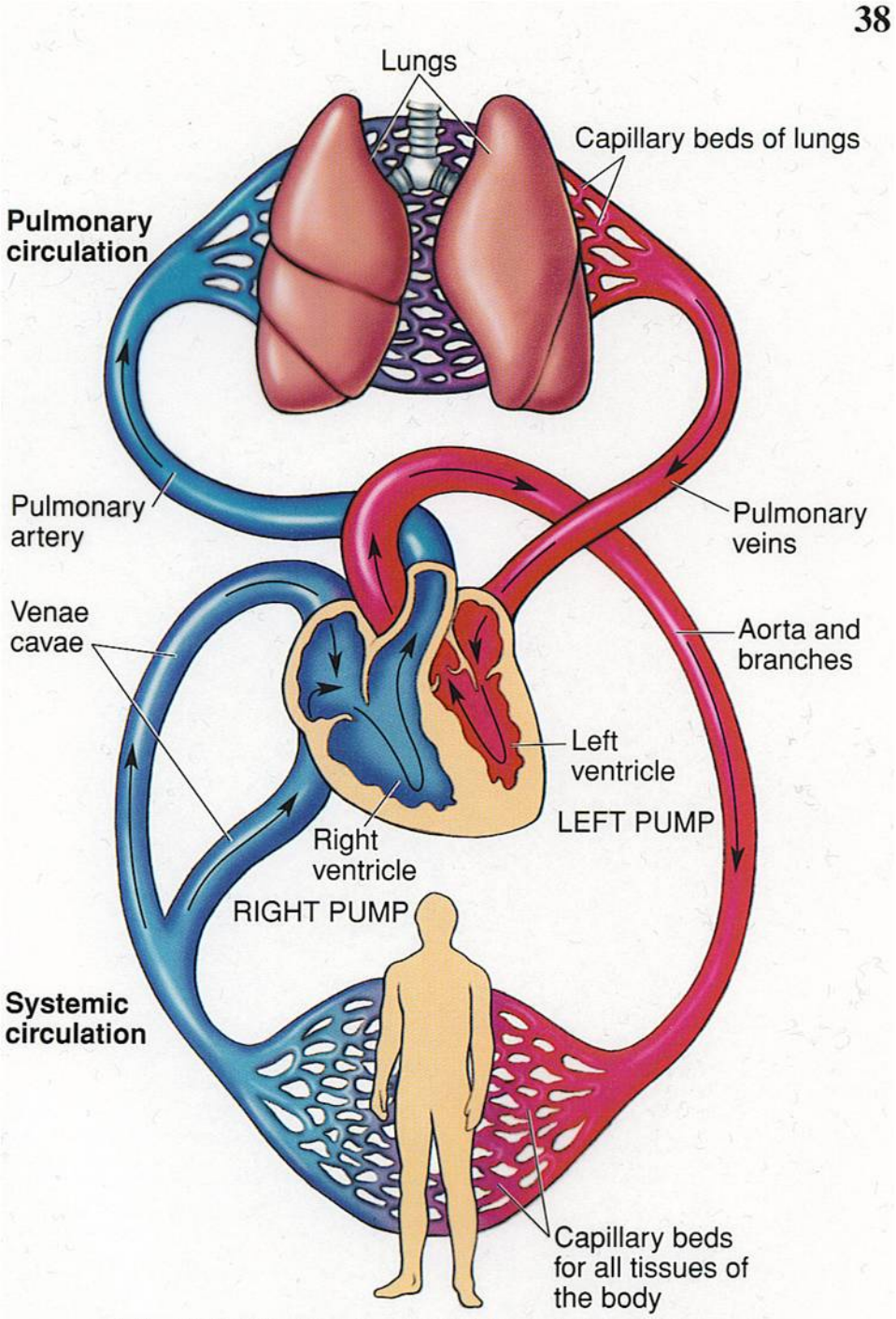
- Purpose of IV Therapy
- Skills for starting and caring for IV
- Complications of IV Therapy

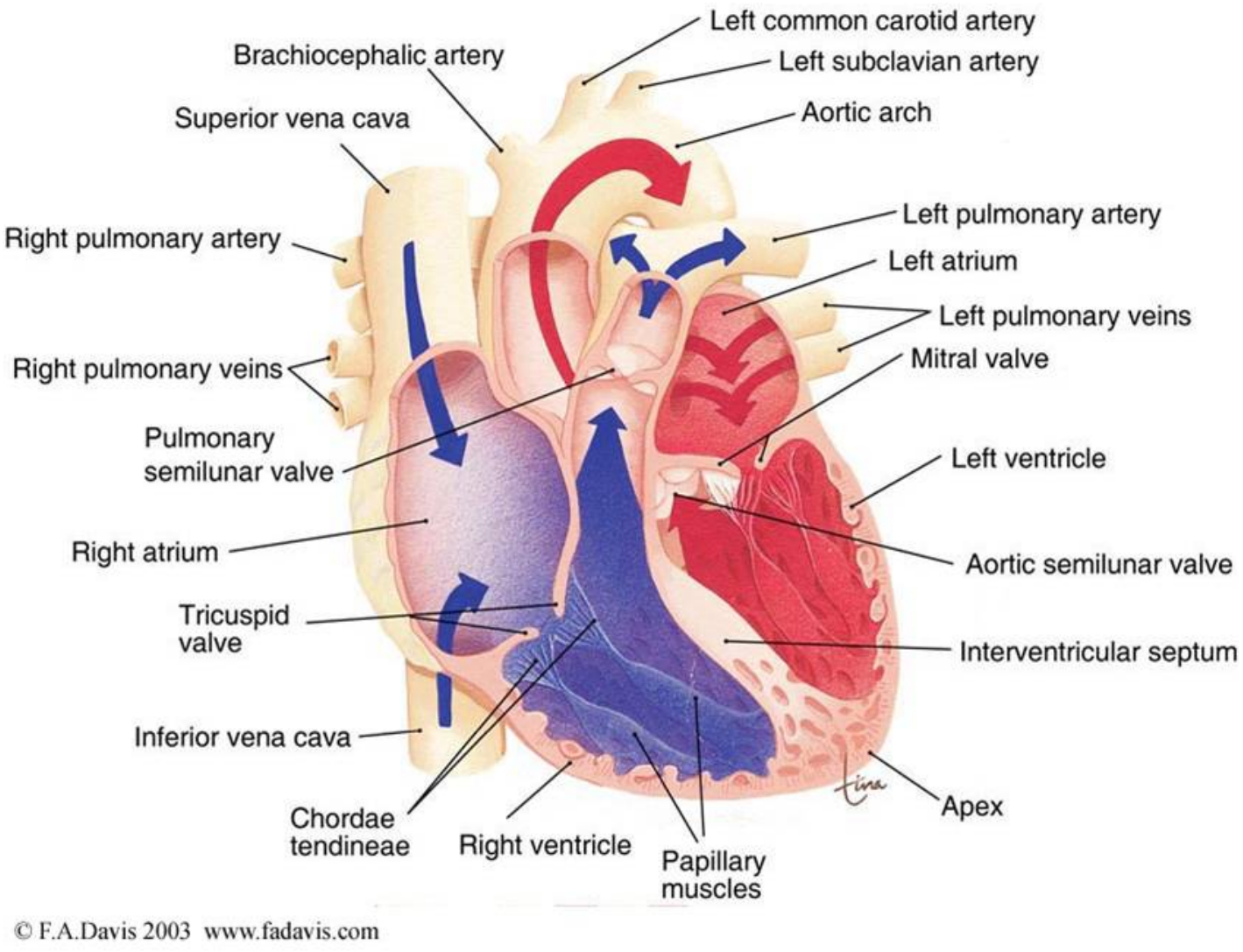
Anatomy and Physiology

- Circulatory System
- Skin
- Fluid and Electrolyte Balance
- Acid-Base Balance

Circulatory System

- Heart
- Blood Vessels
  - Arteries
  - Veins




Left common carotid artery
Brachiocephalic artery
Left subclavian artery
Superior vena cava
Aortic arch
Right pulmonary artery
Left pulmonary artery
Left atrium
Left pulmonary veins
Right pulmonary veins
Mitral valve
Pulmonary semilunar valve
Left ventricle
Right atrium
Aortic semilunar valve
Tricuspid valve
Interventricular septum
Inferior vena cava
Apex
Chordae tendineae
Right ventricle
Papillary muscles
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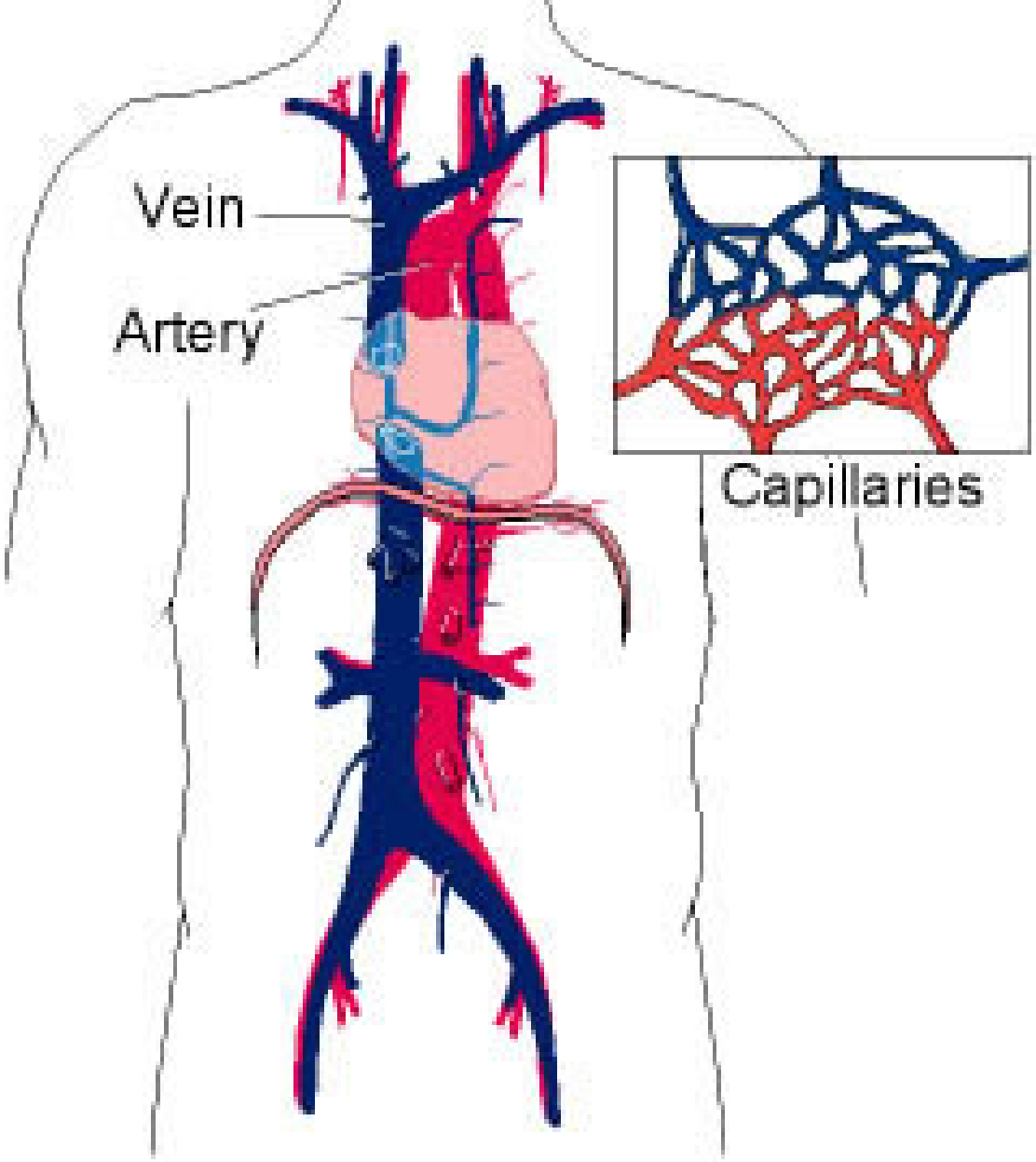

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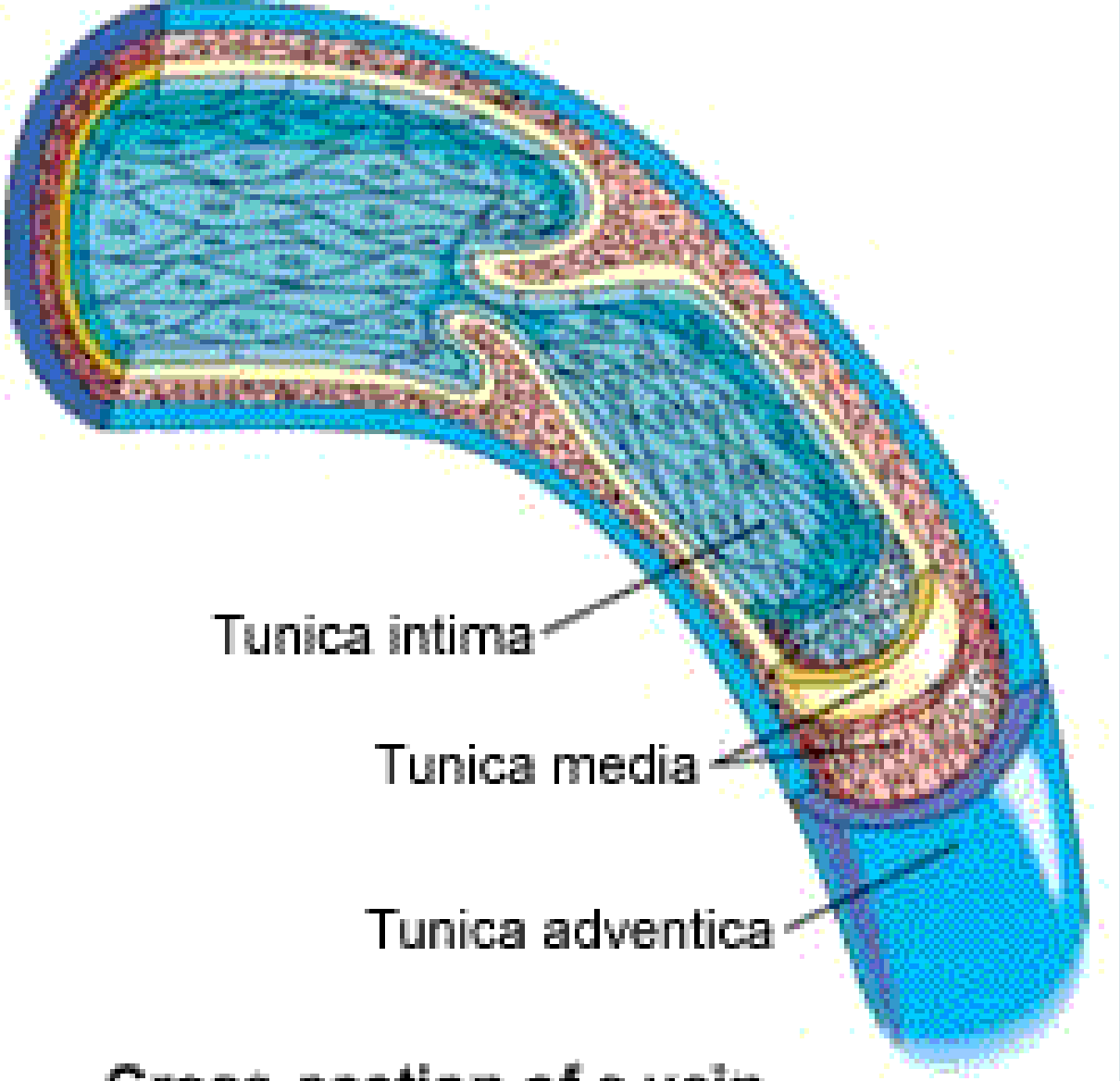
Blood Vessels

- **Arteries** - carry blood away from heart. Repeatedly branch off into smaller and smaller arteries throughout the body, eventually into *capillaries*.
- **Veins** - blood from *capillaries* flow into veins, which carry blood back to the heart

Blood vessel walls

- Tunica intima - innermost layer. Continuous with the endocardium. If irritated in vein, can initiate inflammatory response and form clot.
- Tunica media - middle layer. Smooth muscle and elastic tissue.
- Tunica adventicia - tough outer layer. "Pop" when starting IV.



Cross-section of a vein.

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Arteries vs. Veins

- Middle layer (tunica media) much thicker in artery - can contract and relax.
- Pressure much less within the veins.
- Veins have one-way valves to direct bloodflow toward the heart.
- Veins store blood (70% of blood volume).

Arteries vs. Veins

- Thick wall (tunica media)
- Lacks valves
- Pulsates
- Bright red blood

- Thin wall
- valves present approx. every 3 in.
- Greater distensibility
- No pulsation
- Dark red blood

Veins

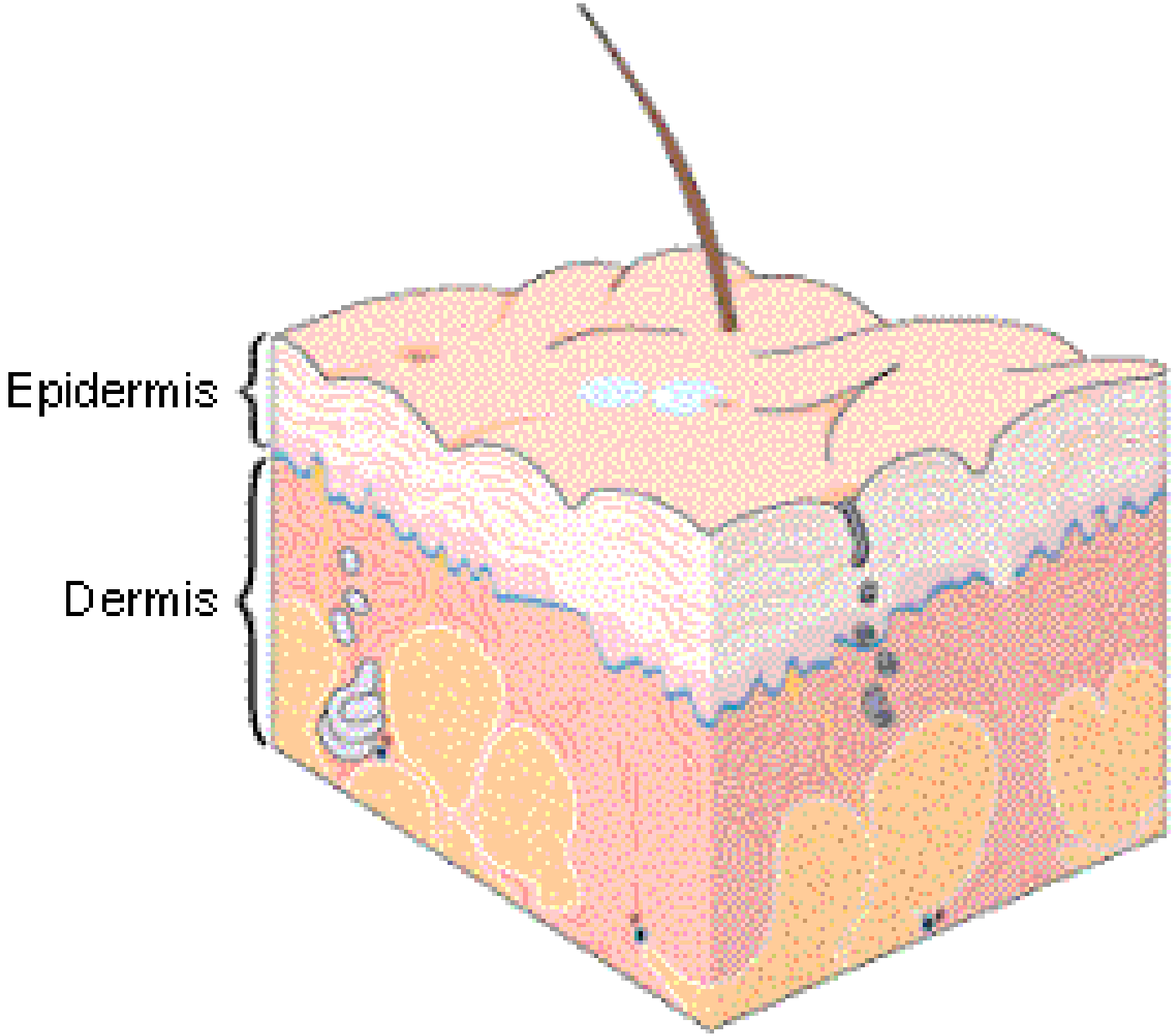
- Used for IV therapy

- Peripheral (arms/hands):
  - cephalic (upper and lower)
  - basilic
  - median
  - metacarpal

Skin

- Review of functions

- Factors affecting IV therapy



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Functions of the skin

- Keeps harmful substances out and retains fluid and electrolytes
- Act as physical barrier to injury or growth of pathogens
- Excretory function
- Vitamin D
- Houses sensory receptors
- Regulates body temperature

Factors to consider

- Adipose tissue
- Edema
- Color
- Hydration
- Tissue elasticity
- Bruising, rashes, breaks in skin
- Sensation

Fluid and Electrolytes

- Fluid compartments
  - Intracellular - all fluid inside cells of the body. High concentrations of potassium(K+), phosphate, and magnesium ions.
  - Extracellular - all fluids outside cells (interstitial and blood/lymphatic fluid). Contains high concentrations of sodium, chloride, and bicarbonate ions.

Fluid Balance

- Intake equals output.
- Intake regulated by hypothalamus
- Output regulated by kidneys

Electrolytes

- Sodium
- Potassium
- Calcium
- Magnesium
- Chloride
- Bicarbonate

Acid-Base Balance

- Involves regulation of hydrogen ions.
- Measured as pH. Norm is 7.35-7.45
- Acids ($\downarrow$pH) have $\uparrow$ conc. of hydrogen ions, bases ($\uparrow$ pH) have $\downarrow$ conc. of hydrogen ions.
- Body must keep acids and bases balanced so that pH remains at particular level.

Acid Base Balance

pH is found on arterial blood gases (ABG's)

- Controlled by :
  - Buffers
  - Respiratory system
  - Kidneys.

Rationale for IV Therapy

- Fluid and Electrolytes
  - Maintenance – water is usually the priority.
  - Replacement – fluid or electrolyte deficit.
  - Restoration- ongoing losses. (i.e. drains, NGT's, burns
- Medications
- Nutrients

IV Nutritional Support

- TPN - intravenous infusion of amino acids, vitamins, electrolytes, and minerals
  - Usually very high dextrose concentration
- Intralipids - intravenous infusion of fat emulsions (fatty acids)
  - essential fatty acid is linoleic acid, needed for proper metabolism.

IV Access

- **Peripheral** - Located in peripheral veins of upper (and sometimes lower) extremities
  - Can be placed by nursing (qualified LPN's)

- **Central** - Located in large vessels near heart.
  - Can only be placed by physician or specially trained practitioners

Peripheral IV

- Smaller vessels
- Slower blood flow
- Easy access
- Veins of hands, arms most commonly used
- Metacarpal, cephalic, basilic, accessory cephalic, median, upper cephalic
- Needs to be changed regularly

Central IV Access

- Higher risk of life-threatening complications
- Larger vessels
- More turbulent blood flow
- Care includes sterile dressing changes and heparin flushes
- Usually used if peripheral access not possible, or for long-term use.
- Can be percutaneous, tunneled, or implanted.
- **Includes PICC lines**

Central IV Lines

- Usually located in subclavian vein, jugular vein, or superior vena cava.

- Can also have access through cephalic, basilic, and axillary veins. (Above the antecubital, usually for PICC lines)

IV Solutions

- Bottle vs. Bag
- Types of Solutions
- Tonicity
- Electrolyte Solutions

Solution Containers

- **Bottle** - Not very commonly used
  - Meds that cannot be in plastic
  - Advantages: Very easy to visualize solution and to see calibrations.
  - Disadvantages: BREAKS. Easier to contaminate. Takes more storage space.

Solution Containers

- **Plastic** - Most common container.
  - Atmospheric pressure collapses bag and forces fluid out.
  - Advantages: Easy to store. Not greatly affected by temp fluctuations. Not cored when spiked.
  - Disadvantages: Can be punctured. Some meds can adhere to plastic.

Types of Solutions

- Colloids - Purpose is to pull fluid into the intravascular space.
- Blood and blood products - Restore blood volume or components.
- Crystalloids - Used for hydration.

Crystalloid IV Solutions

- Tonicity = Osmolality(concentration)
- Isotonic - Stays in vessels
- Hypertonic - pulls fluid from cells into vascular space
- Hypotonic - flows into the cells

Saline

- "NORMAL" saline is **0.9%** and is isotonic.
  - Also called .9%NS, NaCl. sodium chloride
  - osmolality is similar to blood
  - standard "flush" solution

  - **.45% NS** (1/2) is hypotonic

Dextrose

- Contains dextrose and free water.
- Available in a variety of concentrations, but 5% most common.
- 5% (D5W) is isotonic.
- Usually in mixture with saline, because can cause severe hyponatremia, hypokalemia, and water intoxication.

Electrolyte Solutions

- Usually isotonic solutions that contain electrolytes in concentrations similar to plasma.
- Lactated Ringer's most common electrolyte solution - contains potassium, sodium, chloride, and calcium. Lactate added as buffer.
- Relatively short-term use. (48 hours)

IV Solutions

- Saline - "NS" or "NaCl"
  - .9% is isotonic
  - .45% is 1/2, .22% is 1/4
  - When mixed with D5 may become hypertonic - MUST WATCH FOR FLUID OVERLOAD.

IV Solutions

- Dextrose - "D"
  - usually 5%
  - provides calories
  - cannot be used with blood or certain meds
  - can affect blood glucose - monitor diabetics
  - usually not given alone - can lead to hyponatremia

IV Solutions

- Electrolyte solutions
  - either Ringer's or Lactated Ringer's (LR)
  - provides electrolytes and hydration
  - short-term
  - monitor ELECTROLYTES
  - no calories
  - cannot use lactate if liver disease present

Initiating IV Therapy

Prior to procedure

- Physician's order
- Handwashing
- Equipment
- Patient assessment/education
- Site selection

Physician's order

- Date and time to start IV infusion.
- Solution to be infused
- Route of administration
- Dosage
- Rate of infusion
- Duration
- Signed by physician

Physician's order

- **Prescribing Errors:**

These can result for many reasons, including:

- Illegible handwriting.
- Verbal orders transcribed incorrectly.
- Use of abbreviations.
- Incomplete orders.
- Prescriber ignorance.
- Failure of nurses and pharmacists to challenge questionable orders.

INFECTION CONTROL PRACTICES

- Always follow standards od handwashing/glove wearing as per OSHA.
- Universal (standard) Precautions
- Maintain awareness of "Chain of Infection" at all times

CHAIN OF INFECTION

- 1. *Causative agent* – bacterium, fungus, virus, or parasite.
- 2. *Reservoir* –source of the microorganism, usually a human reservoir.
- 3. *Portal of exit* – resp, GI, skin, or blood
- 4. *Mode of transmission* – direct, indirect, or airborne.
- 5. *Portal of entry to host* – usually same as port of exit. Can be break in skin.
- 6. *Susceptible host* – any person at risk for infection.

Equipment

- IV solution
- IV tubing
- Insertion needle or cannula
- Tourniquet
- Antimicrobial solution
- Pump (if needed)
- Tape
- Transparent dressing
- Gloves

Choosing Catheters

- **Catheters**
  - Over the needle preferred
  - Size depends on patient's needs and vein size

  Ex: Large gauge and short length for volume replacement

- **Vein Selection**
  - For *most* patients, choose most distal
  - Hand, forearm, upper arm. (No wrist!)
  - Review of normal anatomy provides clues to locations
  - Avoid injury, fistula, mastectomy side, etc.

Venipuncture Procedure: Tips

- **Talk to your patient**
- Prepare & Assemble equipment ahead of time or direct this task
- Inspect fluid date, appearance, and sterility
- Flush air from tubing
- Select the most distal site if at all possible

Venipuncture Procedure: Tips

- Stabilize extremity
- Stabilize adjacent skin
- Remove tourniquet
  - before removing needle
- Remove needle & place in sharps
- Check for adequate flow
- RECHECK drip rate

Venipuncture Procedure: Tips

DOCUMENTATION

- DATE/TIME
- ARM USED/LOCATION
- VEIN USED
- CATHETER SIZE
- INFUSION
- ATTEMPTS MADE/LOCATION
- CONDITION OF SITE
- PATIENT TOLERANCE

Types of IV Infusions

- Continuous - infuses at all times at an ordered rate.
- Intermittent - access for infusions that are only given at specific times, or for emergencies.
- IV push - meds that are given all at once, not dripped in over time. **Not** given by LPN's with exception of saline flush.

IV push

- Meds NOT administered by LPN's
  - Delivery is immediate.
  - Dire consequences if problem.

- Saline flush (non-med) - 1mL given directly into IV to maintain patency.

Intermittent Infusions

- May be on an emergency basis - need to flush to check patency prior to start.
- "Piggy-back" meds that are intermittent infusions that are given through a continuous primary IV line.
  - Check compatability.
- Intermittent meds are given directly through the capped IV port.
  - Must be flushed.

Continuous IV Infusion

- Can be a large volume (250 to 1000cc) of solution administered continuously to correct or maintain fluid and electolyte balance.

- Can be a medication being delivered an a continuous basis to maintain a constant serum level - continuous IV "drips" **cannot** be titrated (regulated) by LPN's

Continuous IV for fluid and electrolyte balance

- Verify physician's order.
- Set and monitor rate
  - Gravity
  - Pumps
- Complications
  - Local
  - Systemic
- Documentation

Methods of IV Infusion

- Gravity Drip - manually set and regulated with a roller clamp.
  - Simplest method
  - Macrodrip tubing - drop factor determined by manufacturer. Can range from 10gtts/mL to 20gtts/mL (common 10gtts/mL)
    - standard primary tubing
  - Microdrip tubing - 60gtts/mL
    - Used for peds and for slow rates

Gravity Infusion

- Advantages:
  - Easy
  - Does not require power source

- Disadvantages:
  - Not greatly accurate
  - No free-flow prevention

Calculating a gravity IV rate

- Volume *ordered* to be infused
- Drop factor of tubing being used

Factors that will affect the flow rate.

- Height of bag
- Position of clamp
- Patency of tubing

Slowed Infusion Rate

- Check rate - has it been changed?
- Check tubing - is it kinked?
- Check clamp(s) - are they open?
- Check site -
  - is cath or vein being compressed?
  - ANY abnormality?

Electronic Control Devices

- Purpose is to improve accuracy of delivery.
- Require power source
- Deliver a preset fluid rate over a specified period by using constant force to overcome resistance.

Electronic Pump Alarms (Common)

- Occlusion
- Air-in line
- Infusion complete
- Power

NURSING PROCESS

- ASSESSMENT
- DIAGNOSIS
- PLANNING
- IMPLEMENTATION
- EVALUATION

ASSESSMENT

- FIRST STEP, AS ALWAYS.
- NEED TO APPLY HISTORY AND PHYSICAL SKILLS:
  - INTERVIEW - PAST HISTORY, ALLERGIES, PATIENT UNDERSTANDING, SYMPTOMS, ETC.
  - *Cultural considerations*
  - EXAM - HEAD TO TOE, SITE SELECTION, SIGNS, ETC.

NURSING DIAGNOSIS

- Examples:
  - Risk for injury related to (lack of knowledge regarding equipment)
  - Knowledge deficit related to (new IV insertion) AEB (pt verbalization …)
  - Impaired physical mobility related to placement of peripheral IV AEB…
  - Anxiety related to (initiation of IV therapy) AEB...

Planning

- Patient outcomes and goals - what do you (and the patient!) expect.
  - Ex: Patient will remain free of signs/symptoms of complications related to IV therapy (until therapy discontinued).
  - *May need to be more specific.

Implementation

- Your nursing care! examples:
  - Check site at least every 2 hours for signs of complication such as redness, pain, or edema.
  - Instruct patient to call nurse immediately if has pain, bleeding or any other concerns.
  - Instruct patient to call nurse if pump alarm sounds.
  - Maintain correct infusion rate as ordered.
  - Secure IV (to prevent accidental dislodging of catheter during movement).

Evaluation

- How will you know if the goal/outcome has been achieved?
  - Assessment!
  - Patient record
  - Lab values
  - Communication
  - Etc.

Alternative access routes

- Central Lines - percutaneous placement
  - Relatively short-term

- Implanted ports (also tunneled catheters) - Require surgical placement. Designed for long-term (greater than 6 month) use.

- PICC lines - central access placed peripherally. Somewhat longer term.

Central Venous Line (percutaneous)

- Most common in hospital
- Usually have multiple lumens
- Advantages:
  - Can be inserted at bedside.
  - Easy to use.
- Disadvantages:
  - Requires sterile dressing changes q48-72h
  - Requires daily heparin flush if not used continuously
  - Requires activity restrictions

Tunneled Catheters

- Placed in OR
- A tunnel is made from surgical site *near* the subclavian to an exit wound further down on chest. (*Two* surgical wounds)
- Cuff forms a barrier under the skin which stabilizes catheter and prevents bacterial migration into the bloodstream
- examples : Broviac, Hickman, Groshong

Implanted Ports

- Relatively common
- Placed and removed in OR.
- Port is placed in a surgically made "pocket" and sutured in place. Catheter extends into vein from this port/reservoir.
- Must be "accessed" for use.

PICC Lines

- Can be 20 times longer than peripheral cath.
- Can be used up to one year.
- Advantages:
  - Can be inserted by specially trained nurse at bedside. (**Must be confirmed by x-ray.)**
  - Very low infection rate
- Disadvantages:
  - Requires daily flush
  - Limits activity (external catheter)
  - Cannot use for high pressure infusions

PICC Lines

- FLUSHING – used to maintain patency of the line.
  - Dictated by **agency** policy.
  - Most commonly normal saline, followed by **heparin**. (Volume determined by manufacturer, usually 5-10cc).
    - Check for allergies, incompatability, bleeding, etc.
  - MUST USE 10CC SYRINGE

PICC LINE CARE

- CXR COMPLETION!
- ROUTINE IV SITE MONITORING PLUS:
  - ARM CIRCUMFERENCE (DO NOT USE FOR BP).
  - TEMP ↑, RESP STATUS, CARDIAC IRREG.
  - EXTERNAL CATH LENGTH
  - PATIENT EDUCATION

Central line dressing change

- Change **as needed** and according to institution policy
  - q 72 h for CVC
  - Q 7 days for PICC
- **Must** be performed as sterile procedure
- Inspect site at each change.

Central line dressing change

- Cleanse from insertion site outward for 4-6 in area
- Cleanse site well with alcohol first, then betadine - 3 swabs each.
- ASSESS SITE
- Apply transparent dressing, reinforce with tape, and LABEL.

Legal Issues

- Scope of Practice
- Documentation
- Systemic Complications
- Local Complications

Legal Issues (cont.)
FACTS

- The rule of personal liability is "every person is **liable** for his own [wrongdoing]"
- Coercion of a rational adult patient to place an IV catheter constitutes assault and battery
- The 2 most common causes of action involving nursing practice are unprofessional practice and professional malpractice.

Documentation

- Legal, ethical , and professional responsibility.
- Charting of the care given to the patient in relation to their peripheral IV therapy.
- Includes:
  - Insertion procedure
  - Proper infusion and maintenance.
  - Monitoring of site and infusion
  - Direct care given (i.e.: dressings, tubing changes, patient education, etc.

Complications

- Systemic - problem involving the entire body, related to IV therapy
- Local - adverse reaction or trauma to the surrounding venipuncture site.
- (Hypersensitivity can be systemic or local)

Systemic Complications

- Circulatory overload - usually **infused too fast**, or pt with hepatic, cardiac, or renal disease.
- Infection (**septicemia**) - microorganisms in the circulatory system. Related to irrigation of clogged IV's, or break in aseptic technique.
- Pulmonary embolus/Air embolus - rare, but lethal complication.

Systemic Complications (cont)

- Speed Shock - foreign substance (usually medication) is rapidly introduced into circulation

- Incompatibility/Drug interactions

Local Complications

Common area for nursing malpractice.

- Phlebitis - very common. Inflammation of the vein.
  - Mechanical
  - Chemical
  - Bacterial

Local Complications

- Infiltration - seeping of nonvesicant fluid into surrounding tissue.
  - Site is cool with dependent edema, and often painful.
  - Tx: Discontinue catheter, apply cool compresses, elevate extremity.

Local Complications (cont)

- Infection - related to microbial contamination of the catheter or the infusate. Can also be an infection from an intravascular thrombus.
- Extravasation - infiltration of a vesicant medication. Vesicant solutions cause blisters and subsequent sloughing of tissues.

Local Complications (cont)

- **Hematoma** – infiltration of blood into tissues
- SQ hematoma is a localized collection of blood and is the most common local complication.
  - Usually related to nursing skills.
  - Higher risk in pts on anticoagulants
  - Higher risk in elderly