Chapter 14
Venous Access and Medication Administration

Lesson 14.1
Mathematical Equivalents and Drug Calculations
Learning Objectives

• Convert selected units of measurement into the household, apothecary, and metric systems.
• Identify the steps in the calculation of drug dosages.
• Calculate the correct volume of drug to be administered in a given situation.
• Compute the correct rate for an infusion of drugs or intravenous fluids.

Learning Objectives

• List measures for ensuring the safe administration of medications.
• Describe actions paramedics should take if a medication error occurs.
• List measures for preserving asepsis during parenteral administration of a drug.

Drug Dosage Measuring Systems

• Metric system
• Apothecary system
• Household system
• Deals with mass, volume units
• Physicians use any system ordering drugs
Metric System

- French developed, latter 18th century
- 1866, Congress declared official measurement system in the United States
- Not required in the United States, adopted by medical sciences, pharmacies, federal mints, armed forces
  - About 92% of countries in the world use it
- International system of units, modern form, abbreviated SI

Metric System

- Basic metric measurement units
  - Meter, linear measurement, 1 meter slightly longer than 1 yard
  - Liter, capacity/volume, 1 liter slightly more than 1 quart
  - Gram, weight, 1 gram slightly more than weight of metal paper clip

1 kilometer = 1000 meters
1 hectometer = 100 meters
1 dekameter = 10 meters
1 decimeter = 1/10 of a meter
1 centimeter = 1/100 of a meter
1 millimeter = 1/1000 of a meter
Metric System

- Basic units divided, multiplied by 10, 100, 1000 parts, form secondary units
  - Differ from each other by 10, some multiple of 10
  - Subdivisions made when decimal is moved left
  - Multiples made when decimal is moved right
  - Names formed, Greek, Latin prefix on primary unit

Metric System

- Meter
  - Centimeter (cm), millimeter (mm), primary linear medicine measurements
  - Measure body organ size, blood pressure

Metric System

- Liter
  - Fractional part expressed milliliters (mL), cubic centimeters (cc)
  - One liter equal to 1000 mL (1000 cc)
  - Milliliter, 1/1000 of liter
  - Deciliter, 1/10 of liter
  - National Bureau of Standards recommends the use of ml or mL, dl or dL for fractional parts of liter
Metric System

- **Gram**
  - Used in weighing drugs, various pharmaceutical preparations
  - One gram equals 1 mL of distilled water at 4°C
  - Kilogram (kg) equal to 1000 grams, 2.2 pounds
  - Milligram (mg) equal to 1/1000 of gram
  - Microgram (mcg) equal to 1/1,000,000 of gram
Metric System

• Metric style notation
  – National Bureau of Standards recommends metric notation style except where it conflicts with proper English use
    • Units not capitalized
    • Unit abbreviations not followed by period
    • Single space left between quantity and symbol
    • Unit abbreviations not pluralized
    • Fractions not used, only decimal notation
    • Numerical quantities less than 1, place 0 to left of decimal point
    • Trailing zeros should not be used after decimal point

Why does the placement of a 0 to the left of the decimal point reduce the likelihood of making a drug dosing error?

Apothecary System

• Less precise, less convenient
• Seldom used in medical sciences
• Only few medications available
  – Aspirin
  – Nitroglycerin
Apothecary System

- Grain (gr)
  - Primary mass unit
  - Derived from age-old standard weight of single wheat grain, about 60 to 65 mg
  - Aspirin (5 gr) contains 325 mg of medication (5 grain x 65 mg = 325 mg)
  - Nitroglycerin generally labeled both mg (0.3 to 0.4 mg) and grains (1/150th or 1/200th gr)

Apothecary System

- Other units
  - Dram (dr)
  - Ounce (oz)
  - Pound (lb)
    - 60 grains = 1 dram
    - 1 dram = 1 oz

Apothecary System

- Minim (m)
  - Primary volume unit
  - Equals volume of water that would weigh 1 gr (about 0.005 or 0.006 mL)
  - 60 m = 1 fluid dram (f dr)
  - 8 f dr = 1 fluid ounce (f oz)
Apothecary System

- Written prescriptions, abbreviation before numeral
  - Whole numerical amounts usually lower case Roman numerals
  - 10 grains would be grains x
  - Fractional amounts usually Arabic numerals rather than decimal form
  - ¼ grain = grain ¼, not 0.25 grain

Household System

- Measures
  - Glass
  - Cup
  - Tablespoon
  - Teaspoon
  - Drop
  - Quart
  - Pint

Household System

- Standard measures not available in most homes
  - Average coffee cup may hold 5 to 9 oz or more
  - Average teaspoon may hold 4 to 6 mL of liquid
  - Only approximations
Temperature Conversions

- Fahrenheit, Celsius (centigrade) scales measure temperature
  - Measurements compared by freezing and boiling points
  - Fahrenheit scale: water freezes at 32°, boils at 212°
  - Celsius scale: water freezes at 0°, boils at 100°
  - Celsius preferred throughout the world, used in scientific, engineering fields

Temperature Conversions

- United States more accustomed to Fahrenheit scale, used by media, weather forecasts
  - Normal body temperature: 98.6°F, 37°C
- Single formula converts temperatures
  - Celsius to Fahrenheit: multiply Celsius by 9/5 or 1.8, add 32
  - Fahrenheit to Celsius: subtract 32 from Fahrenheit reading, multiply by 5/9, or 0.555
Drug Calculations

• Must calculate adult, pediatric drug dosages, infusion rates, strength of drug solutions, diluted solutions
  – Use math skills, logical order
  – Knowledge of decimals, fractions, ratios, proportions

Calculation Methods

• Precise, reliable
• Performing drug calculations
  – Convert all measure units to same unit, system
  – Check computed dosage, determine whether it is reasonable
  – Use one dosage calculation method consistently

Units of Measure Conversion

• Most emergency drug preparations do not require conversion
  – Most packaged in milligrams, administered in milligrams
  – Some drugs (dopamine) packaged in milligrams, administered in micrograms
Units of Measure Conversion

• Most emergency drug preparations do not require conversion
  – Convert to like units before calculating dose
    • Administer dopamine at rate of 800 mcg/minute, but have 200 mg drug in 250 mL solution
    • Convert 800 mcg to 0.8 mg so both weight measures are the same unit, 800 mcg/1000 = 0.8 mg
  – When dose is given per unit weight (kg), convert patient’s weight from lbs to kg before total dose to be given is calculated

Would you overdose or underdose your patient if you failed to convert the 800 μg of dopamine to 0.8 mg in this example? (Example says: You are to administer 800 μg/min of dopamine [Intropin]. You have 200 mg of the drug in 250 mL of solution.)

Units of Measure Conversion

• Assessment of computed doses
  – Many emergency drugs packaged in units, contain enough for a normal adult dose
  – After performing computations, decide whether answer is reasonable
    • Administer 8 mg diazepam, supplied in 2-mL ampule that contains 1 mg of drug
    • Reasonable calculation of volume would be less than 2 mL
Calculation Methods

• Many performed intuitively, many packaged to supply one adult dose
  – Never rely on intuitive calculations, no matter how simple

Calculation Methods

• Method 1: basic formula (desire over have)
• Desired dose to be given, over dose on hand, × unit of measure
• Volume on hand = unit of measure to be given
  25 mg/50 mg × 10 mL = X
  25/5 × 1 mL = X
  5 × 1 mL = X
  X = 5 mL

Calculation Methods

• Method 2: ratios, proportions
  – Ratio compares two numbers, same as fraction
  • Refers to weight, quantity of drug in solution
  • Ratio of 10 mg morphine in 1 mL solution = 10 mg to 1 mL
  • Proportion: equation made up of two ratios, states two ratios as equal
  • 2/3 = 4/6 (2:3 :: 4:6)
  • Ratios are equivalent, proportions are true
Calculation Methods

• Method 2: ratios, proportions
  – Equation must be set up to ensure same units of measure stated in same sequence (mg : mL = mg : x mL), x is quantity to be solved
  – Dose on hand = volume on hand :: desired dose = desired volume

Calculation Methods

• Method 2: ratios, proportions
  – Administer 40 mg furosemide, have 100 mg in 10 mL solution, how many mL will be given?
    • 100 mg : 10 mL :: 40 mg : x mL
    • Multiply inside numbers (means) and outside numbers (extremes)
    • Drop unit measurement terms
    • Solve proportion, divide both sides of equation by number before x (100)
    • Check answer: multiply means, then multiply extremes
    • Sum of product is equal if proportion is true

Calculation Methods

• Method 3: dimensional analysis
  – Works well for complex calculations
  – May call for several conversions of similar basic dimensional unit, all units of measure changed to like units
  – Based on same tenet as basic formula
  – Does not require memorization of desire over have equation
Calculation Methods

• Method 3: dimensional analysis
  – Conversion factors set up one equation, separated by multiplication signs
  – Administer 0.8 mg naloxone, packaged in 1 mL solution containing 0.4 mg drug
  – Step 1: set up equation, place desired unit of measure in answer to left of equal sign, place first factor right of equal sign, same unit as answer
  – Answer: mL = (1 mL/0.4 mg) × (0.8 mg/1)

Calculation Methods

• Method 3: dimensional analysis
  – Step 2: cancel like units, numerator, denominator, reduce fraction
  – Step 3: multiply numerators, then denominators
    • (1 mL × 0.8 = 0.8 mL) and (0.4 × 1 = 0.4)
  – Step 4: divide numerator by denominator to solve
    • mL = 0.8 mL/0.4 = 2 mL

Calculation Methods

• Calculating intravenous flow rates
  – Know volume to be infused
  – Know period of time, minutes over which fluid is to be infused
  – Know number drops (gtt) per mL infusion set delivers (drop factor)
  – Calculate flow rate

\[
\text{gtt/min} = \frac{\text{Volume to be infused} \times \text{Drop factor}}{\text{Duration of infusion (minutes)}}
\]
When is it best to use microdrip tubing?
When is it better to use macrodrip tubing?

Calculation Methods

- Calculating infusion rates
  - Correct drip rate crucial, helps avoid overdosing, underdosing
  - Properly calculate prescribed drug, continuous infusion
    - Know prescribed dose
    - Know concentration of drug in 1 mL of solution
    - Know drop factor of IV infusion set

  \[
  \text{gtt/min} = \text{Prescribed dose} \times \text{Drop factor} \\
  \text{Concentration of drug in 1 mL}
  \]

Calculation Methods

- Calculating infusion rates
  - Administer procainamide infusion 3 mg/min, have 1 g drug in 250 mL 5% dextrose water, infusion set delivers 60 gtts/mL, how many drops per minute deliver?
    - \[1 \text{ g} \times 1000 = 1000 \text{ mg}\]
    - \[1000 \text{ mg} + 250 \text{ mL} = 4 \text{ mg/mL}\]
Calculation Methods

• Calculating infusion rates
  – Calculate drops per minute, IV drip formula
  \[
  \text{gtt/min} = \frac{3 \text{ mg/min} \times 60 \text{ gtt/mL}}{4 \text{ mg in 1 mL}} = 45 \text{ gtt/min}
  \]

Infants, Children Calculations

• Some administered same proportion body weight as adults, others very reduced doses
  – Differences in child's ability to metabolize drug
  – Rarely exceeds normal adult dose

Infants, Children Calculations

• Often calculated in prehospital setting using memory aids, written advice medical direction
  – Charts
  – Tapes
  – Pocket guides
  – Dosage wheels
  – Personal electronic devices
  – Most precise, child's body surface area
    • Have someone double-check dose before administration
Drug Administration

• Safety considerations, procedures
  – Focus on procedure, avoid distractions
  – In prehospital setting, follow standing orders, protocols, drug therapy
  – Ensure medication orders are fully understood
  – Repeat all orders back, confirmation
  – State name, dose, route drug to be given before administration
  – If order is unclear, question order, have medical direction repeated
Drug Administration

• Safety considerations, procedures
  – Emergency room, patient care areas have written, electronic order for every medication administered
    • Verify patient’s name, allergies
  – Follow patient rights
    • Right patient
    • Right dose
    • Right drug
    • Right route
    • Right time
  – Document drug administration accurately, thoroughly

• Safety considerations, procedures
  – Read drug label, compare to medication order at least three times before administration
    • First: when removing drug from kit, supply area
    • Second: when preparing medication for administration
    • Third: before administering drug to patient, before container is discarded

• Safety considerations, procedures
  – Always check administration route
    • Some medications have several administration routes
  – Make sure label information matches prescriber’s order
  – Never give from unlabeled, illegible container
  – Unsure about drug calculations, have coworker check, contact medical direction, verification
Drug Administration

• Safety considerations, procedures
  – Handle multidose vials carefully using aseptic technique
  • Prevents drugs from being wasted, contaminated
  – Preparing more than one injection, always label syringe immediately
    • Keep medication container with syringe
    • Do not rely on memory
  – Never administer unlabeled medicine prepared by someone else
    • Doing so, you accept responsibility for accuracy, dose, correct medication

Your clinical preceptor hands you an unlabeled syringe of medication and tells you to give it IV push. What will you do?

Drug Administration

• Safety considerations, procedures
  – Never administer outdated, discolored, cloudy, tampered, unusual medication
  – If patient, coworkers express doubt, concern over medication, dose, recheck
    • Do not administer until sure no error is being made
    • Patient has right to refuse medication
  – Monitor at least 5 minutes for adverse effects after administration
    • Intramuscular, oral medicines may be longer
Drug Administration

- Safety considerations, procedures
  - Document all medications given
    - Drug name
    - Dosage
    - Administration time, route
    - Patient's response, adverse, intended
  - Follow governmental guidelines, local EMS policies regarding return, disposal of unused medication

Medication Errors

- Adverse drug events occur with some frequency
  - Estimated 1.5 million people receive wrong medicine, incorrect dose, in the United States each year
    - 7,000 of these people die annually
- Common causes
  - Prescriber ordered wrong dose
  - Incorrect drug calculations
  - Administered wrong route
  - Drug given to wrong patient
  - Wrong drug given to patient

Medication Errors

- If medication error occurs
  - Accept responsibility
  - Immediately advise medical direction, prescriber
  - Assess, monitor patient, drug effects
  - Document error, required local, state drug administration policies, medical direction institution
  - Modify personal practice, avoid similar future error
  - Follow EMS agency procedures, documentation, quality improvement activities
Medical Asepsis

• Removal, destruction of disease-causing organisms, infected material
  – “Clean” technique rather than sterile
    • Hygienic measures
    • Cleaning agents
    • Antiseptics
    • Disinfectants
    • Barrier fields

Medical Asepsis

• Antiseptics, disinfectants
  – Chemical agents, kill specific microorganism groups
    • Not very effective against bacteria, fungi spores, many viruses, some resistant bacterial strains
  – Disinfectants, used on nonliving objects, toxic to living tissue

Medical Asepsis

• Antiseptics, disinfectants
  – Antiseptics, used on living tissue, more dilute, prevent cell damage
  – Some chemical agents have both antiseptic, disinfectant properties
    • Alcohol
    • Some chlorine compounds
Universal Precautions

• Infection control practices
  – Observed with every patient, procedure
  – Prevent blood-borne pathogen exposure
  – Administer drugs, follow hand washing, gloving procedures
  – Face shield usage for splashing blood, body fluids

Lesson 14.2

Enteral and Parenteral Administration

Learning Objective

• Explain drug administration techniques for the enteral and parenteral routes.
Enteral Administration

- Drugs administered, absorbed through GI tract
  - Oral, gastric, rectal administration

Enteral Administration

- Oral route
  - Most frequent method
  - Patient upright, sitting position
  - Place pill/tablet/capsule in patient’s mouth, swallow with enough fluid
  - Some drugs (ondansetron) placed on tongue, dissolve without water
  - Do not administer orally if patient cannot swallow, must have effective gag reflex

Enteral Administration

- Oral route
  - Liquid forms
    - Shake bottle, unit dose thoroughly before administration
    - If not packaged as unit dose, measure with medicine cup, dropper, syringe
Think of some clinical situations where oral medication administration would not be appropriate. Why?

Enteral Administration

- Gastric tube administration
  - Most oral drugs can be given via gastric tube
  - Orogastric tubes, placed through mouth, into esophagus, stomach
  - Nasogastric tubes, placed through nose, esophagus, into stomach

- Before drug administration, make sure tube is correctly inserted
  - Inject 30 mL to 50 mL air into tube, auscultating epigastric region for air movement sound
  - Administer drug after verifying correct insertion, follow with small amount of water, 30 mL
  - Water flushes drug, maintains tube patency
  - Activated charcoal, emergency drug given via gastric tube
Enteral Administration

- Rectal administration medications
  - Suppositories
  - Other drugs can be given by rectal route
    - When vascular access cannot be established
    - Diazepam, lorazepam, emergency drugs

Parenteral Administration

- Administered outside GI tract
  - Usually refers to injections
    - Intradermal
    - Subcutaneous
    - Intramuscular
    - Intravenous
    - Intraosseous
Parenteral Administration

• Equipment for injection use syringes, needles
  – Choice depends on
    • Administration route
    • Fluid characteristics, aqueous, oil based
    • Medication volume
  – Syringes are commonly disposable plastic
    • Sizes: 1 mL tuberculin, insulin syringes to 60 mL irrigation syringes
    • Tuberculin syringes marked in 0.01 mL gradients
    • Used for small volumes

• Insulin syringes
  – 0.5, 1 mL volumes, marked in one-unit increments
  – Used with specified strengths
  – Allows patient to draw up correct dose with no calculations
  – Tuberculin and insulin syringes should not be substituted for each other
Parenteral Administration

• Syringe needles vary in length, gauge
  – Length ranges: 3/8 inch to 3 inches or longer
  – Gauge ranges: 12 (large lumen) to 30 gauge (small lumen)
    • Smaller lumen (larger gauge), usually used for intradermal injections
    • Subcutaneous injections: 5/8 inch, 23 or 25 gauge
    • Intramuscular injections: 1 to 2 inch, 19 or 21 gauge, occasionally 16 or 18 gauge

Parenteral Administration

• 2000, Congress passed Healthcare Worker Needlestick Prevention Act
• 2001, OSHA amended, Bloodborne Pathogens Standard, recommend needleless systems, sharps engineered protection
  – Collect body fluids, deliver medications without needle use

Parenteral Administration

• Help prevent blood exposure, needle-stick injury
  – Self-sheathing hypodermic syringes
  – Retractable injection needles
  – Self-blunting phlebotomy needles
  – Retracting lancets
  – Filter straws
  – Vial access cannula
  – Disposable retracting scalpels
Parenteral Administration

• Containers used
  – Injection medications supplied in three forms
    • Single-dose, glass ampule containers
    • Hold one dose medication injection, discarded sharps container
  – Multidose vials, glass containers with rubber stoppers
    • Permit several doses to be withdrawn, generally intended for single-patient use
  – Prefilled syringes

Injection Preparation

• Choose appropriate needle and syringe
  – Syringe size must be in proportion to solution volume
• Withdraw medication from ampule/vial
  – Assemble equipment
  – Compute volume of medication

• If using vial
  – Clean rubber stopper with alcohol
  – Inject volume of air into vial equivalent to amount of solution to be withdrawn
  – Withdraw required volume, remove syringe from vial
  – Gently push in plunger of syringe to expel air from solution
Parenteral Administration

• If using ampule
  – Lightly tap/shake ampule to dislodge solution from neck of container
  – Wrap neck of glass with alcohol swab
  – Grasp ampule, snap off top, discard top in disposal container
  – Carefully insert 18-gauge filter needle into solution, draw solution into syringe
    • Do not allow needle to touch edges of ampule

• If using ampule
  – Carefully remove needle and discard in appropriate container
  – Attach needle to be used for injection
  – Gently push plunger of syringe to expel air
Parenteral Administration

• Mixing medications
  – Two compatible drugs can be mixed into one injection if total volume of dosage is within accepted limits
  • When mixing, do not contaminate one with the other, maintain aseptic technique
  • Any doubt about compatibility, consult medical direction

Parenteral Administration

• Mixing medications from two vials
  – Use only one syringe to mix drugs
  – Aspirate a volume of air equivalent to dose of first drug, inject air into vial A, making sure needle does not touch solution, withdraw needle
  – Aspirate volume of air equivalent to dose of second drug, inject air into vial B, withdraw required medication from vial B
Parenteral Administration

• Mixing medications from two vials
  – Put a new sterile needle on syringe, insert into vial A
    • Be careful not to push in plunger/expel drug from syringe into vial
  – Withdraw desired amount of drug from vial A into syringe
  – Put new sterile needle on syringe and administer injection

Parenteral Administration

• Mixing medications from one vial and one ampule
  – Withdraw desired drug dose from vial first
  – Use same syringe and needle to withdraw medication from ampule
  – Put new sterile needle on syringe and administer injection

Parenteral Administration

• Prefilled syringes
  – Calculate volume of medication to be administered
  – Remove protective caps from syringe barrel and medication cartridge
  – Screw cartridge into syringe barrel
  – Gently push in plunger of syringe to expel air
Parenteral Administration

- Preparing injection site
  - Cleanse area using aseptic technique
    - Thoroughly scrub site with appropriate cleanser, remove dirt, dead skin, other surface contaminants
    - Using chlorhexidine-based preparation, scrub area up, down, side to side, other products clean site with overlapping, concentric circles, moving outward from site
  - Allow site to dry

Intradermal Injections

- Made just below epidermis, outer layer of skin
  - Commonly used for allergy testing, administration of local anesthetics
- Tuberculin syringe usually used
  - Injected volume usually less than 0.5 mL
- Common sites
  - Forearm
  - Back
Intradermal Injections

- Administration steps
  - Choose injection site, cleanse skin surface
  - Hold skin taut with one hand
  - Hold syringe with other hand, needle bevel up, 10 to 15 degree angle to site
  - Gently puncture skin, insert needle until bevel is completely under skin surface, inject medication
    - Usually produce raised wheal, resembles mosquito bite
  - Withdraw needle, dispose of equipment appropriately
Subcutaneous Injections

- Place medication below skin into subcutaneous layer
- Volume usually less than 0.5 mL
- Administered through ½- or 5/8-inch, 23- or 25-gauge needle
  - Epinephrine, most common prehospital setting drug

Subcutaneous Injections

- Administration steps
  - Choose injection site, cleanse area
  - Elevate subcutaneous tissue, gently pinching injection site
  - Insert needle, 45-degree angle with bevel up, one quick motion
Subcutaneous Injections

- Administration steps
  - Pull plunger back slightly (aspirate), ensure needle placement
    - If no blood is aspirated, gently inject medication
    - If blood is present, indicates inadvertent vascular injection, withdraw needle, discard medication, equipment, begin again
    - Withdraw needle at same angle inserted, use alcohol swab, massage site, helps distribute medication, promote absorption by dilating blood vessels, increasing blood flow
Intramuscular Injections

• Made into muscle tissue
  – Pass through skin, subcutaneous tissue
• Given when drug is too irritating subcutaneously, greater volume, faster absorption needed
• Maximum volume 5 mL, in large muscle mass
Intramuscular Injections

- Needle type factors
  - Injection site
  - Tissue condition
  - Patient size
  - Injected drug type
- Longer needle generally used, 1½ inches, 19 or 21 gauge
  - Insert needle at 90-degree angle
  - Skin held taut, not pinched
Intramuscular Injections

• Commonly used muscles
  – Deltoid
    • Upper arm, triangular shape, triangle base along acromion process, triangle peak approximately 1/3 down lateral aspect of upper arm
    • Primarily used for vaccinations, small volumes
    • Avoid hitting radial nerve, have patient sit upright, lying flat, relax arm muscles
What are the advantages to selecting the upper extremity for intravenous access in an adult?

Intramuscular Injections

- Commonly used muscles
  - Gluteal, dorsogluteal site
    - Several gluteal muscles
    - Gluteus medius most often used
    - Divide buttocks on one side into imaginary quadrants, medication administered in upper outer quadrant
    - Locate posterior-superior iliac spine, greater trochanter femur, draw imaginary line between two landmarks, injection given up and out from this line
Intramuscular Injections

- Commonly used muscles
  - Gluteal, dorsogluteal site
  - Do not use for children under age 3, muscles not well developed, proximity of sciatic nerve poses risk
  - Large, well-developed muscles accommodate injection up to 5 mL, volumes greater than 3 mL uncomfortable
  - Patient should lie prone, toes pointing inward, promotes muscle relaxation
  - Complication, inadvertent injection into hip joint

- Vastus lateralis
  - Lies lateral to midline of thigh
  - Preferred children’s injection site
  - Well developed in all patients, few major blood vessels, nerves
Intramuscular Injections

• Commonly used muscles
  – Rectus femoris
    • Lies midline of middle third of thigh, next to vastus lateralis
    • Most often used for self-injection
    • Acceptable injection volumes vary with patient age, muscle size, up to 5 mL into well-developed adult
    • Patient should sit upright, lying supine, relax muscles

• Commonly used muscles
  – Ventrogluteal
    • Patient lies supine, lateral recumbent position
    • Palpate greater trochanter using palm, with index finger pointing to anterior-superior iliac spine, remaining three fingers extend toward iliac crest
    • Injection made into center V formed by fingers
    • Site may be used for all patients
    • No large nerves, fat tissue
    • Adult may accommodate up to 5 mL
Lesson 14.3
Intravenous Therapy and Complications

Learning Objectives

- Describe the steps for safely initiating an intravenous infusion
- Identify complications and adverse effects associated with intravenous access
Intravenous Therapy

- Intravenous cannulation, gain access to body’s circulation
  - Administer fluids
  - Administer drugs
  - Obtain specimens
- Route puts drug directly into bloodstream, bypasses all absorption barriers

Intravenous Fluid Administration

- Peripheral vein, route of choice, prehospital setting
  - Use lower extremities if upper extremities are not available
- Common prehospital setting IV fluids
  - Normal saline
  - Lactated Ringer’s solution
  - Mixtures of glucose and water
    - Usually, normal saline, lactated Ringer’s solution used for fluid replacement, also used for administering drugs

Intravenous Catheter Types

- Hollow needle (butterfly)
  - Not advised for IV fluid replacement in prehospital setting, difficult to stabilize needle
  - Can be used for pediatric patients if stabilized adequately, arm boards, immobilization devices
Intravenous Catheter Types

• Indwelling plastic catheter over hollow needle
  – Angiocath, Autoguard, Accuvance Safety
  – Preferred catheter in prehospital setting, easily secured, more comfortable
• Indwelling plastic catheter inserted through hollow needle
  – Intracath
  – Seldom used in prehospital setting

Peripheral Intravenous Insertion

• Common areas: hands, arms
  – Antecubital fossae (AC space)
• Other sites
  – Long saphenous leg veins
  – External jugular neck veins
    • Both have higher embolism, infection incidences
Peripheral Intravenous Insertion

• Clinical status factor for use
  – Extremity injury, diseases interfere with vein use
  – Trauma
  – Site infection
  – Dialysis fistula
  – Mastectomy history

Peripheral Intravenous Insertion

• Steps
  – Conscious patient, explain procedure, give reason
  – Assemble equipment
    • Inspect prescribed fluid, contamination, appearance, expiration date, never use if compromised
    • Prepare microdrip infusion set, precise infusions, macrodrip infusion set fluid administration, attach infusion set to solution bag
  – Clamp tubing, squeeze reservoir on infusion set until it fills halfway, open clamp, flush air from tubing, close clamp
Peripheral Intravenous Insertion

• Steps
  — Select catheter
    • Large-bore (14 to 16 gauge) for fluid replacement
    • Smaller bore (18 to 20 gauge) for “keep open” lines, maintain hydration, establish channel for IV medication

Peripheral Intravenous Insertion

• Steps
  — Prepare other equipment
    • Antiseptic to cleanse skin
    • Sterile dressings or 4 x 4 gauze pads
    • Adhesive tape, torn or cut into several strips
    • Syringes, Vacutainers for blood samples
    • Tourniquet (rubber drain tubing or BP cuff may be used)
  — Put on gloves

When would it be an advantage to use a microdrip tubing? When would it be better to use a macrodrip tubing?
Peripheral Intravenous Insertion

• Steps
  — Select puncture site
    • If using upper extremity, allow patient’s arm to hang dependent
  — Apply tourniquet several inches above antecubital space
  — When selecting vein, look at dorsum of hand and forearm
    • If second puncture is necessary, should always be proximal to first puncture
    • Avoid veins near joints and near injured areas

Peripheral Intravenous Insertion

• Steps
  — Prepare puncture site and cleanse area
    • Thoroughly clean site with antiseptic to remove dirt, dead skin, blood, and other surface contaminants
    • Allow the area to dry.
    • Clean the site using overlapping, concentric circles and moving outward

Peripheral Intravenous Insertion

• Steps
  — Stabilize vein by applying distal pressure and tension to point of entry
  — With bevel up, pass needle through skin and into vein at 15- to 20-degree angle from side or directly on top
  — Advance needle and catheter about 2 mm beyond point where blood return in hub of needle was first encountered
  — Slide catheter over needle and into vein
Peripheral Intravenous Insertion

• Steps
  – While stabilizing catheter, withdraw needle
  – Apply pressure on proximal end of catheter to stop escaping blood
  – Obtain blood samples with syringe or Vacutainer
  – Release tourniquet and attach IV tubing
  – Open tubing clamp and allow fluid infusion to begin at prescribed flow rate

Peripheral Intravenous Insertion

• Steps
  – Cover puncture site with occlusive dressing to ensure asepsis and to secure line
  – Anchor tubing and secure catheter
  – Catheter movement can increase risk of phlebitis and cause migration of pathogens along cannula into vein
  – Document infusion procedure
Complications of Intravenous Techniques

- Possible complications
  - Local complications
  - Systemic complications
  - Infiltration
  - Air embolism

Local Intravenous Complications

- Hematoma formation
  - Blood, fluid collection, injection site, cannulation
  - Usually small enough, resolves spontaneously
  - Rarely requires surgical treatment, drainage, other interventions

Local Intravenous Complications

- Thrombosis
  - Blood clot formation inside blood vessel
  - Occurs when blood vessel is injured
  - Clot remains in place, becomes thromboembolism, enters circulatory system
Local Intravenous Complications

• Cellulitis
  – Connective tissue bacterial infection, potentially serious
  – Associated with severe inflammation dermal, subcutaneous skin
  – Caused by introduction of normal skin flora following injection, cannulation
  – Appears swollen, red area, feels hot, tender
  – Can spread to any body part
  – Antibiotic treated

Local Intravenous Complications

• Phlebitis
  – Vein inflammation
  – Common after IV catheter insertion
  – Can result from catheter too large for vein, catheter left in place over 48 hours
  – Causes localized redness, warmth, IV site, may extend along course of cannulized vein
  – Increases risk clot formation in vein
  – Treated, antiinflammatory medicines

Local Intravenous Complications

• Sloughing, necrosis of tissue
  – Can occur from infiltration of some IV medicines (dextrose 50%, sodium bicarbonate, promethazine)
  – Sloughing, tissue separation, necrosis, tissue death, can be avoided, ensuring stable, adequately sized vein chosen for drug administration
  – Important frequent IV site monitoring for position, patency, before, during, after administration
Systemic Intravenous Complications

• Sepsis
  — Bloodstream bacterial infection
  — Caused by contaminated equipment, poor aseptic technique, prolonged IV therapy

Systemic Intravenous Complications

• Sepsis
  — Signs, symptoms
    - Body temperature > 38°C (100.4°F), < 36°C (96.8°F)
    - Profuse sweating
    - Nausea
    - Vomiting
    - Diarrhea
  — Treatment: broad-spectrum antibiotics

  • Abdominal pain
  • Tachycardia
  • Hypotension
  • Increased white blood cell count
  • Altered mental status

Systemic Intravenous Complications

• Pulmonary embolism
  — Sudden blocking of lung artery
  — Caused by solid material (embolus), collection brought through bloodstream, air bubbles introduced through IV catheter (air embolism)
Systemic Intravenous Complications

• Pulmonary embolism
  — Signs, symptoms
    • Sudden onset of chest pain
    • Shortness of breath
    • Tachycardia
    • Hypotension
  — Place patient on high-concentration oxygen, cardiac monitor, transport for physician evaluation, treatment

• Catheter fragment embolism
  — Can occur during IV insertion
  — Result from catheter being sheared off (detached), allowing embolus to travel in bloodstream
  — Can occur when motion at cannula, hub
    • Catheter poorly secured, placed in flexion areas
    • Needle reinsertion through catheter during IV insertion

• Catheter fragment embolism
  — Signs, symptoms
    • Insertion site sharp pain
    • Chest pain
    • Tachycardia
  — If suspected
    • Stop IV
    • Palpate vein for catheter tip
    • Apply venous tourniquet, prevent further fragment movement
Systemic Intravenous Complications

- Inadvertent arterial puncture during IV therapy
  - Presence of pulsating, bright red blood, catheter hub
  - Arteries not suited for drug administration
  - Can cause diminished blood supply, areas nourished by affected artery
  - Catheter should be removed, direct pressure applied at least 5 minutes, 10 minutes for anticoagulant therapy
  - Place new IV
  - Document incident

Infiltration

- Needle, catheter displaced, blood, fluid leaks from around catheter, escapes into tissues (extravasation)
- Vein punctured more than once during IV access initiation
- Signs, symptoms
  - Skin coolness at punctured site
  - Puncture site swelling, with/without pain
  - Sluggish, absent flow rate

Infiltration

- If suspected
  - Lower fluid reservoir to dependent position, check for blood backflow into tubing
  - Absence suggests infiltration
  - Discontinue IV flow
  - Remove needle, catheter
Infiltration

- If suspected
  - Apply pressure dressing
  - Choose alternative puncture site, restart infusion with new equipment
  - Document incident
  - Do not inject medication into IV line if possibly infiltrated

Air Embolism

- Uncommon
- Possibly fatal
- Air volume bloodstream tolerations not firmly established
  - Fatalities reported with 100 mL air entering cardiovascular system
  - 10 mL air, possibly fatal in critically ill patient

Air Embolism

- Caused by air entering bloodstream via catheter tubing
- Greatest risk when catheter is passed into central circulation, where negative pressure may pull air in
  - Air enters during catheter insertion, or when disconnecting tubing or adding new extension tubing
  - With subsequent pumping, blood foaming occurs in heart
  - If enough air enters heart chamber, can impede blood flow, can lead to shock
Air Embolism

- Signs, symptoms
  - Hypotension
  - Cyanosis
  - Weak, rapid pulse
  - Loss of consciousness

Air Embolism

- If suspected
  - Close tubing
  - Turn patient on left side, head down
  - If air in heart chambers, position may keep air on right side of heart, away from cardiac valves
  - Pulmonary artery may absorb small air bubbles
  - Check tubing for leaks
  - Administer high-concentration oxygen
  - Notify medical direction

Air Embolism

- Accidental disconnection, IV tubing can cause air embolism
  - May occur with patient movement
  - To minimize chance, secure all tubing connections
  - Change fluid containers before they are empty
Lesson 14.4
Intravenous and Intraosseous Medications

Learning Objectives

• List the steps for safely initiating intravenous access.
• Describe the steps for safely initiating an intraosseous infusion.

Intravenous Medications

• Administer through
  – Previously established IV infusion line
  – Heparin, saline lock
  – Implantable port
  – Sterile needle
  – Butterfly device
Intravenous Medications

- Administered by
  - Adding drug to infusing IV solution
  - Normal saline
  - Dilute drug in larger fluid volume, give IV push, volume control, in-line device
    - Burette
    - Volutrol
    - Infusion pump
  - Intermittent infusion through existing infusion site
    - IV piggyback
    - Secondary set

Intravenous Medications

- IV injections
  - Involve small medication amounts
    - IV push, bolus medications
  - Clean injection port, needleless port with antiseptic
  - Inject medication slowly, over 1 to 3 minutes
    - Depends on type of medication, patient's response
Intravenous Medications

• IV injections
  – Most tubing have one-way valves
    • Prevent backflow of medication
    • No valves present, clamp tubing above injection site
    • Fluid infusion continued after injection
Intravenous Medications

- Adding medication, fluid reservoir, established IV line
  - Compute drug volume to be added, fluid reservoir
  - Draw up prescribed dose into syringe
    - Prefilled syringes, note medication volume, dose to be used
  - Cleanse fluid reservoir rubber sleeve with antiseptic
  - Puncture rubber sleeve, if needle used, inject prescribed medication into fluid reservoir
  - Withdraw needle, if needleless system not used, discard needle, syringe, gently mix medication with fluid, agitating reservoir
Intravenous Medications

• Adding medication, fluid reservoir, established IV line
  – Label fluid reservoir
    • Name medication added
    • Amount medication added
    • Resultant concentration of medication in reservoir
    • Date, time infusion prepared
    • Paramedic preparer’s name
    • Calculate administration rate, drops per minute as prescribed

Intravenous Medications

• In-line, volume control devices allow more accurate medication delivery, diluted, precise fluid amounts than possible by setting drip rate manually
• Give IV medications to children, adults who need precise doses
• Medications cause toxicity when given too rapidly, well suited to this method
Intravenous Medications

- In-line devices
  - Electronic flow rate regulators
    - Regulate fluid passage, magnetically activated metal ball valve
  - Infusion pumps
    - Exert pressure on tubing, fluid, pumping against pressure gradients
  - Mechanical, nonelectric devices
    - Dial-a-flow
    - Closely regulate flow rate

Intravenous Medications

- Intermittent infusions
  - Given via setup of secondary to primary IV infusion
  - Piggyback medication hung, tandem, connected to primary setup
  - Most meant to have total infusion time of 20 or 30 minutes to 1 hour
    - Depends on drug, patient’s response
Intravenous Medications

• Intermittent infusions
  – Preparation
    • Prepare medication, add to secondary fluid
    • Bleed air out of secondary administration set, attach 1 inch, 18-gauge needle if needleless system is not available
    • Cleanse primary infusion tubing medication port, insert needle, tubing from piggyback medication
    • Tape needle, if present, secure tubing to medication port securely

• Intermittent infusions
  – Preparation
    • Calculate flow rate, secondary infusion, drops/minute
    • Lower primary infusion reservoir so center of gravity lower than secondary infusion reservoir
    • Clamp primary infusion tubing, allow piggyback medication to infuse, open piggyback line flow clamp, adjust flow rate, desired dose, restart primary infusion after piggyback medication administration, discard piggyback equipment
    • Label bag, medication name
    • Document patient effects
Intravenous Medications

- Drug pumps
  - Slow medication injection at home
    - Cancer chemotherapy
    - Patient-controlled analgesia
    - Insulin pumps
  - Consist of syringe with battery attachment, pager device, large pump regulates medication injection
  - Give medication subcutaneously, intravenously, epidural space, indwelling vascular devices

Intraosseous (IO) Medications

- Fluids, drugs infused through access pass quickly from long bone, marrow cavities into sinusoids
  - Pass to large venous channels, emissary veins
  - Next, pass into systemic circulation

Intraosseous (IO) Medications

- Quickly infused medications
  - Normal saline
  - Lactated Ringer’s solution
  - DSW
  - Plasma
  - Blood
  - Most ALS
- Follow drug administration with saline flush at least 5 mL, ensures drug delivered into central circulation

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Intraosseous (IO) Medications

- Infusions indicated for ill, injured patients requiring vascular access for drugs, fluids when peripheral cannulation is difficult, unobtainable
  - Cardiopulmonary arrest
  - Peripheral vascular collapse
    - Shock
    - Major trauma
    - Burns
  - Impaired vascular access by obesity, edema, status asthmaticus

Intraosseous (IO) Medications

- Site choices
  - Tibia, below tubercle, anteromedial surface
  - Femur (children), above lateral condyles in midline
  - Sternum (adults), below sternal notch
  - Medial malleolus (adults)
  - Humerus head (adults)
Intraosseous (IO) Medications

• Special intraosseous devices  
  – Designed to safely insert IO needle through cortex into long bone marrow  
    • Bone Injection Gun (BIG)  
    • Cook Disposable IO Infusion Needle (Sur-Fast Needle)  
    • EZ-IO infusion system  
    • First Access For Shock, Trauma (F.A.S.T.1)™ IO infusion system  
    • Jamshidi IO needle
Intraosseous (IO) Medications

• Necessary equipment
  – Antiseptic
  – Tape
  – Bone marrow needle, commercial intraosseous needle
  – IV tubing (pediatric infusion set)
  – IV fluids (medical direction specified)
    • Normal saline
    • Lactated Ringer solution
    • Special pediatric fluids
  – Pressure infusion bag, pump
Intraosseous (IO) Medications

• Insertion technique
  – Gloves, personal, patient protection
  – Cleanse site for peripheral cannulation
  – Prepare needle, insert needle pointing away from epiphyseal plate, advance to periosteum
  – Using screwing motion, advance needle until it penetrates bone marrow
    • Noted by decreased resistance, slight popping sound
  – Remove stylet

Intraosseous (IO) Medications

• Insertion technique
  – Aspirate bone marrow into saline-filled syringe
    • May not always be aspirated
  – Infuse saline by syringe, ensure needle placement, clear clots
  – Secure needle, tape, securing screw if equipped
  – Attach standard IV tubing, fluids, infuse under gravity, pressure as prescribed
  – Apply dressing to site
  – Document procedure

Intraosseous (IO) Medications

• Contraindications
  – Fracture site, or proximal to site
  – Traumatized extremity
  – Cellulitis
  – Burns that may be infected by technique
  – Congenital bone disease
Intraosseous (IO) Medications

• Potential complications
  – Technical
    • Subperiosteal infusion from improper placement
    • Penetration of posterior wall, medullary cavity, resulting in soft tissue infusion
    • Slow infusion from clotting of marrow

Intraosseous (IO) Medications

• Potential complications
  – Systemic (IO devices short-term, usually removed 24 hours after insertion)
    • Osteomyelitis (fewer than 0.6% of cases)
    • Fat embolism (rare)
    • Slight periostitis at injection site
    • Infection (low rate)
    • Fracture
Learning Objectives

• Explain drug administration techniques for percutaneous routes.
• Identify special considerations in the administration of pharmacological agents to pediatric patients.

Learning Objectives

• Explain the technique for obtaining a venous blood sample.
• Describe the safe disposal of contaminated items and sharps.

Percutaneous Medication Administration

• Absorbed through skin mucous membranes
  – Topical drugs
  – Sublingual drugs
  – Buccal drugs
  – Inhaled drugs
  – Endotracheal drugs
  – Nasal drugs
  – Eye, nose, ear drugs
Topical Drugs

• Nitroglycerin, most common
  – Nitropaste
    • Lanolin‐petrolatum base
    • Applied in ½‐inch increments, special papers measure dose
    • Applied to clean, dry area upper arm, hair‐free chest area
  – Nitroglycerin patches
    • Adhesive back
    • Solid, semisolid form
    • Wear gloves when applying, removing, prevents inadvertent self‐absorption
    • Onset slower, longer duration

Topical Drugs

• Other patch form drugs
  – Fentanyl
  – Scopolamine
  – Clonidine
  – Estrogen
  – Unfavorably affect patient during illness
  – Usual sites
    • Behind ear
    • Chest
    • Back
    • Hip
    • Upper arm
Sublingual Drugs

- Nitrates, treat angina pectoris
- Lorazepam, treat anxiety
- Captopril, manage congestive heart failure
  - Place under tongue, dissolve
  - No fluids during absorption
  - Inadvertent swallowing, effects diminished, delayed
  - Older adults, decreased saliva, absorption slow, unpredictable

Buccal Drugs

- Held between cheek and gum
- Dissolve
- No fluids during absorption
- Do not use for patients with altered level of consciousness, cannot swallow, ineffective gag reflex
- Glucose gel, emergency medication

Inhaled Drugs

- Oxygen
- Nitrous oxide
- Bronchodilators
Inhaled Drugs

• Corticosteroids
• Antibiotics
• Mucokinetic agents

Inhaled Drugs

• Aerosols
  — Liquid, solid particles of substance dispersed in gas, solution
  — Effectiveness depends on
    • Number of droplets suspended in gas, solution
    • Oxygen rate, gas flow
    • Particle size
    • Rate, depth of breathing

Inhaled Drugs

• Aerosols
  — Delivery, certain advantages
    • Rapid onset
    • Fewer, less intense systemic side effects
  — Made by nebulizers
    • Intermittent positive-pressure breathing (IPPB) devices, in-hospital use
    • Metered-dose inhalers (pressure cartridges), hand-held nebulizers, out-of-hospital use
Inhaled Drugs

• Metered-dose inhaler (MDI)
  – Most commonly used
  – Convenient, delivers measured dose
  – Prescribed, self-treatment for asthma
  – Other medications
    • Ipratropium
    • Albuterol
    • Isoetharine

Inhaled Drugs

• Metered-dose inhaler (MDI)
  – Administration
    • Remove mouthpiece, protective cap from canister
    • Snap off cap, turn mouthpiece sideways
    • Insert canister stem into hole inside mouthpiece
    • Shake canister, mouthpiece well
    • Invert MDI, hold close to mouth, instruct patient to exhale, pushing as much air from lungs as possible
Inhaled Drugs

• Metered-dose inhaler (MDI)
  – Administration
    • Place mouthpiece in mouth, instruct to close lips loosely around it, tongue underneath mouthpiece, as patient inhales deeply over 5 seconds, press canister down quickly, release
    • Instruct patient to hold breath 5 to 10 seconds before exhaling
    • Repeat procedure in 5 to 10 minutes to take advantage of deeper penetration second round
  • Most use aero chambers, spacers
  • Beneficial to children with problematic conditions
  • Allow maximum benefit of drug, do not require exact synchronization

What will happen to the medication if the patient does not use the MDI properly?

Inhaled Drugs

• Hand-held nebulizers
  – Kit includes mouthpiece, aerosol mask, oxygen tubing, reservoir tubing
  – Devices attached to nonhumidified portable, on-board oxygen source
  – Use Bernoulli principle, create aerosol mist
Inhaled Drugs

• Hand-held nebulizers
  – Medications
    • Albuterol
    • Atropine
    • Ipratropium
    • Isoetharine
    • Levalbuterol
    • Metaproterenol

Inhaled Drugs

• Hand-held nebulizers
  – Procedure
    • Depends on patient’s ability to tolerate treatment by mouthpiece, mask
    • Tight seal around mouthpiece, cooperation needed
    • Less drug wasted
    • Mask treatment
    • Severe dyspnea, mouth breathers tolerate better
Inhaled Drugs

• Hand-held nebulizers
  – Using aseptic technique, mix prescribed drug with specified amount of normal saline, instill into nebulizer
  – Attach nebulizer to T-piece and mouth piece, connect with tubing to unit
  – Adjust oxygen flowmeter to rate of 4 to 6 L/min to create steady, visible mist
    • If aerosol mask used, oxygen flow rate should be 6 to 8 L/min

Inhaled Drugs

• Hand-held nebulizers
  – When mist is visible, begin treatment
  – Instruct patient to inhale slowly, deeply by mouth, hold breath for 3 to 5 seconds before exhaling
  – Continue inhalation, exhalation until aerosol canister is depleted of medication

Inhaled Drugs

• Hand-held nebulizers
  – Patient must cooperate, follow instructions
  – Ineffective if patient is unable to inhale drug sufficiently, severe bronchospasm
  – Artificially ventilated patients treated by placing into ventilation circuit of BVM or ventilator
  – Notable changes in heart rate, dysrhythmias may occur, stop treatment
Endotracheal Drugs

- Used when intravenous, intraosseous access cannot be established
- Unpredictable, less effective, dose must be increased
- Emergency drugs
  - Naloxone
  - Atropine
  - Vaspressin
  - Epinephrine
  - Lidocaine

Endotracheal Drugs

- Administration
  - Ensure ET tube is in correct position through direct visualization, auscultation
  - Ensure oxygenation, ventilation in lungs is adequate
  - Prepare medication, 2 to 2½ times IV dose, dilute dose to 10 mL with normal saline
Endotracheal Drugs

• Administration
  – Remove air source from ET tube
  – Inject medication though catheter deep into tube, inject directly into tube, follow with normal saline flush
  – Resume ventilations with one to two full ventilations
    • Helps ensure medication penetrates as deeply as possible into pulmonary tree, enhances absorption
  – Monitor for desired effect, side effects

Eye, Nose, Ear Drugs

• Eye medications are usually drops, ointments
• Administration
  – Have patient lie down, sit with head tilted back
  – Stabilize head with one hand, use thumb, fingers of other hand, pull down lower lid
  – Apply medication into conjunctival sac, lower lid, never onto eyeball
Eye, Nose, Ear Drugs

• Nose drops
  – Best given lying down with head over edge bed, midline position
  – Drops instilled into each nostril
  – Instruct patient not to blow nose for several minutes, allows absorption
  – Nasal route, have patient head upright, tilted back, inhale through one nostril while blocking other, squeezing spray applicator

• Ear drops
  – Have patient lie down with affected ear up
  – Gently pull top of ear up and back, straightens ear canal
    • Children under age 3, pull ear down, straight back
  – Instill prescribed number of drops
  – Remain in ear-up position for 10 minutes, allow drops to disperse
  – To prevent contamination, do not allow dropper tip to contact ear canal
  – Place cotton ball in ear canal to reduce seepage onto face
Pediatric Patients

• Administration guidelines
  – Establish positive relationship
    • Accept fearful, anxious behavior, natural response
  – Be honest when explaining medication, unpleasant, painful procedure
  – If appropriate, allow child to help administer
  – Hold child in semireclined position to give oral liquid drugs

Pediatric Patients

• Administration guidelines
  – Place medication in syringe alongside tongue
  – Slowly inject, allowing swallowing of small amounts at a time
  – Only use mild physical restraint if required, explain why needed
  – Enlist assistance when possible
  – Required parenteral medications, stabilize injection site well, give injection quickly
    • Have two or more individuals available to hold child over age 4
  – The younger and smaller the child, the smaller the margin for error

Obtaining Blood Sample

• When possible, obtain from IV line before fluids are infused
  – Prepare equipment in advance
  – After removing needle from IV catheter, exert manual pressure above IV site, prevent free blood flow from catheter
  – While stabilizing site, insert Vacutainer into hub of IV catheter
Obtaining Blood Sample

• When possible, obtain from IV line before fluids are infused
  – Push blood collection vacuum tubes into Vacutainer barrel, which draws blood from IV catheter
  – After obtaining specimens, attach IV tubing, begin infusion
  – Label sample with patient’s name, time, date obtained

Obtaining Blood Sample

• Obtaining sample using Vacutainer, no IV line
  – Apply tourniquet above selected site
  – Cleanse site
  – Enter vein with 18- or 20-gauge needle attached to 10- or 12-cc syringe
  – Draw back plunger using an even, steady motion
  – After sample is obtained, release tourniquet, withdraw needle, apply manual pressure to site
Why should a venous blood sample never be drawn above an IV infusion site?

Obtaining Blood Sample

- Obtaining sample using Vacutainer, no IV line
  - Immediately transfer sample to appropriate evacuation tube
  - Do not force additional blood into tube
  - Each tube has correct amount of vacuum for blood amount
  - Forcing blood can cause expulsion, lead to unnecessary injury, exposure of contents
  - Label sample with patient’s name, time, date obtained

Contaminated Items Disposal

- Needles, sharp objects can injure patients, paramedics, others
- Possible source of infection with hepatitis, HIV
- CDC recommendations
  - Needles should not be capped, bent, broken before disposal
  - Discarded intact in clearly marked container
  - Should be puncture and leak proof
  - When full, container discarded via established policies for disposition of contaminated items and sharps
Summary

• Three systems for measuring drug dosage are in use today
  – Metric system, apothecary system (no longer recommended), and common household system
  – Each system deals with units of mass and volume
  – Any of these three systems may be used by a physician when ordering drugs

Summary

• Paramedics should choose a drug calculation method that is precise
  – Also should be reliable
  – Paramedics should
    • Convert all units of measure to the same size and system
    • Assess computed dosage to determine whether it is reasonable
    • Use one method of dose calculation consistently
Summary

• Many drug calculations can be performed almost intuitively
  – Paramedics should never rely on intuitive calculations
  – Methods of calculation include the basic formula (desire over have), ratios and proportions, and dimensional analysis

Summary

• Intravenous flow rates can be calculated using the following formula
  – \( \text{Drops/min} = \frac{\text{Volume to be infused} \times \text{Drops/mL of infusion set}}{\text{total time of infusion (min)}} \)
• Safety procedures should be a high priority during the administration of any medication
  – Paramedic must make sure the right patient receives the right dose of the right drug via the right route at the right time

Summary

• Medication error may occur. In such cases, paramedics should take responsibility for their actions
  – Should quickly advise medical direction
  – Assess and monitor the patient for effects of the drug
  – Document the error as required by local, state, and medical direction policies
  – Change their personal practice to prevent a similar error in the future
Summary

• Medical asepsis is accomplished by using clean technique, which involves hygienic measures, cleaning agents, antiseptics, disinfectants, and barrier fields

• Enteral drugs are administered and absorbed through the GI tract
  – Given by the oral, gastric, and rectal routes

Summary

• Parenteral drugs are administered outside the intestine
  – Are usually injected
  – Given by the intradermal, subcutaneous, intramuscular, intravenous, and intraosseous routes

Summary

• In prehospital setting, the route of choice for fluid replacement is through a peripheral vein in an extremity
  – Over-the-needle catheter generally is preferred in this setting

• Several possible complications are associated with all intravenous techniques
  – Include local complications, systemic complications, infiltration, and air embolism
Summary

• Fluids and drugs that are infused by the intraosseous route pass from the marrow cavities into the sinusoids
  – Next, they pass into large venous channels and emissary veins
  – Then they pass into the systemic circulation
  – Site of choice for IO infusions in children is the tibia, one to two fingerbreadths below the tubercle on the anteromedial surface
  – Other sites for IO infusions include the distal tibia, humerus, and sternum (adults)

Summary

• Percutaneous drugs are absorbed through the mucous membranes or skin
  – Include topical drugs, sublingual drugs, buccal drugs, inhaled drugs, endotracheal drugs, nasal drugs, and drugs for the eye and ear

Summary

• Administering drugs to infants and children can be quite difficult
  – Often is especially true in emergency situations
  – Paramedics frequently calculate pediatric drug doses by using memory aids
  – Some of these aids include charts, tapes, and dosage books
  – Doses also are calculated with the advice of medical direction
Summary

- If possible, venous blood samples should be obtained when intravenous access is established
  - Also should be obtained before any fluids are infused
  - If no IV line is to be used and a blood sample is still needed, it must be obtained with a needle and syringe (or a special vacuum needle and sleeve)

Summary

- CDC recommends that needles not be capped, bent, or broken before disposal
  - Should be left on the syringe and discarded in an appropriate, clearly marked container that is puncture proof and leak proof

Questions?