



Pharmacology Concepts For Emergency Medical Technicians

*Captain Gene McDaniel BS, NREMT-P
Phoenix Fire Department
Phoenix, Arizona*



Drug Names

- Chemical Name
 - Precise description of the drug's chemical composition and molecular structure
 - 7-chloro-1, 3-dihydro-1methyl-5-phenyl-2H-1, 4-benzodiazepin-2-one
- Generic Name (Non-proprietary Name)
 - Official name approved by the FDA
 - Usually suggested by the first manufacturer
 - diazepam



Drug Names

- Official Name
 - The name assigned by the USP
 - diazepam, USP
- Trade Name (Proprietary Name)
 - The brand name registered to a specific manufacturer or owner
 - Valium ®



Sources of Medications

- Plants
 - morphine sulfate, atropine
- Animals and/or Humans
 - insulin, ACTH
- Minerals
 - sodium bicarb, calcium
- Synthetic (Chemical Substances)
 - lidocaine, diazepam



Drug Classification

- By Body System
 - Sympathetic Agonist, Anticholinergic
- Class of Agent
 - Antidysrhythmic, Analgesic
- Mechanism of Action
 - Calcium Channel Blocker, Diuretic



Sources of Drug Information

- Physicians Desk Reference (PDR)
- Hospital Formulary (HF)
- Drug Inserts
- Other texts/sources
 - Brady
 - Internet
 - Mosby
 - Jones and Bartlett



Components of a Drug Profile

- Brand name
- Generic name
- Classification
- Mechanism of action
- Indication
- Contraindication
- Route of administration
- Side effects/adverse reaction
- Adult & Pediatric dose
- Onset & duration



Scope of Management

- You are held responsible for safe and therapeutically effective drug administration
- Personally responsible for each drug you administer
 - Legally
 - Morally
 - Ethically



The “Six Rights” of Medication Administration

- Right Medication
- Right Dose
- Right Time
- Right Route
- Right Patient
- Right Documentation



General Properties of Drugs

- Drugs do not confer any new functions on a tissue or organ, they only modify existing functions
- Drugs in general exert multiple effects rather than a single effect
- Drug action results from a physiochemical interaction between the drug and a functionally important molecule in the body



Pharmacology

- **Pharmacokinetics**
- The study of how a drug enters the body, reaches its site of action, and is eliminated
- **Principles of pharmacokinetics (M/A)**
 - To exert its biomechanical effects on the body a drug must reach its targeted tissues in suitable form and significant concentration
- Principle of **pharmacodynamics**
 - Interactions at receptor sites



Pharmokinetics

- Mechanisms that affect pharmokinetics
 - Absorption
 - Distribution
 - Biotransformation
 - Excretion



Basic Drug Processes

- To produce a desired effect must be present in an appropriate concentration
 - At various sites of action
- Each drug undergoes four basic processes
- These processes influence the concentration at the site of action



The 4 Basic Drug Processes

- Absorption into the circulatory system
- Distribution throughout the body
- Biotransformation into its active form
- Elimination from the body



Absorption

- *Diffusion*
- Tendency of molecules to move from an area of higher concentration to lower
 - The molecules may be in the form of a gas, solid, or liquid
- Diffusion occurs through a semipermeable membrane



Absorption

- *Osmosis*
- Diffusion of fluid through a semipermeable membrane
- The principle flow being from the less dense to a more dense solution



Drug Concentration

- Concentration of a drug also affects rate of absorption
- Drugs administered in high concentrations are absorbed more rapidly than those administered in low concentrations



Rate of Drug Absorption

- Areas of high vascular supply have more rapid rate of absorption
- Areas of lower vascular supply (subcutaneous tissues) have slower rate
- A general rule is muscle has a higher vascular supply than sub-q tissues
 - Thus rate of absorption is faster in muscle than in sub-q tissues



Distribution

- The process whereby a drug is transported from the site of absorption to the site of action
- Once in the circulatory system a drug will be distributed throughout various body tissues



Distribution

- Organs with the greatest blood supply will receive drugs the fastest
 - Heart, brain, lungs, kidney
- Organs with a smaller blood supply will receive drugs more slowly
 - Skin, GI system, fat



Barriers to Distribution

- Drug distribution is also affected by physiological barriers
- These barriers may inhibit the movement of certain substances, but permit the passage of others



Barriers to Distribution

- Drug reservoirs
 - Plasma protein binding (molecules)
 - Tissue binding (adipose or fat)
- Barriers
 - Blood-brain barrier
 - Placental barrier



Barriers to Distribution

- Examples of these barriers are:
- Blood-brain barrier
- Blood-testes barrier
- Blood-placental barrier



Drug Metabolism

- In pharmacology the term *metabolism* often refers to making a drug more polar or water soluble
- Although this often results in drug inactivation and excretion, it's incorrect to assume that a metabolite will be less active or more easily excreted than the parent drug



Drug Metabolism

- Drugs, chemicals, and toxins are foreign to the body
- The body will attempt to rid itself of these substances, regardless of the therapeutic value of that substance



Drug Metabolism

- Most drugs must be biotransformed, or metabolized, before they can be excreted
- This occurs through a complex cascade of chemical reactions until they become chemically inactive



Drug Metabolism

- Metabolic reactions can transform.....
- An active drug into less active or inactive forms
- A prodrug (inactive or less active drug) into a more active drug



Drug Metabolism and Elimination

- All inactive chemicals, chemical by-products, and waste (often referred to as metabolites) are eventually excreted
- This is the process of elimination



The 4 Basic Drug Processes

- *Elimination*
- K= kidneys
- I= intestines
- L= liver
- L= lungs
- S= skin



Drug Metabolism and Elimination

- The rate of elimination varies with the drug and state of the body
- If the liver or kidneys do not function properly, drugs may not be properly metabolized or eliminated



Drug Metabolism and Elimination

- This may cause higher doses of medication to circulate for a longer period of time
- This produces symptoms of toxicity and over dosage
- A standard method of expressing how long it takes to metabolize and eliminate a drug is called the *half-life*



Drug Metabolism and Elimination

- The half-life is the time it takes to eliminate 50% of the drug from the body
- Because these rates are usually the same for most people, half-life helps determine dosage and frequency required for the administration of different drugs



Drug Forms

- Liquid
- Solid
- Gas



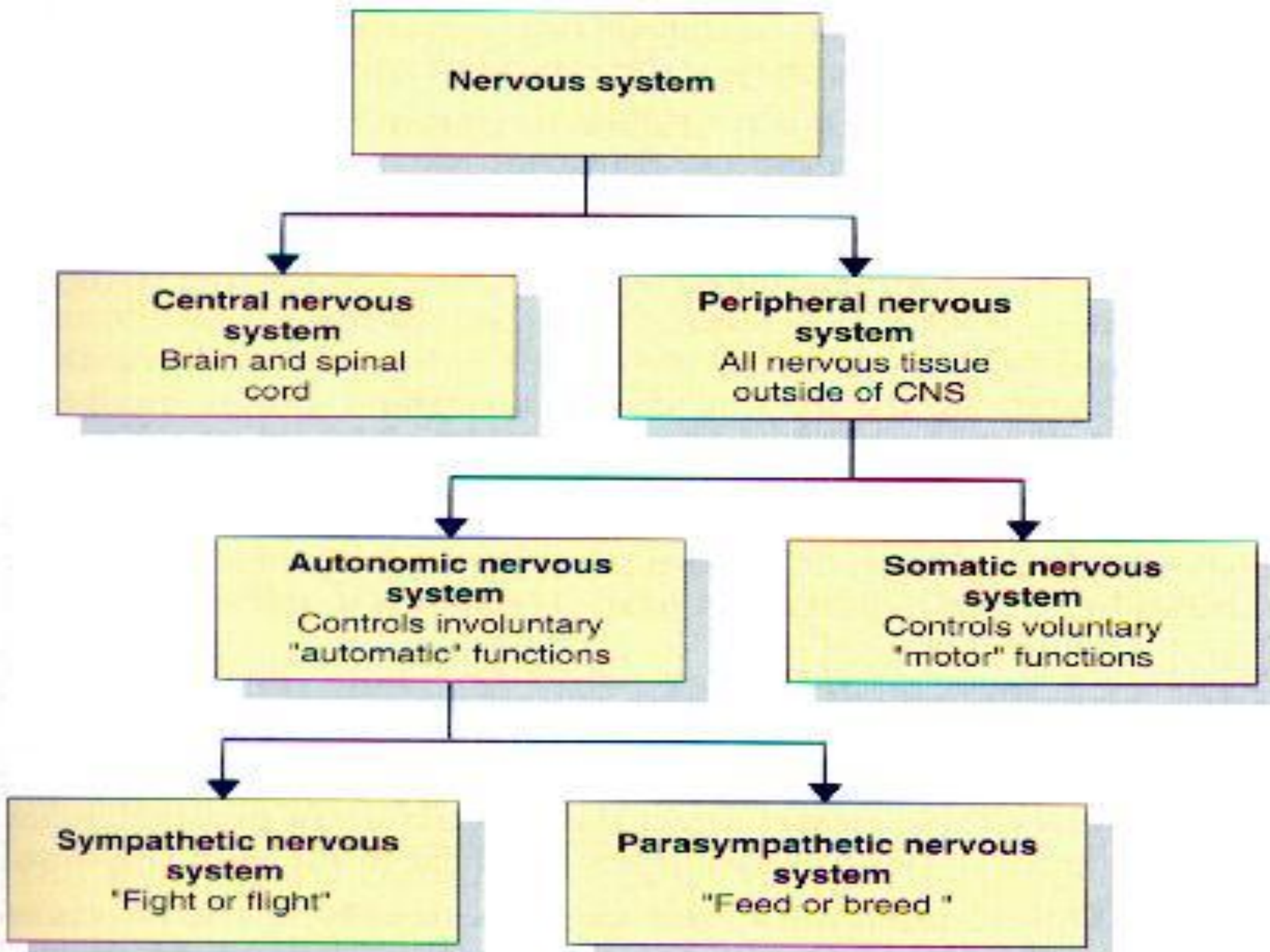
Routes of Drug Administration

- Effects the rate at which the onset of action occurs and may effect the therapeutic response that results



Autonomic Pharmacology

- Central Nervous System (CNS)
- Peripheral Nervous System
 - Somatic Nervous System
 - Autonomic Nervous System (ANS)
 - Sympathetic Branch
 - Parasympathetic Branch





Drug Receptor Interaction

- Affinity
 - Drug's propensity to bind or attach itself to a given receptor site
- Efficacy
 - Drug's ability to initiate biological activity as a result of binding to a receptor site



Drug Receptor Interaction

- Agonists
 - Drug that binds to a receptor site and causes a physiological response
- Antagonists
 - Drug that binds to a receptor site and prevents a physiological response or prevents another drug from binding to a receptor site



Type of Receptors

- Beta 1
- Beta 2
- Alpha 1
- Alpha 2



Beta Receptors

- Beta 1 Receptors
 - Located primarily in the heart
 - Cause increase in force of contraction and heart rate
- Beta 2 Receptors
 - Located primarily in the lungs
 - Dilate bronchioles & blood vessels
 - Relax smooth muscle



Alpha Receptors

- Alpha 1 Receptors
 - Located primarily in the vascular bed
 - Cause increase in contraction of arterial vessels



Predictable Responses

- Desired Action
 - Action or effect is seen that is consistent with why the drug was given
- Side Effects
 - Undesirable and often unavoidable effects of a drug
 - Action or effect other than those for which the drug was given



Unpredictable Adverse Reactions

- Allergic Reaction
 - Activates the Immune System
- Anaphylactic Reaction
 - Severe allergic reaction
- Idiosyncrasy
 - Drug effect unique to individual
 - Different than expected



Unpredictable Adverse Reactions

- Tolerance
 - Physiologic response that requires a drug dosage to be increased to produce the same effect
- Cross Tolerance
 - Tolerance after administration of a different drug
 - Morphine and other opioid agents



Drugs by Classification

- Analgesics and antagonists
- Anesthetics
- Antianxiety, sedative, and hypnotic drugs
- Anticonvulsants
- Central nervous system stimulants
- Psychotherapeutic drugs
- Antidepressant therapy



Beta Effects

- Cardiac acceleration and increased contractility
- Vasodilation of arterioles supplying the skeletal muscle
- Bronchial relaxation
- Uterine relaxation



Indirect Acting & Dual Acting Drugs

- Act indirectly on receptors by triggering the release of the catecholamines norepinephrine and epinephrine which then activates the alpha and beta receptors
- Example
 - Ephedrine Sulfate



Drugs that Affect the Blood

- Anti-Platelet Aggregant



Anticoagulants

- Drugs that interfere with platelet aggregation
- Also known as *antiplatelet* or *antithrombotic* drugs
 - *Aspirin*



Bronchodilators

- Administered via inhalation via a nebulizer or a pressurized cartridge
- Sympathomimetics categorized by receptor action
 - Selective beta2 receptor drugs



Bronchodilators

- *Albuterol*
- *Atrovent*
- *Combi-Vent*



Epinephrine

- ***EPI-Pen Adult***

- ***EPI-Pen Peds***



Captain Gene McDaniel
Phoenix Fire Department

gm1466@yahoo.com