

**1 – Introduction to Pharmacology: Basic Principles**

- 1) Which of the following is NOT part of the etymology of the word pharmacology?
- a) Medicine
  - b) Drug
  - c) Herb
  - d) Poison
  - e) Study
- 2.1) Which of the following describes an agonist?
- a) Any substance that brings about a change in biologic function through its chemical action
  - b) A specific regulatory molecule in the biologic system where a drug interacts
  - c) A drug that binds to a receptor and stimulates cellular activity
  - d) A drug that binds to a receptor and inhibits or opposes cellular activity
  - e) A drug directed at parasites infecting the patient
- 2.2) Xenobiotics are considered:
- a) Endogenous
  - b) Exogenous
  - c) Inorganic poisons
  - d) Toxins
  - e) Ligands
- 2.3) Which of the following would be a toxin (poison of biological origin)?
- a) Pb
  - b) As
  - c) Hg
  - d) Atropine
- 2.4) The vast majority of drugs have molecular weights (MW) between 100 and 1,000. Large drugs, such as alteplase (t-PA), must be administered:
- a) Into the compartment where they have their effect
  - b) Orally so they do not absorb too quickly
  - c) Rectally to prevent irritation to the stomach lining and vessels
  - d) Via the intraosseous (IO) route
  - e) Titrated with buffering agents to prevent cell lysis
- 2.5) Which of the following occurs with drugs that are extremely small, such as Lithium?
- a) Receptor mediated endocytosis
  - b) Minor drug movement within the body
  - c) Vasodilation when injected intravenously (IV)
  - d) Specific receptor binding
  - e) Nonspecific binding
- 2.6) Drugs fit receptors using the lock and key model. Covalent bonds are the \_\_\_\_ and the \_\_\_\_ specific.
- a) Strongest; Most
  - b) Strongest; Least
  - c) Weakest; Most
  - d) Weakest; Least

2.7) Warfarin (Coumadin) is given as a racemic mixture with the S enantiomer being four times more active than the R enantiomer. If the mixture of Warfarin given is 50% S and 50% R, what is the potency compared with a 100% R enantiomer solution?

- a)  $4 * R + 1 * S = 1$
  - b)  $4 * R + 1 * S = 1.5$
  - c)  $4 * R + 1 * S = 2$
  - d)  $4 * R + 1 * S = 2.5$
  - e)  $4 * R + 1 * S = 4$
- 2.8) What determines the degree of movement of a drug between body compartments?
- a) Partition constant
  - b) Degree of ionization
  - c) pH
  - d) Size
  - e) All of the above
- 3.1) Which of the following is NOT a protein target for drug binding?
- a) Side of action (transport)
  - b) Enzymes
  - c) Carrier molecules
  - d) Receptors
  - e) Ion channels
- 3.2) Which of the following is an example of a drug acting directly through receptors?
- a) Protamine binds stoichiometrically to heparin anticoagulants
  - b) Adrenergic beta blockers for thyroid hormone-induced tachycardia
  - c) Epinephrine for increasing heart rate and blood pressure
  - d) Cancer chemotherapeutic agents
  - e) Mannitol for subarachnoid hemorrhage
- 4.1) What is added with drug subclassification, such as an antitubercular drug versus an antibacterial drug?
- a) Cost
  - b) Size
  - c) Ionization
  - d) Precision
  - e) Speed
- 4.2) What type of drug is propranolol (Inderal)?
- a) Anticonvulsive
  - b) Antihypertensive
  - c) Antinauseant
  - d) Antihistamine
  - e) Antipyretic
- 5.1) Which of the following is considered the brand name?
- a) Propranolol
  - b) Inderal
  - c) Adrenergic  $\beta$ -blocker
  - d) "off label" use
  - e) Blocks  $\beta$ -receptors in heart myocardium
- 5.2) Which of the following is considered the class?

- a) Propranolol
  - b) Inderal
  - c) Adrenergic  $\beta$ -blocker
  - d) “off label” use
  - e) Blocks  $\beta$ -receptors in heart myocardium
- 5.3) Which of the following cases would be contraindicated for propranolol (Inderal)?
- a) Hypertension
  - b) Essential tremor
  - c) Angina
  - d) Tachycardia
  - e) Asthma
- 5.4) Which of the following adverse effects (side-effects) is NOT commonly seen with cholinergic antagonists?
- a) Blurred vision
  - b) Confusion
  - c) Miosis
  - d) Constipation
  - e) Urinary retention
- 6.1) The drug chloramphenicol (Chloromycetin) is risky for which of the following?
- a) Neonates
  - b) Geriatric patients
  - c) Adult males
  - d) Obese patients
  - e) Congestive heart failure patients
- 6.2) How does the glomerular filtration rate (GFR) change after the age of 40?
- a) Increase 1% each year
  - b) Increases 2% each year
  - c) Decreases 1% each year
  - d) Decreases 2% each year
  - e) Does not depend on age
- 6.3) A decrease in renal and liver function, as seen in the elderly, would prolong drug half-life, \_\_\_\_ plasma protein binding, and \_\_\_\_ volume of distribution.
- a) Increase; Increase
  - b) Decrease; Decrease
  - c) Increase; Decrease
  - d) Decrease; Increase
- 6.4) When prescribing isoniazid (Rimifon), pharmacogenetics must be considered as >90% of Asians and certain other groups are \_\_\_\_ acetylators, and thus have a \_\_\_\_ blood concentration of a given dose and a decreased risk of toxicity.
- a) Slow; Increased
  - b) Slow; Decreased
  - c) Fast; Increased
  - d) Fast; Decrease
- 6.5) Which of the following are the two modifying factors that contribute to why women have higher blood peak concentrations of alcohol than men when consuming equivalent amounts?

- a) Lower blood volume & increased hormones
- b) Lower fat content & more gastric alcohol dehydrogenase (ADH)
- c) Higher fat content & more gastric alcohol dehydrogenase (ADH)
- d) Lower fat content & less gastric alcohol dehydrogenase (ADH)
- e) Higher fat content & less gastric alcohol dehydrogenase (ADH)

## 2 – Pharmacokinetic Principles: Drug Movement

1) Pharmacokinetics is the effect of the \_\_\_\_\_ and pharmacodynamics is the effect of the \_\_\_\_\_.

- a) Drug on a drug; Body on the drug
  - b) Body on the drug; Drug on a drug
  - c) Drug on the body; Body on the drug
  - d) Body on the drug; Drug on the body
  - e) Drug on a drug; Drug on a drug
- 2.1) Which of the following is NOT an action of the body on a drug?
- a) Absorption
  - b) Distribution
  - c) Metabolism
  - d) Excretion
  - e) Side effects
- 3) If a drug is 80% bound to blood elements or plasma proteins, what part is considered the free form?
- a) 20%
  - b) 40%
  - c) 50%
  - d) 80%
  - e) 100%
- 4.1) Which of the following describes minimal effective concentration (MEC)?
- a) The minimal drug plasma concentration that can be detected
  - b) The minimal drug plasma concentration to enter tissues
  - c) The minimal drug plasma concentration to interact with receptors
  - d) The minimal drug plasma concentration to produce effect
  - e) The minimal drug plasma concentration to reach therapeutic levels
- 4.2) If a patient misses three doses of their daily drug, which of the following (in general) is the best solution?
- a) Take a 4x dose at the next dose time
  - b) Wait 3 more days (week total) then return to normal regimen
  - c) Do nothing and continue normal regimen
  - d) Setup an appointment to have the patient evaluated
  - e) Prescribe a higher dosage pill so missed doses will have less effect
- 4.3) Blood levels of a drug correlate to the effectiveness of that drug, such as with pentazocine (Talwin) or phenobarbital (Luminal).
- a) True
  - b) False
- 5.1) Which of the following drug permeation mechanisms involves polar substances too large to enter cells by other means, such as iron or vitamin B12?

- a) Aqueous diffusion
  - b) Lipid diffusion
  - c) Carrier molecules
  - d) Endocytosis and exocytosis
- 5.2) Which of the following drug permeation mechanisms occurs across epithelial tight junctions and is driven by a concentration gradient?
- a) Aqueous diffusion
  - b) Lipid diffusion
  - c) Carrier molecules
  - d) Endocytosis and exocytosis
- 5.3) Which of the following drug permeation mechanisms uses the Henderson-Hasselbalch equation for the ratio of solubility for the weak acid or weak base?
- a) Aqueous diffusion
  - b) Lipid diffusion
  - c) Carrier molecules
  - d) Endocytosis and exocytosis
- 5.4) Which of the following drug permeation mechanisms is used for peptides, amino acids, glucose, and other large or insoluble molecules?
- a) Aqueous diffusion
  - b) Lipid diffusion
  - c) Carrier molecules
  - d) Endocytosis and exocytosis
- 5.5) Which of the following drug permeation mechanisms uses caveolae?
- a) Aqueous diffusion
  - b) Lipid diffusion
  - c) Carrier molecules
  - d) Endocytosis and exocytosis
- 6.1) Using the Fick Law of Diffusion, how will flux change if membrane thickness is doubled?
- a) It will double
  - b) It will quadruple
  - c) It will halve
  - d) It will quarter
  - e) It will not change
- 6.2) Using the Fick Law of Diffusion, how will flux change if the permeability coefficient is quadrupled?
- a) It will double
  - b) It will quadruple
  - c) It will halve
  - d) It will quarter
  - e) It will not change
- 7.1) Which of the following is the amount of a drug absorbed per the amount administered?
- a) Bioavailability
  - b) Bioequivalence
  - c) Drug absorption

- d) Bioinequivalence
  - e) Dosage
- 7.2) Which of the following is NOT needed for drug bioequivalence?
- a) Same active ingredients
  - b) Same strength or concentration
  - c) Same dosage form
  - d) Same route of administration
  - e) Same side effects
- 7.3) For intravenous (IV) dosages, what is the bioavailability assumed to be?
- a) 0%
  - b) 25%
  - c) 50%
  - d) 75%
  - e) 100%
- 7.4) Although morphine (Avinza, Oramorph SR, MS Contin) is well-absorbed when administered orally (PO), how much of the drug is metabolized on its first pass through the liver?
- a) 90%
  - b) 70%
  - c) 50%
  - d) 30%
  - e) 10%
- 7.5) For a generic drug to be bioequivalent to an innovator drug (per FDA), it must be measured in \_\_\_\_ of subjects to fall within \_\_\_\_ of the mean of the test population bioavailability.
- a) 50; 50
  - b) 80; 20
  - c) 20; 80
  - d) 95; 5
  - e) 5; 95
- 7.6) Using the FDA bioequivalence rule, how much variation could a generic drug potentially have from an innovator and still be considered equivalent?
- a) 100%
  - b) 20%
  - c) 40%
  - d) 60%
  - e) 80%
- 8.1) Which of the following is NOT a pharmacokinetic process?
- a) Alteration of the drug by liver enzymes
  - b) Drug metabolites are removed in the urine
  - c) Movement of drug from the gut into general circulation
  - d) The drug causes dilation of coronary vessels
  - e) The drug is readily deposited in fat tissue
- 8.2) Which of the following can produce a therapeutic response? A drug that is:
- a) Bound to plasma albumin
  - b) Concentrated in the bile

- c) Concentrated in the urine
  - d) Not absorbed from the GI tract
  - e) Unbound to plasma proteins
- 8.3) Which of the following most correctly describes steroid hormones with respect to their ability to gain access to intracellular binding sites?
- a) They cross the cell membrane via aqueous pores
  - b) They have a high permeability coefficient
  - c) They are passively transported via membrane carriers
  - d) They require vesicular transport
  - e) Their transport requires the hydrolysis of ATP

### 3 – Pharmacokinetic Principles: pH and Drug Movement

- 1) Most drugs are either \_\_\_\_ acids or \_\_\_\_ bases.
- a) Strong; Strong
  - b) Strong; Weak
  - c) Weak; Weak
  - d) Weak; Strong
- 2.1) Aspirin readily donates a proton in aqueous solutions and pyrimethamine readily accepts a proton in aqueous solution. Thus, aspirin is a(b) \_\_\_\_ and pyrimethamine is a(n) \_\_\_\_.
- a) Acid; Base
  - b) Base; Acid
  - c) Acid; Acid
  - d) Base; Base
- 2.2) Given the equilibrium  $HA \rightleftharpoons A^- + H^+$  (acid) and  $BH^+ \rightleftharpoons B + H^+$  (base), in an acid environment (low pH) the acid reaction will move to the \_\_\_\_ and the base reaction will move to the \_\_\_\_.
- a) Right; Left
  - b) Right; Right
  - c) Left; Right
  - d) Left; Left
- 3.1) What form of a drug is more lipid-soluble, and thus would remain trapped within a compartment where the pH does not favor the lipid-soluble form?
- a) Strong acid ( $A^-$ )
  - b) Weak acid ( $A^-$ )
  - c) Neutral ( $AH$  and  $B$ )
  - d) Weak base ( $BH^+$ )
  - e) Strong base ( $BH^+$ )
- 3.2) The lipid-soluble form of a base is \_\_\_\_ and the lipid-soluble form of an acid is \_\_\_\_.
- a) Protonated; Protonated
  - b) Protonated; Unprotonated
  - c) Unprotonated; Unprotonated
  - d) Unprotonated; Protonated

- 4.1) If the pKa of Aspirin (acetylsalicylic acid) is 3.5 and the pH of the stomach is 2.5, how much Aspirin is in the protonated species in the stomach and is this the amount available for absorption?
- a)  $\approx 91\%$ ; Yes
  - b)  $\approx 91\%$ ; No
  - c)  $\approx 9\%$ ; Yes
  - d)  $\approx 9\%$ ; No
- 4.2) What percentage of Aspirin would be ionized in the blood compartment (pH = 7.4) assuming pH is 7.5 and Aspirin pKa is 3.5?
- a)  $(10,000 - 1) / 1 = 99.99\%$
  - b)  $(100 - 1) / 1 = 99\%$
  - c) None
  - d)  $1 / (100 - 1) = 0.9\%$
  - e)  $1 / (10,000 - 1) = 0.009\%$
- 4.3) If the pH - pKa = -1, what percentage of weak base is nonionized?
- a) 99
  - b) 90
  - c) 50
  - d) 10
  - e) 1
- 4.4) If the pH - pKa = 2, what percentage of weak acid is nonionized?
- a) 99
  - b) 90
  - c) 50
  - d) 10
  - e) 1
- 4.5) If pH > pKa, the drug is \_\_\_\_ and if pH < pKa, the drug is \_\_\_\_\_. An unprotonated acid is \_\_\_\_ and a protonated base is \_\_\_\_\_.
- a) Protonated; Unprotonated; Charged; Charged
  - b) Protonated; Unprotonated; Neutral; Neutral
  - c) Unprotonated; Protonated; Charged; Charged
  - d) Unprotonated; Protonated; Neutral; Charged
  - e) Unprotonated; Protonated; Charged; Neutral
- 5.1) Weak acids are excreted faster in \_\_\_\_ urine and weak bases are excreted faster in \_\_\_\_ urine.
- a) Acidic; Alkaline
  - b) Alkaline; Acidic
  - c) Acidic; Neutral
  - d) Neutral; Alkaline
  - e) Alkaline; Neutral
- 5.2) A patient presents with an overdose of acidic Aspirin. The drug \_\_\_\_ can be given to \_\_\_\_ the pH of the urine and trap the Aspirin, preventing further metabolism.
- a) NaHCO<sub>3</sub>; Increase
  - b) NaHCO<sub>3</sub>; Decrease
  - c) NH<sub>4</sub>Cl; Increase
  - d) NH<sub>4</sub>Cl; Decrease

5.3) A patient presents with an overdose of alkaline Codeine. The drug \_\_\_\_ can be given to \_\_\_\_ the pH of the urine and trap the Codeine, preventing further metabolism.

- a)  $\text{NaHCO}_3$ ; Increase
- b)  $\text{NaHCO}_3$ ; Decrease
- c)  $\text{NH}_4\text{Cl}$ ; Increase
- d)  $\text{NH}_4\text{Cl}$ ; Decrease

6.1) The principle of drug manipulation for excretion of a drug out of the renal tubule can be accomplished by:

- a) Acidifying the urinary pH
- b) Adjusting the urinary pH to protonate weakly acidic drugs
- c) Adjusting the urinary pH to unprotonate weakly basic drugs
- d) Adjusting the urinary pH to ionize the drug
- e) By neutralizing the urinary pH

6.2) Aspirin is a weak organic acid with a pKa of 3.5. What percentage of a given dose will be in the lipid-soluble form at a stomach pH of 1.5?

- a) About 1%
- b) About 10%
- c) About 50%
- d) About 90%
- e) About 99%

6.3) For which of the following drugs is excretion most significantly accelerated by acidification of the urine?

- a) Weak acid with pKa of 5.5
- b) Weak acid with pKa of 3.5
- c) Weak base with pKa of 7.5
- d) Weak base with pKa of 7.1

6.4) A patient diagnosed with type 2 diabetes is administered an oral dose of 0.1 mg chlorpropamide, an insulin secretagogue and weak acid with a pKa of 5.0. What is the amount of this drug that could be absorbed from the stomach at pH 2.0?

- a) 99.9  $\mu\text{g}$
- b) 90  $\mu\text{g}$
- c) 50  $\mu\text{g}$
- d) 0.05 mg
- e) 0.01 mg

#### 4 – Pharmacokinetic Principles: Absorption

1) Bioavailability (F) is the fraction or percentage of administered drug that reaches the systemic circulation via a given route as compared to what route?

- a) Oral
- b) IV (intravenous)
- c) IO (intraosseous)
- d) CSF (cerebrospinal fluid)
- e) Whatever route attains the target drug concentration in plasma (CT)

2) What organ is responsible for metabolism in the “first pass effect”?

- a) Brain
- b) Heart

- c) Kidney
  - d) Liver
  - e) Spleen
- 3.1) A patient is in the hospital and is stable on digoxin 0.175 mg IV qd (daily). How much digoxin in mg. would you need to give your patient orally, given that the bioavailability for oral digoxin tablets is 0.7?
- a)  $(0.175 * 0.7) / (1.0) = 0.1225$  mg
  - b)  $(0.175 * 1) / (0.7) = 0.25$  mg
  - c)  $(0.175 + 0.7) / (1.0) = 0.875$  mg
  - d)  $(0.175 + 1) / (0.7) = 1.67$  mg
  - e) No change is necessary
- 3.2) Given a graph of plasma drug concentration versus time, what part of the graph would be used to calculate bioavailability for a PO (oral) drug administration?
- a) Maximum concentration
  - b) Steady concentration
  - c) Derivative of the curve (slope)
  - d) Integral of the curve (area underneath)
  - e) The curve is not used to calculate bioavailability
- 4.1) Which of the following routes of administration has a bioavailability of about 80-100%, is usually very slow absorbing, and has prolonged duration of action?
- a) IV (intravenous)
  - b) IM (intramuscular)
  - c) SQ (subcutaneous)
  - d) Rectal
  - e) Transdermal
- 4.2) Which of the following routes of administration is the most convenient, although may have a bioavailability anywhere from 5-100%?
- a) PO (oral)
  - b) IV (intravenous)
  - c) IM (intramuscular)
  - d) SQ (subcutaneous)
  - e) Transdermal
- 4.3) Which of the following enteral administration routes has the largest first-pass effect?
- a) SL (sublingual)
  - b) Buccal
  - c) Rectal
  - d) Oral
- 4.4) Epithelial cells are connected by \_\_\_\_\_, which are tough to cross and materials often must pass through the cells. Endothelial cells of blood vessels are connected by \_\_\_\_\_, which proteins cannot cross but smaller drugs (MW 200-500) can.
- a) Macular gap junctions; Tight junctions
  - b) Tight junctions; Macular gap junctions
  - c) Adherens junctions; Tight junctions
  - d) Tight junctions; Adherens junctions
  - e) Macular gap junctions; Adherens junctions

- 4.5) Which of the following administration routes is not often used, is painful, and has a risk of infection and adhesion?
- a) EPI (epidural)
  - b) IA (intraarterial)
  - c) IP (intraperitoneal)
  - d) IV (intravenous)
  - e) IO (intraosseous)
- 4.6) Which of the following is NOT an advantage of prolonged release medications?
- a) Less frequent administration
  - b) Therapeutic effect overnight
  - c) Lower incidence of side effects
  - d) Patient compliance
  - e) More fluctuation in plasma concentration
- 4.7) What is the common location for the scopolamine motion sickness transdermal patch?
- a) Side of the hip
  - b) Chest
  - c) Over the deltoid muscle
  - d) Behind the ear
  - e) On the back of the neck

### **5 – Pharmacokinetic Distribution: Basics**

- 1.1) Which of the following would receive drug slowly?
- a) Liver
  - b) Brain
  - c) Fat
  - d) Muscle
  - e) Kidney
- 1.2) Which of the following is the least important for passage through capillary walls but the most important for passage through the cell wall?
- a) Molecular size
  - b) Lipid solubility
  - c) Diffusion constant
  - d) pH
  - e) pKa
- 1.3) Which of the following is the most important for movement through capillary walls?
- a) Molecular size
  - b) Lipid solubility
  - c) Diffusion constant
  - d) pH
  - e) pKa
- 1.4) Which of the following locations would most trap a lipid soluble drug?
- a) Blood
  - b) Intestines
  - c) Brain
  - d) Stomach

- 1.5) What type of drugs can cross the blood-brain barrier (BBB)?
- Large and lipid-soluble
  - Large and lipid-insoluble
  - Small and lipid-soluble
  - Small and lipid-insoluble
- 2.1) Acidic drugs, such as phenytoin, bind primarily to which of the following plasma proteins?
- $\alpha$ 1-fetoprotein (AFP)
  - GC Globulin
  - Albumin
  - $\alpha$ 1-acid glycoprotein (AAG)
  - Transcortin
- 2.2) Basic drugs, such as lidocaine, bind primarily to which of the following plasma proteins?
- $\alpha$ 1-fetoprotein (AFP)
  - Gc-Globulin (GcG)
  - Albumin
  - $\alpha$ 1-acid glycoprotein (AAG)
  - Transcortin
- 3.1) A decrease in drug-protein binding will lead to which of the following?
- Decrease in the unbound drug concentration
  - Increase in free drug
  - Increase in rate of drug elimination
  - Decrease in volume of distribution
- 3.2) A patient presents with acute-onset cirrhosis of the liver. They are found to have hypoalbuminemia. In severe cirrhosis it is expected that AAG will be decreased, but the patient presents with increased AAG due to the inflammatory response. Which of the following is the most likely?
- Increased acidic drug binding and increased basic drug binding
  - Increased acidic drug binding and decreased basic drug binding
  - Decreased acidic drug binding and increased basic drug binding
  - Decreased acidic drug binding and decreased basic drug binding
- 3.3) Which of the following is NOT a site of loss (where drug is not used)?
- Fat
  - GI tract
  - Muscle
  - Site lacking receptors
- 4.1) Which of the following locations can accumulate lipid-soluble drugs, has little or no receptors, and can hold distributed drugs like barbiturates?
- Liver
  - Kidney
  - Brain
  - Fat
  - Fetus
- 4.2) Which of the following locations has high blood flow and is a site of excretion?
- Liver

- b) Kidney
  - c) Brain
  - d) Fat
  - e) Fetus
- 4.3) Anything affecting renal perfusion will affect drug delivery to the kidney, drug excretion, and drug levels in the blood.
- a) True
  - b) False
- 4.4) Which of the following can be treated with drugs due to a leaky area in the blood-brain barrier near the medulla?
- a) Seizures
  - b) Shivers
  - c) Diarrhea
  - d) Nausea
  - e) Vomiting
- 4.5) What is the approximate lag time for equilibration between maternal blood and fetal tissues?
- a) 20 mins
  - b) 40 mins
  - c) 1 hour
  - d) 2 hours
  - e) 6 hours

*Match the body compartment with the volume, assuming a 70kg male patient:*

- 5.1) Total body            a) 4
  - 5.2) Plasma                b) 10
  - 5.3) Interstitial          c) 14
  - 5.4) Extracellular        d) 28
  - 5.5) Intracellular        e) 42
- 5.6) If protein plasma binding is decreased, how will volume of distribution be affected?
- a) Increased
  - b) Decreased
  - c) Not changed
- 5.7) 400 mg of a drug is administered to a patient and the drug is later measured in plasma to be 1  $\mu\text{g/ml}$ . What is the apparent volume of distribution (Vd)?
- a) 0.04 L
  - b) 0.4 L
  - c) 4 L
  - d) 40 L
  - e) 400 L
- 5.8) Elderly patients often have \_\_\_\_ muscle mass and thus a(n) \_\_\_\_ Vd.
- a) More; Increased
  - b) More; Decreased
  - c) Less; Increased
  - d) Less; Decreased
- 5.9) Patients with ascites or edema would have \_\_\_\_ Vd for hydrophilic drugs, such as gentamicin.

- a) Increased
- b) Decreased
- c) Unchanged

### 6 – Pharmacokinetics: Drug Metabolism

- 1.1) Which of the following locations is the most likely for finding a free, unaltered drug?
- a) Urine
  - b) Feces
  - c) Breast milk
  - d) Fat
  - e) Sweat
- 1.2) Most drugs are active in their \_\_\_\_ form and inactive in their \_\_\_\_ form.
- a) Non-polar; Polar
  - b) Polar; Non-polar
  - c) Water-soluble; Lipid-soluble
  - d) Lipid-insoluble; Water-insoluble
  - e) Neutral; Neutral
- 2.1) Drug biotransformation phase I makes drugs \_\_\_\_ polar for metabolism and phase II makes drugs \_\_\_\_ polar for excretion.
- a) More; More
  - b) More; Less
  - c) Less; More
  - d) Less; Less
- 2.2) Which of the following is NOT a phase II substrate?
- a) Glucuronic acid
  - b) Sulfuric acid
  - c) Acetic acid
  - d) Amino acids
  - e) Alcohol
- 3) Which of the following reactions is phase II and NOT phase I?
- a) Oxidations
  - b) Reductions
  - c) Conjugations
  - d) Deaminations
  - e) Hydrolyses
- 4) Which of the following metabolically active tissues is the principle organ for drug metabolism?
- a) Skin
  - b) Kidneys
  - c) Lungs
  - d) Liver
  - e) GI Tract
- 5.1) Damage at which of the following locations would most affect the goals of phase II biotransformation?
- a) Skin
  - b) Kidneys

- c) Lungs
- d) Liver
- e) GI Tract

*Match the biotransformation reaction with the drug:*

- |  |                  |
|--|------------------|
| 5.2) Hydroxylation of aromatic ring to increase polarity | a) Codeine       |
| 5.3) N-dealkylation                                      | b) Morphine      |
| 5.4) Sulfoxidation                                       | c) Thioridazine  |
| 5.5) O-dealkylation                                      | d) Nicotine      |
| 5.6) N-oxidation   | e) Phenobarbitol |
| 5.7) Side chain oxidation with -OH to increase polarity  | f) Pentobarbitol |
| 5.8) Conversion to glutathione and reactive intermediate | g) Acetaminophen |
- 6.1) What is the goal of the P450 system (microsomes pinched off from endoplasmic reticulum)?

- a) Metabolism of substances
- b) Detoxification of substances
- c) Increasing pH of compartments containing substances
- d) Decreasing pH of compartments containing substances
- e) A & B

6.2) Regarding the microsomal drug metabolizing system, a patient with late stage alcoholism and liver damage would have more ETOH available due to which of the following concepts?

- a) Increased induction
- b) Decreased induction
- c) Increased inhibition
- d) Decreased inhibition

6.3) Regarding the microsomal drug metabolizing system, a patient who is a chronic user of barbiturates would need more drug to produce the same effects due to which of the following concepts?

- a) Increased induction
- b) Decreased induction
- c) Increased inhibition
- d) Decreased inhibition

6.4) Which of the following are the drugs that induce CYP 1A2 and the drugs that have their metabolism induced by 1A2?

- a) Carbamazepine & phenobarbitol; Theophylline & warfarin
- b) Phenobarbitol & phenytoin; Phenytoin & warfarin
- c) Carbamazepine & phenytoin; Warfarin
- d) Carbamazepine; Cyclosporine

6.5) Which of the following are the drugs that inhibit CYP 1A2 and the drugs that have their metabolism inhibited by 1A2?

- a) SSRIs; Phenytoin & warfarin
- b) Amiodarone & cimetidine; Phenytoin & warfarin
- c) Cimetidine, erythromycin, & grapefruit juice; Theophylline & warfarin
- d) Cimetidine & erythromycin; Cyclosporine

6.6) Which of the following groups of people is the least likely to have biotransformation effects due to altered hepatic function?

- a) Infants
  - b) Adults
  - c) Elderly
  - d) Chronic alcoholics
  - e) Acetaminophen overdoses
- 6.7) In what location does amino acid conjugation of glycine (e.g. salicylic acid) take place?
- a) Microsomal
  - b) Cytosol
  - c) Mitochondria
- 6.8) Where does acetylation conjugation (e.g. isoniazid) and sulfate conjugation (e.g. acetaminophen) take place?
- a) Microsomal
  - b) Cytosol
  - c) Mitochondria
- 6.9) Where does glucuronide conjugation (e.g. digoxin, bilirubin) take place?
- a) Microsomal
  - b) Cytosol
  - c) Mitochondria
- 6.10) What is a result of conjugation of isoniazid via N-acetylation?
- a) Detoxification of liver
  - b) Detoxification of kidneys
  - c) Detoxification of blood
  - d) Detoxification of urine
  - e) Hepatotoxicity

## 7 – Pharmacokinetics: Principles of Eliminations

- 1.1) One liter contains 1,000 mg of a drug. After one hour, 900 mg of the drug remains. What is the clearance?
- a) 100 mL
  - b) 100 mL/hr
  - c) 1 mg/ml
  - d) 100 mg
  - e) 1 mg/sec
- 1.2) To maintain a drug concentration at steady state, the dosing rate should equal the elimination rate. Which of the following is true? (CL = Drug Clearance)
- a) Dosing rate = CL + target concentration
  - b) Dosing rate = CL - target concentration
  - c) Dosing rate = CL \* target concentration
  - d) Dosing rate = CL / target concentration
- 1.3) Which of the following is most useful in determining the rate of elimination of a drug, in general?
- a) Drug concentration in urine (renal elimination)
  - b) Drug concentration in stool (biliary elimination)
  - c) Drug concentration in blood
  - d) Drug concentration in brain

- e) Drug oxidation rate
- 2.1) For first-order drug elimination, half-life  $t(1/2)$  is \_\_\_\_ at two places on the curve and a constant \_\_\_\_ is lost per unit time.
- a) Equal; Amount
  - b) Equal; Percentage
  - c) Not equal; Amount
  - d) Not equal; Percentage
- 2.2) For first-order drug elimination, given the half-life equation of  $t(1/2) = (0.693 * Vd) / CL$ , how many half-lives would be necessary to reach steady state ( $\approx 95\%$ ) without a loading dose?
- a) 1 to 2
  - b) 2 to 3
  - c) 3 to 4
  - d) 4 to 5
  - e) 5 to 6
- 2.3) Which of the following is NOT a drug exhibiting zero-order elimination kinetics?
- a) Aspirin
  - b) Morphine
  - c) Phenytoin
  - d) ETOH
- 2.4) For zero-order drug elimination, half-life  $t(1/2)$  is \_\_\_\_ at two places on the curve and a constant \_\_\_\_ is lost per unit time.
- a) Equal; Amount
  - b) Equal; Percentage
  - c) Not equal; Amount
  - d) Not equal; Percentage
- 2.5) If a drug with a 2-hour half life is given with an initial dose of 8 mcg/ml, assuming first-order kinetics, how much drug will be left at 6 hours?
- a) 8 mcg/ml
  - b) 4 mcg/ml
  - c) 2 mcg/ml
  - d) 1 mcg/ml
  - e) 0.5 mcg/ml
- 3.1) What are the units for steady-state concentration ( $C_{ss}$ ), or infusion rate over clearance?
- a) mg/min
  - b) ml/min
  - c) mg/ml
  - d) ml/mg
  - e) min/mg
- 3.2) What percentage of the steady-state drug concentration is achieved at  $3.3 * t(1/2)$ ?
- a) 10%
  - b) 25%
  - c) 50%
  - d) 75%
  - e) 90%

4.1) Increasing the rate of infusion changes the time necessary to reach the steady-state concentration.

- a) True
- b) False

4.2) An injection of two units of a drug once-daily (qd) will yield the same steady-state concentration as an injection of one unit of a drug twice-daily (bid).

- a) True
- b) False

5.1) Which of the following drugs would most likely need a loading dose to help reach therapeutic levels?

- a) Acetaminophen,  $t(1/2) = 2$  h
- b) Aspirin,  $t(1/2) = 15$  m
- c) Tetracycline,  $t(1/2) = 11$  h
- d) Digitoxin,  $t(1/2) = 161$  h
- e) Adenosine,  $t(1/2) = 10$  s

5.2) A target concentration of 7.5 mg/L of theophylline is required for a 60 kg patient. What is the loading dose, given the following:  $V_d = 0.5$  L/kg,  $Cl = 0.04$  L/kg/hr,  $t(1/2) = 9.3$  hr?

- a)  $0.5$  L/kg \*  $60$  kg \*  $7.5$  mg/L = 225 mg/h, infusion
- b)  $0.5$  L/kg \*  $60$  kg \*  $7.5$  mg/L = 225 mg, bolus
- c)  $0.04$  L/kg/hr \*  $60$  kg \*  $7.5$  mg/L = 18 mg/h, infusion
- d)  $0.04$  L/kg/hr \*  $60$  kg \*  $7.5$  mg/L = 18 mg, bolus

5.3) A target concentration of 7.5 mg/L of theophylline is required for a 60 kg patient. What is the steady state maintenance dose, given the following:  $V_d = 0.5$  L/kg,  $Cl = 0.04$  L/kg/hr,  $t(1/2) = 9.3$  hr?

- a)  $0.5$  L/kg \*  $60$  kg \*  $7.5$  mg/L = 225 mg/h, infusion
- b)  $0.5$  L/kg \*  $60$  kg \*  $7.5$  mg/L = 225 mg, bolus
- c)  $0.04$  L/kg/hr \*  $60$  kg \*  $7.5$  mg/L = 18 mg/h, infusion
- d)  $0.04$  L/kg/hr \*  $60$  kg \*  $7.5$  mg/L = 18 mg, bolus

## 8 – Drug Evaluation and Regulation

1) Which of the following is NOT an approach to drug development?

- a) Chemical modification of a known molecule
- b) Random screening for biologic activity (e.g. natural products)
- c) Rational drug design
- d) Combination of known drugs (e.g. Tylenol with codeine)
- e) Biotechnology and cloning

2.1) Drug screening for an anti-infectious agent would study the drug against a variety of infectious organisms (\_\_\_\_) and against non-infectious assays (\_\_\_\_).

- a) Power; Specificity
- b) Sensitivity; Side-effects
- c) Activity; Selectivity
- d) Selectivity; Activity
- e) Specificity; Power

2.2) Which of the following components of a pharmacologic profile involves assessing pharmacologic activity and comparing against known compounds?

- a) Mechanism of action
  - b) Receptor binding assays
  - c) Activity of CYP 450
  - d) In vitro & in vivo tests
  - e) Tolerance, physical dependence, toxicity
- Match the definition with the term: a) LD50 b) ED50 c) T.I. d) NED*
- 3.1) The amount of drug that produces a therapeutic response in half of the test group
- 3.2) Comparison of the amount of a therapeutic agent that causes the therapeutic effect to the amount that causes toxic effects
- 3.3) The dose that kills half of the test group
- 3.4) The maximum dose where toxicity is not observed
- 3.5) Subacute toxicity testing involves multiple doses over what time frame?
- a) 1 week
  - b) 1 month
  - c) 6 months
  - d) 1 year
  - e) 2 years
- 3.6) For the human clinical trials, what initial doses are used?
- a) 1 – 2 NED
  - b) 1/2 – 1 NED
  - c) 1/10 – 1 NED
  - d) 1/100 – 1/10 NED
  - e) 1/100 – 1/100 NED
- 3.7) What is the minimal number of species tested (pregnant females) at selected organogenesis periods for teratogenesis? (e.g. Thalidomide, ethanol, Accutane, warfarin)
- a) 1
  - b) 2
  - c) 3
  - d) 4
  - e) 5
- 3.8) In the mutagenesis dominant lethal test, which of the following would be exposed to the test substance?
- a) Pre-mating male
  - b) Pre-mating female
  - c) Post-mating male
  - d) Post-mating female (pregnant)
  - e) Newborn
- 3.9) Which of the following teratogens is associated with absence of extremities?
- a) Syphilis
  - b) Rubella
  - c) Thalidomide
  - d) Lithium
  - e) Lead
- 3.10) Which of the following is least likely to be involved in carcinogenesis?
- a) Ethanol
  - b) Vinyl chloride

- c) Urethane
  - d) Benzo[ $\alpha$ ]pyrene
- 4.1) What type of study for an Investigational New Drug (IND) involves neither the investigators or subjects knowing if the drug or placebo is being given?
- a) Single-blind study
  - b) Double-blind study
  - c) Placebo
  - d) Positive-control
  - e) Crossover study
- 4.2) What type of study for an IND involves each subject receiving all treatment conditions?
- a) Single-blind study
  - b) Double-blind study
  - c) Placebo (negative-control)
  - d) Positive-control
  - e) Crossover study
- 4.3) What type of study for an IND involves comparison with a placebo and another previously tested drug?
- a) Single-blind study
  - b) Double-blind study
  - c) Placebo (negative-control)
  - d) Positive-control
  - e) Crossover study
- 4.4) What clinical trial phase involves many patients and often a double-blind study with the purpose to further explore the beneficial action of the drug and toxicities?
- a) Phase 1
  - b) Phase 2
  - c) Phase 3
  - d) Phase 4
- 4.5) What clinical trial phase involves single- or double-blind studies under very controlled conditions with the purpose to determine therapeutic effect at tolerated doses?
- a) Phase 1
  - b) Phase 2
  - c) Phase 3
  - d) Phase 4
- 4.6) What clinical trial phase involves submitting a New Drug Application (NDA), monitoring, and reporting by clinicians using the drug?
- a) Phase 1
  - b) Phase 2
  - c) Phase 3
  - d) Phase 4
- 4.7) What clinical trial phase involves small doses up to profound physiologic responses, or up to minor toxicity (pharmacokinetics)?
- a) Phase 1
  - b) Phase 2
  - c) Phase 3

- d) Phase 4
- 5.1) The Orphan Drug Amendment (1983) gives incentives for the development of orphan drugs, which treat diseases that affect less than how many patients?
- a) 2,000
  - b) 20,000
  - c) 200,000
  - d) 2,000,000
  - e) 20,000,000
- 5.2) Which of the following would NOT be a critique of the Prescription Drug User Fee Act (PDUFA, 1992)?
- a) Obligates FDA to satisfy drug industry
  - b) Reduces FDA independence
  - c) Reduces FDA critical evaluation
  - d) Reduces drug approval process time
  - e) Reduces congressional oversight
- 5.3) Which of the following drug safety categories for pregnancy is the highest risk, where studies have shown a significant risk to women and to the fetus?
- a) A
  - b) B
  - c) C
  - d) D
  - e) X

## 9 – Pharmacodynamics: Receptor Theory and Dose Response

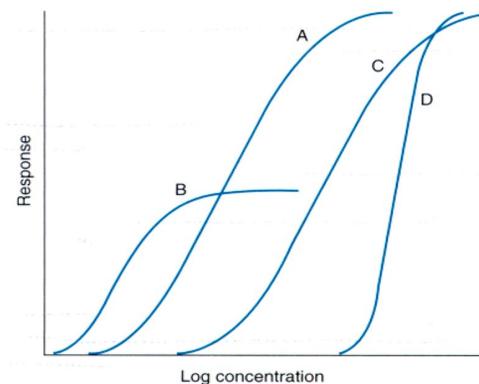
- 1.1) Which of the following occurs on the extracellular domain of the lipid bilayer and not the cytoplasmic domain, with regard to drug action?
- a) Ligand binding
  - b) Coupling with membrane associated molecules
  - c) Trafficking
  - d) Signaling
- 1.2) Which of the following drug targets involves inhibitors, false substrates, and a pro-drug type?
- a) Receptors
  - b) Ion channels
  - c) Enzymes
  - d) Carriers
- 1.3) What is the correct order of bond strength, from strongest to weakest?
- a) Van der Waals > Hydrogen > Ionic > Covalent
  - b) Ionic > Covalent > Hydrogen > Van der Waals
  - c) Covalent > Hydrogen > Ionic > Van der Waals
  - d) Covalent > Ionic > Hydrogen > Van der Waals
  - e) Van der Waals > Hydrogen > Covalent > Ionic
- 2) On a graded dose-response curve (or drug-receptor curve in a laboratory), at what point does response increase the most rapidly?
- a) Initially
  - b) At EC50

- c) At LD50
  - d) At 90% maximal response efficacy ( $E_{max}$ )
  - e) At steady-state
- 3.1) Which of the following is the equilibrium dissociation constant, where the concentration of free drug is at half-maximal binding?
- a)  $EC_{50}$
  - b)  $E_{max}$
  - c)  $K_d$
  - d)  $B_{max}$
  - e) LD50
- 3.2) What kind of graph scaling is often used to compare  $EC_{50}$  to  $K_d$ ?
- a) Linear
  - b) Exponential
  - c) Semilog
  - d) Inverse
  - e) Proportional
- 3.3) Clinical effectiveness of a drug depends on its potency.
- a) True
  - b) False

Use the accompanied diagram for the following two questions:

3.4) Which of the following drugs would require the most care when administering, if the upper portion of the dose-response curve signified severe toxicity?

- a) A
  - b) B
  - c) C
  - d) D
- 3.5) Which drug is the least efficacious?
- a) A
  - b) B
  - c) C
  - d) D



- 3.6) Intrinsic activity is a drug's ability to elicit:
- a) Strong receptor binding
  - b) Weak receptor binding
  - c) Response
  - d) Excretion
  - e) Distribution
- 4.1) Which direction would a partial agonist shift the dose-response curve when compared to a full agonist?
- a) To the left
  - b) To the right
  - c) Down
  - d) Up
  - e) To the right and possibly down
- 4.2) Which direction would a competitive antagonist (plus agonist) shift the dose-response curve when compared to a full agonist?

- a) To the left
  - b) To the right
  - c) Down
  - d) Up
  - e) To the right and possibly down
- 4.3) Which direction would a non-competitive antagonist (plus agonist) shift the dose-response curve when compared to a full agonist?
- a) To the left
  - b) To the right
  - c) Down
  - d) Up
  - e) Down and possibly to the right
- 4.4) A competitive antagonist affects the agonist \_\_\_\_ and a non-competitive antagonist affect the agonist \_\_\_\_.
- a) Potency; Efficacy
  - b) Efficacy; Potency
  - c) Duration; Speed
  - d) Speed; Duration
- 4.5) In which of the following cases could a dose-response curve be constructed?
- a) Prevention of convulsions
  - b) Prevention of arrhythmias
  - c) Reduction of death
  - d) Reduction of fever
  - e) Relief of headache
- 5.1) For most drugs, a frequency distribution of the response plotted against the log of the dose (quantal) produces what kind of curve?
- a) Linear
  - b) Exponential
  - c) Logarithmic
  - d) Gaussian (normal) distribution
  - e) Poisson distribution
- 5.2) Generally, which of the following is the correct order as dosage is increased?
- a)  $ED_{50} < LD_{50} < TD_{50}$
  - b)  $ED_{50} < TD_{50} < LD_{50}$
  - c)  $LD_{50} < TD_{50} < ED_{50}$
  - d)  $LD_{50} < ED_{50} < TD_{50}$
  - e)  $TD_{50} < LD_{50} < ED_{50}$
- 5.3) Which of the following is the median effective dose, or the dose at which 50% of the individuals exhibit the specified quantal response?
- a)  $LD_{50}$
  - b)  $ED_{50}$
  - c)  $EC_{50}$
  - d)  $TD_{50}$
  - e) T.I.
- 6.1) Which of the following is considered the therapeutic index (or ratio)?
- a)  $T.I. = TD_{50} / ED_{50}$

- b) T.I. = LD50 / ED50
  - c) T.I. = ED50 / TD50
  - d) T.I. = ED50 / LD50
  - e) A & B
- 6.2) Which of the following can be used as a relative indicator of the margin of safety of a drug?
- a) LD50
  - b) ED50
  - c) EC50
  - d) TD50
  - e) T.I.
- 6.3) Which of the following is the most relevant use of therapeutic index?
- a) Guide for toxicity in therapeutic the setting
  - b) Multiple measures of effectiveness are possible (e.g. aspirin)
  - c) Measure of impunity with which an overdose may be tolerated
  - d) Toxicities may be idiosyncratic (e.g. propranolol in asthmatics)
- 7.1) Which of the following refers to an increased intensity of response to a drug?
- a) Idiosyncratic
  - b) Hyporeactive
  - c) Hyperreactive
  - d) Hypersensitive
  - e) Tolerance
- 7.2) Tachyphylaxis refers to which of the following?
- a) Responsiveness increased rapidly after administration of a drug
  - b) Responsiveness decreased rapidly after administration of a drug
  - c) Responsiveness increased rapidly after maintenance of a drug (hypersensitive)
  - d) Responsiveness decreased rapidly after maintenance of a drug (desensitized)

### 10 – Receptor-Effector Coupling

- 1) Which of the following would occur with an antagonist binding to a receptor and not an agonist?
- a) Ion channel closed
  - b) Enzyme inhibited
  - c) Endogenous mediator blocked
  - d) Ion channel modulated
  - e) DNA transcription
- 2.1) Nicotinic ACh receptors (ligand-gated) involve the movement of what ion across the membrane?
- a) K<sup>+</sup>
  - b) Ca<sup>++</sup>
  - c) Cl<sup>-</sup>
  - d) Na<sup>+</sup>
  - e) Mg<sup>++</sup>
- 2.2) The nicotinic receptor requires one molecule of ACh to bind to each of the two \_\_\_\_\_ receptors in order to activate the receptor and open the channel.
- a)  $\alpha$  (alpha)

- b)  $\beta$  (beta)
  - c)  $\gamma$  (gamma)
  - d)  $\delta$  (delta)
- 2.3) GABA A receptors (ligand-gated) involve the movement of what ion across the membrane?
- a) K<sup>+</sup>
  - b) Ca<sup>++</sup>
  - c) Cl<sup>-</sup>
  - d) Na<sup>+</sup>
  - e) Mg<sup>++</sup>
- 2.4) Which of the following is increased in intracellular concentration due to second messengers such as IP<sub>3</sub>?
- a) K<sup>+</sup>
  - b) Ca<sup>++</sup>
  - c) Cl<sup>-</sup>
  - d) Na<sup>+</sup>
  - e) Mg<sup>++</sup>
- Match the G protein with the action it causes:*
- 2.5) Activates phospholipase C (PLC)                    a) G<sub>s</sub>
  - 2.6) Activates K<sup>+</sup> channels                                    b) G<sub>i</sub>
  - 2.7) Inhibits Ca<sup>++</sup> channels                                    c) G<sub>o</sub>
  - 2.8) Activates Ca<sup>++</sup> channels                                    d) G<sub>q</sub>
- 2.9) Which of the following signaling mechanisms involves phosphorylation of substrate proteins and has receptors that are polypeptides with cytoplasmic enzyme domains (tyrosine kinase, serine kinase, guanylyl cyclase)?
- a) Intracellular receptors for lipid soluble ligands
  - b) Transmembrane receptors
  - c) G-protein coupled receptors
  - d) Ligand-gated ion channels
- 2.10) Regulated by cytokines and growth factors, the Janus-Kinase JAK-STAT pathway results in which of the following?
- a) Ion channel closing
  - b) Enzyme inhibition
  - c) Endogenous mediator blocking
  - d) Ion channel modulation
  - e) Gene transcription
- 2.11) Which of the following describes the pathway of nitric oxide (NO)?
- a) Stimulates guanylyl cyclase, increase cGMP concentration, vasodilation
  - b) Stimulates guanylyl cyclase, decreases cGMP concentration, vasodilation
  - c) Stimulates guanylyl cyclase, increase cGMP concentration, vasoconstriction
  - d) Inhibits guanylyl cyclase, increase cGMP concentration, vasodilation
  - e) Inhibits guanylyl cyclase, decreases cGMP concentration, vasoconstriction
- 2.12) Which of the following signaling mechanisms can involve heat-shock protein (hsp90)?
- a) Intracellular receptors for lipid soluble ligands
  - b) Transmembrane receptors

- c) G-protein coupled receptors
  - d) Ligand-gated ion channels
- 3.1) All of the following interact with ligand-gated ion channels EXCEPT:
- a) Benzodiazepines
  - b) Insulin
  - c) Glutamate
  - d) Aspartate
  - e) Glycine
- 3.2) Which of the following is NOT a second messenger associated with G proteins?
- a) DAG
  - b) GDP
  - c) IP3
  - d) cAMP
  - e) cGMP
- 3.3) Muscarinic ACh receptors and adrenergic receptors are associated with which of the following?
- a) Intracellular receptors for lipid soluble ligands
  - b) Transmembrane receptors with enzymatic cytosolic domains
  - c) G-protein coupled receptors
  - d) Ligand-gated ion channels
- 3.4) In smooth muscle and glandular tissue, ACh binds to what muscarinic receptor, leading to the DAG cascade?
- a) M1
  - b) M2
  - c) M3
  - d) M4
  - e) M5
- 3.5) In the heart and intestines, what muscarinic receptor inhibits adenylyl cyclase activity?
- a) M1
  - b) M2
  - c) M3
  - d) M4
  - e) M5
- 3.6) Adrenergic  $\alpha_2$  receptors \_\_\_\_ adenylyl cyclase and  $\beta$  receptors \_\_\_\_ adenylyl cyclase.
- a) Stimulate; Stimulate
  - b) Stimulate; Inhibit
  - c) Inhibit; Inhibit
  - d) Inhibit; Stimulate
- 3.7) Which of the following is NOT a ligand-regulated transmembrane enzyme (agent)?
- a) Insulin
  - b) EGP
  - c) PDFG
  - d) ANP
  - e) NO

3.8) Which of the following cytokine receptors (transmembrane enzyme) is antagonized by anakinra (Kineret), for treatment of rheumatoid arthritis?

- a) Growth hormone
- b) Erythropoietin
- c) Interferons
- d) Interleukin-1

3.9) Which of the following is NOT an intracellular receptor for lipid-soluble agent, which stimulates gene transcription in the nucleus by binding to DNA sequences?

- a) Steroids
- b) Vitamin A
- c) Vitamin D
- d) Thyroid hormone
- e) Nitric oxide

*Match the receptors with their time scale:*

- |                              |                 |
|------------------------------|-----------------|
| 4.1) Insulin receptor        | a) Milliseconds |
| 4.2) Muscarinic ACh receptor | b) Seconds      |
| 4.3) Estrogen receptor       | c) Minutes      |
| 4.4) Nicotinic ACh receptor  | d) Hours        |

### **11 – Autonomic Pharmacology: Sympathetic Nervous System**

1.1) The sympathetic nervous system (SNS) and parasympathetic nervous system are divisions of which of the following?

- a) Somatic nervous system division of peripheral nervous system
- b) Somatic nervous system division of central nervous system
- c) Autonomic nervous system division of peripheral nervous system
- d) Autonomic nervous system division of central nervous system

1.2) Preganglionic sympathetic and parasympathetic fibers release \_\_\_\_, postganglionic parasympathetic fibers release \_\_\_\_ (for muscarinic cholinergic receptors), and postganglionic sympathetic fibers release \_\_\_\_ (for adrenergic receptors).

- a) ACh; ACh; NE
- b) ACh; NE; ACh
- c) NE; ACh; NE
- d) NE; NE; ACh

1.3) Which of the following adrenergic receptors is most commonly found pre-synaptic?

- a)  $\alpha$ 1
- b)  $\alpha$ 2
- c)  $\beta$ 1
- d)  $\beta$ 2
- e)  $\beta$ 3

1.4) Which of the following describes the result of adrenal medulla stimulation?

- a) Mass parasympathetic discharge, 85:15 ratio of epi:norepi
- b) Mass parasympathetic discharge, 15:85 ratio of epi:norepi
- c) Mass sympathetic discharge, 85:15 ratio of epi:norepi
- d) Mass sympathetic discharge, 15:85 ratio of epi:norepi

*Match the sympathetic response with the receptor:*

- 1.5) Increased lipid breakdown a)  $\alpha$ 1

- 1.6) Peripheral vasoconstriction b)  $\beta$ 1
- 1.7) Increased heart rate and blood pressure c)  $\beta$ 2
- 1.8) Bronchial dilation, coronary dilation, glucose conversion d)  $\beta$ 3
- 1.9) What amino acid is converted into catecholamines (NE, Epi, Dopamine)?
- a) Alanine
  - b) Proline
  - c) Lysine
  - d) Tyrosine
  - e) Valine
- 1.10) Which of the following is transported into vesicles via the vesicular monoamine transporter (VMAT), uptake 2, a proton antiporter?
- a) Epinephrine
  - b) Norepinephrine
  - c) Dopamine
- 1.11) Which of the following is co-stored and co-released with ATP?
- a) Epinephrine
  - b) Norepinephrine
  - c) Dopamine
- 1.12) Which of the following form varicosities or en passant synapses, with the arrival of an action potential leading to  $Ca^{++}$  influx and exocytosis?
- a) Presynaptic sympathetic
  - b) Presynaptic parasympathetic
  - c) Postsynaptic sympathetic
  - d) Postsynaptic parasympathetic
- 2.1) Which of the following methods of terminating axon response is NOT a target for drug action?
- a) Reuptake via NE transporter (NET): Uptake 1
  - b) Metabolism of NE of inactive metabolite
  - c) NE diffusion away from synaptic cleft
- 2.2) NET is a symporter of what ion?
- a)  $K^+$
  - b)  $Ca^{++}$
  - c)  $Cl^-$
  - d)  $Na^+$
  - e)  $Mg^{++}$
- 2.3) Which of the following is recycled via VMAT into vesicles after response termination?
- a) NE
  - b) L-DOPA
  - c) NET
  - d) EPI
  - e) DOPGAL
- 2.4) Which of the following is broken down by MAO-B (monoamine oxidase) more than the others?
- a) Serotonin (5-HT)
  - b) Norepinephrine (NE)

- c) Dopamine (DA)
- 2.5) Where is the cytosolic catecholamine metabolizing enzyme catechol-O-methyl transferase (COMT) primarily found?
- a) Liver
  - b) GI tract
  - c) Placenta
  - d) Blood platelets
- 3.1) Which of the following receptor subtypes relaxes smooth muscle and causes liver glycogenolysis and gluconeogenesis?
- a)  $\alpha 1$  (Gq/Gi/Go)
  - b)  $\alpha 2$  (Gi/Go)
  - c)  $\beta 1$  (Gs)
  - d)  $\beta 2$  (Gs)
  - e)  $\beta 3$  (Gs)
- 3.2) Which of the following receptor subtypes causes vascular smooth muscle contraction and genitourinary smooth muscle contraction?
- a)  $\alpha 1$  (Gq/Gi/Go)
  - b)  $\alpha 2$  (Gi/Go)
  - c)  $\beta 1$  (Gs)
  - d)  $\beta 2$  (Gs)
  - e)  $\beta 3$  (Gs)
- 3.3) Which of the following receptor subtypes increases cardiac chronotropy (rate) and inotropy (contractility), increases AV-node conduction velocity, and increases rennin secretion in renal juxtaglomerular cells?
- a)  $\alpha 1$  (Gq/Gi/Go)
  - b)  $\alpha 2$  (Gi/Go)
  - c)  $\beta 1$  (Gs)
  - d)  $\beta 2$  (Gs)
  - e)  $\beta 3$  (Gs)
- 3.4) Which of the following receptor subtypes decreases insulin secretion from pancreatic  $\beta$ -cells, decreases nerve cell norepinephrine release, and contracts vascular smooth muscle?
- a)  $\alpha 1$  (Gq/Gi/Go)
  - b)  $\alpha 2$  (Gi/Go)
  - c)  $\beta 1$  (Gs)
  - d)  $\beta 2$  (Gs)
  - e)  $\beta 3$  (Gs)
- 4.1) What type(s) of second messenger(s) interact with adenylyl cyclase?
- a)  $\alpha 1$
  - b)  $\alpha 2$
  - c)  $\beta$
  - d)  $\beta$  &  $\alpha 1$
  - e)  $\beta$  &  $\alpha 2$
- 4.2) What type(s) of second messenger(s) are associated with phospholipase C (PLC)?
- a)  $\alpha 1$

- b)  $\alpha_2$   
 c)  $\beta$   
 d)  $\beta$  &  $\alpha_1$   
 e)  $\beta$  &  $\alpha_2$
- 4.3) Which of the following adrenergic receptor activation mechanisms is involved with ephedrine, amphetamine, and tyramine?  
 a) Direct binding to the receptor  
 b) Promoting release of norepinephrine  
 c) Inhibiting reuptake of norepinephrine  
 d) Inhibiting inactivation of norepinephrine
- 4.4) Which of the following adrenergic receptor activation mechanisms is involved with MAO inhibitors?  
 a) Direct binding to the receptor  
 b) Promoting release of norepinephrine  
 c) Inhibiting reuptake of norepinephrine  
 d) Inhibiting inactivation of norepinephrine
- 4.5) Which of the following adrenergic receptor activation mechanisms is involved with tricyclic antidepressants and cocaine?  
 a) Direct binding to the receptor  
 b) Promoting release of norepinephrine  
 c) Inhibiting reuptake of norepinephrine  
 d) Inhibiting inactivation of norepinephrine
- 4.6) Which of the following is NOT true of catecholamines?  
 a) Non-polar  
 b) Cannot cross the blood-brain barrier  
 c) Cannot be used as an oral drug  
 d) Have brief duration  
 e) MAO and COMT act rapidly
- Match the catecholamine with the receptor(s):*
- 4.7) Isoproterenol                      a)  $\alpha$  &  $\beta$   
 4.8) Dobutamine                        b)  $\beta$   
 4.9) Norepinephrine                    c)  $\beta_1$   
 4.10) Dopamine                         d) D1 & D2  
 4.11) Epinephrine
- 4.12) The basic structure of a catecholamine involves a catechol ring and which of the following types of amines?  
 a) Methyl amine  
 b) Ethyl amine  
 c) Butyl amine  
 d) Tert-butyl amine  
 e) Propyl amine
- Match the noncatecholamines with the receptor agonist:*
- 4.13) Clonidine                            a)  $\alpha_1$ -agonist  
 4.14) Metaproterenol, terbutaline, ritodine    b)  $\alpha_2$ -agonist  
 4.15) Phenylephrine                      c)  $\beta_2$ -agonist

- 5.1) Which of the following is a long-acting (oral)  $\alpha$ 1-agonist and not a short-acting (nasal spray, ophthalmic drops)  $\alpha$ 1-agonist?
- Phenylephrine
  - Oxymetazoline
  - Tetrahydrozoline
  - Pseudoephedrine
- 5.2) Which of the following would NOT be used as a topical vasoconstrictor for a patient with epistaxis (nasal pack soaked in drug)?
- Phenylephrine
  - Epinephrine
  - Oxymetazoline
  - Isoproterenol
- 5.3)  $\alpha$ 1 drugs can be given with local anesthetics to vasoconstrictor and decrease blood flow to the site of administration. Which of the following should not be given above the web space?
- Phenylephrine
  - Epinephrine
  - Methoxamine
- 5.4) Which of the following is the  $\alpha$ 1 drug of choice (DOC) for retinal exams and surgery, giving mydriasis (dilation of iris)?
- Ephedrine
  - Epinephrine
  - Oxymetazoline
  - Isoproterenol
  - Phenylephrine
- 5.5)  $\alpha$ 2-agonists are only approved for hypertension and work by decreasing sympathetic tone and increasing vagal tone. Which of the following is NOT a  $\alpha$ 2-agonist?
- Clonidine
  - Methyldopa
  - Guanabenz
  - Guanfacine
  - Epinephrine
- 5.6) At the adrenergic synapse, what does  $\alpha$ 2 do?
- Stimulates NE release
  - Inhibits NE release
  - Stimulates ACh release
  - Inhibits ACh release
- 5.7) Which of the following agonists would be used for asthma patients or to delay premature labor?
- $\alpha$ 2-agonist
  - $\alpha$ 1-agonist
  - $\beta$ 3-agonist
  - $\beta$ 2-agonist
  - $\beta$ 1-agonist
- 5.8) Which of the following agonists would be used for cardiogenic shock, cardiac arrest, heart block, or heart failure?

- a)  $\alpha$ 1-agonist
  - b)  $\alpha$ 2-agonist
  - c)  $\beta$ 1-agonist
  - d)  $\beta$ 2-agonist
  - e)  $\beta$ 3-agonist
- 5.9) Which of the following is NOT a  $\beta$ 2-agonist?
- a) Terbutaline
  - b) Ritodrine
  - c) Metaproterenol
  - d) Albuterol
  - e) Phenylephrine
- 5.10)  $\beta$ 2 stimulation leads to an increase in the cellular uptake of what ion, and thus a decrease in plasma concentration of that ion?
- a)  $K^+$
  - b)  $Ca^{++}$
  - c)  $Cl^-$
  - d)  $Na^+$
  - e)  $Mg^{++}$
- 5.11) Dopamine receptor activation ( $D_1$ ) dilates renal blood vessels at low dose. At higher doses (treatment for shock), which of the following receptor is activated?
- a)  $\alpha$ 1
  - b)  $\alpha$ 2
  - c)  $\beta$ 1
  - d)  $\beta$ 2
  - e)  $\beta$ 3
- 5.12) Which of the following responses to sympathetic stimulation would prevent receptors from being coupled with G-proteins?
- a) Sequestration
  - b) Down-regulation
  - c) Phosphorylation
- 5.13) Which of the following is the action of the indirect-acting sympathomimetic drug cocaine?
- a) Stimulator of NET (uptake 1)
  - b) Inhibitor of NET (uptake 1)
  - c) Stimulator of VMAT (uptake 2)
  - d) Inhibitor of VMAT (uptake 2)
- 5.14) Tricyclic antidepressants (TCAs) have a great deal of side effects. Which of the following is the action of TCAs?
- a) Stimulator of NET (uptake 1)
  - b) Inhibitor of NET (uptake 1)
  - c) Stimulator of VMAT (uptake 2)
  - d) Inhibitor of VMAT (uptake 2)
- 5.15) Which of the following is NOT a mixed sympathomimetic?
- a) Amphetamine
  - b) Methamphetamine
  - c) Ephedrine

- d) Phenylephrine
  - e) Pseudoephedrine
- 5.16) Prior to an operation to remove a pheochromocytoma (neuroendocrine tumor of the medulla of the adrenal glands), which of the following should be given to the patient?
- a)  $\alpha$ -agonist
  - b)  $\alpha$ -blocker
  - c)  $\beta$ -agonist
  - d)  $\beta$ -blocker
- 5.17) Which of the following is NOT an indication for  $\beta$ -blocker therapy?
- a) Hypotension
  - b) Angina pectoris
  - c) Arrhythmias
  - d) Myocardial infarction
  - e) Glaucoma
- 5.18) Which of the following  $\beta$ -blockers is used for decreasing aqueous humor secretions from the ciliary body?
- a) Propranolol
  - b) Nadolol
  - c) Carvedilol
  - d) Timolol
  - e) Metoprolol
- 5.19) Which of the following is NOT considered cardioselective?
- a) Metoprolol
  - b) Atenolol
  - c) Esmolol
  - d) Carvedilol
- 5.20) Blocking  $\alpha_2$  presynaptic receptors will do which of the following?
- a) Stimulate NE release
  - b) Inhibit NE release
  - c) Stimulate DA release
  - d) Inhibit DA release
- 5.21) Which of the following drugs irreversibly damages VMAT?
- a) Tyramine
  - b) Guanethidine
  - c) Reserpine
  - d) Propranolol
  - e) Epinephrine
- 6.1) Which of the following is the most likely to occur with parenteral administration of a  $\alpha_1$ -agonist drug?
- a) Hypotension
  - b) Hypertension
  - c) Tissue necrosis
  - d) Vasodilation
  - e) Lipolysis
- 6.2) Which of the following agonists can have dose-related withdrawal syndrome if the drug is withdrawn too quickly, leading to rebound hypertension?

- a)  $\alpha$ 1-agonist
  - b)  $\alpha$ 2-agonist
  - c)  $\beta$ 1-agonist
  - d)  $\beta$ 2-agonist
  - e)  $\beta$ 3-agonist
- 6.3) Which of the following agonists can have sedation and xerostomia (dry mouth) in 50% of patients starting therapy, sexual dysfunction in males, nausea, dizziness, and sleep disturbances?
- a)  $\alpha$ 1-agonist
  - b)  $\alpha$ 2-agonist
  - c)  $\beta$ 1-agonist
  - d)  $\beta$ 2-agonist
  - e)  $\beta$ 3-agonist
- 6.4) Which of the following agonists can cause hyperglycemia in diabetics?
- a)  $\alpha$ 2-agonist
  - b)  $\alpha$ 1-agonist
  - c)  $\beta$ 3-agonist
  - d)  $\beta$ 2-agonist
  - e)  $\beta$ 1-agonist
- 6.5) Angina pectoris, tachycardia, and arrhythmias are possible adverse effects of which of the following agonists?
- a)  $\alpha$ 2-agonist
  - b)  $\alpha$ 1-agonist
  - c)  $\beta$ 3-agonist
  - d)  $\beta$ 2-agonist
  - e)  $\beta$ 1-agonist
- 6.6) If a patient is taking MAO inhibitors and ingests tyramine (red wine, aged cheese), which of the following acute responses is most likely? (sympathomimetic)
- a) Stimulation of NE release
  - b) Inhibition of NE release
  - c) Stimulation of ACh release
  - d) Inhibition of ACh release
  - e) No response due to MAO inhibitor
- 6.7) Which of the following occurs acutely, leading to a false neurotransmitter, with increased guanethidine? (sympathomimetic)
- a) Stimulation of NE release
  - b) Inhibition of NE release
  - c) Stimulation of ACh release
  - d) Inhibition of ACh release
- 6.8) Major adverse effects of the  $\alpha$ 1 blockade include reflex tachycardia and which of the following?
- a) Orthostatic tachycardia
  - b) Orthostatic bradycardia
  - c) Orthostatic hypertension
  - d) Orthostatic hypotension

- e) Increased cardiac output
- 6.9) Which of the following effects would be intensified with the  $\alpha_2$  blockade?
- a) Reflex tachycardia
  - b) Reflex bradycardia
  - c) Orthostatic hypertension
  - d) Orthostatic hypotension
  - e) Platelet clotting
- 6.10) Which of the following is NOT an adverse affect of the  $\beta_1$  blockade?
- a) Bradycardia
  - b) Decreased cardiac output
  - c) AV node block
  - d) Increased arrhythmias
  - e) Heart failure
- 6.11) Which of the following is the most severe adverse effect that has been associated with sudden termination of  $\beta_1$ -blockers?
- a) Atrial fibrillation
  - b) Reflex bradycardia
  - c) Syncope (fainting)
  - d) Angina
  - e) Sudden death
- 6.12) Which of the following groups of patients is most at risk for adverse effect seen in  $\beta_2$ -blockers?
- a) Asthmatics
  - b) Congestive heart failure patients
  - c) Trauma patients
  - d) Diabetics
  - e) Patients with deep vein thromboses (DVTs)
- 6.13) Which of the following can be detrimental in diabetics and also can lead to masking of tachycardia, which is indicative of hypoglycemia?
- a)  $\alpha_1$ -blocker
  - b)  $\alpha_2$ -blocker
  - c)  $\beta_1$ -blocker
  - d)  $\beta_2$ -blocker
  - e)  $\beta_3$ -blocker

## 12 – Autonomic Pharmacology: Parasympathetic Nervous System

- 1.1) Which of the following is NOT true regarding the parasympathetic nervous system?
- a) Is considered cranio-sacral
  - b) Involves rest and digestion functions
  - c) Has nicotinic receptors on cell bodies of all postganglionic neurons
  - d) Target organs have muscarinic receptors for ACh
  - e) Innervation of vascular smooth muscle
- 1.2) Where is acetyl CoA synthesized (pre-synthesis for ACh)?
- a) Synaptic cleft
  - b) Cytosol
  - c) Mitochondria

- d) Extracellular matrix
  - e) Lysosomes
- 1.3) Which of the following locations contains choline from phosphatidylcholine?
- a) Milk
  - b) Liver
  - c) Eggs
  - d) Peanuts
  - e) Blood plasma
- 1.4) What part of the cholinergic synapse is affected by botulinum toxin?
- a) ACh increased
  - b) ACh decreased
  - c) Muscarinic ACh receptor modified
  - d) Nicotinic ACh receptor modified
  - e) AChE inhibited
- 1.5) ACh is packaged into vesicles via what ACh ion antiporter?
- a) K+
  - b) Ca<sup>++</sup>
  - c) Cl<sup>-</sup>
  - d) Na+
  - e) H+
- 1.6) Influx of what ion causes ACh release into the synaptic cleft, prior to ACh being terminated by acetylcholinesterase (AChE)?
- a) K+
  - b) Ca<sup>++</sup>
  - c) Cl<sup>-</sup>
  - d) Na+
  - e) H+
- 2.1) Nicotinic N2 receptors are the \_\_\_\_ subtype and nicotinic N1 receptors are the \_\_\_\_ subtype.
- a) Neuronal; Muscular
  - b) Muscular; Neuronal
  - c) Nodal; Neuronal
  - d) Neuronal; Nodal
  - e) Sympathetic; Parasympathetic
- 2.2) Which of the following best description of the drug nicotine?
- a) Muscular subtype nicotinic agonist
  - b) Muscular subtype nicotinic antagonist
  - c) Neuronal subtype nicotinic agonist
  - d) Neuronal subtype nicotinic antagonist
- 2.3) Amanita muscaria (fly Amanita) is a fungal muscarinic agonist, which is most often associated with which side effect?
- a) Tachycardia
  - b) Bradycardia
  - c) Euphoria
  - d) Sedation
  - e) Hallucinations

- 2.4) Which of the following G-protein is associated with smooth muscle and glandular tissue, muscarinic receptor M3, mobilizing internal Ca<sup>++</sup> and the DAG cascade?
- Gs
  - Gi
  - Gq
  - Go
- 2.5) Which of the following G-protein is associated with heart and intestines, muscarinic receptor M2, decreasing adenylyl cyclase activity.
- Gs
  - Gi
  - Gq
  - Go
- 2.6) The drugs bethanechol and pilocarpine are:
- Acetylcholine agonists
  - Acetylcholine antagonists
  - Muscarinic agonists
  - Muscarinic antagonists
  - Acetylcholinesterase inhibitors
- 3.1) Which of the following is NOT a primary effect of stimulating muscarinic M receptors?
- Release of nitric oxide (vasodilation)
  - Iris contraction (miosis)
  - Ciliary muscle contraction and accommodation of the lens (near vision)
  - Bronchi dilation and decreased bronchiole secretions
  - Salivary/lacrimal thin and watery secretions
- 3.2) Which of the following is NOT a primary effect of stimulating muscarinic M receptors?
- Tachycardia, increased conduction velocity
  - Increased GI tract tone and secretions
  - Diaphoresis from sweat glands
  - Penile erection
  - Contraction of urinary detrusor muscle and relaxation of urinary sphincter
- 3.3) What is bethanechol most commonly used for?
- For decreasing heart rate
  - To decrease blood pressure (vasodilation)
  - For urinary retention
  - Decreasing intraocular pressure
  - For erectile dysfunction
- 3.4) What is pilocarpine most commonly used for?
- For decreasing heart rate
  - To decrease blood pressure (vasodilation)
  - For urinary retention
  - Decreasing intraocular pressure
  - For erectile dysfunction
- 3.5) Which of the following is NOT a result of excessive cholinergic stimulation, as would be seen with a nerve agent or organophosphate poisoning?

- a) Diarrhea
  - b) Diaphoresis
  - c) Mydriasis
  - d) Nausea
  - e) Urinary urgency
- 3.6) What type of drugs are atropine, scopolamine, and pirenzepine?
- a) Acetylcholine agonists
  - b) Acetylcholine antagonists
  - c) Muscarinic agonists
  - d) Muscarinic antagonists
  - e) Acetylcholinesterase inhibitors
- 3.7) What drug is a natural alkaloid found in Solanaceae plants (deadly nightshade)?
- a) Bethanechol
  - b) Pilocarpine
  - c) Pirenzepine
  - d) Scopolamine
  - e) Atropine
- 4) What two clinical results of atropine facilitate ophthalmoscopic examination?
- a) Mydriasis (iris dilation) and increased lacrimation
  - b) Cycloplegia (ciliary paralysis) and miosis (iris constriction)
  - c) Miosis and increased lacrimation
  - d) Mydriasis and cycloplegia
  - e) Xerophthalmia (dry eyes) and mydriasis
- 5.1) Which of the following is an adverse affect of atropine?
- a) Increased salivation
  - b) Blurred vision
  - c) Bradycardia
  - d) Diaphoresis
  - e) Decreased intraocular pressure
- 5.2) Which of the following is NOT a major symptom of atropine toxicity?
- a) Blind as a bat
  - b) Red as a beet
  - c) Mad as a hatter
  - d) Hot as a hare
  - e) Wet as a towel
- 5.3) Which of the following topical ophthalmic drugs is also used for motion sickness? (injection, oral, or transdermal patch)
- a) Atropine
  - b) Scopolamine
  - c) Homatropine
  - d) Tropicamide
- 5.4) Of the following mydriatics/cycloplegics, \_\_\_\_ last 7-10 days (longest) and \_\_\_\_ last 6 hours (shortest).
- a) Atropine; Scopolamine
  - b) Scopolamine; Homatropine
  - c) Homatropine; Tropicamide

- d) Tropicamide; Atropine
  - e) Atropine; Tropicamide
- 6) Butyrylcholinesterase (BuChE) is a nonspecific pseudocholinesterase located in glia, plasma, liver, and other organs. What type of local anesthetics are metabolized by BuChE (e.g. procaine), along with succinylcholine (paralytic)?
- a) Ester
  - b) Ether
  - c) Amine
  - d) Alkane
  - e) Alcohol
- 7.1) Which of the following reversible cholinesterase inhibitors is used for atropine intoxication?
- a) Neostigmine
  - b) Physostigmine
  - c) Endrophonium
  - d) Donepezil
  - e) Pyridostigmine
- 7.2) Which of the following reversible cholinesterase inhibitors is used for anesthesia?
- a) Neostigmine
  - b) Physostigmine
  - c) Endrophonium
  - d) Donepezil
  - e) Pyridostigmine
- 7.3) Which of the following reversible cholinesterase inhibitors is used for Alzheimer disease?
- a) Neostigmine
  - b) Physostigmine
  - c) Endrophonium
  - d) Donepezil
  - e) Pyridostigmine
- 7.4) Which of the following cholinesterase inhibitors is NOT used for Myasthenia Gravis (MG)?
- a) Neostigmine
  - b) Physostigmine
  - c) Endrophonium
  - d) Pyridostigmine
- 7.5) Which of the following is NOT an irreversible cholinesterase inhibitor (organophosphate AChE inhibitors)?
- a) Tacrine
  - b) Echothiophate
  - c) Sarin, toban, soman
  - d) Malathion, parathion
  - e) Isoflurophate
- 7.6) By what mechanism do irreversible ACHE inhibitors permanently bind to the esteratic site enzyme?
- a) Hydroxylation

- b) Hydrolysis
  - c) Phosphorylation
  - d) Peptide
  - e) Methylation
- 7.7) A MARK-1 autoinjection kit is given to certain medical and military personnel who may be exposed to nerve agents or organophosphate pesticides. The kit has two drugs, an acetylcholinesterase inhibitor and a cholinesterase reactivator (antidote). What two drugs would you expect to be in this kit?
- a) Pralidoxime (2-PAM) and echothiophate
  - b) Parathion and adenosine
  - c) Scopolamine and tropicamide
  - d) Mecamylamine and pralidoxime (2-PAM)
  - e) Atropine and pralidoxime (2-PAM)
- 7.8) Some organophosphate AChE inhibitor insecticides have a 40 hour half life. What is the approximate half life of soman?
- a) 6 seconds
  - b) 6 minutes
  - c) 1 hour
  - d) 6 hours
  - e) 60 hours
- 8.1) What is currently the only ganglion blocker (shuts down entire ANS) still available in the United States?
- a) Mecamylamine
  - b) Scopolamine
  - c) Echothiophate
  - d) Pralidoxime
  - e) Parathion
- 8.2) Which of the following is NOT an effect of autonomic ganglion blocking?
- a) Anhidrosis and xerostomia
  - b) Mydriasis
  - c) Tachycardia
  - d) Hypertension
  - e) Cycloplegia

AnswerKey	8.2) E	4.1) D	2.2) D
<b>Pharm #1</b>	8.3) B	4.2) B	2.3) B
1) C		4.3) A	2.4) C
2.1) C	<b>Pharm #3</b>	4.4) E	2.5) D
2.2) B	1) C	4.5) B	3.1) C
2.3) D	2.1) A	5.1) E	3.2) E
2.4) A	2.2) D	5.2) A	4.1) B
2.5) E	3.1) C	5.3) B	4.2) A
2.6) B	3.2) D	5.4) C	5.1) D
2.7) D	4.1) A	5.5) D	5.2) B
2.8) E	4.2) A	5.6) A	5.3) C
3.1) A	4.3) D	5.7) E	
3.2) C	4.4) E	5.8) D	<b>Pharm #8</b>
4.1) D	4.5) C	5.9) A	1) D
4.2) B	5.1) B		2.1) C
5.1) B	5.2) A	<b>Pharm #6</b>	2.2) D
5.2) C	5.3) D	1.1) D	3.1) B
5.3) E	6.1) D	1.2) A	3.2) C
5.4) C	6.2) E	2.1) A	3.3) A
6.1) A	6.3) C	2.2) E	3.4) D
6.2) C	6.4) A	3) C	3.5) C
6.3) B		4) D	3.6) D
6.4) D	<b>Pharm #4</b>	5.1) B	3.7) B
6.5) E	1) B	5.2) E	3.8) A
	2) D	5.3) B	3.9) C
<b>Pharm #2</b>	3.1) B	5.4) C	3.10) A
1) D	3.2) D	5.5) A	4.1) B
2.1) E	4.1) E	5.6) D	4.2) E
3) A	4.2) A	5.7) F	4.3) D
4.1) D	4.3) D	5.8) G	4.4) C
4.2) C	4.4) B	6.1) E	4.5) B
4.3) B	4.5) C	6.2) D	4.6) D
5.1) D	4.6) E	6.3) A	4.7) A
5.2) A	4.7) D	6.4) A	5.1) C
5.3) B		6.5) C	5.2) D
5.4) C	<b>Pharm #5</b>	6.6) B	5.3) E
5.5) D	1.1) C	6.7) C	
6.1) C	1.2) B	6.8) B	<b>Pharm #9</b>
6.2) B	1.3) A	6.9) A	1.1) A
7.1) A	1.4) D	6.10) E	1.2) C
7.2) E	1.5) C		1.3) D
7.3) E	2.1) C	<b>Pharm #7</b>	2) A
7.4) A	2.2) D	1.1) B	3.1) C
7.5) B	3.1) C	1.2) C	3.2) C
7.6) C	3.2) C	1.3) C	3.3) B
8.1) D	3.3) C	2.1) B	3.4) D

3.5) B  
 3.6) C  
 4.1) C  
 4.2) B  
 4.3) E  
 4.4) A  
 4.5) D  
 5.1) D  
 5.2) B  
 5.3) B  
 6.1) E  
 6.2) E  
 6.3) C  
 7.1) C  
 7.2) B

**Pharm #10**

1) C  
 2.1) D  
 2.2) A  
 2.3) C  
 2.4) B  
 2.5) D  
 2.6) B  
 2.7) C  
 2.8) A  
 2.9) B  
 2.10) E  
 2.11) A  
 2.12) A  
 3.1) B  
 3.2) B  
 3.3) C  
 3.4) C  
 3.5) B  
 3.6) D  
 3.7) E  
 3.8) D  
 3.9) B  
 4.1) C  
 4.2) B  
 4.3) D  
 4.4) A

**Pharm #11**

1.1) C

1.2) A  
 1.3) B  
 1.4) C  
 1.5) D  
 1.6) A  
 1.7) B  
 1.8) C  
 1.9) D  
 1.10) C  
 1.11) B  
 1.12) C  
 2.1) C  
 2.2) D  
 2.3) A  
 2.4) C  
 2.5) A  
 3.1) D  
 3.2) A  
 3.3) C  
 3.4) B  
 4.1) E  
 4.2) A  
 4.3) B  
 4.4) D  
 4.5) C  
 4.6) A  
 4.7) B  
 4.8) C  
 4.9) A  
 4.10) D  
 4.11) A  
 4.12) B  
 4.13) B  
 4.14) C  
 4.15) A  
 5.1) D  
 5.2) D  
 5.3) B  
 5.4) E  
 5.5) E  
 5.6) B  
 5.7) D  
 5.8) C  
 5.9) E  
 5.10) A  
 5.11) C

5.12) C  
 5.13) B  
 5.14) B  
 5.15) D  
 5.16) B  
 5.17) A  
 5.18) D  
 5.19) D  
 5.20) A  
 5.21) C  
 6.1) B  
 6.2) B  
 6.3) B  
 6.4) D  
 6.5) E  
 6.6) A  
 6.7) A  
 6.8) D  
 6.9) A  
 6.10) D  
 6.11) E  
 6.12) A  
 6.13) D

**Pharm #12**

1.1) E  
 1.2) C  
 1.3) E  
 1.4) B  
 1.5) E  
 1.6) B  
 2.1) A  
 2.2) C  
 2.3) E  
 2.4) C  
 2.5) B  
 2.6) C  
 3.1) D  
 3.2) A  
 3.3) C  
 3.4) D  
 3.5) C  
 3.6) D  
 3.7) E  
 4) D  
 5.1) B

5.2) E  
 5.3) B  
 5.4) E  
 6) A  
 7.1) B  
 7.2) A  
 7.3) D  
 7.4) B  
 7.5) A  
 7.6) C  
 7.7) E  
 7.8) B  
 8.1) A  
 8.2) D

**Quiz by:  
 James  
 Lamberg**

**Please let me know if there  
 are any errors and I will fix  
 them. Email James Lamberg:**

**James.Lamberg@gmail.com**

*If you think these quizzes are a  
 good resource, please help me  
 make them better.*