MEDICAL PHYSIOLOGY: SECTION III (CARDIAC PHYSIOLOGY)
Part 1
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1. Under normal conditions, at end diastole
   A. blood pressure in the aorta is near its maximum.
   B. blood pressure in the aorta is about 5 mmHg.
   C. the heart is in its period of rapid filling with blood.
   D. the aortic and pulmonic valves are closed.
   E. none of the above is correct.
2. The calcium ions that activate contraction by binding to the myofilaments during a beat of the heart
   A. bind to phospholamban and initiate relaxation.
   B. come mostly from the sarcoplasmic reticulum.
   C. do so by binding to actin.
   D. come mostly from the mitochondria.
   E. none of the above is correct.
3. If C.O. = 5.6 L/min, HR = 70 bpm and ESV = 100 ml; then EDV and SV are respectively, in ml
   A. 180 and 70.
   B. 190 and 80.
   C. 170 and 70.
   D. 200 and 120.
   E. 180 and 80.
4. A pronounced tachycardia (200 bpm) in an individual confined to a hospital bed is most likely associated with
   A. increased C.O. resulting from increased ESV.
   B. decreased C.O. resulting from decreased EDV.
   C. increased SV resulting from increased ESV.
   D. decreased ventricular capacity resulting from ventricular hypertrophy.
   E. decreased C.O. resulting from enhanced myocardial contractility.
5. Cardiac contractility
   A. varies inversely with end diastolic volume.
   B. varies directly with preload.
   C. depends on the amounts of Ca\(^{++}\) bound to troponin.
   D. varies inversely with heart rate.
   E. none of the above is correct.
6. Right ventricular end diastolic pressure in a normal recumbent adult is about (in mmHg)
   A. 24
   B. 4
   C. 130
   D. 70
   E. 85
7. The end diastolic sarcomere length of ventricular fibers in a normal individual at rest is most likely
   A. about 3.0 mm.
   B. about 3.5 mm.
   C. about 1.0 mm.
   D. less than 2.2 mm.
   E. none of the above is correct.
8. Left ventricular cardiac muscle and skeletal muscle are similar in that
   A. they both operate over the entire range of the sarcomere length tension relation.
   B. in both the velocity of shortening increases as the load increases.
   C. all troponin sites are saturated with Ca\(^{++}\) during each contraction/relaxation cycle.
   D. they both exhibit the same resting tension at Lmax (2.2 mm sarcomere length).
   E. none of the above is correct.
9. A patient undergoes a cardiac transplant in which all neural inputs to the heart are destroyed and in which the heart is paced at 70 beats/min. After recovery, during the time he climbs a long set of stairs
   A. cardiac output would most likely remain constant.
   B. preload would fall greatly.
   C. end diastolic volume would most likely rise.
   D. end systolic volume would most likely decrease greatly.
   E. venous return would decrease.
10. An individual lying at rest experienced an unexplained pronounced tachycardia: heart rate increased form a resting level of 70 beats per min to about 180 beats per min. The subject fainted. Probably,
   A. stroke volume increased more than heart rate so that cardiac output decreased.
   B. the pronounced decrease in cardiac work could not sustain the required increase in cardiac output.
   C. stroke volume decreased more than heart rate increased resulting in a marked decrease in cardiac output.
   D. arterial pressure markedly increased resulting in compensatory cerebral ischemia.
   E. sympathetic tone increased resulting in pronounced peripheral vasodilation.
11. If mean arterial pressure is 100 mmHg and diastolic pressure is 90 mmHg, then systolic pressure and pulse pressure are, respectively (in mmHg)
   A. 120 and 120
   B. 50 and 140
   C. 140 and 50
   D. 30 and 120
   E. 120 and 30
12. The systolic pressure in the right ventricle under normal conditions is about (in mmHg):
   A. 120
   B. 200
   C. 80
   D. 30
   E. 8
13. If heart rate is 70, end diastolic volume (EDV) is 140 ml and C.O. is 5.6 L/min, the end systolic volume (ESV) is (in ml):
   A. unknown.
   B. 60
   C. 220
   D. 200
   E. 80
14. A healthy patient takes a sedative drug with a side effect involving a moderate depression of left ventricular contractility with no change in afterload or heart rate. After taking the drug, the new steady state cardiac output does not change indicating that
   A. SV increased.
   B. EDV increased, SV did not change and ESV increased.
   C. SV decreased, EDV did not change and ESV decreased.
   D. EDV decreased, SV did not change and ESV decreased.
   E. venous return decreased.
15. If O\textsubscript{2} consumption is 200 ml O\textsubscript{2}/min, the aortic O\textsubscript{2} concentration is 20 ml O\textsubscript{2}/100 ml blood and the right atrial O\textsubscript{2} is 15 ml O\textsubscript{2}/100 ml blood, then the cardiac output, C.O., (ml/min) is
   A. 1000
   B. 4000
   C. 5714
   D. 1333
   E. 5000
16. An increase in firing rate of the sympathetic nerves innervating the heart of a dog resulted in an increase of heart rate from 100 to 120 beats/min with no change in afterload. Cardiac output increased from 3.0 to 3.6 L/min. The increase in cardiac output was most likely associated with
   A. a decrease in calcium binding to troponin in the cardiac cells.
   B. a decreased velocity of ejection of blood into the aorta.
   C. a large change in mean aortic pressure.
   D. a decrease in venous return.
   E. no change in stroke volume.
17. In a subject at rest C.O. was 6 L/min, HR = 75 bpm and EDV was 175 ml; ESV and SV were respectively (in ml)
   A. 85 and 90
   B. 80 and 185
   C. 80 and 95
   D. 185 and 80
   E. 95 and 80
18. An individual sitting at rest experienced an unexplained and marked tachycardia, heart rate increasing from a resting level of 68 bpm to 191 bpm. The subject fainted. Most likely,
   A. reflexogenic activation of vascular a adrenergic receptors induced a passive decrease in total peripheral resistance.
   B. arterial pressure increased markedly because of sympathetic withdrawal.
   C. cerebral vascular hyperemia exceeded the requirement for passive local vasoconstriction.
   D. stroke volume decreased more than heart rate increased causing a pronounced decrease in cardiac output.
   E. none of the above is correct.

19. Within the framework of the adenosine theory for regulation of coronary blood flow an increase in contractility resulting form stimulation of the myocardial sympathetic nerve supply should be associated with
   A. decreased coronary blood flow resulting from adenosine mediated stimulation of a adrenergic receptors.
   B. increased coronary blood flow resulting from increased conversion of adenosine to inosine.
   C. decreased formation of adenosine resulting from stimulation of 5’ nucleotidase.
   D. increased coronary blood flow resulting from and increase in the conversion of AMP to adenosine.
   E. increased coronary blood flow resulting from adenosine mediated inhibition of inosine utilization.

20. Severe failure of the left ventricle often leads to:
   A. hypertension
   B. pulmonary edema.
   C. a decrease in left atrial pressure.
   D. a decrease in left ventricular end diastolic pressure.
   E. a decrease in right ventricular end diastolic pressure.

21. Blood vessels (A & B) of equal diameter and wall thickness have measured luminal pressures of 100 (A) and 50 (B) mmHg, resulting in wall tension that is:
   A. two times greater in A than in B.
   B. four times greater in A than in B.
   C. two times greater in B than in A.
   D. four times greater in B than in A.
   E. unknown.

22. Over a period of several months, a patient with a constant heart rate and aortic blood pressure begins to experience a decline in stroke volume accompanied by dyspnea (shortness of breath). This situation is most likely caused by:
   A. a decreased calcium uptake by sarcoplasmic reticulum.
   B. an altered afterload.
   C. a decreased ventricular end diastolic volume.
   D. myocardial stretch beyond L max.
   E. decreased ventricular wall tension.

23. When right ventricular stroke volume and end diastolic volume simultaneously increase it can be concluded that:
   A. end systolic volume has increased.
   B. end systolic volume has decreased.
   C. contractility has increased.
   D. contractility has decreased.
   E. none of the above may have occurred.

24. In a subject at rest, heart rate was 74 bpm, end diastolic volume (EDV) was 155 ml and end systolic volume (ESV) was 83 ml. Cardiac output and stroke volume were respectively:
   A. 6242 ml/min, 68 ml/beat.
   B. 4876 ml/min, 79 ml/beat.
   C. 5328 ml/min, 64 ml/beat.
   D. 5328 ml/min, 72 ml/beat.
   E. 4876 ml/min, 78 ml/beat.

25. The $O_2$ content in pulmonary arterial blood was found to be 0.18 ml $O_2$/ml blood in a subject at rest; arterial (aorta) oxygen content was 0.22 ml $O_2$/ml blood. If cardiac output was 5875 ml/min, then $O_2$ utilization was (in ml/min)
   A. 248
   B. 235
   C. 250
   D. 244
   E. 237
26. The Law of Laplace would predict that a direct relationship exists between
A. ventricular wall tension and chamber pressure.
B. duration of diastole and stroke volume.
C. arterial diastolic pressure and ejection fraction.
D. heart rate and cardiac output.
E. arterial and venous pressures.

27. An increase only in heart rate would be expected to decrease the
A. duration of ventricular systole.
B. end systolic ventricular volume.
C. ventricular systolic pressure.
D. end diastolic ventricular volume.
E. arterial diastolic blood pressure.

28. Decrease only in arterial vascular resistance would be expected to increase
A. arterial diastolic blood pressure.
B. end diastolic ventricular volume.
C. heart rate.
D. stroke volume.
E. ventricular systolic pressure.

29. Extravascular compression of coronary blood vessels produces near zero blood flow in which vessel during which phase?
A. right coronary artery / diastole.
B. left coronary artery / diastole.
C. right coronary artery / systole.
D. left coronary artery / systole.
E. none of the above is correct.

30. An increase only in contractility would most likely decrease
A. end diastolic volume.
B. end systolic volume.
C. arterial diastolic blood pressure.
D. arterial systolic blood pressure.
E. stroke volume.

31. During exercise, heart rate doubled from 100 beats/min and cardiac output increased three times from 4 liter/min. Stroke volume would therefore have increased by a factor of
A. 0
B. 1.5
C. 2
D. 3
E. 5

32. Cardiac output is measured by dye dilution. 10 mg of dye are injected, I.V., at rest and during exercise with the following results:

<table>
<thead>
<tr>
<th></th>
<th>Rest</th>
<th>Exercise</th>
</tr>
</thead>
<tbody>
<tr>
<td>average dye concentration</td>
<td>2 mg/L</td>
<td>2.2 mg/L</td>
</tr>
<tr>
<td>time for dye disappearance</td>
<td>60 sec</td>
<td>5 sec</td>
</tr>
</tbody>
</table>

Cardiac output in exercise exceeds that at rest by a factor of approximately
A. 1.1
B. 2.2
C. 5
D. 10
E. 22

33. If pulmonary artery pressure is 15 mmHg, left atrial pressure is 5 mmHg and pulmonary vascular resistance is 2.5 mmHg L 1 min 1, cardiac output (in L/min) would approximately equal:
A. 1
B. 2
C. 3
D. 4
E. 5
Directions: For each of the questions or incomplete statements below, #34 - 51, ONE or MORE of the answers or completions given are correct. On the answer sheet, fill in the circle containing

A if only 1, 2 and 3 are correct
B if only 1 and 3 are correct
C if only 2 and 4 are correct
D if only 4 is correct
E if ALL are correct

34. If only the left ventricle is in failure, which of the following could occur?
   1. an increase in total peripheral resistance.
   2. an increase in left atrial pressure.
   3. an increase in central venous pressure in the superior and inferior vena cava.
   4. pulmonary edema.

35. Which of the following statements is (are) true?
   1. At rest the extraction ratio of oxygen in the coronary circulation is greater than that of glucose.
   2. Wall tension is inversely proportional to the pressure inside the isovolumic left ventricle.
   3. The bulk flow of glucose to heart muscle cells is equal to the product of the concentration of glucose in arterial blood and the cardiac output.
   4. The compliance of the arteries is greater than the compliance of the veins.

36. Inhibition of the firing rate of the sympathetic nerves going to the heart of a dog resulted in a decrease of heart rate from 120 to 100 beats/min with no change in mean aortic pressure. Cardiac output decreased from 3.5 L/min to 3.0 L/min. The decrease in cardiac output was likely associated with
   1. a decrease in calcium binding to troponin in the cardiac muscle cells.
   2. an increased velocity of ejection of blood into the aorta.
   3. no change in the afterload.
   4. an increased stroke volume.

37. Peak pressure during an isovolumic beat of the left ventricle
   1. changes only with changes in preload.
   2. is constant and independent of the inotropic state of the heart.
   3. is called the diastolic pressure.
   4. provides a measure of the relative contractility of the ventricle.

38. Cardiac output
   1. always increases with an increase in heart rate.
   2. increases only if end diastolic volume increases.
   3. increases only if end systolic volume decreases.
   4. can increase during contraction of skeletal muscles.

39. Which of the following statements is (are) true?
   1. Increases in cardiac output of the left ventricle must be associated with increases in EDV.
   2. The extraction ratio of glucose is less than the extraction ratio of oxygen.
   3. Increases in heart rate must always be associated with increases in cardiac output.
   4. Cardiac cells exhibit a significant resting tension at a sarcomere length of 2.2 microns.

40. An increased firing rate of sympathetic nerves going to the heart of an anesthetized dog increases the H.R. from 100 to 120 beats/min and increases the cardiac output from 3.0 to 4.0 L/min. The increase in cardiac output is likely to be associated with
   1. an increased intracellular release of Ca** in the ventricular cells.
   2. a greatly increased stroke volume.
   3. an increase in venous return.
   4. a greatly increased end systolic volume.

41. The Law of Laplace
   1. predicts that hearts operating at relatively high end diastolic volumes are relatively inefficient.
   2. predicts that pressure in the ventricle during isovolumic contraction is directly proportional to the wall tension.
   3. states that pressure in the isovolumic left ventricle is directly proportional to the wall thickness.
   4. states that tension decreases as the radius increases.

42. The left ventricular pressure near the end of diastole
   1. is due to the release of Ca** and actin myosin interaction.
   2. is related to the volume of blood in the left ventricle.
   3. is about 120 mmHg.
   4. is related to the resting tension of the cells in the left ventricle.
43. In order to accurately determine cardiac output based on O\textsubscript{2} utilization and the Fick Principle, one must
   1. measure O\textsubscript{2} consumption
   2. collect a sample of mixed venous blood from the pulmonary artery.
   3. collect a sample of peripheral arterial blood.
   4. collect a sample of venous blood from any convenient vein.

44. In a normal recumbent adult, at end left ventricular diastole
   1. pulmonary artery pressure is 80 mmHg.
   2. aortic pressure is 5 mmHg.
   3. the sarcomere length of the cardiac cells is about 3.5 microns.
   4. the aortic and pulmonic valves are closed.

45. Cardiac output
   1. increases only if ESV decreases.
   2. increases only if EDV increases.
   3. most likely decreases when skeletal muscles contract during exercise.
   4. must decrease if heart rate falls at constant stroke volume.

46. Blood vessel compliance is:
   1. greater in arteries than in veins.
   2. related to age.
   3. directly proportional to the 4th power of the radius.
   4. non linear.

47. Ernest Starling, in the early 1900's, demonstrated in the heart that:
   1. heart rate is proportional to venous pressure (preload).
   2. end diastolic volume is proportional to preload.
   3. contractility is proportional to afterload.
   4. cardiac output is proportional to preload.

48. At identical ventricular pressures, the wall of a ventricle of a patient with congestive heart failure, compared
   with a normal ventricle, will show:
   1. higher wall tension.
   2. lower wall tension.
   3. higher O\textsubscript{2} consumption.
   4. lower O\textsubscript{2} consumption.

49. Direct cardiac effects of norepinephrine include increased
   1. intracellular calcium.
   2. heart rate.
   3. crossbridge cycling.
   4. force generation by muscle.

50. The best measure of the onset of ventricular systole is
   A. the initiation of the QRS complex of the ECG.
   B. the first heart sound.
   C. the closure of the semilunar valves.
   D. the opening of the semilunar valves.
   E. the T wave of the EKG.

51. Closure of the aortic valve is most closely associated in time with:
   A. the R S interval.
   B. the first heart sound.
   C. ventricular repolarization.
   D. the QRS complex.
   E. none of the above is correct.

52. In a patient with cardiac failure the contractility of both ventricles was found to be clearly decreased. In this
   diseased heart during light exercise:
   A. the right ventricular preload would probably fall.
   B. the right ventricular end diastolic pressure would most likely be greater than in normal hearts.
   C. the central venous pressure would probably fall.
   D. the left ventricular preload would probably fall.
   E. none of the above is correct.
53. Pulmonary capillary wedge pressure was measured when the mitral valve was closed and found to be 5 mmHg. Pulmonary artery pressure was 15 mmHg and pulmonary artery blood flow was 4 L/min. What was pulmonary vascular resistance (in mmHg/L/min) and cardiac output (in L/min), respectively?
   A. 5 and 5
   B. 2.5 and 4
   C. 0.25 and 4
   D. 10 and 4
   E. 5 and 4

Use the following data, obtained from a patient with mitral valve regurgitation, to answer questions #54-57:

Heart rate = 100 beats/min
O₂ consumption = 200 ml O₂/min
Pulmonary artery O₂ content = 15 ml O₂/100 ml blood
Aortic O₂ content = 20 ml O₂/100 ml blood
Angiographic volumes of left ventricle (in ml): EDV = 200, ESV = 100
Pressures (in mmHg):
   Pulmonary artery mean P = 36
   Pulmonary capillary wedge (PCW) mean P = 30
   Aortic mean P = 104
   Right atrial mean P = 6

54. What are the total left ventricular stroke volume (in ml/beat) and forward stroke volume (into aorta in ml/beat), respectively?
   A. 100 and 60
   B. 60 and 100
   C. 40 and 100
   D. 100 and 40
   E. cannot be calculated

55. What is the ejection fraction (as a %)?
   A. 40
   B. 50
   C. 70
   D. 80
   E. 60

56. What is the regurgitant fraction (as a %)?
   A. 40
   B. 60
   C. 30
   D. 50
   E. 20

57. What are the pulmonary and systemic vascular resistances (in mmHg/L/min), respectively?
   A. 15 and 245
   B. 2.5 and 35
   C. 1.5 and 24.5
   D. 3.0 and 16.0
   E. 10 and 100

58. A drug is given to a patient suffering from depressed myocardial function. Shortly thereafter, a cardiac function curve revealed an increase in contractility. The mechanism of action of the drug may have been to:
   A. increase extracellular Na+
   B. stimulate Ca²⁺-ATPase activity in the sarcolemmal membrane
   C. increase intracellular Na⁺ by inhibition of the Na⁺-K⁺ ATPase
   D. decrease extracellular Ca²⁺
   E. decrease arterial blood pressure

59. Which of the following is true?
   A. An increase in afterload causes a downward shift in the cardiac function curve and, therefore, decreases contractility.
   B. Central venous pressure is inherently driven to the equilibrium value that makes cardiac output and venous return equal.
   C. End diastolic volume and end systolic volume are both increased with an increased afterload.
   D. When compared to the left ventricle, both right ventricular pressures and stroke volumes are lower.
   E. Whenever circulating blood volume increases, peripheral venous pressure (Ppv) decreases.
60. Coronary blood flow to the left ventricle
   A. is maximal during isovolumic contraction
   B. is about equal to the normalized value for cardiac output (ie. the cardiac index)
   C. does not increase significantly during exercise but the extraction of oxygen is enhanced significantly
   D. at steady state, always equals the coronary flow to the right ventricle
   E. would be higher at an aortic diastolic pressure of 90 mmHg than at 70 mmHg

61. Increases in the supply of oxygen to the normal myocardium during increased demand are most dependent on
   A. increasing the pressure gradient between the aorta and epicardial arteries
   B. increasing blood flow mediated by the sympathetic nervous system
   C. increasing blood flow mediated by the release of local vasodilators secondary to changes in local metabolism
   D. increasing respiration, thereby increasing the arterial-venous oxygen difference
   E. decreases in heart rate thereby allowing the heart to fill more during diastole

62. For a normal cardiac function curve relating left ventricular end diastolic volume (abcissa or X-axis) to the stroke volume (ordinate or Y-axis), the same relation will apply if cardiac output is substituted for stroke volume on the Y-axis, but only if what is held constant?
   A. preload
   B. afterload
   C. heart rate
   D. contractility
   E. total peripheral resistance

63. An increase in systemic arterial pressure would most likely lead to which of the following (prior to any compensatory changes):
   A. An increase in the velocity of blood flow ejected from the left ventricle during systole.
   B. An increase in cardiac output.
   C. A decrease in preload and an increase in stroke volume.
   D. A decrease in the maximal wall tension developed in the left ventricle.
   E. An increase in the end systolic volume and no significant change in end diastolic volume.

64. An individual at rest suddenly experienced marked dizziness and fainted. His past history revealed arrhythmias and occasional fainting episodes that were unrelated to his activity level. His normal resting heart rate was 65 beats/min but during the fainting episode he demonstrated tachycardia with a heart rate of 210 beats/min. Which of the following is most likely?
   A. Sympathetic tone increased dramatically causing a pronounced peripheral vasodilation.
   B. The elevated heart rate did not allow adequate time for contraction to occur and therefore cardiac output suddenly fell.
   C. The higher heart rate dramatically increased cardiac output so that cerebral blood pressure fell.
   D. Stroke volume increased at a rate faster than the increase in heart rate so that cardiac output decreased.
   E. The elevated heart rate did not allow adequate time for diastolic filling and therefore stroke volume and cardiac output suddenly fell.

For questions #65-71, match the cardiac event with the interval of the cardiac cycle in which it occurs. (The same answer can be used more than once.)

   Interval of the cardiac cycle:
   A. rapid ejection
   B. reduced ejection
   C. rapid filling
   D. reduced filling
   E. isovolumic relaxation

65. Atrial contraction
66. Aortic pressure less than left ventricular pressure
67. Tension in the wall of the left ventricle decreases while radius remains constant
68. Brief period when all valves are closed
69. The c wave of the venous pulse
70. Ventricular repolarization
71. The S-T interval on the ECG
72. In young people, the 2nd heart sound ($S_2$) is often split (has two audibly distinct components). During normal respiration, which factor is most responsible for the splitting of the second heart sound ($S_2$):

A. increased filling of the left ventricle during inspiration.
B. decreased filling of the left ventricle during expiration.
C. decreased ejection from the left ventricle during expiration.
D. increased filling of the right ventricle during inspiration.
E. decreased filling of the right ventricle during expiration.

73. In the above question, the split of $S_2$ is caused by:

A. delayed opening of the tricuspid valve.
B. delayed closing of the tricuspid valve.
C. delayed closing of the pulmonary valve.
D. delayed opening of the pulmonic valve.
E. early closing of the aortic valve.

74. Pulmonary edema in congestive heart failure is most likely caused by

A. an increase in plasma colloid osmotic pressure.
B. a decrease in plasma colloid osmotic pressure.
C. a decrease in pulmonary vascular resistance.
D. failure of the left ventricle.
E. failure of the right ventricle.

ANSWER KEY: CARDIAC PHYSIOLOGY
Part 1
71 A 72. D 73. C 74. D

Part 2 ECG Questions
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Department of Internal Medicine
1. The T wave of an electrocardiogram indicates
   A. the duration of the cardiac action potentials.
   B. the repolarization of the ventricular myocardium.
   C. conduction of the depolarizing impulse of the ventricle.
   D. the refractory period of a ventricular myocardial cell.
   E. AV conduction delay.

2. Conduction of impulses through the AV node
   A. is characterized by a reduced conduction velocity and reduced amplitude of action potential (decremental conduction).
   B. accounts for the delay between ventricular depolarization and repolarization.
   C. is depressed during sympathetic stimulation.
   D. is facilitated by virtue of the increased diameter of the conducting fibers.
   E. is reflected by the QT interval of the ECG.

3. The speed of conduction of electrical impulses is slowest in the:
   A. sino-atrial node.
   B. atrio-ventricular node.
   C. bundle of His.
   D. right bundle branch.
   E. left bundle branch.
4. "Re entry" of a cardiac impulse into an already repolarized area of the myocardium usually produces:
   A. 1st degree heart block
   B. 2nd degree heart block
   C. 3rd degree (complete) heart block
   D. premature ventricular depolarizations (extrasystoles)
   E. Cardiac standstill.

5. A P R interval longer than 0.2 sec indicates
   A. an aberrant AV conduction pathway.
   B. complete AV block.
   C. 1st degree AV conduction block.
   D. sympathetic influence on AV conduction.
   E. none of the above.

6. The duration of an action potential of a ventricular muscle cell is mostly influenced by the:
   A. conduction velocity of the impulse.
   B. origin of the heart beat.
   C. interval between it and the immediately preceding action potential.
   D. excitability of the muscle cell.
   E. none of the above.

7. The PR interval gives you an approximation of:
   A. atrial de and re polarization
   B. atrio ventricular conduction time.
   C. conduction time in the Purkinje system.
   D. velocity of atrial conduction.
   E. heart rate.

8. The SA node usually acts as the primary pacemaker of the heart because its automatic impulse formation is:
   A. strongest
   B. the only one available
   C. fastest
   D. slowest
   E. governed by the autonomic nervous system

9. Tom volunteers to have his ECG taken in front of the class. When he takes off his shirt, everyone hoots and whistles. He is very embarrassed, but also kind of flattered. He gets an adrenaline "rush" and his heart rate increases progressively as the ECG is recorded. What would his ECG tracing show?
   A. A progressive lengthening of the P-P interval
   B. A progressive shortening of the P-P interval
   C. An ST segment elevation
   D. An ST segment depression
   E. An increase in his QRS duration

10. The QRS complexes of the 12 lead ECG enable us to understand:
    A. the excitation-contraction interval.
    B. the mean electrical axis of the patient's heart.
    C. velocity of impulse conduction from atrium to ventricle.
    D. the second heart sound.
    E. cardiac repolarization.

11. Prolongation of the PR interval beyond 0.2 sec. is seen during:
    A. exercise
    B. parasympathetic stimulation
    C. fever
    D. rest
    E. none of the above.

12. The diagnosis of a first degree heart block can be made from the:
    A. T wave
    B. QT interval
    C. ST segment
    D. QRS complex
    E. PR interval
13. In the normal ECG the average duration of the action potentials of the ventricular myocardium are reflected in the:
   A. T wave
   B. QRS segment
   C. ST segment
   D. QT interval
   E. PR interval

14. An increased sodium conductance ($g_{Na}$) in a myocardial (non pacemaker) fiber may lead to:
   A. faster impulse conduction
   B. block of the impulse
   C. faster repolarization
   D. longer action potential duration
   E. an increase in the resting potential

15. Identify the cardiac function listed below that is initiated by the QRS complex:
   A. atrial contraction
   B. A V conduction
   C. ventricular filling
   D. atrial filling
   E. ventricular contraction

16. Third degree heartblock is signified by:
   A. a QRS complex duration of more than 0.2 sec.
   B. a P R interval of more than 0.2 sec.
   C. Q T interval of more than 0.2 sec.
   D. ventricular heart rate completely independent from atrial heart rate.
   E. two atrial depolarizations followed by one ventricular depolarization.

Directions: For each of the questions or incomplete statements below ONE or MORE of the answers or completions given are correct. On the answer sheet, fill in the circle containing
A if only 1,2 and 3 are correct
B if only 1 and 3 are correct
C if only 2 and 4 are correct
D if only 4 is correct
E if ALL are correct

17. A decrease in heart rate can be produced by:
   1. an increase in K+ conductance.
   2. an increase in body temperature.
   3. inhibition of the sympathetic nervous system.
   4. mild exercise.

18. Slow Ca++ currents can be involved:
   1. in the formation of the SA nodal action potential.
   2. in excitation contraction coupling.
   3. in re entry.
   4. in AV conduction.

19. Under normal conditions, the velocity of impulse conduction in the heart is influenced by:
   1. the diameter of the conducting fibers.
   2. the resting membrane potential.
   3. the fast inward (Na+) current.
   4. the SA nodal rate.

20. Heart rate is:
   1. reflected by the QT interval.
   2. influenced by K+ conductance.
   3. influenced by the autonomic nervous system.
   4. reflected by a lengthened PR interval.

21. Bradycardia can be produced by:
   1. vagal stimulation.
   2. a slow walk.
   3. inhibition of sympathetic NS.
   4. re-entrant impulses.
22. Reasons for the conduction delay in the AV node include:
   1. small fiber diameter.
   2. partial depolarization of the membrane resting potential.
   3. "slow current" conduction.
   4. decremental conduction.
23. The onset of ventricular systole is associated with:
   1. the QRS complex.
   2. closure of the aortic valve.
   3. the first heart sound.
   4. relaxation of the mitral valve.
24. AV conduction can be delayed by:
   1. sympathetic stimulation.
   2. stimulation of Ca\(^{++}\) conductance.
   3. increased pacemaker activity.
   4. parasympathetic stimulation.
25. Tachycardia can be caused by:
   1. a reentrant focus.
   2. fever.
   3. sympathetic stimulation.
   4. rest.
26. The duration of the action potentials of ventricular myocardial cells is influenced by:
   1. the sodium conductance of the cell membrane.
   2. the interval between beats.
   3. the chloride conductance of the cell membrane.
   4. phase 3 repolarization.
27. Reasons for the conduction delay in the AV node include(s):
   1. small fiber diameter.
   2. partial depolarization of the membrane resting potentials.
   3. parasympathetic tone.
   4. decremental conduction.
28. In myocardial fibers showing slow response action potentials:
   1. the inward current is often carried by Ca\(^{++}\).
   2. conduction velocity is slow.
   3. unidirectional block can exist.
   4. the resting membrane potential is hyperpolarized.
29. Increase heart rate will be reflected in:
   1. the QRS duration.
   2. the QT interval.
   3. the velocity of conduction of the cardiac impulse.
   4. the duration of the myocardial action potential.
30. Partial depolarization of myocardial contractile tissue:
   1. decreases the velocity of conduction of the cardiac impulse.
   2. promotes slow conduction.
   3. inhibits or decreases the fast inward Na current.
   4. inhibits the slow action potential.
31. An SA node bradycardia (decrease in heart rate) may be produced by
   1. an increase in potassium conductance (g\(_K\)).
   2. a decrease in body temperature.
   3. parasympathetic stimulation.
   4. an increase in sodium conductance (g\(_Na\)).
32. Slow response action potentials in the myocardium:
   1. are usually found in the AV conduction system.
   2. are usually found in partially depolarized fibers (resting potential about 60 mV).
   3. are usually found in fibers with very small diameters.
   4. depend on Ca\(^{++}\) current (I\(_i\)).

Answer Key Part 2

1. The intrinsic determinants of resistance to blood flow include
   A. parasympathetic and sympathetic cholinergic vascular tone.
   B. viscosity of blood and vessel wall thickness.
   C. a direct proportionality to radius and length and an inverse proportionality to viscosity.
   D. blood viscosity, vessel length and radius.
   E. transmural pressure.

2. Which of the following conditions is apt to produce the greatest reabsorption of fluid at the level of the microcirculation?
   A. arteriolar dilation and venular contraction.
   B. an increase in venular resistance and a decrease in arteriolar resistance.
   C. a decrease in arteriolar and venular resistance.
   D. an increased concentration of plasma protein.
   E. a decreased concentration of plasma protein.

3. Which one of the following statements is incorrect.
   A. The myocardial circulation is protected by a large degree of collateralization.
   B. Movement of fluid from intra- to extravascular compartments increases when capillary hydrostatic pressure is increased.
   C. Active changes in vascular resistance involve changes in the contractile state of vascular smooth muscle.
   D. The most important determinant of resistance to blood flow is vessel diameter.
   E. Significant decreases in the concentration of plasma proteins can result in marked edema.

4. The carotid sinus baroreflex
   A. is not operative during sleep.
   B. involves efferent and afferent components contained in the 10th cranial nerve.
   C. results in marked activation of cholinergic sympathetic fibers innervating the cutaneous vasculature.
   D. is responsive to changes in arterial pressure between about 60 and 150 mmHg.
   E. is initiated by stimulation of receptors located in the carotid bodies.

5. Active hyperemia is
   A. a decrease in blood flow associated with increased metabolism in the tissue.
   B. an increase in blood flow resulting from an increase in the contractile state or tone of the blood vessels in the region considered.
   C. different from reactive hyperemia because it is dependent on an intact vascular innervation.
   D. increase in flow that occurs following a period of local ischemia.
   E. an increase in blood flow resulting from heightened metabolic activity in the organ or tissue considered.

6. An increase in pressure at the aortic arch baroreceptors will
   A. decrease afferent firing and increase efferent firing in the 10th cranial nerve.
   B. increase both afferent and efferent action potential frequency in the vagus nerve.
   C. decrease firing in the IX cranial nerve thereby increasing peripheral vascular resistance.
   D. increase the mechanical assist to venous return occurring during the expiratory phase of respiration.
   E. result in sympathetic activation such that blood flow is shunted from muscle to skin thereby relieving the pressure load.

7. In most vascular beds neural regulation of blood flow is ascribable to:
   A. minute to minute modulation of the number of muscarinic receptors.
   B. interaction of norepinephrine with cholinergic receptors.
   C. modulation of the frequency of action potentials in efferent adrenergic sympathetic fibers.
   D. modulation of the frequency of action potentials in efferent cholinergic sympathetic fibers.
   E. modulation of the frequency of action potentials in efferent parasympathetic fibers.

8. Autoregulation of blood flow:
   A. assures adequate flow of lymph back to the heart.
   B. illustrates how the osmotic pressure of plasma proteins may cause filtration at the capillary bed.
   C. refers to a remote regulatory mechanism involving humoral vasoactive agents.
   D. is best developed in the cutaneous and skeletal muscle vascular beds.
   E. is a local regulatory mechanism maintaining flow constant over a wide range of perfusion pressures.

9. The relative distribution of blood volume in the peripheral circulation is:
   A. arteries > capillaries > veins.
   B. capillaries > veins > arteries.
   C. veins > capillaries > arteries.
   D. veins > arteries > capillaries.
   E. arteries > veins > capillaries.
10. The arteriolar segments are described as:
   A. the capacitance unit because arterial pressures are highest in this segment.
   B. the resistance unit because resistance to blood flow is lowest.
   C. collateral free because all A V shunts are distal.
   D. the resistance unit because resistance to blood flow is greatest.
   E. the capacitance unit because the capacity to retain blood is limited only by the high compliance of the system (relative to veins).

11. Which one of the following statements is true?
   A. The single most important determinant of capillary hydrostatic pressure is precapillary (arteriolar) compliance.
   B. Active hyperemia is ascribable to a decrease in transmural pressure.
   C. Cross sectional area is greatest and linear flow velocity is least in the capillary bed as compared to other areas of the circulation.
   D. Stimulation of the carotid sinus increases heart rate.
   E. The largest fraction of circulating blood volume is in the capillary bed.

12. The major normal regulator of resistance to the flow of blood through circulation is the smooth muscle of the:
   A. Arteriole.
   B. Small vein.
   C. Precapillary sphincter.
   D. Venule.
   E. Aorta.

13. The major part of the decrease in pressure in the entire circulation occurs in the:
   A. Small vein.
   B. Capillary
   C. Arteriole
   D. Aorta.
   E. Thoroughfare channel.

14. Venous return is increased by:
   A. Standing still.
   B. Exhaling forcefully.
   C. Increasing right atrial pressure.
   D. Decreasing peripheral venous pressure.
   E. Inspiring deeply.

15. Under resting conditions blood flow per gram of tissue is:
   A. Higher in skeletal muscle than in the heart.
   B. Higher in skeletal muscle than in the liver.
   C. Higher in bone than in the brain.
   D. Higher in the kidneys than in the heart.
   E. Lower in the kidneys than in the heart.

16. A vasodilator substance:
   A. Renin.
   B. Nitric Oxide.
   C. Endothelin.
   D. Calcium.
   E. Low P CO2.

17. The neurotransmitter between pre and postganglionic fibers in the autonomic nervous system is:
   A. histamine
   B. acetylcholine
   C. norepinephrine
   D. angiotensin
   E. epinephrine

18. Resistance to blood flow in series coupled circuits is:
   A. equal to the sum of the resistance through each segment.
   B. equal to the sum of the reciprocals of the resistance through each circuit.
   C. calculable only if nutritional flow is given.
   D. inversely proportional to the total length of the circuits.
   E. directly proportional to arteriolar radius raised to the fourth power.
19. The cardiac output of a person is 6.5 L. The content of oxygen in the arterial blood is 0.20 ml/ml whereas the oxygen content in mixed venous blood is 0.15 ml/ml. The person’s O2 consumption on this basis is:
   A. 325 ml/min
   B. 300 ml/min
   C. 275 ml/min
   D. 250 ml/min
   E. indeterminate

20. The myogenic hypothesis suggests that an increase in perfusion pressure (in a responsive vascular bed) produces a(n):
   A. passive increase in vessel radius and resistance to flow.
   B. passive increase in vessel radius and sustained decrease in resistance.
   C. passive increase in vessel radius, stretching the smooth muscle leading to its active relaxation to relieve the stretch and to increase resistance.
   D. passive increase in vessel radius, stretching the smooth muscle resulting in contraction and an active increase in resistance.
   E. active decrease in vessel caliber resulting in decreased resistance.

21. Which of the following is true?
   A. In the heart, the extraction ratio of glucose is about the same as that of oxygen.
   B. O2 flow across muscle capillaries is by active transport.
   C. Presentation of oxygen to the capillary near a muscle cell by bulk flow is never a rate limiting step in getting O2 to cells.
   D. The compliance of the arteries is lower than the compliance of the veins.
   E. The largest fraction of the blood is found in the capillaries.

22. In a vascular bed where autoregulation occurs, pressure is decreased from 100 mmHg to 80 mmHg and then increased to 125 mmHg:
   A. Flow will be essentially constant and resistance will increase at low (80 mmHg) and high (125 mmHg) pressure.
   B. Flow will decrease at low pressure, increase at high pressure and resistance will be constant.
   C. Flow and resistance will be essentially unchanged during each pressure change.
   D. Flow will be essentially constant but resistance will decrease at the lower pressure and increase at the higher pressure.
   E. The information provided is not sufficient to provide a reasonable response to the question.

23. For a person in Cincinnati, which of the following groups of vascular beds is arranged in increasing order of the fraction (%) of cardiac output received at rest (low at left, high at right).
   A. Skin, kidney, brain.
   B. Skin, brain, kidney.
   C. Kidney, skin, brain.
   D. Brain, skin, kidney.
   E. Kidney, brain, skin.

24. Ganglionic blockade is likely to be associated with:
   A. a decrease in circulating angiotension.
   B. edema resulting from reduced capillary hydrostatic pressure.
   C. a marked increase in heart rate.
   D. a decrease in arterial pressure.
   E. a decrease in renal blood flow.

25. In a normal individual, cerebral perfusion pressure is abruptly decreased from an initial value of 110 mm Hg to 95 mm Hg and is maintained throughout the period of observation. Under these conditions cerebral blood flow would probably:
   A. decrease throughout the period of observation.
   B. increase transiently and decrease to the level initially present at 110 mm Hg.
   C. decrease transiently and increase to a level roughly equal to the flow initially present at 110 mm Hg.
   D. increase throughout the period of observation.
   E. be unaltered because of the associated increase in sympathetic nerve activity.

26. The steady state response of the cerebral vasculature in the maneuver described in question 25 is probably due to:
   A. reactive hyperemia
   B. active hyperemia
   C. carotid sinus reflex
   D. carotid body reflex
   E. autoregulation
27. An increase in carotid sinus pressure would be expected to:
   A. increase afferent carotid sinus nerve (CSN) activity, increase efferent sympathetic nerve activity (SA) and increase efferent parasympathetic nerve activity (PA).
   B. decrease CSN, SA, and PA.
   C. increase CSN and PA, and decrease SA.
   D. increase CSN and SA, and decrease PA.
   E. decrease CSN and increase SA and PA.

28. A subject's arterial pulse pressure was 30 mmHg and mean arterial pressure was 100 mmHg. The subject's arterial systolic and diastolic pressures were, respectively (in mmHg):
   A. 126/95
   B. 100/130
   C. 130/100
   D. 90/120
   E. 120/90

29. In a patient who suffers from aortic insufficiency:
   A. arterial systolic and pulse pressures are markedly decreased.
   B. arterial compliance approximates venous compliance.
   C. arterial pulse pressure is markedly increased and diastolic pressure is decreased.
   D. left ventricular end systolic volume is markedly decreased.
   E. arterial pulse pressure decreases, reflecting the associated decrease in arteriolar compliance.

30. The following data were obtained from a normal subject at rest: CO = 5 L/min, TPR = 20 mmHg/L/min, mean aortic pressure = 105 mmHg. The right atrial mean pressure was:
   A. 10 mmHg
   B. 5 mmHg
   C. 8 mmHg
   D. 4 mmHg
   E. not calculable from the data given.

31. When arterial mean pressure falls below 50 60 mmHg during circulatory shock:
   A. carotid sinus and aortic arch baroreceptors promote rapid restoration of arterial blood pressure to normal values.
   B. carotid sinus baroreceptors become more activated whereas aortic baroreceptors become less activated.
   C. further involvement of the aortic and carotid sinus baroreceptors is unlikely.
   D. activation of carotid and aortic chemoreceptors (bodies) prevents reflexogenic activation of corresponding baroreceptors.
   E. the individual is in an irreversible state.

32. Sympathetic nerve stimulation of the heart is associated with an increase in coronary blood flow because:
   A. stimulation of myocardial alpha receptors decreases coronary vascular resistance.
   B. increased myocardial metabolism produces metabolites, such as adenosine, which relaxes coronary arterial smooth muscle thereby over riding the constrictor effects of alpha stimulation in the vasculature.
   C. coronary alpha receptors are not innervated.
   D. coronary beta receptors are blocked by increased heart rate.

33. Changes in the fractional distribution of cardiac output among different vascular beds are most likely ascribable to:
   A. increases in cross sectional area of the vasculature as one moves from capillaries through venules and the large veins.
   B. active changes in capillary hydrostatic pressure.
   C. changes in arteriolar radius and hence resistance to blood flow which vary from one vascular bed to another.
   D. sequential decreases in capillary oncotic pressure resulting from changes in venous return.
   E. site specific changes in transmural pressure causing selective passive increases and decreases in resistance to blood flow which vary from one vascular bed to another.

34. When a normal person moves from a lying to sitting position (head up tilt) carotid sinus pressure falls slightly but significantly. This is likely to elicit:
   A. a decrease in heart rate (HR) and arterial blood pressure (ABP).
   B. a decrease in HR and an increase in ABP.
   C. an increase in HR and ABP.
   D. an increase in HR and a decrease in ABP.
   E. no change in HR but ABP will decrease by about 10%.
35. Failure of the left ventricle often leads to:
   A. decrease in right ventricular end diastolic pressure.
   B. decrease in left ventricular end diastolic pressure.
   C. pulmonary edema.
   D. hypertension.
   E. none of the above.

Directions: For each of the questions or incomplete statements below ONE OR MORE of the answers or completions given are correct. On the answer sheet, fill in the circle containing
   A if only 1,2 and 3 are correct
   B if only 1 and 3 are correct
   C if only 2 and 4 are correct
   D if only 4 is correct
   E if ALL are correct

36. Mean arterial blood pressure in a normal subject at rest is:
   1. influenced more by systolic than by diastolic pressure.
   2. the arithmetic average of systolic and diastolic pressures.
   3. approximated by adding 2/3 of the systolic and 1/3 of the diastolic pressure, thus reflecting the duration of ventricular systole and diastole.
   4. influenced more by diastolic than by systolic pressure because diastole is longer in time than systole.

37. Which event(s) would tend to cause an increase in the movement of fluid from the capillary into the interstitial space.
   1. Hypoxic damage to the capillary endothelium.
   2. Standing still for a period of two hours.
   3. An intravenous infusion of one liter of isotonic sodium chloride solution.
   4. Ligation of the thoracic duct.

38. Chronic severe elevation of mean arterial pressure will lead to:
   1. Increased work of the heart.
   2. Left ventricular hypertrophy.
   4. A decrease in the proportion of extracellular fluid located in the plasma.

39. Transcapillary exchange of nutrients and water is facilitated at the level of the capillary because:
   1. linear velocity of flow is very small.
   2. total cross sectional area is very large.
   3. the thickness of the capillary is small.
   4. viscosity is highest.

40. Resistance to blood flow in parallel coupled circuits is
   1. indeterminate.
   2. equal to the sum of the resistances through each circuit.
   3. calculatable providing one series coupled vasculature is included.
   4. equal to the sum of the reciprocals of the resistances through each circuit.

41. A normal individual engages in moderate exercise resulting in about a 20% increase in heart rate and myocardial contractility. In this setting
   1. coronary flow is increased,
   2. myocardial production of inosine is probably decreased.
   3. the change in flow is largely due to active hyperemia.
   4. the change in flow is largely due to reactive hyperemia.

42. Bilateral occlusion of the carotid arteries below the level of the sinuses reflexly increases arterial pressure. When the maneuver is repeated after bilateral vagotomy one would expect:
   1. the pressor response to be smaller.
   2. the pressor response would be increased.
   3. the buffering exerted by the aortic arch baroreceptors would be heightened.
   4. the buffering exerted by the aortic arch baroreceptors would be eliminated.

43. In order to accurately determine cardiac output based on O\textsubscript{2} utilization and the Fick Principle, one must
   1. measure O\textsubscript{2} consumption.
   2. collect a sample of mixed venous blood from the pulmonary artery.
   3. collect a sample of peripheral arterial blood.
   4. collect a sample of venous blood from any convenient vein.
44. In the systemic circulation
   1. the intestinal and cutaneous vasculatures are series coupled.
   2. cutaneous and skeletal muscle vasculatures are parallel coupled.
   3. arteries, capillaries, and veins are parallel coupled.
   4. arteries, capillaries, and veins are series coupled.
45. With respect to the coronary circulation.
   1. left myocardial blood flow is greatest during diastole.
   2. left myocardial blood flow falls to virtually zero during early systole.
   3. right myocardial blood flow is greatest during systole.
   4. adenosine is believe to be a major determinant of myocardial blood flow.
46. The compensatory stage of circulatory shock is characterized by:
   1. cutaneous vasoconstriction.
   2. increased heart rate.
   3. reduced pulse pressure.
   4. decreased coronary vascular resistance.
47. Active increases in resistance to blood flow involve
   1. Ca$^{++}$ mediated activation of the contractile proteins.
   2. increased Ca$^{++}$ efflux from smooth muscle cells.
   3. decreases in arteriolar diameter.
   4. reduced Ca$^{++}$ activity in the cytosolic compartment of smooth muscle cells.
48. Cardiac output can be increased when
   1. myocardial contractility increases.
   2. preload increases without exceeding optimal sarcomere length.
   3. stroke volume increases.
   4. heart rate increases over the range of about 5 30 bpm assuming an initial rate of about 65 76 bpm.
49. In severe congestive heart failure:
   1. central venous pressure is increased.
   2. right atrial pressure is increased.
   3. body weight is increased.
   4. heart size is increased.
50. Removal of the baroreceptors causes, after three weeks:
   A. net arterial hypertension.
   B. net arterial hypotension.
   C. increased variability in blood pressure.
   D. decreased variability in blood pressure.
   E. no alteration in blood pressure regulation.
51. A decrease in mean arterial pressure will cause which of the following?
   A. increased firing in vagus fibers from the aortic baroreceptor.
   B. increased firing in vagus fibers to the SA node.
   C. increasing firing in sympathetic noradrenergic fibers to the splanchnic bed and skin.
   D. increased P R interval in the ECG.
   E. increased P P interval in the ECG.
52. In a certain artery, the mean arterial pressure at the beginning of the artery is 90 mmHg and the mean arterial pressure at the end of the artery is 75 mmHg. The tissue pressure surrounding the artery is 5 mmHg. What is the driving pressure for flow within the artery?
   A. 90 mmHg
   B. 85 mmHg
   C. 20 mmHg
   D. 15 mmHg
   E. 10 mmHg
53. In or near a given capillary the following pressures are measured.
   Capillary hydrostatic pressure = 18 mmHg
   Interstitial hydrostatic pressure = 6 mmHg
   Capillary oncotic pressure = 25 mmHg
   Interstitial oncotic pressure = 10 mmHg
   The net pressure promoting water flux is:
   A. 39 mmHg out of the capillary
   B. 3 mmHg into the capillary
   C. 3 mmHg out of the capillary
   D. 9 mmHg into the capillary
   E. 39 mmHg into the capillary

54. Which of the following events occurs at birth?
   A. Pulmonary vascular resistance decreases.
   B. Systemic vascular resistance decreases.
   C. Heart rate decreases.
   D. Left atrial pressure decreases.
   E. Cardiac output decreases.

55. In an adult, if there is an atrial septal defect (a hole between the left and right atria):
   A. blood will flow from right to left atria because right ventricular pressure is greater than left atrial pressure.
   B. blood will flow from left to right atria because left atrial (LA) mean pressure is greater than right atrial (RA) mean pressure.
   C. blood will flow from left to right atria because left ventricular pressure is greater than right atrial pressure.
   D. the flow through the systemic circulation will always be greater than that through the pulmonary circulation.
   E. there will be no net flow in either direction because mean RA and mean LA pressures are the same.

56. What happens in the fetus immediately after a pregnant woman smokes 3 cigarettes in rapid succession?
   A. Blood flow to the brain decreases.
   B. Blood flow to the heart decreases.
   C. Blood flow to the lungs decreases.
   D. Arterial blood pressure decreases.
   E. Nothing

57. Which of the following is a feature of local regulation of blood flow?
   A. In the brain, a decrease in O2 vasodilates.
   B. In the lungs, a decrease in O2 vasodilates.
   C. In muscle, a decrease in pH vasoconstricts.
   D. Adenosine is an important regulator of skin blood flow.
   E. In the arm, a decrease in O2 vasoconstricts.

58. Arteriosclerosis ("hardening of the arteries") will NOT:
   1. increase systolic pressure in the aorta.
   2. decrease mean arterial pressure.
   3. decrease diastolic pressure in the aorta.
   4. increase arterial compliance.

59. During an intravenous injection of vasopressin
   1. systolic arterial pressure decreases.
   2. arteriolar resistance decreases.
   3. firing of aortic baroreceptors decreases.
   4. heart rate decreases
60. You have just ingested a drug that increases vascular compliance. Which of the following events occur(s)?
   1. the volume of blood in the arteries increases.
   2. the volume of blood in the veins increases.
   3. arterial blood pressure decreases.
   4. left ventricular output increases.

61. The arterial baroreceptor reflex:
   1. is an important long term controller of blood pressure.
   2. is also known as the Cushing reflex.
   3. is most active at arterial pressures below 50 mm Hg.
   4. is most active between arterial pressures of 70 and 150 mm Hg.

62. Which of the following are characteristics of the fetal circulation?
   1. there is a shunt between the umbilical vein and inferior vena cava.
   2. pulmonary blood flow is equal to systemic blood flow.
   3. there is a shunt between the pulmonary artery and descending aorta.
   4. left and right ventricular outputs are equal.

63. Three hours after losing of 20% of my blood volume, which of the following is increased above normal (prehemorrhage levels):
   1. plasma renin concentration.
   2. plasma vasopressin concentration.
   3. plasma aldosterone concentration.
   4. plasma atrial natriuretic factor concentration.

64. Vascular resistance increases when
   1. blood flow decreases while driving pressure remains constant.
   2. you go from an upright to supine position.
   3. hematocrit increases.
   4. the cross sectional area of the arterioles increases.

Answer Key
Peripheral Circulation
64. B

MEDICAL PHYSIOLOGY: SECTION V (PHYSIOLOGY OF HEMOSTASIS)
Dr. Robert Highsmith
Department of Molecular and Cellular Physiology
1. A 15 year old boy was admitted to the hospital with severe bleeding tendencies, a normal prothrombin time and a normal platelet count. Without further analyses, which of the following diagnoses can be ruled out?
   A. Hemophilia A
   B. Qualitative platelet defect.
   C. Factor XI deficiency.
   D. Vitamin K deficiency.
   E. None of the above can be ruled out (i.e. they are all possible).

2. Which of the following in not a result of the direct action of thrombin?
   A. Causes the conversion of soluble fibrinogen to polymeric fibrin insoluble in 5M urea.
   B. Causes irreversible aggregation of platelets and release of phospholipid.
   C. Potentiation of the activities of Factors V and VIII.
   D. Catalyzes the conversion of Factor XIII to XIIIa in the presence of Ca++. 
   E. Causes the formation of fibrinopeptides A and B by specific cleavage of the A and B chains of the fibrinogen molecule.
3. A severe vitamin K deficiency could be differentiated from classic hemophilia by which of the following tests?
   A. Bleeding time.
   B. Partial thromboplastin time.
   C. Prothrombin time.
   D. Thrombin time.
   E. Fibrinogen level.

4. Vitamin K:
   A. Is necessary for the hepatic synthesis of normal fibrinogen and prothrombin molecules.
   B. Its only source is in the dietary food intake.
   C. Its mechanism of action is inhibited by the anticoagulant heparin.
   D. Could be used to reverse the adverse effects of an overdose of coumarin (Wafarin).
   E. Is an effective anticoagulant for the treatment of venous thrombosis.

5. In response to vessel injury, which of the following set of events is arranged in the correct temporal sequence?
   A. Release of platelet serotonin, blood vessel constriction, platelet adherence to collagen.
   B. Activation of Factor X by the "intrinsic pathway", activation of Factor X by the "extrinsic pathway".
   C. Exposure of blood to subendothelial collagen, fibrin polymerization, activation of Factor XII.
   D. Release of fibrinopeptides A and B, conversion of prothrombin to thrombin, platelet adherence to collagen.
   E. None of the above is in the correct sequence.

6. A patient with severe bleeding tendencies has a normal partial thromboplastin time and a platelet count of 275,000 per microL. Which one of the following diagnoses could be correct?
   A. Qualitative platelet defect.
   B. Hemophilia A.
   C. Thrombocytopenia.
   D. Factor X deficiency.
   E. Hypofibrinogenemia.

7. Classic hemophilia A (Factor VIII defect)
   A. Is a sex linked, autosomal dominant inherited disorder.
   B. Is accompanied by a marked prolongation of the thrombin time.
   C. Is more likely seen in a young female than in an adult female.
   D. Occurs more frequently in the general population than thrombotic disorders.
   E. None of the above statements are true.

8. A patient with severe bleeding tendencies has a normal coagulation profile of prothrombin time, platelet count, partial thromboplastin time, and normal Factor VIII levels. Which of the following tests would uncover the most likely cause of the abnormal bleeding?
   A. Plasma fibrinogen levels.
   B. Bleeding time.
   C. Thrombin time.
   D. Measurement of fibrinopeptides A & B.
   E. Clot solubility in 5M urea.

9. Which of the following are constituents of normal platelets?
   A. Serotonin, collagen ADP.
   B. Contractile proteins, thrombin, DNA.
   C. Lysosomal enzymes, ADP, microtubules.
   D. Fibrinogen, mitochondria, plasminogen.
   E. Nucleus, ATP, Ca++.

10. A Factor IX deficiency could best be differentiated from a vitamin K deprivation by which of the following tests?
    A. Thrombin time.
    B. Plasma fibrinogen level.
    C. Prothrombin time.
    D. Partial thromboplastin time.
    E. Bleeding time.

11. Anticoagulation by heparin:
    A. Will markedly prolong the bleeding time.
    B. Is widely used in the treatment of arterial thrombosis.
    C. Is achieved more rapidly than that obtained with coumarin.
    D. Is not effective when added to whole blood in a test tube.
    E. Is not dependent on the plasma antithrombin levels.
12. Phospholipid plays a key role in the hemostatic mechanism because:
   A. It provides a surface to which platelets adhere.
   B. It supplies phosphorus which is needed for effective coagulation.
   C. It effectively removes ionized Ca\textsuperscript{2+} thereby preventing thrombosis.
   D. Thrombin cannot convert fibrinogen to fibrin without it.
   E. It provides a surface for the activation of several procoagulants.

13. Substance X is given to a patient and after 3 days is found to prolong the bleeding time, but to have no significant effect on the partial thromboplastin time, prothrombin time or thrombin time. Substance X could be:
   A. Serotonin.
   B. Coumarin.
   C. Heparin.
   D. Aspirin.
   E. A platelet concentrate.

14. As regards the intrinsic pathway of coagulation and the extrinsic pathway, which of the following statements is true?
   A. The rate of intrinsic activation is more affected by Factor VIII deficiency (hemophilia A) than is that for extrinsic activation.
   B. In vivo, either one of the pathways (intrinsic or extrinsic) is sufficient for a competent hemostatic system.
   C. Biological amplification occurs to an equal extent in both pathways.
   D. The fibrinolytic and inflammatory responses appear to have their origin during the activation of the extrinsic pathway.
   E. All of the above.

15. The liver plays an important role in hemostasis because:
   A. It is the only site of synthesis of Factor VIII.
   B. It effectively clears the circulation of the procoagulant forms of all the factors but permits the activated forms to circulate.
   C. It can rapidly manufacture new platelets following the onset of acute thrombocytopenia.
   D. It is the major site of production of the Vitamin K dependent factors.
   E. None of the above.

16. Which one of the following combinations of substances in a test tube will cause the formation of a visible fibrin clot. (Assume optimal amounts of Ca\textsuperscript{2+} and phospholipid are available)?
   A. Factors V, Xa, fibrinogen
   B. Factors V, Xa, fibrinogen and Factor XIII.
   C. Factors XIII, IXa, V, prothrombin and fibrinogen.
   D. Factors V, Xa, fibrinogen, prothrombin.
   E. None of the above.

17. Which of the following would not tend to prolong the thrombin time?
   A. Severe liver disease.
   B. Abnormal fibrinogen molecule.
   C. Excessive fibrinolysis.
   D. Classic hemophilia
   E. I.V. heparin therapy.

18. Which of the following statements is true?
   A. Chronic inherited hemorrhagic disease is more prevalent than thrombotic disease.
   B. A platelet count of 300 x 10\textsuperscript{3} /microl blood would result in a significant prolongation of the bleeding time.
   C. The only source of Vitamin K is from the diet.
   D. An abnormal prothrombin molecule would cause a prolongation of the thrombin time.
   E. None of the above.

19. Which of the following statements is true?
   A. Heparin is a competitive inhibitor of Vitamin K
   B. Platelets contain nearly all of the basic elements of a contractile cell and have a half life of about 2 days.
   C. Hemophilia A is a sex linked recessive disorder while von Willebrand's disease is autosomal dominant.
   D. The mortality due to inherited hemorrhagic disorders far exceeds that due to thrombotic disease.
   E. In severe thrombocytopenia, the partial thromboplastin time is prolonged due to a lack of platelet phospholipid.

20. Which of the following statements is true in regard to venous thrombosis?
   A. Is accompanied by increased platelet consumption and near normal fibrinogen levels.
   B. Is a likely underlying cause of myocardial infarction.
   C. Is more effectively treated by anti platelet aggregating agents than is arterial thrombosis.
   D. Often occurs even though the vascular endothelium may be normal.
   E. Rarely occurs in areas of static blood flow and low pressure.
21. Substance X is given to a patient and, after 3-4 days, is found to prolong the prothrombin time, but to have no significant effect on the bleeding time or the thrombin time. Substance X could be:
   A. Aspirin.
   B. Heparin.
   C. Coumarin.
   D. Purified antithrombin.
   E. Factor VII.

22. Which of the following statements is false?
   A. The relative importance of each of the major components of the hemostatic mechanism varies with vessel caliber or size.
   B. Platelets contain specific receptors for fibrinogen.
   C. Within the platelet, cyclooxygenase converts arachidonic acid primarily to PGI₂ (prostacyclin).
   D. The electron dense platelet granules contain ADP and serotonin while the alpha granules have fibrinogen and lysosomal enzymes.
   E. Normal platelets have a half life of approximately 9 to 10 days and may be dendritic in shape.

23. Activation of the fibrinolytic enzyme system would be expected to:
   A. Be accompanied by a fall in plasma prothrombin levels.
   B. Indirectly inhibit platelet aggregation by stimulating the production of PGI₂ (prostacyclin) by endothelial cells.
   C. Be therapeutically more beneficial in the treatment of arterial thrombosis than venous thrombosis.
   D. Inhibit the polymerization of fibrin.
   E. None of the above.

24. In a test tube containing optimal concentrations of Ca²⁺ and phospholipid, which of the following combinations of substances would cause the most rapid formation of a visible fibrin clot?
   A. Prothrombin, Factor Xa and soluble fibrin monomer.
   B. Factor XIII, fibrinogen, and prothrombin.
   C. Factors VII, X, prothrombin and fibrinogen.
   D. Factors VIII, V, Xa, and prothrombin.
   E. Fibrinogen and thrombin.

25. Thrombin plays multiple roles in hemostasis. These include all of the following except:
   A. Activation of Factor XIII.
   B. Stimulation of platelet aggregation.
   C. Conversion of fibrinogen to fibrin.
   D. Inhibition of the thrombomodulin Protein C system.
   E. Enhancement of the activity of Factors VIII and V.

26. Which of the following statements is true?
   A. Under normal conditions, more platelets are present in the spleen than are circulating.
   B. The half life of a platelet is approximately 120 days while that of an RBC is about 9-10 days.
   C. Platelets divide rapidly and contain serotonin, actin, and myosin.
   D. Platelet membranes are inherently "sticky" due to the presence of receptor sites occupied by fibrinogen.
   E. A platelet count of 300,000/microL of blood would result in a marked prolongation of the bleeding time.

27. A substance was given daily to a patient for 1 week and was found to result in a severe bleeding problem. Blood tests on the 7th day indicated a prolonged partial thromboplastin time, a prolonged prothrombin time, a normal thrombin time and a normal platelet count. The substance could be:
   A. A compound which specifically inhibits platelet production.
   B. A compound which antagonizes the action of Vitamin K.
   C. Vitamin K.
   D. Aspirin.
   E. A compound which results in the synthesis of abnormal fibrinogen.

28. Classic hemophilia A (Factor VIII defect) could best be differentiated from hemophilia B (Factor IX defect) by which of the following?
   A. Prothrombin time.
   B. Partial thromboplastin time.
   C. Platelet count.
   D. Bleeding time.
   E. Only by specific factor assays.

29. As compared to arterial thrombosis, which one of the following best describes ongoing venous thrombosis?
   A. Occurs primarily at sites of an abnormal vessel wall.
   B. Is best treated with antiplatelet therapies.
   C. Can be caused by a Vitamin K deficiency.
   D. Would tend to be alleviated by a Vitamin K deficiency.
   E. Increased platelet consumption.
30. Which of the following statements is true?
   A. Polymerized fibrin which is insoluble in plasma cannot form in Factor XIII deficient plasma.
   B. In classic hemophilia, both functional and immunological levels of Factor VIII are decreased.
   C. A prolonged bleeding time would likely occur following surgical removal of the spleen.
   D. A Factor VII defect could be distinguished from hypoprothrombinemia by the thrombin time test.
   E. None of the above is true.

31. The normal unstimulated platelet:
   A. Has a half life in the circulation of approximately 10 hours.
   B. Contains contractile proteins, DNA, and intracellular thrombin.
   C. Produces large quantities of thromboxane A2.
   D. Treatment with aspirin prevents oxidation of arachidonic acid by prostacyclin synthetase.
   E. Microtubules are clearly evident encircling the platelet just below its surface membrane.

32. In an experiment, a single injection of substance X was given to an animal and after 3 days was found to prolong the bleeding time, but had no significant effect on the arterial blood pressure, partial thromboplastin time, prothrombin time or platelet count. Substance X could most likely be:
   A. An antibody directed against Factor VIII.
   B. A transfusion of whole plasma from a normal donor animal.
   C. A snake venom which specifically depletes plasma fibrinogen levels.
   D. A drug containing aspirin.
   E. A compound which causes arteriolar vasoconstriction.

33. Which of the following statements is true in regard to fibrinogen?
   A. Turnover or consumption is much greater during arterial thrombosis than during venous thrombosis.
   B. An isolated, purified preparation is rapidly cleaved in a highly specific fashion by thrombin to yield a molecule which immediately polymerizes to form a clot which is covalently linked.
   C. Is formed faster in the prothrombin time test than in the partial thromboplastin time test.
   D. Is an inactive procoagulant that is converted to an active proteolytic enzyme by thrombin.
   E. None of the above.

34. All of the following tend to limit intravascular coagulation except:
   A. Platelet and coagulation factor consumption at the site of vessel injury.
   B. Prostacyclin (PGI₂) production by vascular endothelial cells.
   C. Activation of the fibrinolytic enzyme system.
   D. The relative abundance and high concentration of fibrinogen in plasma.
   E. Hepatic clearance of activated coagulation factors but not their inactive precursors.

35. Which of the following accurately describes the most common hereditary coagulation deficiency (Hemophilia A)?
   A. Autosomal dominant mode of inheritance.
   B. Is accompanied by a prolonged bleeding time due to a decreased platelet count.
   C. Does not affect the partial thromboplastin time.
   D. Would be alleviated by the administration of Vitamin K.
   E. Represents the synthesis of an abnormal molecule.

For question 36-39, select the one best answer from the following:
   A. Arterial thrombosis
   B. Venous thrombosis
   C. Both
   D. Neither

36. Appear(s) to require an abnormal vessel wall.
37. Treatment is/are directed towards an anti platelet effect rather than an anticoagulant effect.
38. Usually accompanied by an increased fibrinogen turnover and consumption.
39. Frequency of occurrence is greater than that for inherited hemorrhagic disorders.
40. In response to vessel injury,
   A. Platelets in contact with collagen release ATP and PGI₂ which jointly promote further platelet
      aggregation.
   B. Blood vessel constriction is primarily responsible for halting bleeding at the capillary level.
   C. Factor X is rapidly activated to Factor Xa which in turn, directly converts fibrinogen to fibrin.
   D. Exposure of platelets to collagen results in the activation of phospholipase A₂ and the release of
      arachidonic acid from the platelet membrane.
   E. No TXA₂ is formed in aspirin treated platelets because aspirin inhibits thromboxane synthetase
      irreversibly.
41. Vitamin K:
   A. Is a fat soluble vitamin derived from both dietary sources and from intestinal bacterial action.
   B. Antagonizes the adhesion of platelets to subendothelial tissue.
   C. Activates Factor XIII and thereby elicits covalent linkage of adjacent fibrin molecules.
   D. Is necessary for the synthesis of certain key coagulation factors   namely, Factors I (fibrinogen), V, and
      VIII.
   E. Like most coagulation factors, is synthesized in the liver.
42. Fibrinogen:
   A. Is a high molecular weight dimeric glycoprotein composed of two identical halves. Each half contains
      four polypeptide chains.
   B. Is converted to fibrin monomer by thrombin induced proteolytic cleavage of the NH₂ terminal ends of
      the alpha and beta chains. The release of fibrinopeptides A precede that of the fibrinopeptides B.
   C. Synthesis is dependent on Vitamin K.
   D. Degradation by plasmin occurs via a single cleavage step yielding two products of equal molecular
      weight.
   E. Concentration in the plasma of a normal person (as compared to levels of other coagulation factors) is
      only exceeded by the concentration of prothrombin.
43. Bleeding due to classic hemophilia could be differentiated from a severe deficiency of Vitamin K by which
    one of the following tests:
   A. Fibrinogen levels.
   B. Bleeding time and platelet count.
   C. Partial thromboplastin time.
   D. Thrombin time.
   E. Prothrombin time.
44. deleted
45. Which of the following is true concerning patients with von Willebrand's Disease (vWD) and classic
    Hemophilia (H)?
   A. Both are sex linked inherited disorders that only affect males.
   B. The bleeding time of vWD is prolonged and the prothrombin times of H and vWD are normal.
   C. Both have a decreased platelet count relative to normal.
   D. vWD has a combined deficiency of an abnormal platelet count and a Factor VII deficit while H has only
      a prolonged partial thromboplastin time.
   E. Both are bleeding disorders accompanied by a decrease in Factor VIII antigen (immunological) levels but
      with normal Factor VIII functional levels.
For each of the questions or incomplete statements below, ONE or MORE of the answers or completions given are correct. Select:
A if only 1, 2 and 3 are correct
B if only 1 and 3 are correct
C if only 2 and 4 are correct
D if only 4 is correct
E if all are correct

46. Which of the following sets of data would be consistent with Hemophilia A?

A PTT partial thromboplastin time
B PT prothrombin time
C TT thrombin time
D BT bleeding time

1. Prolonged TT, prolonged PTT, normal PT.
2. Normal TT, normal BT, normal platelet count.
3. Normal TT, normal PTT, prolonged PT.
4. Prolonged PTT, normal PT, normal BT.

47. In contrast to the "extrinsic" pathway of coagulation, the "intrinsic" pathway is:

A More susceptible to the positive feedback effects of thrombin.
B Impaired in the most common coagulation defect.
C Kinetically slower due to more rate limiting steps.
D Not impaired in a Factor VII deficient patient.

48. In regard to the prothrombin time (PT) and the partial thromboplastin time (PTT):

A Both can be normal despite severe thrombocytopenia.
B Both are prolonged in Factor XIII deficient plasma.
C Both can be prolonged despite a normal thrombin time.
D The PTT would be more prolonged than the PT in an afibrinogenemic patient.

49. A normal platelet count, normal prothrombin time, and normal thrombin time would be obtained with which of the conditions listed below?

A Classic hemophilia.
B Functional (qualitative) platelet disorder.
C Factor XIII deficiency.
D Factor X deficiency.

50. Concerning the thrombin time (TT) and the partial thromboplastin time (PTT),

A The TT is shorter than the PTT in normal plasma.
B Both are prolonged in a patient with an abnormal fibrinogen molecule (dysfibrinogenemia).
C Only the PTT is prolonged in a patient suffering from the most common inherited coagulation defect.
D Both are prolonged in a patient having abnormally low levels of prothrombin.

51. Two patients (A and B) were confirmed to have ongoing thrombosis. Fibrinogen and platelet turnover (T) values and platelet counts were determined for both patients and were as follows:

<table>
<thead>
<tr>
<th>Patient A</th>
<th>Patient B</th>
</tr>
</thead>
<tbody>
<tr>
<td>T (fibrinogen) 1.8mg/ml/day</td>
<td>T (fibrinogen) 0.4mg/ml/day</td>
</tr>
<tr>
<td>T (platelet) 6x10^4 plalets/microL/day</td>
<td>T (platelet) 12.0x10^4 plalets/microL/day</td>
</tr>
<tr>
<td>platelet count 300,000 plalets/ml</td>
<td>platelet count 240,000 plalets/ml</td>
</tr>
</tbody>
</table>

Which of the following statements is/are true?

1. Patient A most likely had venous thrombosis while patient B most likely had arterial thrombosis.
2. The mean platelet survival time in patient A is 5 days while that for patient B is 2 days.
3. Following heparin therapy, the mean fibrinogen survival time for patient A would increase significantly while that for patient B would remain essentially unchanged.
4. Coumarin therapy would be equally effective in treating the thrombotic condition of both patients.

52. Which of the following statements is/are true?

A A quantitative platelet defect (thrombocytopenia) with a platelet count of <20,000/microL will usually result in spontaneous bleeding.
B In classic hemophilia, both the immunological and functional levels of Factor VIII are low.
C Severe enlargement of the spleen could be associated with a prolonged bleeding time.
D An insoluble, polymerized mass of fibrin cannot form in Factor XIII deficient plasma.

53. In contrast to arterial thrombosis, venous thrombosis:

A Is a frequent occurrence in bedridden patients.
B Is accompanied by an increased fibrinogen consumption.
C Is aggravated by any condition which causes static blood flow.
D Is not amenable to antiplatelet treatment.
54. Which of the following tend to limit intravascular coagulation?
   1. Fibrinogen degradation products (FDP).
   3. Plasma protease inhibitors.

55. A person with a persistent and long standing (2-3 years) bleeding problem had a normal partial thromboplastin time and a platelet count of 275,000 per microL. Which of the following diagnoses could be correct?
   1. Hypofibrinogenemia.
   2. A chronic deficiency of Vitamin K.
   3. Factor VIII deficiency (Hemophilia).
   4. A qualitative platelet defect.

56. Which of the following substances or combination of substances would produce an insoluble fibrin clot when added to a test tube containing optimal concentrations of Factors X, V, Ca++, prothrombin, and fibrinogen?
   1. Thrombin + Factor XIII.
   2. Thrombin + phospholipid.
   3. Factor VIII + activated Factor IXa + phospholipid.
   4. Phospholipid.

57. Two patients (A and B) with ongoing thrombosis had the following turnover (T) profiles and platelet counts:

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tf (fibrinogen)</td>
<td>0.40 mg/ml/day</td>
<td>2.0 mg/ml/day</td>
</tr>
<tr>
<td>Tp (platelet)</td>
<td>1.2 x 10^5 platelets/microL/day</td>
<td>6 x 10^4 platelets/microL/day</td>
</tr>
<tr>
<td>platelet count</td>
<td>240,000 platelets/microL</td>
<td>240,000 platelets/microL</td>
</tr>
</tbody>
</table>

Which of the following statements is/are true?
   1. Patient A most likely had venous thrombosis while patient B most likely had arterial thrombosis.
   2. Assuming that a normal fibrinogen concentration is 200 mg%, the mean fibrinogen survival time of patient A is 5 days while that for patient B is 1 day.
   3. The mean platelet survival time of patient A is greater than that for patient B.
   4. Following heparin therapy, the fibrinogen turnover rate for patient B would most likely decrease while that for patient A would remain essentially unchanged.

58. A patient with a bleeding disorder had a normal platelet count, normal thrombin time, and normal prothrombin time. Which of the following causes is (are) possible?
   1. von Willebrand's disease.
   2. Classic Hemophilia.
   3. Factor XIII defect.
   4. The patient ingested an overdose of a Vitamin K antagonist 3-4 days previously.

59. A person has the following laboratory values:
   - Platelet count = 250,000 platelets/microL
   - Mean platelet survival time = 10 days
   - Fibrinogen turnover = 0.4 mg/ml/day
   - Plasma fibrinogen level = 2.0 mg/ml

Which of the following is (are) true?
   1. The bleeding time would be significantly prolonged.
   2. The person most likely has ongoing venous thrombosis.
   3. The fibrinogen survival time is 50 days.
   4. The platelet turnover = 2.5 x 10^4 platelets/microL per day.

60. Which of the following statements is (are) true?
   1. Fibrinolysis is triggered by the conversion of plasminogen to plasmin by plasminogen activator.
   2. Activated protein C tends to limit the coagulation process by virtue of its ability to irreversibly inactivate thrombin.
   3. An antithrombin defect would favor the development of thrombosis.
   4. Activated coagulation factors are not significantly metabolized during passage through the liver.

61. A patient with a bleeding disorder has a normal platelet count and a prolonged thrombin time. Based only on these tests, which of the following single factor defects could possibly be correct?
   1. Classic hemophilia.
   2. Factor VII defect.
   3. Factor X defect.
   4. Abnormal fibrinogen molecule.
62. Which of the following statements is/are true?
1. Platelets are produced from megakaryocytes in the bone marrow, are anuclear and have a half life of about 9-10 days.
2. The hepatic synthesis of normal molecules of coagulation factors I (fibrinogen), II (prothrombin), VII, IX, and X are dependent on Vitamin K.
3. Concomitant with blood coagulation, activation of the fibrinolytic, complement, and inflammatory pathways is most likely tied into the contact activation of Factor XII.
4. Vitamin K is a fat soluble vitamin that covalently links Ca^{++} into fibrinogen and thereby stabilizes the fibrin molecule when it is formed.

63. In the process of platelet adhesion to subendothelial tissue after vascular injury,
1. The presence of a plasma cofactor protein, termed von Willebrand Factor (vWF), is required.
2. The presence of a platelet membrane receptor protein (GP1b) for vWF is required.
3. vWF, synthesized by endothelial cells, is absorbed by circulating platelets and by exposed subendothelial tissue.
4. ADP is released from the dense granules of the platelets in contact with collagen.

64. deleted

65. A person has the following laboratory values:
   Plasma fibrinogen level = 2.0 mg/ml
   Platelet count = 200,000 platelets/microL
   Fibrinogen survival time = 1.33 days
   Platelet turnover = 8 x 10^4 platelets/microL/day
Which of the following is/are true?
1. Fibrinogen turnover is about 1.5 mg/ml/day.
2. The person most likely has ongoing venous thrombosis and would therefore benefit from anticoagulant therapy.
3. Platelet survival time is about 2.5 days.
4. Although the fibrinogen level and platelet count are low to borderline normal, both fibrinogen and platelet turnover are markedly increased as compared to normal.

ANSWER KEY  HEMOSTASIS AND BLOOD COAGULATION