Pharmacology

NBDE II Review

(Tufts)

Prepared by M.L. Thompson, Ph.D., Dept. of General Dentistry, Tufts Dental School

Pharmacology Board Review 2005

This list of questions and topics is the result of going through about 10 years worth of old Board Exams in Pharmacology, cutting out all the questions, categorizing them into topic areas (e.g. antibiotics, local anesthetics, etc.), and then further grouping them into the type of information about a category of drugs that was being asked for. When you do this, you see that many exams repeat questions (sometimes they reword them a little bit to make them look different!), but in actuality it is possible to get a feel for the various facts that you are expected to know, and that there aren't that many of them. As you go through this handout, you will see that I point out to you the major facts that tend to get asked over and over again for the various major drug categories, and I also give you actual examples of questions (and the reworded versions), as well as the correct answer. In many cases, I have written out a detailed explanation of the answer, just to enlighten you further. So good luck and enjoy.

The downside is that these questions are from old Board exams. Some of the material is obviously dated, as drugs fall out of fashion, newer drugs get used instead of older drugs, etc. At the beginning of each section I will try to indicate some things that have changed and thus you may want to place less emphasis on some of the questions here.

On a positive note, there used to be a separate pharmacology section of 100 questions. Nowadays, you might see 25-30 in some versions, other versions less. Unfortunately, they still can draw from the realm of pharmacology so you gotta review it all. However, the good thing is that since they ask fewer questions, and since they are trying to ask more clinically relevant stuff, if you really focus your efforts on analgesics, antibiotics, and anesthetics, you should be covered for the majority of questions.

There are always going to be some random, unpredictable questions that means you have to review more if you want to do really well. Maybe you will luck out, and these will be the questions they are testing and they don't count.

Local Anesthetics

I. The largest category of LA questions focuses on your ability to distinguish amide LAs from esters: ***(This I hope is deemphasized, since amide local anesthetics are used almost exclusively now)***

esters = procaine, tetracaine, cocaine. All the rest are amides: lidocaine, mepivacaine, bupivacaine, prilocaine, dibucaine. They also require you to know that amides are metabolized in the liver, esters mainly by esterases in plasma. An infrequent question asks which class of drugs has the most consistency in structure . LAs are the drug group most consistent in drug structure, because LAs are either amides or esters, differing only in their structure in the intermediate chain (its either an amide or an ester) that connects the aromatic group to the secondary or tertiary amino terminus.

II. The next category of questions has to do with toxic reactions to local anesthetics, either due to high systemic levels of local anesthetics in general (cardiovascular collapse due to myocardial depression, hypotensive shock) or to a specific agent such as prilocaine, which causes methemoglobinemia.

III. A 3rd class of questions are aimed at your knowledge of the mechanism of action of local anesthetics: they prevent the generation of nerve impulses by interfering with sodium transport into the neuron.

IV. The last most frequent type of question regarding local anesthetics has to do with issues regarding absorption of local anesthetics. Remember, only the non-ionized (or free base form) form can penetrate tissue membranes. Inflamed tissue has a lower than normal pH, which decreases the amount of non-ionized form available to penetrate.

V. Usually at least one question comes up asking you to calculate how many mg of local anesthetic a patient has received, e.g. how many mg of lidocaine in 1.8 ml of a 2% lidocaine solution? 2% lidocaine is 20 gm/100 ml or 20 mg/1 ml, so 36 in 1.8 ml.

1. Which of the following is a local anesthetic subject to inactivation by plasma esterases?
   a. Procaine
   b. Lidocaine
   c. Prilocaine
   d. Mepivacaine
   e. Bupivacaine

   (a) Proccaine is the only ester listed -- all the rest are amides

2. Procaine differs from lidocaine in that
   a. Procaine is a p-aminobenzoic acid ester and lidocaine is not
   b. Lidocaine is a meta-aminobenzoic acid ester and procaine is not
   c. The duration of action of procaine is longer than that of an equal total dose of lidocaine
   d. Procaine hydrochloride is metabolized into diethylaminoethanol and benzoic acid.

   (a) this is basically a true-false type question. (a) is the only statement that is true

3. Which of the following local anesthetics would be expected to produce a sensitization reaction in a patient allergic to lidocaine?
   a. Mepivacaine
   b. Tetracaine
   c. Procaine
   d. Prilocaine
   e. Dibucaine

   i. (a), (b) and (c)
   ii. (a), (d) and (e)
   iii. (b) and (c) only
   iv. (b), (c) and (d)
   v. (b), (d) and (e)

   (ii) another ester vs. amide type identification question. Lidoccaine is an amide, thus other amides will be cross-allergenic - mepivacaine, prilocaine and dibucaine are the other amides listed. Procaine and tetracaine are esters and will not be cross-allergenic.

9. The hydrolysis of procaine occurs mainly in the
   a. Liver

b. Lungs
c. Plasma
d. Muscles
e. Kidneys

(c) procaine is an ester; esters are metabolized predominately by pseudocholinesterases in the plasma.

10. Which of the following is local anesthetic subject to inactivation by plasma esterases?
    a. Lidocaine
    b. Prilocaine
    c. Tetracaine
    d. Mepivacaine
    e. Bupivacaine

(c) esters are metabolized by plasma esterases - tetracaine is the only ester listed, all the rest are amides

11. The activity of procaine is terminated by
    a. Elimination by the kidney
    b. Storage in adipose tissue
    c. Metabolism in the liver only
    d. Metabolism in the liver and by pseudocholinesterase in the plasma

(d) remember #9 above? see the word "mainly"? same question, but worded a little differently to throw you off. Again, procaine is an ester; esters are metabolized predominately by pseudocholinesterases in the plasma, but also to some extent by esters in the liver.

12. All of the following factors are significant determinants of the duration of conduction block with amide-type local anesthetics EXCEPT the
    a. pH of tissues in the area of injection
    b. Degree of vasodilatation caused by the local anesthetic
    c. Blood plasma cholinesterase levels
    d. Blood flow through the area of conduction block
    e. Concentration of the injected anesthetic solution

(c) the word "EXCEPT" should alert you that this is basically a true-false type question with 4 true statements and 1 false statement; you just have to figure out which one! In this case, you just have to remember that plasma cholinesterase levels are only important for the duration of action of ester-type LAs, not amides, which are metabolized in the liver. All the other statements are variables which affect duration of the block, but apply to both esters and amides.

13. Which of the following is contraindicated for a patient who had an allergic reaction to procaine six months ago?
    a. Nerve block with lidocaine
    b. Topical application of lidocaine
    c. Topical application of tetracaine
    d. Infiltration with an antihistamine

(c) again, just another question that requires you to be able to pick out an ester or an amide from a list. Since procaine is an ester, only another ester LA would be cross-allergenic. In this list the only ester listed is tetracaine.

14. Bupivacaine (Marcaine) has all of the following properties relative to lidocaine (Xylocaine) EXCEPT bupivacaine
    a. Is more toxic
    b. Is an ester-type local anesthetic
    c. Has a slower onset of action
    d. Has a longer duration of action

(d) According to textbooks, local anesthetics fall into the following classes in terms of duration of action: <u>short</u>: procaine; <u>moderate</u>: prilocaine, mepivacaine, lidocaine; <u>long</u>: bupivacaine, tetracaine, etidocaine. Statements (a), 3, and 4 would be true if the question was comparing mepivacaine to bupivacaine, which are structurally similar; but the comparison is to lidocaine. The only difference that applies is duration of action ((d)), bupivacaine is longer. (b) is wrong, both are amides.

15. Amide-type local anesthetics are metabolized in the
    a. Serum
    b. Liver
    c. Spleen
    d. Kidney
    e. Axoplasm

(b) don't forget: esters in plasma; amides in liver

15. The duration of action of lidocaine would be increased in the presence of which of the following medications?
    a. Prazosin
    b. Propranolol
    c. Hydrochlorothiazide
    d. Lisinopril
    e. Digoxin

(b) this is an interaction I tested you on several times – now you know why! Propranolol interacts with lidocaine in two ways. By slowing down the heart via beta receptor blockade, blood delivery (and lidocaine) to the liver is reduced, thus lidocaine remains in the systemic circulation longer, and can potentially accumulate to toxic levels. Propranolol and lidocaine also compete for the same enzyme in the liver, thus metabolism of lidocaine can be reduced.

16. Severe liver disease least affects the biotransformation of which of the following?
    a. Lidocaine
    b. Procaine
    c. Prilocaine
    d. Mepivacaine

(b) Answer is (b)- You should be able to recognize that all of these drugs are local anesthetics. Local anesthetics are of one of two types, either esters or amides. Ester types are subject to hydrolysis in the plasma and thus have short half lives. Amides are metabolized primarily in the liver and have longer half lives. Thus the biotransformation (e.g., metabolism; again, the rats are using a different word to confuse you, even though they are asking the same basic question) of an amide type local anesthetic would be the most altered in the presence of sever liver disease. The key word here is "least". Of the drugs listed, only procaine is an ester. The rest are amides.

Questions regarding toxicity:

17. A patient has been given a large volume of a certain local anesthetic solution and subsequently develops cyanosis with methemoglobinemia. Which of the following drugs most likely was administered?
    a. Procaine
    b. Prilocaine
    c. Dibucaine
    d. Lidocaine
    e. Mepivacaine

(b) strictly memorization

18. Use of prilocaine carries the risk of which of the following adverse effects?
    a. Porphyria
    b. Renal toxicity
    c. Gastric bleeding
    d. Methemoglobinemia

(d) same as above but asked backwards. Methemoglobinemia may result from a toluidine metabolite of prilocaine, orthotoluidine.

19. The most probable cause for a serious toxic reaction to a local anesthetic is
    a. Psychogenic
    b. Deterioration of the anesthetic agent
    c. Hypersensitivity to the vasoconstrictor
    d. Hypersensitivity to the local anesthetic
    e. Excessive blood level of the local anesthetic

(e) Most toxic reactions of a serious nature are related to excessive blood levels arising from inadvertent intravascular injection. Hypersensitivity reactions (options b & c) are rare, but excessive blood levels will induce toxic reactions like CNS stimulation in most everyone. This is a case where option (e) is the "best" answer, because it is more likely than the other alternatives, which might be true, but are not as likely (e.g, "most probable") to happen.

20. High plasma levels of local anesthetics may cause
    a. Inhibition of peristalsis
    b. stimulation of baroreceptors resulting in severe hypotension
    c. Inhibition of the vagus nerve to the heart
    d. Depression of inhibitory neurons in the CNS

(d) Initially LAs inhibit central inhibitory neurons, which results in CNS stimulation, which can proceed to convulsions. At higher doses, they inhibit both inhibitory and excitatory neurons, leading to a generalized state of CNS depression which can result in respiratory depression and death.

20a. Unfortunately, you injected your lidocaine intra-arterially. The first sign of lidocaine toxicity that might be seen in the patient would be
    a. Elevated pulse rate
    b. Sweating
    c. CNS excitation
    d. Cardiovascular collapse
    e. CNS depression

(c) same question as above just worded differently. The intra-arterial injection would result in the high plasma levels mentioned in the previous question.

20. The first sign that your patient may be experiencing toxicity from too much epinephrine would be
    a. Cardiovascular collapse
    b. Convulsions
    c. Elevated pulse rate
    d. Slurred speech

(c) it is a sympathomimetic after all. All the other reactions are related to elevated lidocaine levels

20. Which disease condition would make the patient most sensitive to the epinephrine in the local anesthetic?
    a. Grave's disease
    b. Diabetes
    c. HIV
    d. Alcoholism
    e. Schizophrenia

(a) Grave's disease is an autoimmune disease that causes hyperthyroidism – the resulting high levels of circulating thyroid hormone result in a hypermetabolic state with heightened sympathetic activity, which combined with injected epinephrine could result in a hypertensive crisis.

21. Cardiovascular collapse elicited by a high circulating dose of a local anesthetic may be caused by
    a. Syncope
    b. Vagal stimulation
    c. Histamine release
    d. Myocardial depression
    e. Medullary stimulation

(d) Cardiovascular collapse is due to a direct action of the local anesthetic on the heart muscle itself (LA's in toxic doses depress membrane excitability and conduction velocity), thus (d) is the correct answer. All of the other alternatives are indirect ways to affect the heart.

22. The most serious consequence of systemic local anesthetic toxicity is
    a. Vertigo
    b. Hypertension
    c. Hyperventilation
    d. Post depressive central nervous system convulsions
    e. Postconvulsive central nervous system depression

(e) Of the options listed, this is the one that will kill the patient, which I guess makes it the most serious.

23. Hypotensive shock may result from excessive blood levels of each of the following local anesthetics EXCEPT
    a. Cocaine
    b. Procaine
    c. Lidocaine
    d. Tetracaine
    e. Mepivacaine

(a) All the listed local anesthetics except cocaine are vasodilators, especially ester-ctype drugs such as proccaine and the amide lidocaine. Cocaine is the only local anesthetic that predictably produces vasoconstriction. Cocaine is also the only local anesthetic to block the reuptake of NE into adrenergic neurons, and thus potentiate the NE that has been released from nerve endings

24. Which of the following anesthetic drugs produces powerful stimulation of the cerebral cortex?
    a. Cocaine
    b. Procaine
    c. Lidocaine
    d. Tetracaine
    e. Mepivacaine

    (a) see explanation above

Questions regarding mechanism of action:

25. Local anesthetics block nerve conduction by
    a. Depolarizing the nerve membrane to neutrality
    b. Increasing membrane permeability to K+
    c. Increasing membrane permeability to Na+
    d. Preventing an increase in membrane permeability to K+
    e. Preventing an increase in membrane permeability to Na+

    (e) didn't I make you memorize this? You should at keast remember Na+ ions are involved, which limits your choices to (c) and (e). (c) would increase or facilitate nervous impulse conduction, which is the opposite of what you want the local anesthetic to do, so pick (e).

26. Which of the following is true regarding the mechanism of action of local anesthetics?
    a. Usually maintain the nerve membrane in a state of hyperpolarization
    b. Prevent the generation of a nerve action potential
    c. Maintain the nerve membrane in a state of depolarization
    d. Prevent increased permeability of the nerve membrane to potassium ions
    e. Interfere with intracellular nerve metabolism

    (b) this should be really obvious!

27. Local anesthetic agents prevent the generation of nerve impulses by
    a. Decreasing threshold for stimulation
    b. Decreasing resting membrane potential
    c. Decreasing inward movement of sodium ion
    d. Increasing inward movement of potassium ion

    (c) Answer is (c)- straight memorization- nerve impulses are generated by the influx of sodium resulting in depolarization. repolarization and inactivity occurs when potassium moves out. (sodium-potassium pump). LAs act by blocking Na+ movement.

28. Local anesthetics interfere with the transport of which of the following ions during drug-receptor interaction
    a. Sodium
    b. Calcium
    c. Chloride
    d. Potassium
    e. Magnesium

    (a) see how many different ways they can ask the same question?

Questions regarding pH effects on absorption of local anesthetics

30. If the pH of an area is lower than normal body pH, the membrane theory of local anesthetic action predicts that the local anesthetic activity would be
    a. Greater, owing to an increase in the free-base form of the drug
    b. Greater, owing to an increase in the cationic form of the drug
    c. Less, owing to an increase in the free-base form of the drug
    d. Less, owing to a decrease in the free-base form of the drug
    e. None of the above

    (d) the next three or four questions are all versions of the same thing – see the explanation below

31. A local anesthetic injected into an inflamed area will NOT give maximum effects because
    a. The pH of inflamed tissue inhibits the release of the free base
    b. The drug will not be absorbed as rapidly because of the decreased blood supply
    c. The chemical mediators of inflammation will present a chemical antagonism to the anesthetic
    d. Prostaglandins stabilize the nerve membrane and diminish the effectiveness of the local anesthetic

    (a) while some of the other alternatives sound plausible, think about the factoids you were taught about local anesthetics and variables that affect their action. An important one was the role of pH and ionization factors. Remember, the free base or nonionized form is the form that passes through membranes, yet once inside the neuron only the ionized form is effective. Inflamed tissue has a lower pH than normal tissue and will shift the equilibrium of the LA solution such that most of it remains ionized and thus unavailable to penetrate

32. The penetration of a local anesthetic into nervous tissue is a function of the
    a. Length of the central alkyl chain
    b. Lipid solubility of the ionized form
    c. Lipid solubility of the unionized form
    d. Ester linkage between the aromatic nucleus and the alkyl chain
    e. Amide linkage between the aromatic nucleus and the alkyl chain

    (c) only options (b) and (c) are relevant here - the others have nothing to do with LA penetration into membranes. Membrane permeability is affected by whether or not the molecule is "charged" or ionized or not (e.g., unionized). Only the latter form passes readily through membranes. See, they're asking the same thing they asked in the previous question, just coming at it from another angle. Remember the fact and you can cover the angles.

35. At a pH of 7.8, lidocaine (pKa = 7.8) will exist in
    a. the ionized form
    b. the nonionized form
    c. an equal mixture of ionized and nonionized forms
    d. a mixture 10 times more ionized than nonionized forms

    (c) the ratio of ionized to unionized forms is given by the formula log A/AH= pH-pKa. In this instance the difference between pH and pKa is 0. Thus lidocaine will exist as an equal mixture (so (c) is correct). Most local anesthetics are weak bases with pKa ranging from 7.5 to 9.5. LA's intended for injection are usually prepared in salt form by addition of HCl. They penetrate as the unionized form into the neuron where they re-equilibrate to both charged and uncharged forms inside

the neuron - the positively charged ion blocks nerve conduction.

33. The more rapid onset of action of local anesthetics in small nerves is due to
    a. The slightly lower pH of small nerves
    b. The greater surface-volume ratio of small nerves
    c. The increased rate of penetration resulting from depolarization
    d. Smaller nerves usually having a higher threshold

Who knows? Who cares? probably the answer is (b) - the theory goes that there is a size dependent critical length of anesthetic exposure necessary to block a given nerve. Small fibers will be blocked first because the anesthetic concentration to h critical length in a small fiber will be reached faster than the critical length in a larger fiber. You have to block three nodes of ranvier, and they are farther apart in larger fibers than they are in small diameter fibers. Make sense?

34. Which of the following statements are true regarding onset, degree and duration of action of local anesthetics?
    a. The greater the drug concentration, the faster the onset and the greater the degree of effect
    b. Local anesthetics block only myelinated nerve fibers at the nodes of Ranvier
    c. The larger the diameter of the nerve fiber, the faster the onset of effect
    d. The faster the penetrance of the drug, the faster the onset of effect

    i. (a), (b), and (c)
    ii. (a), (b) and (d)
    iii. (a) and (c) only
    iv. (b), (c) and (d)

(ii) if you knew the fact above about small nerves, then this question basically becomes a true false type thing, and (c) is the false statement. (a) and (d) make logical sense so you are stuck picking between (b) and (c). You have your pick of memorizing the small nerve thing or the myelinated nerve nodes of ranvier thing.

And now, for those of you that complained in class "do we really have to know this stuff?"

35. A dentist administers 1.8 ml of a 2% solution of lidocaine. How many mg of lidocaine did the patient receive?
    a. 3.6
    b. 9
    c. 18
    d. 36
    e. 180

(d) 2% solution = 20 mg/ml X 1.8 ml = 36 mg lidocaine. And you thought you would never have to do this stuff again!

36. Three ml of a local anesthetic solution consisting of 2% lidocaine with 1:100,000 epinephrine contains how many milligrams of each?
    a. 6 mg. lidocaine, 0.3 mg. epinephrine
    b. 6 mg. lidocaine, 0.03 mg. epinephrine
    c. 60 mg. lidocaine 0.3 mg. epinephrine
    d. 60 mg. lidocaine 0.03 mg epinephrine
    e. 600 mg lidocaine, 0.3 mg. epinephrine
    f. 600 mg. lidocaine, 0.03 mg. epinephrine

(d) 2% lidocaine = 20 mg/ml x 3 = 60 mg lidocaine
1:100,000 epi = 0.01 mg/ml x 3 = 0.03 mg epi

37. The maximum allowable adult dose of mepivacaine is 300 mg. How many milliliters of 2% mepivacaine should be injected to attain the maximal dosage in an adult patient?
    a. 5
    b. 10
    c. 15
    d. 20
    e. 25

(c) 2% mepivacaine = 20 mg/ml, so 300 mg / 20 mg/ml = 15 ml

38. A recently introduced local anesthetic agent is claimed by the manufacturer to be several times as potent as procaine. The product is available in 0.05% buffered aqueous solution in 1.8 ml. cartridge. The maximum amount recommended for dental anesthesia over a 4-hour period is 30 mg. The amount is contained in approximately how many cartridges?
    a. 1-9
    b. 10-18
    c. 19-27
    d. 28-36
    e. Greater than 36

(d) 0.05% = 0.5 mg/ml . To give 30 mg, you have to give 30mg/0.5 mg/ml or 60 ml. 1 cartridge = 1.8 ml, thus 60ml /1.8ml = 33.3 cartridges. - first express the percentage of solution as a fraction of 100, then add the units gm/ml. 0.05% equals 0.5 or 1/2 gms per 100 ml. The cartridge is 1.8 ml which you can round off to almost 2 mls total. In this 2 ml you would have 1 gm of the local anesthetic. You need to give 30 gms, which would require 30 cartridges. The alternative that meets this answer is (d). Don't get tricked by the placement of the decimal point- many people read the 0.05% as being the same as 5 gms rather than 0.5 gms.

39. According to AHA guidelines, the maximum # of carpules of local anesthetic containing 1:200,000 epinephrine that can be used in the patient with cardiovascular disease is
    a. 1
    b. 2
    c. 3
    d. 4
    e. 11

(d) the AHA limit is 0.04 mg, compared to 0.2 mg in the healthy patient. 1:200,000 equals 0.005 mg/ml or 0.009 per 1.8 ml carpule. 4 carpules would thus contain 0.036 mg, which is just below the 0.04 mg limit

Antibiotics

1. The most frequently asked type of question requires you to be able to compare various penicillin antibiotics in terms of potency against certain bugs, allergenicity, drug of choice against certain conditions, etc. For example:

a. Penicillin V vs. penicillin G: the latter is more sensitive to acid degradation and thus is usually injected rather than taken orally **(Certainly no one in dentistry uses Pen G, so I would think they would not use too many of these questions)**

b. Which penicillin has the best gram-negative spectrum: ampicillin

c. Which drugs from a list are or are not cross-allergenic with penicillin: most usually asked about ones are: cephalosporins and ampicillin are, erythromycin isn't

d. Which penicillin is useful against penicillinase-producing bugs such as staphylococcus: dicloxacillin

e. Which is specific for Pseudomonas infections: an extended spectrum such as carbenicillin

f. Which combination of agents should be used prophylactically for patient with heart valve to prevent bacterial endocarditis: ampicillin and gentamycin (1988- according to latest recommendation of AHA and ADA, although use the latest guidelines that you have heard about)) (**here's a big change obviously, since combinations are no longer used, and neither are doses given before and after treatment – review your latest prophylaxis guidelines)**

Prophylaxis Regimens For SBE (AHA 1997 Guidelines)
1st choice: Amoxicillin: 2 g (4 X 500 mg), PO 1 hr before treatment. # of pills to be dispensed depends on # of appointments Children: 50 mg/kg 1 hr prior
For PCN allergic: Clindamycin: 600 mg (4 X 150 mg) PO 1 hr before treatment. . # of pills to be dispensed depends on # of appointments
non-oral: Ampicillin IV/IM 2 g, 1/2 hr before (Kids: 50 mg/kg) Clindamycin (for PCN-allergic) 600 mg IV 1/2 hr prior, kids (20 mg/kg)
Prophylaxis for the patient with a prosthetic joint
Keflex, 2 g, (4 X 500mg), PO 1 hr before treatment . # of pills to be dispensed depends on # of appointments

Examples of patient cardiovascular conditions that require prophylaxis and some that don't (AHA 1997 Guidelines)	
Prophylaxis Required	**Prophylaxis Not Required**
Prosthetic valves	Cardiac pacemakers
Previous endocarditis	Rheumatic fever without valvular dysfunction
Pulmonary shunts	Mitral valve prolapse without valvular regurgitation

Examples Of Dental Procedures That Require Prophylaxis And Some That Don't **(According to AHA 1997 Guidelines. Caveat: our clinic guidelines, should they differ from these, are also considered correct answers)**	
Required	**Not Required**
Extractions	Restorative Procedures
Periodontal Surgery	Intracanal endodontic treatment
Implants	Taking Of Impressions

Common Prescription Regimens For Treating An Infection:	
Penicillin VK	250-500mg, dispense 30, take 2 tablets at once*, then 1 tab every 6 hrs until gone (7 days) *some sources do not indicate loading dose, so dispense 28, take 1 q6h until gone Kids (less than 12 yrs): 20-50 mg/kg qid
Clindamycin	150-300 mg, dispense 21, take 1 capsule every 8 hrs until gone (7 days) Kids: 8-12 mg/kg tid or qid
Amoxicillin	500 mg, dispense, 21, take 1 capsule every 8 hrs until gone (7 days) Kids (under 20 kg): 20-40 mg/kg tid

2. The 2nd largest category expects you to know the mechanism of action of the various antibiotics:
   a. Bactericidal agents such as penicillin kill rapidity growing cells by inhibiting cell wall synthesis
   b. Bacteriostatic agents such as tetracycline limit population growth, but do not kill bugs by interfering with protein synthesis on bacterial ribosomes
   c. Antifungals such as nystatin bind to ergosterol in fungal cell walls to weaken the wall
   d. Bacteriostatic agents such as the sulfonamides compete with PABA in folic acid synthesis, thus resulting in folic acid deficiency

3. Many questions are asked regarding side effects or toxicities of penicillins, tetracyclines, clindamycin, etc:
   a. What are symptoms seen during allergic reactions to penicillins: dermatitis, stomatitis, bronchoconstriction and cardiovascular collapse
   b. What agent produces GI upset and pseudomonas colitis: clindamycin
   c. Which agents are most likely or least likely to cause superinfection: most: broad spectrum agents such as tetracyclines; least: narrow spectrum agents such as penicillin G
   d. Aplastic anemia is associated with chloramphenicol
   e. Liver damage or hepatotoxicity is associated with tetracycline
   f. Erythromycin estolate associated with allergic cholestatic

hepatitis

4. Questions involving interactions between antibiotics and other drugs:
   a. Tetracycline and penicillin (cidal-static interaction)cancel each other out due to opposing mechanisms of action
   b. Probenecid alters the rate of renal clearance of penicillin
   c. Effectiveness of tetracyclines is reduced by concurrent ingestion of antacids or dairy products
   d. Broad spectrum antibiotics enhance the action of coumarin anticoagulants because of the reduction of Vitamin K sources
   e. Antibiotics such as ampicillin decrease the effectiveness of oral contraceptives due to suppression of normal GI flora involved in the recycling of active steroids from bile conjugates, leading to more rapid excretion of the steroids from the body
   f. Macrolides such as erythromycin inhit the metabolism of drugs such as seldane, digoxin, etc.

5. More and more questions these days are being asked about antivirals and antifungals, so review

a. Acyclovir: an antiviral used for various forms of herpes

b. Fluconazole or ketoconazole: systemic-acting antifungals useful for treating candidiasis

Frequently asked questions on antibiotics:

5. For treating most oral infections, penicillin V is preferred to penicillin G because penicillin V
   a. Is less allergenic
   b. Is less sensitive to acid degradation
   c. Has a greater gram-negative spectrum
   d. Has a longer duration of action
   e. Is bactericidal, whereas penicillin G is not

   (b) memorization: basically the only difference

6. The sole therapeutic advantage of penicillin V over penicillin G is
   a. Greater resistance to penicillinase
   b. Broader antibacterial spectrum
   c. More reliable oral absorption
   d. Slower renal excretion
   e. None of the above

   (c) reworded version of the above

7. Which of the following penicillins is administered ONLY by deep intramuscular injection?
   a. Ampicillin
   b. Dicloxacillin sodium
   c. Penicillin G procaine
   d. Penicillin V potassium

   (c) Answer is (c)- (a), (b) and (d) are all used orally. Penicillin G is destroyed by acid in the stomach resulting in variable and irregular absorption. Penicillin V is acid stable and available for oral use. Penicillin G procaine is typically given intramuscularly in repository form, yielding a tissue depot from which the drug is absorbed over hours. In this form, it cannot be given IV or subcutaneously.

8 The principal difference among potassium, procaine and benzathine salts of penicillin G is their
   a. Potency
   b. Toxicity
   c. Duration of action
   d. Antibacterial spectrum
   e. Diffusion into the cerebrospinal fluid

   (c) again, just asking you to know something about the various forms of penicillin. Since in most cases you are going to use Pen VK orally, this question is an old one showing its age and probably not likely to appear anymore on board excams

11. Which of the following antibiotics is cross-allergenic with penicillin and should NOT be administered to the penicillin-sensitive patient?
   a. Ampicillin
   b. Erythromycin
   c. Clindamycin
   d. Lincomycin
   e. Tetracycline

   (a) ampicillin sort of sounds like penicillin so it must be the answer

12. Which of the following antibiotics may be cross-allergenic with penicillin?
   a. Neomycin
   b. Cephalexin
   c. Clindamycin
   d. Erythromycin
   e. All of the above

   (b) This is a memorization question, with (b) the correct answer. You have to remember that the cephalosporins (like cephalexin) are chemically related to the penicillins. The others are not chemically related and thus cross-allergenicity is unlikely

13. Which of the following antibiotics shows an incidence of approximately 8% cross-allergenicity with penicillins?
   a. neomycin
   b. cephalexin
   c. bacitracin
   d. vancomycin
   e. tetracycline

   (b) just slightly reworded version of the above question, but with some different alternatives thrown in. Obviously, if you can recognize whther or not a drug is a penicillin or a cephalosporin , and you remember that these are the classes that show cross-allergenicity, then you can handle any rewording of this question.

14. Which of the following groups of antibiotics is related both structurally and by mode of action to the penicillins?
   a. Polymyxins
   b. Cycloserines
   c. Cephalosporins
   d. Chloramphenicols

   (c) see above

13. For the dentist, the most reliable method of detecting a patient's allergy to penicillin is by

a. Injecting penicillin intradermally
b. Taking a thorough medical history
c. Placing a drop of penicillin on the eye
d. Having the patient inhale a penicillin aerosol
e. Injecting a small amount of penicillin intravenously

(b) all of the other methods involve unacceptable risk. Once sensitized, even a small amount can cause an allergic response. Remember, it is not a dose-related response that won't be problematic if you only inject a little bit.

14. Which of the following antibiotics is the substitute of choice for penicillin in the penicillin-sensitive patient?
a. Bacitracin
b. Erythromycin
c. Tetracycline
d. Chloramphenicol

(b) boy, if you haven't heard this a zillion times by now.. None of the alternatives listed would be a problem in terms of cross-allergenicity, but the reason (b) is the right answer is that the spectrum of activity of erthromycin is very similar to penicillin. The others offer a much broader spectrum of coverage than we usually require; always use the drug with the narrowest spectrum possible that includes the microbe in question. ***Standards have now changed such that clindamycin is the drug of choice in this situation. But if they don't include clindamycin, look for erythromycin, or for that matter Azithromycin***

15. Most anaphylactic reactions to penicillin occur
a. When the drug is administered orally
b. In patients who have already experienced an allergic reaction to the drug
c. In patients with a negative skin test to penicillin allergy
d. When the drug is administered parenterally
e. Within minutes after drug administration

i. (a), (b) and (d)
ii. (b), (c) and (d)
iii. (b), (d) and (e)
iv. (b) and (e) only
v. (c), (d) and (e)

(iii) memorize

16. Which of the following penicillins has a broader gram-negative spectrum than penicillin G?
a. Nafcillin
b. Ampicillin
c. Cephalexin
d. Methicillin
e. Penicillin V

(b) that's why it is considered an "extended-spectrum" form of penicillin

17. Which of the following penicillins has the best gram-negative spectrum?
a. Nafcillin
b. Ampicillin
c. Methicillin
d. Penicillin V
e. Phenethicillin

(b) didn't they just ask the same thing in the question above?

18. Which of the following antibiotics should be considered the drug of choice in the treatment of infection caused by a penicillinase-producing staphylococcus?
a. Neomycin
b. Ampicillin
c. Tetracycline
d. Penicillin V
e. Dicloxacillin

(e) that's really the only use for dicloxacillin

19. Oral infections caused by organisms that produce penicillinase should be treated with
a. Ampicillin
b. Dicloxacillin
c. Erythromycin
d. Any of the above
e. Only (a) or (c) above

(b) of those listed only (b) is penicillinase resistant. Ampicillin is an extended spectrum penicillin, and is not penicillinase resistant. Erythromycin shouldn't be affected by penicillinases, since it isn't a peniciilin, but it doesn't work against staph for other reasons.

20. Which of the following antibiotics is LEAST effective against penicillinase-producing microorganisms?
a. Ampicillin
b. Cephalexin
c. Methicillin
d. Clindamycin
e. Erythromycin

(a) same question asked backassward

21. Which of the following is a bactericidal antibiotic used specifically in the treatment of infections caused by *Pseudomonas* species and indole-positive *Proteus* species?
a. Ampicillin
b. Penicillin V
c. Tetracycline
d. Dicloxacillin
e. Carbenicillin

(e) Wow, I bet you didn't think they would ask something like this!. An extended spectrum agent is required. Ampicillin is ineffective, while Pen-V is too narrow in spectrum.

22. Penicillin's effectiveness against rapidly growing cells is primarily due to its effect on
a. Protein synthesis
b. Cell wall synthesis
c. Nucleic acid synthesis
d. Chelation of metal ions
e. Cell membrane permeability

(b) memorize, memorize

23. Chlortetracycline acts by interfering with
a. Cell wall synthesis
b. Nuclear acid synthesis
c. Protein synthesis on bacterial but not mammalian ribosomes

d. Protein synthesis on mammalian but not bacterial ribosomes

(c) that's why it is selectively toxic. Wouldn't you like it if your doctor prescribed a drug for you that did (d)?

24. The probable mechanism of the bacteriostatic action of sulfonamides involves
    a. Disruption of the cell membrane
    b. Coagulation of intracellular proteins
    c. Reduction in oxygen utilization by the cells
    d. Inhibition of metabolism by binding acetyl groups
    e. Competition with para-aminobenzoic acid in folic acid synthesis

    (e) memorize

25. The sulfonamides act by
    a. Suppressing bacterial protein synthesis
    b. Inhibiting the formation of the cytoplasmic bacterial membrane
    c. Inducing the formation of "lethal" bacterial proteins
    d. Inducing a deficiency of folic acid by competition with para-aminobenzoic acid

    (d) same as above worded differently

26. Which antibiotic is able to achieve a higher concentration in bone than in serum?
    a. penicillin
    b. erythromycin
    c. clindamycin
    d. metronidazole
    e. amoxicillin

    (c) that's why it is very useful for treating bone infections such as osteomyelitis. The question might have substituted gingival fluid for bone – that would make the answer tetracycline

27. Tetracycline reduces the effectiveness of concomitantly administered penicillin by
    a. Reducing absorption of penicillin
    b. Increasing metabolism of penicillin
    c. Increasing renal excretion of penicillin
    d. Increasing binding of penicillin to serum proteins
    e. None of the above

    (e) tetracycline is bacteriostatic and would slow the rapid growth of the microbial population that a bactericidal drug such as penicillin needs to be effective, sine only when rapidly dividing are the cells making cell walls

37. The action of which of the following drugs will most likely be impaired by concurrent administration of tetracycline?
    a. Clarithromycin
    b. Erythromycin
    c. Sulfonamide
    d. Penicillin
    e. Lincomycin

    (d) the classic cidal- static interaction! See above, since this is just a reworded version of the same fact

28. Which of the following antibiotics is most likely to cause liver damage?
    a. Streptomycin
    b. Penicillin G
    c. Tetracycline
    d. Cephalosporins
    e. Amphotericin B

    (c) (a) streptomycin can damage the eighth nerve, affecting both balance and hearing, but is not associated with liver damage. (b) other than allergic reactions, penicillins are extremely safe, with no effect on the liver. (d) the cephalosporins are chemically related to the penicillins and share their relatively nontoxic nature. (e) amphotericin B, is an antifungal agent that produces such adverse side effects as nephrotoxicity and hypokalemia, but not liver toxicity. Thus (c) is the correct answer. Tetracyclines have been shown to be hepatotoxic following high doses in pregnant patients with a history of renal disease.

29. Which of the following erythromycins associated with an allergic cholestatic hepatitis?
    a. Erythromycin base
    b. Erythromycin stearate
    c. Erythromycin estolate
    d. Erythromycin succinate

    (c) just because

30. Which of the following antibiotics is LEAST likely to cause superinfection?
    a. Gentamicin
    b. Tetracycline
    c. Penicillin G
    d. Streptomycin
    e. Chloramphenicol

    (c) superinfections are usually seen following the use of broad spectrum agents. Of those listed, all are wide spectrum except Pen-G

31. Gastrointestinal upset and pseudomembranous colitis has been prominently associated with
    a. Nystatin
    b. Cephalexin
    c. Clindamycin
    d. Polymyxin B
    e. Erythromycin

    (c) The only 2 possibilities that produce GI upset are (c) and (e). As for producing colitis, (b) and (c) are associated with this adverse side effect. (c) is the only drug which does both, therefore it's the right answer.

32. Symptoms that may be characterized as allergic manifestations during penicillin therapy are
    a. Deafness, dizziness and acute anemia
    b. Crystalluria, nausea, vomiting and anaphylactic shock
    c. Oliguria, hematuria, bronchoconstriction and cardiovascular collapse
    d. Dermatitis, stomatitis, bronchoconstriction and cardiovascular collapse

    (d)

33. Aplastic anemia is a serious toxic effect that occurs particularly after a course of treatment with which of the following antibiotics?
    a. Penicillin

b. Lincomycin
c. Tetracycline
d. Streptomycin
e. Chloramphenicol

(e) memorize

34. Each of the following is a side effect of prolonged tetracycline hydrochloride therapy EXCEPT:
a. Suprainfection
b. Photosensitivity
c. Vestibular disturbances
d. Discoloration of newly forming teeth
e. Gastrointestinal symptoms (when administered orally)

(c) memorize

36. Colitis that results following clindamycin therapy is caused by an overgrowth of
a. C. dificile
b. Staph aureus
c. Pseudomonas
d. Candida albicans

(a) memorize

Antibiotics, Miscellaneous

37. Which antibiotic is appropriate for premedication in the penicillin allergic patient?
a. Cephalexin
b. Clindamycin
c. Erythromycin
d. Amoxicillin
e. Ampiciilin

(b) clindamycin is the current recommendation. Erythromycin used to be, so if you get a question that doesn't include clindamycin as an answer, look for erythromycin. Cephalexin might be a choice, but there is the issue of cross-allergencicity, and it must certainly be avoided in the anaphylactic patient. Amoxicillin and ampicillin are penicillins!

38. Acyclovir is useful for treating
a. Candidiasis
b. Colitis
c. Herpes simplex
d. HIV
e. ANUG

(c) always think used for herpes as the first answer

38. A distinct advantage that tetracyclines have over penicillins is that tetracyclines
a. Have no side effects
b. Do not cause superinfections
c. Are safer to use during pregnancy
d. Have a wider range of antibacterial activity
e. Produce higher blood levels faster after oral administration

(d) broad spectrum vs. narrow spectrum. Tetracyclines certainly have more side effects than penicillin, and are certainly one of the antibiotics to avoid during pregnancy.

39. Which of the following has the broadest antimicrobial spectrum?
a. Vancomycin (Vancocin)
b. Clindamycin (Cleocin)
c. Erythromycin (Erythrocin)
d. Chlortetracycline (Aureomycin)
e. A third generation cephalosporin

(d) Answer is (d)- remember, tetracyclines are broad spectrum antibiotics effective against both gram-negative and gram-positive cocci and bacilli. Clindamycin has a spectrum of activity similar to erthyromycin and vancomycin, which is less than that of the tetracylines, mainly affecting gram-positive microorganisms. Ist generation cephalosporins are effective against both gram-negative and gram-positive organisms, but the third generation ones have increased activity against gram-negative but greatly decreased activity against gram-positive microorganisms.

40. Sulfonamides and trimethoprim are synergistic bacteriostatic agents because in bacteria they
a. Both inhibit folic acid synthesis
b. Interfere sequentially with folinic acid production
c. Are both antimetabolites of para-aminobenzoic
d. Are both inhibitors of dihydrofolic acid reductase
e. Are both transformed *in vivo* into a single active compound

(b)

41. Which of the following substances is the most effective agent against fungus infections of the mucous membrane?
a. Nystatin ointment
b. Undecylenic acid
c. Polymyxin ointment
d. Saturated magnesium sulfate
e. 10 per cent aluminum chloride solution

(a)

42. The most desirable property of an antibiotic when used to treat an odontogenic infection is
a. Rapid absorption
b. Little allergenicity
c. Ability to achieve and maintain adequate concentrations at the site of infection
d. Lack of significant binding to plasma proteins
e. No effects on drug metabolism

(c) if it can't do this it isn't going to be very effective.

14. Nystatin is of greatest clinical usefulness in treating
a. viral infections
b. fungal infections
c. spirochetal infections
d. Bacterroides infections
e. penicillin resistant gram positive infections

(b) Nystatin is the prototypic antifungal agent, thus (b) is the most obvious 1st choice, and eliminates (a). (d) & (e) require an antibiotic, not an antifungal

42. Which of the following drugs chelates with calcium?

a. Erythromycin
b. Polymyxin B
c. Tetracycline
d. Penicillin G
e. Chloramphenicol

(c)

43. Which of the following is NOT characteristic of tetracycline antibiotics?
a. Absorption is impaired when taken with antacids
b. They predispose to monilial superinfection
c. They form a stable complex with the developing tooth matrix
d. They have a low tendency for sensitization, but a high therapeutic index
e. They are effective substitutes for penicillin prophylaxis against infective endocarditis

*Answer is (e)- Again, the important phrase in the question is **not** (Hey, just Wayne and Garth). Obviously the fact that you will remember about tetracylines is that they can discolor teeth in the fetus when taken by the mother during pregnancy. But don't circle that answer because (a) is also characteristic of tetracyclines (they are the most likely of all the antibiotics to cause superinfection), and is an annoying side effect in adults resulting from alteration of the oral, gastric and intestinal flora. The real answer is (e). Tetracyclines are not the drug of choice for prophylaxis against infective endocarditis. This is due to streptococcal infection. 15-20% of group A streptococci are resistant to tetracyclines, but none are resistant to penicillin or erythromycin. Recently a non-streptococcal induced subacute bacterial endocarditis has been identified, especially in juvenile periodontitis patients. The causative bacterium is not susceptible to penicillin or erythromycin. It may be necessary to treat predisposed patients with tetracycline for a few weeks, and then follow this with a course of penicillin or erythromycin. Remember that these drugs are antagonistic to each other and thus can't be used concurrently. Penicillin is a bactericidal drug which kills or destroys microorganisms by interfering with the synthesis or function of the cell wall, cell membrane or both. Thus it is most effective against bacteria that are multiplying. Tetracycline is a bacteriostatic antibiotic that acts by inhibiting the growth and multiplication of organisms by inhibiting protein synthesis by binding reversibly to the 30 S subunit of the bacterial ribosome. When the two types are given together, their effectiveness is negated or reduced.*

Antibiotics, Drug Interactions

44. The concurrent administration of penicillin G and probenecid results in
a. Increased metabolism of penicillin G.
b. Increased renal excretion of probenecid
c. Decreased renal excretion of penicillin G
d. Decreased bactericidal effect of penicillin G
e. Increased excretion of probenecid in the feces

(c)

71. Interaction between penicillin and probenicid is best described by which of the following mechanisms?
a. competition at the receptor site
b. acceleration of drug biotransformation
c. alteration in the acid-base balance
d. alteration in the rate of renal clearance

Answer is (d)- penicillin is metabolized in the liver, but it rapidly disappears from the blood due to rapid clearance by the kidneys. 90% is excreted by tubular secretion. Thus patients with renal disease will show high blood levels of penicillin. Similarly, probenicid, a uricosuric agent (a drug which tends to enhance the excretion of uric acid by reducing renal tubular transport mechanisms), reduces the renal clearance of penicillins. And you wondered why we had those lectures on pharmacokinetics!

45. When broad-spectrum antibiotics are administered with coumarin anticoagulants, the anticoagulant action may be
a. Reduced because of enhanced hepatic drug metabolism
b. Reduced because of increased protein-binding
c. Increased because of reduction of vitamin K sources
d. Increased because of decreased renal excretion of the anticoagulant

(c)

46. The therapeutic effectiveness of which of the following drugs will be most affected by concomitant ingestion of antacids?
a. Cephalexin
b. Erythromycin
c. Tetracycline
d. Sulfisoxazole
e. Penicillin V

(c) hey, I asked you this on the exam!

47. Erythromycin should be avoided in the patient taking
a. Aspirin
b. Seldane
c. Benadryl
d. Ibuprofen
e. Propranolol

(b) remember the famous erythromycin –Seldane potentially lethal interaction, whereby erythromycin blocks the metabolism of Seldane to its antihistamine metabolite – it stays unmetabolized and causes cardiac arrthymias. Of course this question could have many other options listed, since erythromycin decreases the metabolism of so many other useful drugs, such as digoxin.

Cardiovascular Drugs

This category covers a lot of drugs and a lot of questions. They can be categorized as:

1. Questions asking about which drug from a list might be used to treat a certain condition:

hypertension:

1) Diuretics such as the high ceiling or loop-acting diuretic, furosemide;
2) Beta-blockers such as propranolol or the cardioselective beta blocker metoprololor atenolol
3) Alpha-1 blockers such as prazosin,
4) Centrally acting adrenergic drugs such as methyldopa or clonidine
5) Neuronal blockers such as guanethidine (reserved for severe hypertension)
6) Angiotensin converting enzyme inhibitors such as Captopril, lisinopril

angina: Nitroglycerin, sometimes propranolol, calcium channel blockers such as verapamil

arrhythmias:

1) Lidocaine (ventricular arrhythmias),
2) Phenytoin (to reverse digitalis induced arrhythmias),
3) Quinidine (supraventricular tachyarrhythmias, atrial fibrillation),
4) Verapamil (supraventricular tachyarrhythmias, paroxysmal tachycardia, atrial fibrillation),
5) Digitalis (atrial fibrillation, paroxysmal tachycardia)
6) Propranolol (paroxysmal tachycardia)

Congestive heart failure: Glycosides such as digitalis, digoxin, ACE inhibitors such as captopril

2. The second major category of questions concerns mechanism of action of the various agents:

Antiarrhythmics: Remember problem is that the heart beats irregularity

a. Type 1A agents such as quinidine: acts by increasing the refractory period of cardiac muscle
b. Type 1B agents such as lidocaine decrease cardiac excitability
c. When digitalis is used for atrial fibrillation it acts by decreasing the rate of A-V conduction

Antiangina drugs: problem is insufficient oxygen to meet demands of myocardium

a. Nitroglycerin increases oxygen supply to the heart by a direct vasodilatory action on the smooth muscle in coronary arteries
b. Propranolol reduces oxygen demand by preventing chronotropic responses to endogenous epinephrine, emotions and exercise.
c. Calcium channel blockers decrease oxygen demand by reducing afterload by reducing peripheral resistance via vasodilation

Antihypertensives: Remember, most drugs have the ultimate effect of reducing peripheral resistance via vasodilation

ACE inhibitors: Captopril blocks the enzyme which converts angiotensin I to angiotensin II. The latter is a potent vasoconstrictor (administration of angiotensin will result in an elevation of blood pressure).

Adrenergic Agents:

a. Prazosin: selective alpa-1 blocker, inhibits binding of nerve induced release of NE resulting in vasodilation
b. Methyldopa: acts centrally as a false neurotransmitter stimulating alpha receptors to reduce sympathetic outflow resulting in vasodilation
c. Clonidine: selective agonist stimulates alpha-2receptors in the CNS to reduce sympathetic outflow to peripheral vessels resulting in vasodilation
d. Propranolol: nonselective beta blocker reduces cardiac output and inhibits renin secretion
e. Metoprolol: selective beta-1 blocker, reduces cardiac output

Diuretics: decrease the renal absorption of sodium, thus resulting in fluid loss and a reduction in blood volume. This decreases the work the heart has to pump. Also have weak dilatory action. Types of diuretics which may be mentioned include:

a. Thiazides: chlorothiazide

b. High-ceiling or loop acting: furosemide

c. Potassium sparing: spironolactone

Congestive heart failure drugs:

a. Cardiac glycosides such as digitalis or digitoxin are effective because they have a positive inotropic effect, increasing the force of contraction of the myocardium. This is achieved by an inhibition of Na+, K+ ATPASE leading to increased calcium influx. Digitalis therapy reduces the compensatory changes that are associated with congestive heart failure such as increased heart size, rate, edema, etc.

Drug-condition questions

1. Quinidine is principally used to treat
   a. Hypertension
   b. Angina pectoris
   c. Congestive hear failure
   d. Supraventricular tachyarrhythmias

   (d) by elimination. Hypertension ((a)) is treated primarily with beta blockers such as propranolol. Angina is primarily treated with nitroglycerin, while digoxin (digitalis) is the drug of choice for congestive heart failure. Quinidine is classed as an antiarrthymic drug (Type I-blocks sodium channels). It reduces automaticity and responsiveness and increases refractoriness. It also has an antimuscarinic action preventing the bradycardia that follows vagal stimulation.

2. Quinidine is used to treat
   a. Hypertension
   b. Angina pectoris
   c. Atrial fibrillation
   d. Ventricular fibrillation
   e. Congestive hear failure

   (c) same question as above, just gave you a different type of

arrythmia

3. Verapamil is most efficacious in the treatment of
   a. Atrial fibrillation
   b. Atrial tachycardia
   c. Ventricular tachycardia
   d. Catecholamine-induced arrhythmias

   (a) memorize

4. Which of the following drugs is most useful in treating or preventing angina pectoris?
   a. Digitalis
   b. Quinidine
   c. Propranolol
   d. Procainamide
   e. Pentobarbital

   (c)

5. Each of the following drugs can be used in the prevention and treatment of angina pectoris EXCEPT
   a. Digitalis
   b. Propranolol
   c. Nitroglycerin
   d. Isosorbide dinitrate
   e. Pentaerythritol tetranitrate

   (a)

6. All of the following drugs are useful in the treatment of hypertension EXCEPT
   a. Ephedrine
   b. Reserpine
   c. Methyldopa
   d. Thiazide diuretics

   (a)

7. Digitalis is useful in the treatment of which of the following conditions?
   a. Atrial fibrillation
   b. Congestive heart failure
   c. Paroxysmal atrial tachycardia
   d. All of the above

   (d)

8. All of the following drugs are useful in the treatment of cardiac arrhythmias EXCEPT
   a. Digitalis
   b. Lidocaine
   c. Phenytoin
   d. Procainamide
   e. Aminophylline

   (e)

9. The drug of choice for initial therapy for mild hypertension is
   a. Reserpine
   b. Guanethidine
   c. Phenobarbital
   d. Chlorothiazide
   e. Alpha-methyldopa

   (d)

10. Which of the following antihypertensives are usually reserved for treatment of severe hypertension?
    a. Sedatives and reserpine
    b. Thiazide diuretics and reserpine
    c. Sedatives and thiazide diuretics
    d. Guanethidine and ganglionic blocking agents

    (d)

11. Which of the following beta-adrenergic receptor blocking agents is thought to be cardioselective?
    a. Nadolol
    b. Timolol
    c. Metoprolol
    d. Propranolol

    (c)

Mechanism of Action Questions

Antiarrhythmics

12. Antiarrhythmic drugs, such as quinidine, suppress certain cardiac arrhythmias by
    a. Stimulating the beta-adrenergic receptor
    b. Suppressing cardiac ATP-ase activity
    c. Increasing ectopic pacemaker activity
    d. Increasing the refractory period of cardiac muscle

    (d)

13. Most drugs useful in the treatment of cardiac arrhythmias act primarily by
    a. Blocking Purkinje fibers
    b. Blocking the alpha-adrenergic receptor
    c. Suppressing SA node impulse formation
    d. Causing a positive inotropic effect
    e. Increasing the refractory period of cardiac muscle

    (e)

14. The most important pharmacologic action of drugs that suppress cardiac arrhythmias is
    a. Blockade of the vagus nerve
    b. Stimulation of cardiac ATP-ase activity
    c. Blockade of the Beta-adrenergic receptor
    d. Stimulation of the beta-adrenergic receptor
    e. Increased refractory period of cardiac muscle

    (e)

15. Lidocaine produces its antiarrhythmic effects by
    a. Increasing AV conduction
    b. Decreasing cardiac excitability
    c. Increasing cardiac conduction velocity
    d. Increasing spontaneous pacemaker activity

    (b) arrhythmias are defined as any abnormality of the normal

sinus rhythm of the heart due to disease or injury induced damage to the impulse conducting systems. They also result from the development of ectopic pacemakers or abnormal pacemaker rhythms. Drugs such as lidocaine are used to normalize these rhythms. Lidocaine, a local anesthetic, depresses cardiac excitability, answer (b). The refractory period of cardiac muscle is increased, thus slowing the heart down. All of the other alternatives given would exacerbate the arrhythmia.

16. When digitalis is used in atrial fibrillation, the therapeutic objective is to
    a. Abolish cardiac decompensation
    b. Inhibit vagal impulses to the heart
    c. Decrease the rate of A-V conduction
    d. Increase the rate of cardiac repolarization
    e. Produce a decrease in the rate of atrial contraction

    (c)

Antiangina Drugs

17. Nitroglycerin dilates the coronary arteries in angina pectoris by
    a. Decreasing the heart rate reflexly
    b. Increasing the metabolic work of the myocardium
    c. Direct action on smooth muscle in the vessel walls
    d. Increasing the effective refractory period in the atrium
    e. Blocking beta-adrenergic receptors

    (c)

18. Propranolol is of value in treating angina pectoris because it
    a. Has a direct action on vascular smooth muscle
    b. Blocks autoregulatory mechanisms in the heart
    c. Inhibits oxygen metabolism in cardiac cells
    d. Provides relief within seconds of an acute anginal attack
    e. Prevents chronotropic responses to endogenous epinephrine emotions and exercise

    (e)

ACE Inhibitors

19. Administration of angiotensin results in
    a. Anti-inflammatory effects
    b. Antihistaminic effects
    c. Increased blood pressure
    d. Increased heart rate
    e. A sedative effect

    (c)

20. The primary antihypertensive effect of captopril (Capoten) is due to accumulation of
    a. Serotonin
    b. Angiotensin I
    c. Angiotensin III
    d. Bradykinin metabolites

    (b) Captopril is an angiotension-converting enzyme inhibitor that blocks the activation of angiotension I to angiotension II. The decreased blood concentration of angiotension II reduces blood pressure, because angiotension II is a potent vasoconstrictor. Thus (c) is wrong, accumulation of angiotension I is the usual effect. Captopril also maintains lowered BP by elevating bradykinin (which has potent vasodilatory action) in the blood by blocking its metabolism. Thus (d) is wrong, bradykinin metabolites do not accumulate.

21. Administration of angiotensin results in
    a. A sedative effect
    b. Increased heart rate
    c. Increased blood pressure
    d. Antihistaminic effects
    e. Anti-inflammatory effects

    (c) I guess because more angiotensin II would be formed, and that is a potent vasoconstrictor

Mechanism of Action

Diuretics

22. Which of the following is NOT characteristic of the thiazide diuretics?
    a. Increase renal excretion of sodium and chloride
    b. Increase renal excretion of potassium
    c. Increase the toxicity of digitalis
    d. Exacerbate existing diabetes
    e. Cause hypokalemia
    f. Cause hypoglycemia

    (f) first off, how can you have an option (f)?! (a) is how diuretics lower BP, (b) is why they can cause hypokalemia, which is conveniently option (e), and hypokalemia can potentiate digitalis induced arrythmias option(c). Theyy apparently can also cause hyperglycemia, which would relate to option (d). How the heck are you supposed to remember all of this?

23. The most useful diuretic drugs act by
    a. Increasing the glomerular filtration rate
    b. Decreasing the renal reabsorption of sodium
    c. Decreasing the renal excretion of chloride
    d. Increasing the renal reabsorption of potassium
    e. Increasing the secretion of antidiuretic hormone

    (b) people with high BP are always told to reduce salt intake, since high sodium levels cause fluid retention which can increase BP, so ipso facto, reducing renal reabsorption of sodium makes BP go down

24. Which of the following drugs act by inhibiting renal reabsorption of sodium?
    a. Urea
    b. Chlorothiazide
    c. Theophylline
    d. digitalis glycosides
    e. Procainamide

    (b) same question as above, just reversed.

Cardiac Glycosides

25. Digoxin exerts its positive inotropic effect by
    a. Activation of adenylcyclase
    b. Inhibition of phosphodiesterase
    c. An agonist effect of beta-receptors

d. Inhibition of Na+, K+ ATPASE leading to increased calcium influx
e. Decreasing the amount of calcium available for excitation-contraction coupling

Answer is (d)- Remember, cardiac glycosides such as digoxin are used in the treatment of congestive heart failure, which is the failure of the heart to function adequately as a pump and thus maintain an adequate circulation. Cardiac glycosides are thought to act by altering calcium ion movement, with a desired effect of increasing the force of contraction of the myocardium (e.g. the inotropic effect). While several of the alternatives involve calcium, the way digoxin does it is via (d), inhibition of Na+, K+ ATPase, resulting in an increase of calcium ion influx into the cardiac cells, and a subsequent enhancement of the contractile mechanism. (a) is the way epinephrine works.

26. Digitoxin is effective in the treatment of cardiac failure because it
a. Is primarily a diuretic
b. Reduces the ventricular rate
c. Decreases abnormal cardiac rhythms
d. Produces peripheral vasoconstriction
e. Has a positive cardiac inotropic action

(e)

27. The primary action of therapeutic doses of digitalis on cardiac muscle is an increase in
a. Force of contraction
b. Ventricular excitability
c. Refractory period of the atrial muscle
d. Refractory period of the ventricular muscle
e. Rate of conduction of impulse to the muscle

(a)

28. The beneficial effects of digitalis in congestive heart failure result in part from the fact that digitalis causes
a. A decrease in end-diastolic volume
b. A decrease in end-diastolic pressure
c. An increase in stroke volume and cardiac output
d. A decrease in central venous pressure
e. A decrease in rate of the hear where tachycardia exists

i. (a), (b) and (c)
ii. (a) and (c) only
iii. (c) and (d)
iv. (e) only
v. All of the above

(v)

29. The cardiac glycosides will increase the concentration of which ion in an active heart muscle?
a. Sodium
b. Bromide
c. Calcium
d. Chloride
e. Potassium

(c)

30. Which of the following ions augments the inotropic effect of digitalis?
a. Sodium
b. Lithium
c. Calcium
d. Chloride
e. Magnesium

(c)

31. In the treatment of congestive heart failure, digitalis glycosides generally decrease all of the following EXCEPT
a. Edema
b. Urine flow
c. Heart size
d. Heart rate
e. Residual diastolic volume

(b)

Adrenergic Agents

32. The mechanism of action of prazosin, an antihypertensive agent is to
a. Block beta-adrenergic receptors
b. Inhibit formation of angiotensin II
c. Inhibit nerve-induced release of norepinephrine
d. Stimulate central inhibitory alpha-adrenergic receptors
e. Inhibit the postsynaptic action of norepinephrine on vascular smooth muscle

(e)

33. Which of the following owes a significant amount of its antihypertensive effect to a central action?
a. Methyldopa
b. Metoprolol
c. Hydralazine
d. Propranolol
e. Guanethidine

(a) All of these drugs are used to treat hypertension, but act by different mechanisms. (a), methyldopa, is the drug with central action- it alters CNS control of blood pressure by acting on cardioregulatory and vasomotor systems of the brain by stimulating alpha2 receptors in the brain stem. Clonidine is the usual drug that is involved in this particular question. (b) metropolol is a selectively blocks beta-1 receptors in the heart to reduce cardiac output. (c) hydralazine has a direct action on vascular smooth muscle to reduce hypertension via vasodilation. (d) propranolol blocks beta receptors in the heart, while (e) guanethidine prevents the release and causes depletion of catecholamines taken up into storage vesicles and is released like a false transmitter. It does not cross the blood-brain barrier.

34. Which of the following drugs is thought to reduce arterial blood pressure by activating alpha receptors in the vasomotor center of the medulla?
a. Prazosin
b. Clonidine
c. Propranolol
d. Guanethidine
e. Chlorothiazide

(b)- see above explanation

35. Propranolol (Inderal) can be useful in the treatment of hypertension because it blocks
    a. Alpha-1 adrenergic receptors
    b. Sodium reabsorption in the kidney
    c. The release of renin from juxtaglomerular cells
    d. The release of norepinephrine from nerve terminals
    e. The reflex tachycardia seen with the use of other antihypertensives

        i. (a) and (b)
        ii. (a) and (d)
        iii. (b), (c) and (d)
        iv. (c), (d) and (e)
        v. (c) and (e) only

    (v) Answer is (v)- You should immediately recognize that propranolol is the prototypic beta-adrenergic receptor blocker, thus any answer with alternative a (i and ii) is wrong. Similarly, d is wrong as well-propranolol is a competitive beta- receptor blocker- it has no effect on NE release. Another drug used for hypertension, Clonidine, acts via this mechanism by stimulating alpha-2 autoreceptors. Thus ii, iii, and iv are wrong. This leaves (v) as the only possible right answer. Indeed, aside from blocking beta-1 receptors, blocking of renin release is thought to be the other mechanism whereby beta-blockers alter hypertension.

36. One of the proposed mechanisms of the antihypertensive effect of beta-adrenergic receptor blocking agents is
    a. Sedation
    b. A diuretic effect
    c. An antirenin effect
    d. A vagal blocking effect
    e. An increase in cardiac output

    (c)

37. Selective beta-1 adrenergic agonists will produce which of the following effects?
    a. Glycogenolysis
    b. Increased cardiac output
    c. Decreased diastolic pressure
    d. Decreased peripheral resistance
    e. Relaxation of bronchial smooth muscle

    (b)

Miscellaneous Side Effect Questions

38. Ototoxicity with deafness may encountered occasionally in patients taking which of the following diuretic agents?
    a. Osmotic
    b. Thiazide
    c. Mercurial
    d. High-ceiling

    (d) answer is (d)- straight memorization- deafness is typically associated with use of ethacrynic acid, a loop or high-ceiling diuretic. How the hell are you supposed to remember all of this stuff???

39. Symptoms of digitalis toxicity include all of the following EXCEPT
    a. Extrasystoles
    b. Nausea and vomiting
    c. Yellow-green vision
    d. A-V conduction block
    e. Decreased P-R interval

    (e)

40. Administration of which of the following drugs increases the likelihood of a toxic response to digitalis?
    a. Diazepam
    b. Lidocaine
    c. Spironolactone
    d. Chlorothiazide
    e. Acetylsalicylic acid

    (d) Chlorthiazide is a diuretic which causes potassium loss or hypokalemia. This results in greater penetration of digitalis into the myocardium, and thus potential toxicity.

    41.

Analgesics- NSAIDS:

1. Mechanism of action questions regarding analgesic, antipyretic and effects on bleeding:

   Analgesic effects: aspirin inhibits the synthesis of prostaglandins

   Antipyretic effects: aspirin inhibits PG synthesis in the hypothalamic temperature regulation center

   Bleeding time: inhibit synthesis of thromboxane A2 preventing platelet synthesis

2. A 2nd type of question has to do with pharmacological or toxic effects of aspirin: you get to pick which of the list is or is not associated with aspirin. Therapeutic effects of aspirin include pain relief, antipyretic effects, antirheumatic and anti-inflammatory effects. Adverse or toxic effects include all of the following: occult bleeding from the GI tract, tinnitus, nausea and vomiting, acid-base disturbance or metabolic acidosis, decreased tubular reabsorption of uric acid, salicylism, delirium, hyperventilation, etc.

3. A third type of question focuses on the difference between 1) aspirin and acetaminophen, 2) aspirin and other anti-inflammatories like prednisone, and 3) between aspirin and ibuprofen:

   1) Acetaminophen lacks anti-inflammatory activity, is hepatotoxic, and does not cause GI upset
   2) Anti-inflammatories like prednisone, hydrocortisone, triamcinolone etc. are steroids and do not act primarily by PG inhibition
   3) Ibuprofen causes much less GI irritation
   4) Diflunisal (Dolobid) has a longer half-life than aspirin, acetaminophen and ibuprofen

4. Newer versions of the boards have questions about COX-2 inhibitors like vioxx. (Which of the following is a COX-2 inhibitor?)

5. These old questions focus a lot on aspirin. Nowadays, acetaminophen and ibuprofen are used much more commonly than aspirin, because of the many side effects of aspirin that turn up in these kinds of questions. So since aspirin is the comparator prototype drug, reviewing these questions are still useful.

1) But expect newer questions asking you to know:

a. Acetaminophen causes liver toxicity, especially when combined with alcohol or taken in excess of 4 gr/day.

b. Acetaminophen is the drug of choice for the feverish child (they usually ask the reverse, which is which drug should be avoided in the feverish child (aspirin- increased risk of Reye's syndrome)

Frequently asked questions on NSAIDS

4. The therapeutic effect of the salicylates is explained on the basis of the ability of the drug to
   a. Activate autonomic reflexes
   b. Uncouple oxidative phosphorylation
   c. Inhibit the synthesis of prostaglandins
   d. Competitively antagonize prostaglandins at the receptor site

(c)

5. The mechanism of the antipyretic action of salicylates probably results from
   a. Inhibition of prostaglandin synthesis in the CNS affecting hypothalamic temperature regulation
   b. Inhibition of bradykinin in the periphery leading to sweating
   c. Depression of oxidative enzymes leading to decreased heat production
   d. Suppression of cholinergic mediators in the hypothalamus
   e. Stimulation of norepinephrine in the hypothalamus

(a)

6. The antipyretic action of salicylates is explained in part by
   a. Analgesia leading to sedation
   b. Increased blood flow through the hypothalamus
   c. Cutaneous vasodilation leading to increased heat loss
   d. Depression of oxidative processes leading to decreased heat production

(c)

7. The locus of action of aspirin's central antipyretic effect is the
   a. Brain stem
   b. Hypothalamus
   c. Basal ganglia
   d. Limbic system
   e. Cerebral cortex

(b) memorization question- remember antipyresis means antifever. Temperature regulation center is in the hypothalamus.

8. A patient who has been taking large quantities of aspirin might show increased postoperative bleeding because aspirin inhibits
   a. Synthesis of thromboxane A2 and prevents platelet aggregation
   b. Synthesis of prostacyclin and prevents platelet aggregation
   c. Synthesis of prostaglandin and prevents production of blood platelets
   d. Thrombin and prevents formation of the fibrin network
   e. G.I. absorption of vitamin K and prevents synthesis of blood clotting factors

(a) The first fact you must remember is that aspirin prevents platelet aggregation- this limits your choices to (a) and (b). They hope to confuse you by using prostacylin, but of course you know that this is wrong immediately, the right word is prostaglandin, as in (c), but you have already eliminated that choice because it doesn't mention prevention of platelet aggregation. Thus, even if you didn't remember that thromboxane A2 induces platelet aggregation, and aspirin blocks this action, you could get the answer by elimination. (d) is how heparin works, while (e) is how coumarin works.

9. Anti-inflammatory agents, such as aspirin, interfere with hemostasis by
   a. Activating antithrombin
   b. Preventing vasoconstriction
   c. Inhibiting thrombin generation
   d. Inhibiting platelet aggregation
   e. Inhibiting polymerization of fibrin

(d)

10. Which of the following anti-inflammatory agents does NOT act primarily by inhibiting activity of prostaglandin synthetase?
    a. Diflunisal
    b. Ibuprofen
    c. Triamcinolone
    d. Oxyphenbutazone
    e. Acetylsalicylic acid

    (c) triamcinolone is a corticosteroid. Corticosteroids inhibit phospholipase A2, the enzymatic step that precedes prostaglandin synthetase. Diflunisal is a salicylate analgesic, like aspirin.

11. A nonsteroidal, anti-inflammatory agent that appears to produce fewer gastrointestinal disturbances than high does of aspirin is
    a. Ibuprofen
    b. Probenecid
    c. Pentazocine
    d. Acetaminophen
    e. Phenylbutazone

    (a) you might be tempted to answer acetaminophen, because it doesn't cause GI upset, but remember it is also not anti-inflammatory. The answer is ibuprofen. Tricky – you had to sort through two distinguishing characteristics. Good question!

12. Prolonged use of which of the following drugs does NOT cause a predisposition to gastric irritation and bleeding?
    a. Phenytoin
    b. Ibuprofen
    c. Indomethacin
    d. Phenylbutazone
    e. Acetylsalicylic acid

    (a) This is a straight drug identification question. Answers 2-5 are all non-steroidal antiinflammatory drugs which cause gastric irritation and bleeding due to their effects on prostaglandin synthesis in the mucosal wall of the gut. # , phenytoin, is an anti-convulsant-its major side effect that often appears as a question on boards is the production of gingival hyperplasia.

13. Each of the following agents has been associated with gastric irritation EXCEPT
    a. Aspirin
    b. Alcohol
    c. Ibuprofen
    d. Indomethacin
    e. Acetaminophen

    (e) note the difference in this question and #11 and 12. Ibuprofen was previously the answer to "shows reduced GI irritation", but it does cause some, which you have to remember to answer #12 and this question. So aspirin and ibuprofen are out. Indomethacin is a very strong NSAID that causes lots of GI irritation, so much that use is limited in humans, so it is out. What about alocohol vs. acetaminophen. Well, you should really know that acetaminophen is usually the answer to these types of analgesics questions, but if you didn't know that, perhaps you may know that alcohol also causes GI irritation, so it is out.

14. Which of the following is NOT produced by excessive doses of acetylsalicylic acid?
    a. Delirium
    b. Tinnitus
    c. Hypothermia
    d. Hyperventilation
    e. Metabolic acidosis

    (c) it only lowers your temperature if you have a fever,, taking aspirin does not have any effect on body temperature in the non-feverish patient, but high doses can cause all the other effects listed.

15. All of the following are pharmacologic and toxicologic properties of aspirin EXCEPT
    a. Tinnitus
    b. Analgesia
    c. Salicylism
    d. Antipyresis
    e. Suppression of the immune response

    (e)

16. Therapeutic effects of aspirin include
    a. Analgesia
    b. Tranquilization
    c. Pyretic action
    d. Anti-inflammatory action
    e. Antirheumatic action

    i. (a), (b) and (c)
    ii. (a), (c) and (d)
    iii. (a), (d) and (e)
    iv. (b), (c) and (d)
    v. (b), (d) and (e)

    (iii)

17. All of the following are pharmacologic or toxicologic properties of acetylsalicylic acid EXCEPT
    a. Tinnitus
    b. Analgesia
    c. Antipyresis
    d. Methemoglobinemia
    e. Inhibition of prostaglandin synthesis

    (d)

18. All of the following are possible effects of aspirin EXCEPT
    a. Reduction of fever
    b. Shortening of bleeding time
    c. Suppression of inflammatory response
    d. Bleeding from the gastronintestinal tract
    e. Increase in the renal excretion of uric acid at high doses

    (e)

19. Of the following, aspirin does NOT cause
    a. Occult bleeding
    b. Nausea and vomiting
    c. Acid-base disturbance
    d. Suppression of the cough reflex
    e. Decreased tubular reabsorption of uric acid

    (d) Answer is (d)- (a) & (b) are the major side effects of aspirin