PRACTICE QUESTIONS

1. A patient has a genetic polymorphism such that they cannot rapidly metabolize drugs by acetylation. You would be most concerned about this polymorphism if the patient was taking which drug?

   A. Sotalol
   B. Clonidine
   C. Nitroglycerin
   D. Hydralazine
   E. Prazosin

2. Which side effect is associated with spironolactone?

   A. Alkalosis
   B. Hirsutism
   C. Hyperkalemia
   D. Hypercalcemia
   E. Hyperglycemia

3. Lidocaine is an effective antiarrhythmic because it

   A. suppresses excitability in hypoxic areas of the heart
   B. prolongs the QT interval
   C. prolongs the PR interval
   D. depresses the slope of phase 0 in slow response tissues
   E. acts on inhibitory G-protein coupled receptors

4. Sildenafil has been prescribed for years to treat erectile dysfunction. Recently, this drug is also being used for what condition?

   A. Vasospastic angina
   B. Supraventricular tachycardia
   C. Cyanide poisoning
   D. Raynaud disease
   E. Pulmonary hypertension

5. A patient with hypertension also suffers from essential tremor. Optimal treatment of the patient should include management with

   A. prazosin
   B. clonidine
   C. metoprolol
   D. lidocaine
   E. propranolol

6. Selective β-1 blockers are preferred over nonselective beta blockers in some patients because they

   A. cause less cardiodepression
   B. are less likely to cause bronchoconstriction
   C. are more effective for migraine prophylaxis
   D. are more effective as an antiarrhythmics
   E. have greater prophylactic value post-MI

7. Which drug will utilize the same signaling pathway as endogenous bradykinin on smooth muscle?

   A. minoxidil
   B. nitroprusside
   C. theophylline
   D. phenylephrine
   E. cocaine

8. A 75-year-old patient suffering from congestive heart failure accidentally ingests a toxic dose of digoxin. Clinical consequences due to the toxic effects of cardiac glycosides are likely to include

   A. seizures
   B. hypercalcemia
   C. bicarbonaturia
   D. intermittent claudication
   E. visual disturbances

9. In the management of a cardiac arrhythmia, lidocaine is to be administered by way of an IV loading dose. What variable must be known to calculate an appropriate loading dose?

   A. renal clearance
   B. bioavailability
   C. volume of distribution
   D. lag time
   E. time to steady-state

10. Both dobutamine and inamrinone increase cardiac contractility by

   A. activation of adenylyl cyclase
   B. inactivation of Na channels
   C. inhibition of Na^+/K^+-ATPase
   D. increasing cAMP
   E. activation of Na/Cl cotransporter

11. Which one of the following is likely to occur following treatment of a hypercholesterolemic patient with cholestyramine?

A. Increased recycling of bile salts
B. Increased circulating cholesterol
C. Decreased VLDL synthesis
D. Downregulation of LDL receptors
E. Elevation of plasma triglycerides

12. A new diuretic is being studied in human volunteers. Compared with placebo, the new drug increases urine volume, increases urinary Ca^{2+}, increases plasma pH, and decreases serum K^{+}. If this new drug has a similar mechanism of action to an established diuretic, it probably

A. blocks the NaCl cotransporter in the DCT
B. blocks aldosterone receptors in the CT
C. inhibits carbonic anhydrase in the PCT
D. inhibits the $Na^{+}/K^{+}/2Cl^{-}$ cotransporter in the TAL
E. acts as an osmotic diuretic

13. Which one of the following drugs is most likely to block K+ channels in the heart responsible for cardiac repolarization, and also blocks calcium channels in the AV node?

A. Amiodarone
B. Quinidine
C. Lidocaine
D. Sotalol
E. Verapamil

14. The treatment of hyperlipidemic patients with nicotinic acid (niacin) results in

A. increases in VLDL
B. decreases in both plasma cholesterol and TGs
C. inhibition of HMG-CoA reductase
D. decreases in HDL
E. no change in total cholesterol in the plasma

15. Which drug is useful for patients with congestive heart failure because it reduces both preload and afterload, and also inhibits cardiac remodeling?

A. Hydralazine
B. Hydrochlorothiazide
C. Prazosin
D. Nifedipine
E. Captopril

16. Enhancement of the effects of bradykinin is most likely to occur with drugs like

A. clonidine
B. diazoxide
C. lisinopril
D. losartan
E. propranolol

17. Outpatient prophylaxis of a patient with an SVT is best accomplished with the administration of

A. adenosine
B. diltiazem
C. esmolol
D. lidocaine
E. mexiletine

18. Which one of the following is the most appropriate drug to use for the patient described in parentheses?

A. Captopril (60-year-old woman with diabetic nephropathy)
B. Nitroprusside (50-year-old man with BP of 140/95 mm Hg)
C. Losartan (29-year-old pregnant woman)
D. Propranolol (40-year-old patient with peripheral vascular disease)
E. Milrinone (57-year-old patient with chronic CHF)

19. In a patient suffering from angina of effort, nitroglycerin may be given sublingually because this mode of administration

A. bypasses the coronary circulation
B. causes less reflex tachycardia than oral administration
C. improves patient compliance
D. has a decreased tendency to cause methemoglobinemia
E. avoids first-pass hepatic metabolism

20. A patient with a supraventricular tachycardia has an atrial rate of 280/min with a ventricular rate of 140/min via a 2:1 AV nodal transmission. After treatment with a drug, the atrial rate slowed to 180/min, but the ventricular rate increased to 180/min. Which of the following drugs was most likely to have been given to this patient?

A. Adenosine
B. Digoxin
C. Esmolol
D. Quinidine
E. Verapamil

ANSWERS AND EXPLANATIONS

1. **Answer: D.** Hydralazine is metabolized by *N*-acetyltransferase (a phase II drug metabolism reaction) associated with a genetic polymorphisms. Patients who are classified as slow acetylators may develop SLE-like symptoms when treated with hydralazine. Other drugs metabolized via *N*-acetyltransferase, including isoniazid and procainamide, have also been associated with lupus-like symptoms in slow acetylators.

2. **Answer: C.** Spironolactone blocks aldosterone receptors thereby inhibiting the production of Na^+ channels in the collecting duct and is used as a K^+-sparing agent because the reabsorption of Na^+ in the CT is coupled (indirectly) to the secretion of K^+ ions. Hyperkalemia is characteristic of this drug and may lead to clinical consequences at high doses, or if patients fail to discontinue K^+ supplements or ingest foodstuffs high in K^+. Because Na^+ reabsorption is associated with secretion of protons, spironolactone causes retention of H^+ ions, leading to acidosis. It has no significant effect on the renal elimination of Ca^{2+} or on the plasma level; of glucose.

3. **Answer: A.** Lidocaine, a class IB drug, effectively targets ischemic areas of the heart. Its major effect is on sodium channels in fast response fibers such as ventricular muscle. It has no significant effect on the PR or QT intervals.

4. **Answer: E.** Sildenafil (a PDE5 inhibitor) is used for erectile dysfunction but has been recently approved for use in pulmonary hypertension. Other useful drugs in pulmonary hypertension are epoprostenol and bosentan.

5. **Answer: E.** Propranolol is a nonselective beta blocker useful in a variety of cardiac conditions including hypertension. The drug is also useful in essential tremor where blocking the beta-2 receptor is beneficial. Metoprolol, beta-1 selective, is useful in hypertension but not essential tremor. Clonidine and prazosin are second-line drugs for hypertension and not effective in essential tremor. Lidocaine, an antiarrhythmic, is not effective in either condition.

6. **Answer: B.** β1-selective blockers like atenolol and metoprolol are less likely to block receptors in the bronchiolar smooth muscle and therefore less likely to cause bronchoconstriction, especially in asthmatic patients. Nonselective beta blockers are considered to be equally as effective as selective beta-1 blockers in arrhythmias, migraine prevention, and in post-MI prophylaxis. Both types of drugs are cardiodepressant.

7. **Answer: B.** Bradykinin binds to endothelial receptors and causes the formation of nitric oxide, which signals through the cGMP pathway to relax smooth muscle. Nitroprusside utilizes nitric oxide and cGMP in a similar fashion to relax smooth muscle.

8. **Answer: E.** Digoxin toxicity is associated with CNS consequences including disorientation and visual dysfunctions such as halos around lights and blurry, yellow vision. More serious manifestations include life-threatening arrhythmias.

9. **Answer: C.** Back to basic principles! Recall that to calculate a loading dose you must know volume of distribution and target plasma concentration. Since lidocaine is being given IV, its bioavailability is 100% (f=1) so no adjustment is required to the equation. Renal clearance is needed to calculate a maintenance dose, and time to steady-state applies only when using a maintenance dose. There is no lag time for an IV drug.

10. **Answer: D.** Dobutamine acts as a beta-1 agonist to activate adenylyl cyclase and increase cAMP. Inamrinone inhibits phosphodiesterase III which increases the amount of cAMP in the heart. In each case, there is an increase in intracellular Ca^{2+} being sequestered in the SR which leads to enhance contractility.

11. **Answer: E.** Cholestyramine and colestipol are resins that sequester bile acids in the gut, preventing their reabsorption. This leads to release of their feedback inhibition of 7-alpha hydroxylase and the diversion of cholesterol toward new synthesis of bile acids. Increase in high-affinity LDL receptors on hepatocyte membranes decreases plasma LDL. These drugs have a small but significant effect to increase plasma HDL rather than decrease it, but their ability to increase TGs precludes their clinical use in the management of hypertriglyceridemias.

12. **Answer: D.** The effects described are typical of loop diuretics, which inhibit the $Na^+K^+2Cl^-$ cotransporter in the thick ascending limb. This action prevents the reabsorption of Ca^{2+} from the paracellular pathway and provides for the use of these drugs in hypercalcemia. The increased load of Na^+ in the collecting tubules leads to increased excretion of both K^+ and H^+, so hypokalemia and alkalosis may occur.

13. **Answer: A.** Amiodarone is a highly effective antiarrhythmic drug, in part because of its multiple actions, which include Na+ channel block, beta adrenoceptor block, K^+ channel block, and Ca^{2+} channel block. Drugs that block K^+ channels prolong APD and ERP and predispose toward torsades de pointes ventricular arrhythmias. Quinidine, class Ia, can block both sodium and potassium channels but not calcium channels. Lidocaine, class Ib, blocks only sodium channels. Sotalol is both a beta blocker and a potassium channel blocker. It is a class III drug that also has class II properties. Verapamil is a class IV calcium channel blocker with no effect on potassium.

14. **Answer: B.** Nicotinic acid inhibits the synthesis of the VLDL apoprotein and decreases VLDL production. Its use results in decreases of both cholesterol and triglycerides, so total cholesterol in the plasma decreases. The drug is not an inhibitor of HMG-CoA reductase, and it increases plasma HDL to a greater extent than any other available antihyperlipidemic drug.

15. **Answer: E.** Captopril and other ACE inhibitors are primary treatment options for congestive heart failure because they reduce preload by dilating veins and reduce afterload by dilating arterioles. They inhibit cardiac remodeling which results in improved survival for patients with heart failure. Hydralazine reduces afterload but does not affect preload. Hydrochlorothiazide reduces preload but does not affect afterload and does not inhibit remodeling. Neither prazosin nor nifedipine has any significant role in heart failure.

16. **Answer: C.** ACE inhibitors prevent the conversion of angiotensin I to angiotensin II and lower blood pressure by decreasing both the formation of aldosterone formation and the vasoconstrictive action of AII at AT-1 receptors. ACEIs also inhibit the metabolism of bradykinin, and this leads to additional hypotensive effects, because bradykinin is an endogenous vasodilator. Unfortunately, increases in bradykinin are associated with side effects, including cough and angioedema. Losartan, which blocks AT-1 receptors, does not increase bradykinin levels.

17. **Answer: B.** Supraventricular tachycardias (SVTs) are treated effectively by class II and class IV antiarrhythmics. In addition, adenosine is indicated for SVTs and nodal tachycardias but only acutely since it must be administered IV and has an extremely short duration. The primary actions of both beta blockers (esmolol) and CCBs (diltiazem) are at the AV node, but esmolol is too short-acting to be useful as prophylaxis. Lidocaine and mexiletine are both class Ib drugs that are used in ventricular arrhythmias.

18. **Answer: A.** ACEIs slow the progression of diabetic nephropathy and are indicated for management of HTN in such patients. Nitroprusside is used IV in severe HTN or hypertensive crisis, not for management of mild-to-moderate HTN. Losartan, which blocks AT-1 receptors, is associated with teratogenic effects during fetal development, as are the ACEIs. Nonselective beta blockers are not ideal for patients who suffer from peripheral vascular disease, diabetes, or asthma. Milrinone, like most inotropes, is not useful long-term in CHF patients. The drug has been shown to increase mortality with chronic use, and thus is indicated for acute CHF. Digoxin is currently the only inotrope used chronically.

19. **Answer: E.** The sublingual administration of a drug avoids its absorption into the portal circulation and hence eliminates the possibility of first-pass metabolism, which can often have a major impact on oral bioavailability. Given sublingually, nitroglycerin is more effectively absorbed into the systemic circulation and has improved effectiveness in angina by this mode of administration. Effective absorption is unlikely to decrease reflex tachycardia or propensity toward methemoglobinemia. There is no bypass of the coronary circulation—nitrates actually decrease coronary vasospasm, which makes them effective in variant angina.

20. **Answer: D.** An increase in AV conduction is characteristic of quinidine, which exerts quite marked blocking actions on muscarinic receptors in the heart. Thus, an atrial rate, formerly transmitted to the ventricles in a 2:1 ratio, may be transmitted in a 1:1 ratio after quinidine. This effect of quinidine can be offset by the prior administration of an antiarrhythmic drug that decreases AV nodal conduction, such as digoxin or verapamil. All of the drugs listed (except quinidine) slow AV nodal conduction, but adenosine and esmolol (a beta blocker) are very short-acting agents used IV only.