

Atherosclerosis-Thrombosis (Questions 1 - 52)

Question 1

A 56-year-old has not received any medical care nor seen a physician for years. He reports reduced exercise tolerance over the past 5 years. On occasion in the past year he has noted chest pain after ascending a flight of stairs. He smokes 2 packs of cigarettes per day. He is found to have a blood pressure of 155/95 mm Hg. His body mass index is 30. Laboratory findings include a total serum cholesterol of 245 mg/dL with an HDL cholesterol that is 22 mg/dL. Which of the following vascular abnormalities is most likely to be his most serious health risk?

- A Hyperplastic arteriolosclerosis
- B Lymphedema
- C Medial calcific sclerosis
- D **Atherosclerosis**
- E Deep venous thrombosis
- F Plexiform arteriopathy

(D) CORRECT. He has multiple risk factors for atherosclerosis, including his weight, smoking, hypertension, and high total cholesterol with low 'good' HDL cholesterol. His findings suggest coronary artery disease.

Question 2

A 55-year-old previously healthy woman is hospitalized for pneumonia. On the 10th hospital day she is found to have swelling and tenderness of her right leg, which apparently has developed over the past 48 hours. Raising the leg elicits pain. An ultrasound examination reveals findings suggestive of femoral vein thrombosis. Which of the following conditions is most likely to have contributed the most to the appearance of these findings?

- A Trousseau syndrome
- B Protein C deficiency
- C **Prolonged immobilization**
- D Pregnancy
- E Chronic alcoholism
- F Hypertension

(C) CORRECT. The immobilization would predispose to thrombosis of leg veins. This is the most common cause for deep venous thrombosis.

Question 3

A 63-year-old man has had insulin dependent diabetes mellitus for over two decades. The degree of control of his disease is characterized by the laboratory finding of a hemoglobin A1C of 10.1%. He has noted episodes of abdominal pain following meals. These episodes have worsened over the past year. On physical examination, there are no masses and no organomegaly of the abdomen, and he has no

tenderness to palpation. Which of the following pathologic findings is most likely to be present in this man?

- A Ruptured aortic aneurysm
- B Hepatic infarction
- C **Mesenteric artery occlusion**
- D Acute pancreatitis
- E Chronic renal failure

(C) CORRECT. He has 'abdominal angina' from diminished blood flow to the bowel as a consequence of severe atherosclerosis. Persons with diabetes mellitus may have this finding, because all branches of major arteries to the bowel are affected by atherosclerosis.

Question 4

A 62-year-old man has experienced substernal chest pain upon exertion with increasing frequency over the past 6 months. An electrocardiogram shows features consistent with ischemic heart disease. He has a total serum cholesterol of 262 mg/dL. By angiography, there is 75% narrowing of the left anterior descending artery. Which of the following vascular complications is most likely to occur in this patient?

- A A systemic artery embolus from thrombosis in a peripheral vein.
- B A systemic artery embolus from a left atrial mural thrombus.
- C Pulmonary embolism from a left ventricular mural thrombus.
- D A systemic artery embolus from a left ventricular mural thrombus.
- E Pulmonary embolism from thrombosis in a peripheral vein.

(D) CORRECT. Left ventricular mural thrombi are prone to embolize to the systemic arterial circulation. Such mural thrombi are likely to result from damage to the left ventricle from ischemic heart disease, either acutely with an underlying myocardial infarction, or with a left ventricular aneurysm formed following resolution of a large myocardial infarction.

Question 5

On sectioning of an organ from a 60-year-old man at the time of autopsy, a focal, wedge-shaped area that is firm is accompanied by extensive hemorrhage, giving it a red appearance. The lesion has a base on the surface of the organ. In which of the following situations will this lesion most likely occur?

- A Lung with pulmonary thromboembolism
- B Heart with coronary thrombosis
- C Liver with hypovolemic shock
- D Kidney with septic embolus
- E Spleen with embolized mural thrombus
- F Brain with cerebral arterial aneurysm

(A) CORRECT. The bronchial arterial supply to the lung does not provide enough oxygenation to prevent infarction, but does provide blood to make the infarct hemorrhagic.

Question 6

A 44-year-old woman has a family history of heart disease. Her father and mother both developed congestive heart failure and myocardial infarction as a result of extensive coronary atherosclerosis. A dietary modification to include consumption of which of the following is most likely to reduce her risk for ischemic heart disease?

- A 40% of total caloric intake as fat
- B A diet high in saturated fat
- C Foods with cholesterol
- D Fish oil
- E Fat found in beef products
- F Trans-fats

(D) CORRECT. Fish oils diminish arachidonic acid metabolites and reduce platelet aggregation.

Question 7

An 81-year-old woman has the sudden onset of dyspnea and palpitations with chest pain. A pulmonary ventilation-perfusion scan is performed and indicates a high probability for a perfusion defect involving right segmental pulmonary arterial branch. Of the following findings or conditions, which is the most important factor favoring development of these findings?

- A An increased white blood cell count
- B Cirrhosis of the liver
- C Altered blood flow with stasis
- D An increased platelet count
- E Generalized atherosclerosis

(C) CORRECT. She has a pulmonary thromboembolus. Stasis predisposes to thrombosis, as is evidenced by the danger for thromboembolism in hospitalized patients.

Question 8

A 66-year-old woman has the sudden loss of movement on part of the left side of her body. She has smoked a pack of cigarettes a day for the past 45 years. She has vital signs including T 37.1 C, P 80/minute, RR 16/minute, and BP 160/100 mm Hg. A cerebral angiogram reveals occlusion of a branch of her middle cerebral artery. Laboratory findings include a hemoglobin A1C of 9%. Which of the following components of blood lipids is most important in contributing to her disease?

- A Chylomicrons
- B Lipoprotein lipase
- C Oxidized LDL
- D VLDL
- E HDL cholesterol

(C) CORRECT. She has had a 'stroke' which is most often a consequence of cerebral atherosclerosis or embolic disease from the heart as a consequence of ischemic heart disease from atherosclerosis. LDL brings cholesterol to arterial walls, and when increased LDL is present or when there is hypertension, smoking, and diabetes, there is more degradation of LDL to oxidized LDL which is taken up into arterial walls via scavenger receptors in macrophages to help form atheromas.

Question 9

An autopsy study reveals that evidence for atheroma formation can begin even in children. The gross appearances of the aortas are recorded and compared with microscopic findings of atheroma formation. Which of the following is most likely to be the first visible gross evidence for the formation of an atheroma?

- A Thrombus
- B Fatty streak
- C Calcification
- D Hemorrhage
- E Exudate
- F Ulceration

(B) CORRECT. This is the first sign. It is benign and reversible, but it may be the precursor to more severe plaques.

Question 10

A 63-year-old man has had increasing exercise intolerance for the past 5 years so that he now becomes short of breath upon climbing a single flight of stairs. Laboratory studies have shown fasting blood glucose measurements from 145 to 210 mg/dL for the past 25 years, but he has not sought medical treatment. If he dies suddenly, which of the following is most likely to be the immediate cause of death?

- A Myocardial infarction
- B Nodular glomerulosclerosis
- C Cerebral hemorrhage
- D Hyperosmolar coma
- E Right lower leg gangrene

(A) CORRECT. This is the most common cause of death in persons with diabetes mellitus, because of the high prevalence of coronary atherosclerosis.

Question 11

A 45-year-old man dies suddenly and unexpectedly. The immediate cause of death is found to be a hemorrhage in the right basal ganglia region. On microscopic examination his renal artery branches have concentric endothelial cell proliferation which markedly narrows the lumen, resulting in focal ischemia and hemorrhage of the renal parenchyma. An elevation in which of the following substances in his blood is most likely to be associated with these findings?

- A Ammonia
- B Calcium

- C Cholesterol
- D Renin
- E Troponin I
- F Triglyceride
- G C-reactive protein

(D) CORRECT. The findings suggest hyperplastic arteriolosclerosis, which accompanies malignant hypertension.

Question 12

A 10-year-old previously healthy child has been noted by her parents to be constantly thirsty. She is consuming large amounts of soft drinks. She is urinating often. Her diet and exercise patterns have not changed, except for an increased appetite, yet she appears cachectic and has lost 7 kg over the past 4 months. On physical examination there are no abnormal findings, other than peripheral muscle wasting and weakness. Which of the following laboratory findings would you most strongly suspect is present in this girl?

- A Increased blood insulin
- B Decreased blood glucagon
- C Ketonuria
- D Markedly increased serum osmolality
- E Decreased plasma hydrogen ion (alkalosis)
- F Decreased plasma cortisol

(B) CORRECT. Ketonuria is typical for type I diabetes mellitus.

Question 13

A 73-year-old woman who exercises regularly falls down the stairs and injures her right hip. A radiograph is taken of the pelvis. There is no fracture but the radiograph reveals calcification of the small muscular arteries lateral to her uterus. What is the probable vascular lesion which accounts for this calcification?

- A Ulcerative atherosclerosis
- B Calcific medial sclerosis
- C Metastatic calcification
- D Trauma
- E Dystrophic calcification

(B) CORRECT. Monckeberg calcific medial sclerosis is a benign, incidental finding most often seen in the elderly. Small arteries in pelvis and extremities are typically involved. The vascular lumen is not compromised.

Question 14

A 55-year-old woman has been treated in the hospital for pancreatitis for the past three weeks. She is examined one morning on rounds and found to have a swollen right leg. It is tender to palpation

posteriorly but is not warm. This condition is most likely to be the result of which of the following vascular complications?

- A Venous thrombosis
- B Septic embolization
- C Congestive heart failure
- D Cellulitis
- E Infarction

(A) CORRECT. The signs point to thrombophlebitis.

Question 15

A 29-year-old woman is involved in a motor vehicle accident that results in severe lacerations to her lower extremities, along with blunt abdominal trauma. In the emergency room she is noted to have cool, pallid skin. She has vital signs showing T 36.9 C, P 103/minute, RR 18/minute, and BP 70/30 mm Hg. She has decreased urine output. Which of the following laboratory findings on a blood sample from this patient is most likely to be present?

- A Hematocrit of 54%
- B Glucose of 181 mg/dL
- C PaO₂ of 20 mm Hg
- D **Lactic acid of 4.8 mmol/L**
- E Troponin I of 4 ng/mL

(D) CORRECT. She has marked blood loss with shock. There will be vasoconstriction in skin in response to the hypovolemia. Decreased renal blood flow from shock can lead to acute tubular necrosis. The lack of tissue perfusion with shock leads to increased anaerobic glycolysis and lactic acidosis.

Question 16

A 61-year-old man has the sudden onset of severe chest pain. Vital signs include T 37 C, P 101/minute, RR 20/minute, and BP 80/40 mm Hg. An electrocardiogram demonstrates changes that are consistent with myocardial ischemia involving the left lateral ventricular free wall. He is given thrombolytic therapy with tissue plasminogen activator (tPA). However his serum creatinine kinase is found to be 450 U/L 3 hours after this therapy. Which of the following cellular events has most likely occurred?

- A Cellular regeneration
- B Drug-induced necrosis
- C **Reperfusion injury**
- D Increased synthesis of creatine kinase
- E Myofiber atrophy

(C) CORRECT. The restoration of blood flow is helpful if the existing cell damage is not great, so further damage can be prevented. However, the reperfusion of damaged cells results in generation of oxygen free radicals to produce a reperfusion injury.

Question 17

A 52-year-old woman has experienced marked substernal, crushing chest pain for the past 6 hours. Her vital signs show T 36.9 C, P 80/minute, RR 16/minute, and BP 100/60 mm Hg. Laboratory studies include a serum creatine kinase MB fraction of 10 microgm/L as well as a serum troponin I of 4.5 ng/mL. Which of the following findings is the best evidence for the presence of a coronary arterial thrombus as the etiology for her chest pain?

- A Total serum cholesterol of 300 mg/dL
- B Large size of the infarction by scintigraphic scanning
- C 80% coronary occlusion by angiography
- D Response to thrombolytic therapy**
- E Hemoglobin A1C of 10.1%

(D) CORRECT. The purpose of thrombolytic therapy is to lyse the thrombus and restore blood flow.

Question 18

In an experiment, a glass bead is embolized to a branch of the renal artery. A day later there is a focal area in which the renal parenchymal cells in the distribution of the occluded artery show karyolysis and karyorrhexis. The outlines of the cells are still visible, but the nuclei have lost basophilic staining and the cytoplasm is eosinophilic but pale. Which of the following types of cellular necrosis is most likely present?

- A Caseous
- B Coagulative**
- C Fatty
- D Gangrenous
- E Liquefactive

(B) CORRECT. A typical ischemic infarction with coagulative necrosis is described.

Question 19

A 52-year-old man has the sudden onset of chest pain. He is found to have a serum troponin I of 5 ng/mL. A year later he has reduced exercise tolerance. An echocardiogram reveals an akinetic segment of left ventricle, and he has reduced cardiac output, with an ejection fraction of 25%. He then experiences a transient ischemic attack (TIA). His serum troponin I is now <0.5 ng/mL. Thrombus formation involving which of the following locations is most likely to have put him at greatest risk for the TIA?

- A Cerebral vein
- B Vertebral artery
- C Superior vena cava
- D Left ventricle**
- E Coronary artery
- F Saphenous vein

(D) CORRECT. Mural thrombi can form over the damaged area of ventricular wall following myocardial infarction. Portions of the mural thrombus can break off and embolize via the systemic arterial circulation to places such as the cerebral circulation.

Question 20

A 25-year-old previously healthy primigravida is in the first trimester of pregnancy. During two successive prenatal visits, she has fasting serum glucose levels of 127 and 131 mg/dL. Prior to this pregnancy, her fasting serum glucose was 80 mg/dL. A hemoglobin A1C level is 8.1% at the last visit, at 18 weeks gestation. She feels well and has no major health problems. Which of the following problems is most likely to become apparent in the latter part of her pregnancy?

- A Intrauterine fetal growth retardation
- B Ketoacidosis
- C Hyperosmolar coma
- D Congenital anomalies
- E **Placental insufficiency**

(E) CORRECT. The big problem in gestational diabetes is eventual placental malfunction in later pregnancy (third trimester) with potential fetal demise.

Question 21

A 54-year-old man with diabetes mellitus has had 3 urinary tract infections during the past year. He now sees the physician for an ulceration on his right big toe which has not healed in 2 months. Laboratory studies on each of his doctor visits over the past year show blood glucose levels below 110 mg/dl. This situation could be best explained by which of the following laboratory findings?

- A **Elevated hemoglobin A1C level**
- B Increased urine ketones
- C Elevated serum osmolarity
- D Decreased plasma insulin
- E Elevated titer of anti-insulin antibodies

(A) CORRECT. Out-of-control diabetes over time can be better detected because the glycosylated RBCs will persist for months and the Hgb A1C increased.

Question 22

A 25-year-old man experiences chest pain on exercise when he attempts to climb three flights of stairs. This pain is relieved by sublingual nitroglycerin. He is 178 cm tall and weighs 101 kg. Laboratory studies show a total serum cholesterol of 550 mg/dL with an HDL cholesterol component of 25 mg/dL. He is worried about these findings because his brother died of a myocardial infarction at age 34. Which of the following conditions is this man most likely to have?

- A Diabetes mellitus, type II
- B Malignant hypertension
- C **Familial hypercholesterolemia**

D Cushing syndrome

E Morbid obesity

(C) CORRECT. The very high cholesterol with symptoms of coronary artery disease at such a young age, coupled with the family history, are all consistent with familial hypercholesterolemia. In most persons with hypercholesterolemia from multifactorial causes, including diet and exercise patterns, the cholesterol rarely exceeds 400 mg/dL.

Question 23

In a clinical study of patients with diabetes mellitus, a group of patients is found who had blood glucose measurements ranging from 140 to 180 mg/dL for at least 10 years. Rectal biopsies from these patients now show that there is a form of osmotic cellular injury present in arterioles. This form of injury is most likely to be manifested by which of the following complications?

A Cerebral infarction

B Colonic adenocarcinoma

C **Congestive heart failure**

D Impotence

E Pyelonephritis

(C) Incorrect. However, the major damage to the heart with diabetes mellitus is done via atherosclerotic coronary artery disease. Atherosclerosis affects muscular arteries by formation of intimal atheromatous plaques which occlude the lumen and lead to ischemic injury.

Question 24

A 49-year-old woman has experienced marked pain in her lower extremities on ambulation more than 300 meters for the past 5 months. On physical examination, her lower extremities are cool and pale, without swelling or erythema. No dorsalis pedis or posterior tibial pulses are palpable. Her body mass index is 32. She is a smoker. Which of the following abnormalities of the vasculature is most likely to account for these findings?

A Lymphatic obstruction

B Arteriolosclerosis

C **Atherosclerosis**

D Medial calcific sclerosis

E Venous thrombosis

(C) CORRECT. She has claudication from severe peripheral arterial atherosclerosis, most likely from the iliac arteries down. She has risk factors for atherosclerosis.

Question 25

An autopsy study is conducted involving the gross appearance of the aorta of adults ranging in age from 60 to 90. In some of these patients, the aorta demonstrates atheromatous plaques covering from 70 to 95% of the intimal surface area, mainly in the abdominal portion, with ulceration and calcification.

Which of the following contributing causes of death are these patients most likely to have?

A Hyperparathyroidism

B **Hypertension**

- C Marfan syndrome
- D Thrombophlebitis
- E Vasculitis
- F Colonic adenocarcinoma
- G Systemic lupus erythematosus

(B) CORRECT. Hypertension is a risk factor that accelerates atheromatous plaque formation.

Question 26

A 59-year-old woman has the sudden onset of severe dyspnea and goes into cardiac arrest, from which she cannot be resuscitated. At autopsy, she has the gross finding of a saddle pulmonary embolus. This event is most likely to be present as a consequence of which of the following?

- A **Placement of a hip prosthesis**
- B Marked thrombocytopenia
- C Chronic alcoholism
- D Infection with the human immunodeficiency virus
- E An autoimmune disease

(A) CORRECT. Immobilization is a major risk for the development of venous thrombosis and subsequent pulmonary embolization.

Question 27

At autopsy, the kidneys of a 44-year-old woman who died suddenly are found to be of normal size. Their surfaces appear finely granular. There are small hemorrhages noted. The cortices appear pale. Microscopically, many small renal arteries and arterioles demonstrate concentric intimal thickening with marked luminal narrowing. These findings are most likely to be present as a result of which of the following underlying diseases?

- A Amyloidosis
- B Systemic lupus erythematosus
- C **Scleroderma**
- D Rheumatoid arthritis
- E Viral hepatitis
- F Diabetes mellitus

(C) CORRECT. Hyperplastic arteriolosclerosis is typically seen with severe hypertension, which can occur with progressive systemic sclerosis (scleroderma).

Question 28

A 35-year-old previously healthy woman notes that she has bruises form on her arms and legs with just minor trauma. Physical examination reveals areas of purpura from 1 to 3 cm in size over her trunk and extremities, but no swelling, warmth, or erythema. Peripheral pulses are all palpable and full. Her blood pressure is 110/70 mm Hg. An ultrasound examination of her lower extremities with Doppler flow measurement reveals no evidence for thrombosis. Laboratory findings include serum urea nitrogen of 20 mg/dL, LDH 300 U/L, total protein 6.9 g/dL, albumin 5.3 g/dL, alkaline phosphatase 50 U/L, AST 40

U/L, and ALT 20 U/L. Which of the following additional laboratory findings is most likely to be present in this patient?

- A Hyperglycemia
- B Hypercholesterolemia
- C Lactic acidosis
- D Thrombocytopenia**
- E Hypoprothrombinemia
- F Anemia

(D) CORRECT. The platelets are responsible for dealing with small leaks in vessels. Thrombocytopenia is marked by petechiae and purpura. She does not have evidence for peripheral vascular disease, since her circulation is good. Venous thrombosis should lead to swelling and tenderness.

Question 29

Grandma falls down the steps leading to the entrance of the house of a relative hosting a family reunion, who is heard to remark, "I've been meaning to get that loose step fixed." Grandma is hospitalized for surgery to replace the broken hip she sustains and is then moved to a nursing home, but she is unable to ambulate until about a month later, when she dies suddenly. Which of the following is most likely to be the immediate cause of death found at autopsy?

- A Squamous cell carcinoma of lung
- B Tuberculosis
- C Pulmonary embolism**
- D Pneumonia with pneumococcus
- E Congestive heart failure

(C) CORRECT. Immobilization following fracture, particularly in the elderly, is a significant risk for development of deep venous thrombosis, followed by pulmonary embolism.

Question 30

A 53-year-old woman is found on a routine physical examination to have vital signs with T 36.9 C, P 77/minute, R 15/minute, and BP 165/110 mm Hg. There are no other significant findings. She has an abdominal ultrasound examination that shows the right kidney to be atrophic. Angiography reveals markedly reduced blood flow to the right renal artery from an occlusion at the orifice in the abdominal aorta. Which of the following laboratory findings is she most likely to have?

- A Serum sodium of 161 mmol/L
- B Serologic evidence of anti-cardiolipin antibody
- C Prothrombin time of 25 seconds
- D Plasma renin activity of 4.8 ng/mL/hr supine**
- E Serum lactic acid of 5.5 mmol/L

(D) CORRECT. She has renal artery stenosis that is reducing renal blood flow on the right and stimulating the JG cells to secrete renin to try and raise blood pressure to increase renal blood flow.

Question 31

A study of pathologic findings in the islets of Langerhans is performed. It is observed that insulinitis may occur in the islets. The inflammatory infiltrate is predominantly composed of T lymphocytes. Which of the following is most likely to occur as a consequence of insulinitis?

- A Neoplasia
- B Malabsorption
- C **Ketoacidosis**
- D Obesity
- E Sepsis

(C) CORRECT. An insulinitis is seen with type I diabetes mellitus. Actually, it is rare to see it because by the time the patients present with overt diabetes mellitus, the islets are long gone.

Question 32

A 20-year-old man incurs blunt trauma to his upper outer arm. On physical examination, there is a 2 x 3 cm contusion. The initial soft tissue bleeding stops in a few minutes and the size of the bruise does not increase. Which of the following chemical mediators is most important in this episode of hemostasis?

- A Leukotriene
- B Prostaglandin
- C Prostacyclin
- D Plasminogen
- E **Thromboxane**

(E) CORRECT. Thromboxane is released by platelets to promote formation of a stable 'secondary plug' to achieve hemostasis.

Question 33

A 45-year-old man feels some crushing chest pain along with numbness in his left arm after shoveling 15 cm of snow off his driveway. Three hours later he collapses and is taken to the emergency room. Which of the following laboratory tests run on a blood specimen is most useful in this situation?

- A Total white blood cell count
- B Glucose
- C Platelet count
- D **Creatine kinase**
- E Amylase

(D) CORRECT. Elevations in CK enzymes are going to be seen acutely with myocardial infarction beginning within hours and remaining for days.

Question 34

A 68-year-old woman has survived multiple episodes of pulmonary thromboembolism during the past three months. Which of the following is the most likely underlying condition leading to this patient's recurrent pulmonary thromboembolism?

- A Micronodular cirrhosis of the liver
- B **Adenocarcinoma of the pancreas**
- C Thrombocytopenia

- D Familial hypercholesterolemia
- E Mitral valve endocarditis
- F Type II diabetes mellitus

(B) CORRECT. The recurrent episodes suggest a hypercoagulable state, and carcinomas can do this (Trousseau syndrome).

Question 35

A 77-year-old woman has experienced abdominal pain for the past month. On physical examination, she has a pulsatile lower abdominal mass. An abdominal CT scan reveals an abdominal aorta dilated to 7 cm in diameter, with calcification of the aortic wall. While awaiting surgery, she has an episode of severe abdominal pain and a repeat CT scan shows marked retroperitoneal hemorrhage. Which of the following laboratory test findings is she most likely to have?

- A Factor V Leiden mutation
- B Factor VIII deficiency
- C Increased carcinoembryonic antigen
- D **Homocystinemia**
- E Increased HDL cholesterol

(D) CORRECT. An elevated plasma homocysteine is a risk for atherosclerosis as well as thrombosis. Her findings point to an abdominal aortic aneurysm which ruptured. Such aneurysms are invariably the result of atherosclerosis.

Question 36

A 70-year-old man has noted coldness and numbness of his lower left leg, increasing over the past 4 months. He also experiences pain in this extremity when he tries walking more than the distance of half a city block. On physical examination, his dorsalis pedis, posterior tibial, and popliteal artery pulses are not palpable. Which of the following laboratory test findings is he most likely to have?

- A Protein S deficiency
- B Blood culture with *Staphylococcus aureus*
- C Decreased arterial oxygen saturation
- D **Hyperglycemia**
- E Hypercalcemia

(D) CORRECT. This is peripheral arterial vascular disease from severe atherosclerosis, which is promoted by diabetes mellitus. The absence of pulses defines this as an arterial process, as does the claudication (pain with exercise). Thrombophlebitis is a venous process and leads to swelling and pain in the leg, but not loss of pulses..

Question 37

A 72-year-old man suffered a myocardial infarction involving half the left ventricular free wall 3 months ago. He now has increasing dyspnea and orthopnea. On echocardiography his ejection fraction is 29%. On examination he has poor capillary filling in hands and feet. A chest x-ray shows pulmonary edema.

Which of the following laboratory test analytes is most likely to be increased in this man at this point in time?

- A Sodium
- B Creatine kinase
- C **Lactic acid**
- D Hematocrit
- E Sedimentation rate

(C) CORRECT. Under conditions of poor tissue perfusion, there will be more anaerobic glycolysis and more acidosis. The blood lactate rises in this condition.

Question 38

A 44-year-old African-American man has had elevated blood pressure for years which has not been treated. He now has severe headaches. On physical examination his blood pressure is 275/150 mm Hg. Laboratory studies show Hgb 13.8 g/dL, serum glucose 76 mg/dL, and creatinine 3.5 mg/dL. These findings are most likely to be associated with which of the following pathologic lesions involving his kidneys?

- A **Hyperplastic arteriolosclerosis**
- B Hyaline arteriolosclerosis
- C Monckeberg medial calcific sclerosis
- D Atherosclerosis
- E Thrombophlebitis

(A) CORRECT. Hyperplastic arteriolosclerosis is seen in the setting of malignant hypertension, and renal failure is common.

Question 39

A 60-year-old woman has become increasingly obtunded over the past day. She was found by her daughter in a stuporous condition and brought to the emergency department. On physical examination, she has poor skin turgor. She is afebrile. Her vital signs reveal a blood pressure of 90/40 mm Hg, respirations 15 and shallow, pulse 95, and temperature 36 C. Laboratory studies show a hemoglobin A1C of 10%. Her serum electrolytes show sodium 144 mmol/L, potassium 5 mmol/L, chloride 95 mmol/L, CO₂ 22 mmol/L, and glucose 940 mg/dL. Which of the following is the most likely diagnosis?

- A Insulin overdose
- B **Hyperosmolar coma**
- C Hyperlipidemia
- D Ketoacidosis
- E Overeating

(B) CORRECT. This is an extremely elevated serum glucose that would increase the serum osmolality markedly.

Question 40

A study is performed involving persons who have a history of diabetes mellitus type 1 or type 2. These patients are found to have cellular injury that results from glycosylation end products and from sorbitol

accumulation within cells. The same patients are also shown to have ischemic tissue damage from accelerated and advanced atherosclerosis. Which of the following complications is most likely to result from atherosclerosis in these patients?

- A Chronic renal failure
- B Impotence
- C **Stroke**
- D Cataracts
- E Retinopathy

(C) CORRECT. Stroke from cerebral atherosclerosis or from embolization of mural thrombi from a heart involved with ischemic injury as a consequence of atherosclerosis....

Question 41

A 30-year-old man goes to his physician for a routine health checkup. On physical examination there are no abnormal findings. Laboratory test findings include serum glucose 80 mg/dL, hemoglobin A1C 4%, total cholesterol 240 mg/dL, LDL cholesterol 180 mg/dL, and HDL cholesterol 20 mg/dL. Through which of the following mechanisms is endothelial vascular injury in this patient most likely to occur?

- A Accumulation of sorbitol
- B **Insudation of lipid in foam cells**
- C Inflammation with neutrophils
- D Genetic mutation
- E Activation of complement

(B) CORRECT. He has hypercholesterolemia with more of the 'bad' LDL cholesterol that can become oxidized and taken up by modified arterial wall LDL receptors. The lipid collects in macrophages and becomes a lipid lesion--the precursor to more serious atheromatous plaques.

Question 42

A 65-year-old man has had increasing lower leg swelling along with reduced exercise tolerance for the past 5 years. He sometimes has chest pain on exertion. He has not experienced dyspnea. He has experienced 4 episodes of transient ischemic attacks in the past year. He has experienced abdominal pain in the past 2 months. Vital signs show T 36.9 C, P 82/min, RR 15/min, and BP 130/85 mm Hg. He has pitting edema to the knees bilaterally. The lower extremities have palpable pulses, no tenderness, and no erythema. An abdominal CT scan shows dilation of the abdominal aorta to 5 cm, filled with mural thrombus. Other family members have had similar problems. Which of the following underlying conditions is most likely to produce these findings:

- A Factor V Leiden mutation
- B Adenocarcinoma of the colon
- C Multiple blunt trauma
- D Vasculitis
- E **Diabetes mellitus**

(E) CORRECT. He has findings associated with atherosclerosis, including coronary and aortic disease at least, with congestive heart failure and evidence for an aortic aneurysm. Diabetes mellitus causes advanced atherosclerosis. There is a genetic component, with a family history often present, particularly for type II diabetes mellitus.

Question 43

A 45-year-old woman who has been bedridden for several weeks has the onset of left sided chest pain along with dyspnea. She has some tenderness in her left leg, which has a slightly greater circumference in the thigh than the right. A ventilation/perfusion scan shows evidence for a left lower lobe perfusion defect. Which of the following vascular diseases is most likely to cause these findings:

- A Hyaline arteriolosclerosis
- B Monckeberg's medial calcific sclerosis
- C Complex calcified coronary atherosclerosis
- D Arterial mural thrombosis
- E **Phlebothrombosis**

(E) CORRECT. A pulmonary infarction is due to a thromboembolus that arose in a vein (usually legs or pelvic region) and travelled to the lungs. Immobilization with vascular stasis predisposes to phlebothrombosis to form thrombi that can then dislodge and become thromboemboli.

Question 44

A 27-year-old woman had a hemoglobin A1C of 7.9% noted during a prenatal visit. She gives birth to a 4350 gm baby at 37 weeks gestation. Just after the delivery, the baby becomes irritable and displays seizure activity. Which of the following laboratory findings is most likely to be found in the baby:

- A Decreased hemoglobin A1C
- B Markedly increased serum osmolality
- C Inflammation of islets of Langerhans
- D **Blood glucose of 20 mg/dl**
- E Ketoacidosis

Question 45

Which of the following chemical components of the blood is mainly responsible for transporting exogenous (dietary) triglyceride from the intestine following a meal.

- A Apoprotein (apolipoprotein)
- B **Chylomicron**
- C Lipoprotein lipase
- D Oxidized low density lipoprotein
- E High density lipoprotein

(B) CORRECT. Chylomicrons formed in intestinal epithelial cells contain apoproteins, triglyceride and cholesterol.

Question 46

Some cells demonstrate glucose uptake regardless of the plasma insulin level. In a person who has had persistent hyperglycemia for years, cellular injury can occur. Which of the following cell types is most likely to show injury from hyperglycemia:

- A Cardiac muscle cells
- B Fibroblasts
- C Steatocytes
- D Neurons**
- E Smooth muscle cells.

(D) CORRECT. Neurons do not require insulin for glucose uptake. The excess glucose diffusing into the cells is shunted into the sorbitol pathway and can lead to osmotic injury, resulting in neuropathy.

Question 47

During hospitalization, a 40-year-old woman develops thrombophlebitis. She recovers and is discharged. She returns to her job as an electrician. A couple of months later, which of the following terms would best describe the process seen in a femoral vein after recovery from her thrombophlebitis:

- A Acute inflammation
- B Rupture
- C Embolization
- D Organization**
- E Propagation

(D) CORRECT. Thrombi will organize over time, with much of the clot eventually removed and the vascular lumen restored.

Question 48

A 52-year-old man has an ulcerated area on the sole of his foot that has not healed for 2 months. He is 180 cm tall, weighs 126 kg, and has continued to gain weight gradually. He has not had any major illnesses. His blood pressure is normal. Which of the following laboratory tests performed on serum from a blood sample would be most useful in elucidating the underlying cause for his problem:

- A Antithrombin III
- B Cortisol
- C Creatine kinase
- D Glucose**
- E Carcinoembryonic antigen

(D) CORRECT. The history suggests diabetes mellitus, most likely type II, and persistent hyperglycemia would confirm the diagnosis.

Question 49

A 57-year-old man has had blood pressure measurements in the range of 160/95 to 180/110 mm Hg for many years. He has taken no medications. A renal scan reveals kidneys of normal size for age. These findings with benign nephrosclerosis are most likely to occur with which of the following vascular changes:

A Hyaline arteriolosclerosis

B Monckeberg's medial calcific sclerosis

C Complex calcified atherosclerosis

D Arterial mural thrombosis

E Hyperplastic arteriolosclerosis

(A) CORRECT. Hyaline arteriolosclerosis is a feature of long-standing hypertension and is part of benign nephrosclerosis which may go on for many years with no complications. The small arterioles are thickened.

Question 50

A 70-year-old woman with a history of type II diabetes mellitus is found comatose at her home. There are no external signs of trauma. When seen a week ago she was depressed, but in no apparent distress. She had not been ingesting much food or drinking much water for several days. Vital signs show T 35.8 C, P 85, R 16, and BP 100/65 mm Hg. Which of the following laboratory test findings is most likely to be present:

A Decreased hemoglobin A1C

B Markedly increased serum osmolality

C Lactic acidosis

D Blood glucose of 20 mg/dl

E Ketoacidosis

(B) CORRECT. There is insulin production in type II diabetes mellitus, but not enough to prevent hyperglycemia, either from abnormal secretion patterns or from peripheral resistance. When dehydration occurs, the glucose can rise significantly.

Question 51

A 20-year-old woman was diagnosed last year with pulmonary thromboembolism. In her 6th month of her first pregnancy, she delivered a stillborn baby. Laboratory testing revealed the presence of a normal prothrombin time, normal partial thromboplastin time, platelet count of 250,000/microliter, and presence of lupus anticoagulant. These findings are most characteristic for which of the following hypercoagulable states:

A Antiphospholipid syndrome

B Factor V Leiden mutation

C Paraneoplastic syndrome

D Elevated factor VIII

E Protein C deficiency

(A) CORRECT. There are circulating antibodies that bind plasma proteins with an affinity for phospholipid surfaces, and this can cause thrombosis and in women stillbirth. This syndrome is most often acquired in adulthood, either from an underlying disease or as an idiopathic condition. The two subsets of this syndrome, as defined by laboratory testing, are: lupus anticoagulant (which may or may not be seen with SLE), and anti-cardiolipin antibody.

Question 52

A 52-year-old woman has a history of urinary tract infections. Recently, one of these episodes was complicated by acute pyelonephritis involving her kidneys. She became septic, and a blood culture grew *Escherichia coli*. She developed severe hypotension. She had purpuric areas on her skin. A stool for occult blood was positive. She had a prothrombin time of 50 sec (control 12), partial thromboplastin time of 100 sec (control 25), platelet count of 20,000/microliter, and D-dimer of 4 microgm/mL. These findings are most characteristic for which of the following conditions:

- A Hemophilia A
- B Von Willebrand disease
- C **Disseminated intravascular coagulation**
- D Antiphospholipid syndrome
- E Acute fulminant hepatitis

(C) CORRECT. She has a coagulopathy in which there is consumption of coagulation factors leading to hemorrhage. Conditions such as sepsis, severe trauma, neoplasia, and obstetric complications can set off the coagulation system in a generalized fashion, resulting in DIC.

[Cellular Injury](#)

Question 1

A 48-year-old woman has a malignant lymphoma involving lymph nodes in the para-aortic region. She is treated with a chemotherapeutic agent which results in the loss of individual neoplastic cells through fragmentation of individual cell nuclei and cytoplasm. Over the next 2 months, the lymphoma decreases in size, as documented on abdominal CT scans. By which of the following mechanisms has her neoplasm primarily responded to therapy?

- A Coagulative necrosis
- B Mitochondrial poisoning
- C Phagocytosis
- D Acute inflammation
- E **Apoptosis**

(E) CORRECT. The induction of individual cell death occurs in the process of apoptosis. The drug effect is targeted primarily at neoplastic cells, not normal cells.

Question 2

A 53-year-old man has experienced severe chest pain for the past 6 hours. On physical examination he is afebrile, but has tachycardia. Laboratory studies show a serum troponin I of 10 ng/mL. A coronary angiogram is performed emergently and reveals >90% occlusion of the left anterior descending artery. In this setting, an irreversible injury to myocardial fibers will have occurred when which of the following cellular changes occurs?

- A Glycogen stores are depleted

B Cytoplasmic sodium increases

C Nuclei undergo karyorrhexis

D Intracellular pH diminishes

E Blebs form on cell membranes

(C) CORRECT. Chromatin clumping is reversible, but dissolution of the entire nucleus is not, and when the nucleus is lost, the cell will die.

Question 3

While in a home improvement center warehouse buying paint, a 35-year-old man hears "Look out below!" and is then struck on the leg by a falling pallet rack, which strikes him on his left leg in the region of his thigh. The skin is not broken. Within 2 days there is a 5 x 7 cm purple color to the site of injury. Which of the following substances has most likely accumulated at the site of injury to produce a yellow-brown color at the site of injury 16 days later?

A Lipofuscin

B Bilirubin

C Melanin

D Hemosiderin

E Glycogen

(D) CORRECT. The iron in the heme pigment from the red blood cells in the hemorrhage beneath the skin is incorporated into hemosiderin granules that impart the yellow to brown color of the healing bruise.

Question 4

A 54-year-old man with a chronic cough has a squamous cell carcinoma diagnosed in his right lung. While performing a pneumonectomy, the thoracic surgeon notes that the hilar lymph nodes are small, 0.5 to 1.0 cm in size, and jet black in color throughout. Which of the following is the most likely cause for this appearance to the hilar nodes?

A Anthracotic pigment

B Lipochrome deposits

C Melanin accumulation

D Hemosiderosis

E Metastatic carcinoma

(A) CORRECT. The black color comes from carbon pigments in dust inhaled over the years, engulfed by macrophages, and sent via lymphatics to the nodes. It looks bad but does not compromise lung function. Smokers will have more anthracosis.

Question 5

A 50-year-old woman with a history of unstable angina suffers an acute myocardial infarction.

Thrombolytic therapy with tissue plasminogen activator (tPA) is administered to restore coronary blood flow. In spite of this therapy, the degree of myocardial fiber injury may increase because of which of the following cellular abnormalities?

- A Cytoskeletal intermediate filament loss
- B Decreased intracellular pH from anaerobic glycolysis
- C **Increased free radicals**
- D Mitochondrial swelling
- E Nuclear chromatin clumping and decreased protein synthesis
- F Reduced protein synthesis

(C) CORRECT. Such toxic oxygen radicals are released from neutrophils when blood flow is restored following ischemia. This is a reperfusion injury. Overall, there is likely to be more good than harm to restoration of blood flow.

Question 6

A 12-year-old boy has had multiple episodes of ear pain accompanied by fever. On examination his right tympanic membrane is red and bulging with yellow exudate. Laboratory studies of the exudate show culture positive for *Hemophilus influenzae*. A year later he has conductive hearing loss on the right, and a head CT scan shows a mass in the right middle ear. Which of the following materials is most likely to be seen in the tissue curetted from his middle ear?

- A Lipofuscin
- B Russell bodies
- C Neutrophils
- D **Cholesterol crystals**
- E Anthracotic pigment

(D) CORRECT. The lipid from the red cell membranes is broken down and cholesterol crystals form. The boy has the complication of otitis media known as a cholesteatoma

Question 7

A 43-year-old man has complained of mild burning substernal pain following meals for the past 3 years. Upper GI endoscopy is performed and biopsies are taken of an erythematous area of the lower esophageal mucosa 3 cm above the gastroesophageal junction. There is no mass lesion, no ulceration, and no hemorrhage noted. The biopsies show the presence of columnar epithelium with goblet cells. Which of the following mucosal alterations is most likely represented by these findings?

- A Dysplasia
- B Hyperplasia
- C Carcinoma
- D Ischemia
- E **Metaplasia**

(E) CORRECT. Metaplasia is the substitution of one tissue normally found at a site for another. The esophageal epithelium undergoes metaplasia in response to the ongoing inflammation from reflux of gastric contents. This is common in the lower esophagus with gastroesophageal reflux disease (GERD).

Question 8

A 59-year-old woman had the loss of consciousness that persisted for over an hour. When she becomes arousable, she cannot speak nor move her right arm or leg. A cerebral angiogram revealed an occlusion to her left middle cerebral artery. Months later, a computed tomographic (CT) scan shows a large 5 cm

cystic area in her left parietal lobe cortex. This CT finding is most likely the consequence of resolution from which of the following cellular events?

A **Liquefactive necrosis**

B Atrophy

C Coagulative necrosis

D Caseous necrosis

E Apoptosis

(A) CORRECT. She had a 'stroke' with loss of brain tissue. The brain undergoes liquefactive necrosis with infarction. As it resolves, macrophages remove the dead cells and debris, leaving a cystic area that forms in the region of infarction.

Question 9

A 19-year-old woman gives birth to her first child. She begins breast feeding the infant. She continues breast feeding for almost a year with no difficulties and no complications. Which of the following cellular processes that began in the breast during pregnancy allowed her to nurse the infant for this period of time?

A Stromal hypertrophy

B Epithelial dysplasia

C Steatocyte atrophy

D Ductal epithelial metaplasia

E **Lobular hyperplasia**

(E) CORRECT. There is an increase in the breast lobules under hormonal influence with pregnancy to provide for lactation.

Question 10

An 80-year-old man dies from complications of Alzheimer disease. At autopsy, his heart is small (250 gm) and dark brown on sectioning. Microscopically, there is light brown perinuclear pigment with H&E staining of the cardiac muscle fibers. Which of the following substances is most likely increased in the myocardial fibers to produce this appearance of his heart?

A Hemosiderin from iron overload

B **Lipochrome from 'wear and tear'**

C Glycogen from a storage disease

D Cholesterol from atherosclerosis

E Calcium deposition following necrosis

(B) CORRECT. Lipochrome deposition is a very common finding, though ordinarily there are small amounts of it, and it has little effect upon cardiac function. The 'brown atrophy' of the heart in this case is a rare finding.

Question 11

In an experiment, a series of immunohistochemical stains are employed to identify different cellular components. One particular stain identifies the presence of intermediate filaments within cells. This cytokeratin stain is most likely to be useful for which of the following diagnostic purposes?

A Cytoskeletal alterations indicate impending cell death

B A neoplasm is determined to be a carcinoma

C Contractile properties of the cells can be assessed

D A history of chronic alcoholism can be confirmed

E The degree of metaplasia or dysplasia can be assessed

(B) CORRECT. Carcinomas are derived from epithelium and contain cytokeratins, while sarcomas derived from mesenchymal cells contain vimentin.

Question 12

A 20-year-old woman had Goodpasture syndrome which progressed to chronic renal failure. She was 165 cm tall and weighed 55 kg. She had blood pressure measurements in the range of 150/90 to 180/110 mm Hg, but she did not regularly take medications. Laboratory studies showed her blood urea nitrogen was over 100 mg/dL. She required chronic dialysis. She died from heart failure. At autopsy, her heart weighed 540 gm. The size of her heart is most likely to be the result of which of the following processes involving the myocardial fibers?

A Hypertrophy

B Fatty infiltration

C Hyperplasia

D Fatty degeneration

E Edema

(A) CORRECT. The ongoing pressure load of the systemic hypertension led to myocardial fiber hypertrophy and a heart that increased to twice normal size.

Question 13

A 29-year-old man goes on a snorkeling trip to Looe Key Marine Sanctuary and later spends time on the beach at Bahia Honda State Park. The next day he has a darker complexion. His skin does not show warmth, erythema, or tenderness. His skin tone fades to its original appearance within a month. Which of the following substances contributes the most to the biochemical process leading to these skin changes?

- A Iron oxide
- B Lipofuscin
- C Tyrosine**
- D Homogentisic acid
- E Glycogen

(C) CORRECT. The tanning process in skin is stimulated by ultraviolet light exposure. Melanocytes have the enzyme tyrosinase to oxidize tyrosine to dihydroxyphenylalanine in the pathway for melanin production.

Question 14

A study is performed to identify predisposing risks for tissue changes. In some persons epithelial metaplasia occurs. In which of the following situations is the process of epithelial metaplasia most likely to take place?

- A Tanning of the skin following sunlight exposure
- B Lactation following pregnancy
- C Vitamin A deficiency**
- D Acute myocardial infarction
- E Urinary obstruction from an enlarged prostate

(C) CORRECT. Vitamin A is necessary to maintain epithelia, and squamous metaplasia of the respiratory tract may occur if there is a deficiency. The stratified squamous epithelium does not function as well as the normal pseudostratified columnar respiratory epithelium, and there is an increased risk for respiratory infections.

Question 15

In an experiment, a disease process is found which leads to scattered loss of individual cells, with the microscopic appearance of karyorrhexis and cell fragmentation. The overall tissue structure remains intact. This process is most typical for which of the following diseases?

- A Viral hepatitis**
- B Brown atrophy of the heart
- C Renal transplant rejection
- D Chronic alcoholic liver disease

E Barbiturate overdose

(A) CORRECT. Viral infection leads to apoptosis with individual hepatocyte necrosis, either from effects of viral replication or from the body's immune response..

Question 16

A 60-year-old woman has noted a dark red-black appearance to her great toe and second and third toes of her left foot for the past month. On physical examination, the toes are cold to touch and have no sensation to touch. The dorsalis pedis and posterior tibial pulses are not palpable on the left. A transmetatarsal amputation is performed. These findings are most typical for a patient with which of the following conditions?

A **Diabetes mellitus**

B Monckeberg arteriosclerosis

C Blunt force trauma

D AIDS

E Autoimmunity

(A) CORRECT. This is gangrenous necrosis. Occlusive peripheral atherosclerotic vascular disease is typical for diabetes mellitus. Many arteries are involved, reducing collateral flow.

Question 17

A study is performed involving the microscopic analysis of tissues obtained from surgical procedures. Some of these tissues have the microscopic appearance of an increased cell size of multiple cells within the tissue, due to an increase in the amount of cytoplasm, with nuclei remaining uniform in size. Which of the following conditions is most likely to have resulted in this finding?

A **Uterine myometrium in pregnancy**

B Female breast at puberty

C Liver following partial resection

D Ovary following menopause

E Cervix with chronic inflammation

(A) CORRECT. This cellular hypertrophy with increase in cell size (not hyperplasia with increase in cell number) accounts for the marked increase in size of the uterus during pregnancy. Following pregnancy and reduction in hormonal stimulation, the uterus returns back to its normal size.

Question 18

A 17-year-old adolescent receives whole body radiation as part of a preparatory regimen for bone marrow transplantation to treat acute lymphocytic leukemia. Which of the following cells and tissues in the body is most likely to remain unaltered by the effects of this therapeutic radiation?

- A Ovarian follicles
- B Small intestinal epithelium
- C Erythropoietic cells of bone marrow
- D Spermatogonia of testicular tubules

E Neurons of cerebral cortex

(E) CORRECT. Neurons are terminally differentiated cells that do not actively divide or proliferate. However, at higher radiation doses, cerebral injury does occur from damage mainly to white matter and to the vasculature.

Question 19

A 79-year-old man has a large myocardial infarction involving much of the left ventricular free wall. He develops congestive heart failure (CHF) with decreased cardiac output. Now, a year later, his CHF is worsening. By echocardiography there is a large, bulging akinetic area typical for a left ventricular aneurysm. Which of the following laboratory tests on serum would best indicate poor peripheral tissue perfusion in this patient?

- A Elevated troponin I
- B Increased sodium
- C Elevated lactate**
- D Increased hematocrit
- E Increased sedimentation rate

(C) CORRECT. Under conditions of poor tissue perfusion, there will be more anaerobic glycolysis and more acidosis in cells throughout the body. The blood lactate rises in this condition.

Question 20

A 22-year-old woman has a congenital anemia. She has required multiple transfusions of red blood cells for many years. She now has no significant findings on physical examination. Laboratory studies now show a serum AST of 74 U/L and ALT 75 U/L with albumin 3.6 g/dL. Which of the following microscopic findings would most likely appear in a liver biopsy?

- A Steatosis in hepatocytes
- B Bilirubin in canaliculi
- C Hemosiderin in hepatocytes**
- D Glycogen in hepatocytes
- E Amyloid in portal triads

(C) CORRECT. There is 250 mg of iron in each unit of blood. The body has no mechanism for getting rid of excess iron. A small amount of iron is lost with normal desquamation of epithelia, and menstruating women will lose a bit more. The excess iron becomes storage iron, or hemosiderin. Over time, hemosiderosis involves more and more tissues of the body, particularly the liver.

Question 21

A 20-year-old man is involved in a motor vehicle accident which results in multiple blunt trauma and lacerations to his lower extremities. The left femoral artery is lacerated, and he incurs extensive blood loss and remains hypotensive for hours during transport to the emergency department. On admission, his hematocrit is 12%. Which of the following tissues is most likely to withstand the impact of these events with the least damage?

- A Skeletal muscle**
- B Small intestinal epithelium
- C Retina
- D Myocardium
- E Hippocampus

(A) CORRECT. The skeletal muscle tissue is the least metabolically active of the ones listed, and is also able to function with anaerobic glycolysis.

Question 22

A 40-year-old woman has the sudden onset of severe abdominal pain. On physical examination she has diffuse tenderness in all abdominal quadrants, with marked guarding and muscular rigidity. She has laboratory findings that include serum AST of 43 U/L, ALT of 30 U/L, LDH 630 U/L, and lipase 415 U/L. An abdominal CT scan reveals peritoneal fluid collections and decreased attenuation along with enlargement of the pancreas. Which of the following cellular changes is most likely to accompany these findings?

- A Coagulative necrosis
- B Dry gangrene
- C **Fat necrosis**
- D Apoptosis
- E Liquefactive necrosis

(C) CORRECT. The enzymes released from the pancreas with acute pancreatitis damage the surrounding fat and form soaps -- localized soft tan to yellow areas of fat necrosis. The damaged pancreatic exocrine cells release lipase and amylase as markers for their injury.

Question 23

A 26-year-old man died from complications of destruction of the aortic valve by large, irregular vegetations from which *Staphylococcus aureus* was cultured. At autopsy, the spleen on sectioning grossly reveals the presence of a tan to white, wedge-shaped 1.5 x 3 cm lesion with base on the capsule. The splenic findings are most likely to result from which of the following cellular abnormalities?

- A **Coagulative necrosis**
- B Abscess formation
- C Metaplasia
- D Caseous necrosis
- E Liquefactive necrosis

(A) CORRECT. The description is that of a typical infarct with vascular occlusion following embolization from vegetations of infective endocarditis.

Question 24

A 35-year-old woman developed increasing icterus over the last week of life. Laboratory studies had shown hyperammonemia. She is found at autopsy to have a 3500 gm liver with a uniform, yellow, greasy cut surface. No necrosis of hepatocytes is noted microscopically. This pathologic appearance of the liver most likely resulted from which of the following conditions?

- A Galactosemia

B Hemochromatosis

C Tuberculosis

D Alcoholism

E Hypoxemia

(D) CORRECT. The marked fatty change of the liver with hepatomegaly is a typical sequel of chronic alcohol abuse.

Question 25

A clinical study is performed in which the conditions leading to the appearance of calcification on chest and abdominal CT scans are analyzed in patients from 60 to 90 years of age. One set of patients has the finding of incidental calcification, with no serious health problems. In which of the following tissue locations was this incidental calcification most likely to be noted?

A Coronary artery

B Renal cortex

C Mitral valve

D Pulmonary parenchyma

E **Aortic arch**

(E) CORRECT. Such calcification is commonly seen in adults, and though part of atherosclerosis, would not have major consequences if mild to moderate because the function of the aorta in carrying blood would not be seriously compromised.

Question 26

A 55-year-old man has a 30-year history of poorly controlled diabetes mellitus. He has had extensive black discoloration of skin and soft tissue of his right foot, with areas of yellowish exudate, for the past 2 months. Staphylococcus aureus is cultured from this exudate. A below-the-knee amputation is performed. The amputation specimen received in the surgical pathology laboratory is most likely to demonstrate which of the following pathologic abnormalities?

A Neoplasia

B Gangrene

C Coagulopathy

D Hemosiderosis

E Caseation

(B) CORRECT. Gangrenous necrosis is a typical complication of diabetes mellitus with marked peripheral vascular disease. Gangrene is a form of coagulative necrosis that involves a body part, including several tissues. The infection adds an element of liquefactive necrosis, best described as 'wet gangrene.'

Question 27

The lifestyle patterns of healthy persons from 20 to 30 years of age are studied. A subset of these persons have a lifestyle characterized by consumption of a lot of pizza and very little physical exercise. Which of the following tissue changes is most likely to develop in this subset of persons as a consequence of this lifestyle?

- A Fatty metamorphosis of liver
- B Pancreatic fat necrosis
- C Fatty degeneration of myocardium
- D Hypertrophy of steatocytes
- E Metaplasia of muscle to adipose tissue

(D) CORRECT. The fat cells (adipocytes) increase in size (hypertrophy) with obesity in adults, and this is the predominant effect of weight gain.

Question 28

In an experiment, a tissue preparation is subjected to oxidant stress. There are increased numbers of free radicals generated within the cells. Generation of which of the following substances within these cells is the most likely protective mechanism to reduce the number of free radicals?

- A **Glutathione peroxidase**
- B Catalase
- C Hydrogen peroxide
- D NADPH oxidase
- E Myeloperoxidase

(A) CORRECT. The glutathione peroxidase system is designed to help break down free radicals generated from various forms of cell injury. This system works in the background with small numbers of free radicals. Disease processes with greater amounts of cell injury can overwhelm this system.

Question 29

A 38-year-old man incurs a traumatic blow to his upper left arm. He continues to have pain and tenderness even after 3 months have passed. A plain film radiograph reveals a 4 cm circumscribed mass in the soft tissue adjacent to the humerus. The mass contains areas of brightness on the x-ray. Over the next year this process gradually resolves. Which of the following terms best describes this process?

- A Dysplasia
- B Hyperplasia
- C Hypertrophy
- D Metaplasia**
- E Neoplasia

(D) CORRECT. The brightness on x-ray suggests calcification from osseous metaplasia of connective tissues that developed in the healing process. This condition is known as myositis ossificans, because there is bone formation in the injured muscle.

Question 30

A 31-year-old primigravida has a difficult delivery of a term infant, with loss of 1500 cc of blood. She has hypotension for 6 hours. Over the next month, her ACTH level decreases. Within the next 3 months, her adrenal glands become only about 2 grams each (normal 4 to 6 grams). This alteration of the adrenals is primarily due to which of the following cellular processes?

- A Metaplasia
- B Lipid depletion
- C Apoptosis
- D Autophagocytosis**
- E Coagulative necrosis

(D) CORRECT. The loss of ACTH leads to cortical atrophy from cellular downsizing, with the consequence of decreased glucocorticoid and mineralocorticoid production.

Question 31

A 48-year-old man has a history of chronic alcohol abuse. He is still able to perform work at his job. He has had no major illnesses. On physical examination, there are no significant findings. Laboratory studies

show a serum albumin of 4.1 g/dL, ALT 40 U/L, AST 40 U/L, and total bilirubin 1.1 mg/dL. Which of the following microscopic findings in his liver is most likely to be present?

A Cholestasis

B Fatty change

C Hemochromatosis

D Hypertrophy of smooth endoplasmic reticulum

E Coagulative necrosis

(B) CORRECT. The toxic effects of the alcohol culminate in large lipid droplet accumulation within hepatocytes. Over time, more hepatocytes are affected and the liver is less able to compensate.

Question 32

A 44-year-old woman has had episodes of right upper quadrant pain during the past 2 weeks. Her stools have become pale in color over the past 3 days. Laboratory studies show a serum total bilirubin of 9.7 mg/dL. A cholangiogram shows that a gallstone has passed into the common bile duct, resulting in obstruction of the biliary tract. Which of the following cellular alterations is most likely to be visualized on her skin surfaces?

A Hemosiderosis

B Calcification

C Lipofuscin deposition

D Icterus

E Steatosis

(D) CORRECT. She probably has a 'jaundiced' appearance to her sclerae and skin due to the increased amount of bilirubin. The bile pigments impart a yellow color to the tissues. She has biliary tract obstruction from cholelithiasis and choledocholithiasis.

Question 33

A 45-year-old man has a traumatic injury to his forearm and incurs extensive blood loss. On physical examination in the emergency department his blood pressure is 70/30 mm Hg. Which of the following cellular changes is most likely to represent irreversible cellular injury as a result of this injury?

A Epithelial dysplasia

B Cytoplasmic fatty metamorphosis

C Nuclear pyknosis

D Atrophy

E Anaerobic glycolysis

F Autophagocytosis

(C) CORRECT. The hypotension leads to diminished tissue perfusion with ischemic injury. Nuclear chromatin clumping is reversible, but nuclear pyknosis is not.

Question 34

A 73-year-old man suffers a "stroke." On physical examination he cannot move his right arm. A cerebral angiogram demonstrates occlusion of the left middle cerebral artery. An echocardiogram reveals a thrombus within a dilated left atrium. Which of the following is the most likely pathologic alteration from this event that has occurred in his brain?

A Cerebral softening from liquefactive necrosis

B Pale infarction with coagulative necrosis

C Predominantly the loss of glial cells

D Recovery of damaged neurons if the vascular supply is reestablished

E Wet gangrene with secondary bacterial infection

(A) CORRECT. Liquefactive necrosis typifies brain infarction. The brain tissue contains abundant lipid. After the initial softening, tissue macrophages will increase and clear the debris, leaving a cystic space. Since neurons cannot regenerate, the size of the infarct determines the amount of functional loss. The brain has some capacity for rewiring, but this diminishes with age.

Question 35

A 30-year-old woman is claiming in a civil lawsuit that her husband has abused her for the past year. A workup by her physician reveals a 2 cm left breast mass. There is no lymphadenopathy. No skin lesions are seen, other than a bruise to her upper arm. An excisional biopsy of the breast mass is performed. On microscopic examination, the biopsy shows fat necrosis. This biopsy result is most consistent with which of the following etiologies?

A Physiologic atrophy

B Breast trauma

C Lactation

D Radiation injury

E Hypoxic injury

(B) CORRECT. Fat necrosis is seen with trauma to the breast, and her lawyer will make good use of that documentation. The pattern of multiple injuries of differing ages at different sites suggests abuse.

Question 36

A 45-year-old man has smoked 2 packs of cigarettes per day for the past 30 years. He has had a chronic cough for the past 3 years, worsening over the past 2 weeks. A suspicious left pulmonary parenchymal lesion is seen on a chest x-ray. He has a bronchoscopy performed. A biopsy of a segmental bronchus shows squamous metaplasia. Which of the following is the most appropriate interpretation of this finding?

A Ischemic tissue damage

B Irritant effect

C Early stage of cancer

D Viral infection

E Congenital anomaly

(B) CORRECT. The irritant effect, such as the various chemicals in cigarette smoke, leads to replacement of the normal epithelium with another (such as squamous epithelium replacing respiratory epithelium). This metaplastic process is the first step that could lead to dysplasia and then to neoplasia. Note that histologists call any flattened epithelium a 'squamous' epithelium, but pathologists refer to specific cell types, and consider a true squamous epithelium to be a stratified squamous epithelium.

Question 37

A 45-year-old woman has had congestive heart failure for the past 4 years. She develops a fever that persists for over a week. On physical examination, a heart murmur is present. Her temperature is 38.4 C. The spleen tip is palpable. On echocardiography she has an abnormally thickened mitral valve. Laboratory studies show a blood culture positive for *Streptococcus, viridans* group. Another echocardiogram reveals a 1 cm vegetation on the superior aspect of her mitral valve. Which of the following findings would you most expect to appear in the kidney as a consequence of these events?

A Marked passive congestion

B Ischemic infarct

C Extensive edema

D Granulomatous inflammation

E Gangrenous necrosis

(B) CORRECT. Friable mitral valvular vegetations from infective endocarditis can embolize into the systemic circulation. Occlusion of a branch of the arterial supply to an organ can result in an infarction, which is characterized by the appearance of coagulative necrosis in most visceral organs.

Question 38

A 19-year old G2 P1 woman has an amniocentesis performed at 18 weeks gestation. Fibroblasts recovered from amniocentesis are grown in culture to assess the karyotype of fetal cells. These cells are subcultured for additional experimental work, but the culture is lost after 50 doublings of the cells has occurred, and the fibroblasts no longer grow. Which of the following factors affecting these cells is most likely demonstrated by this phenomenon?

A Nutrition

B Mutation

C Apoptosis

D Aging

E Oxidation

(D) CORRECT. A number of factors play a role in aging, but the lack of immortality of individual cells is one feature. The lack of telomerase activity in most cells prevents repeated division. Stem cells have greater replicative capacity.

Question 39

A 55-year-old man has sudden onset of severe, sharp chest pain with diaphoresis and dyspnea. On physical examination he has tachycardia with an irregular heart rhythm. Electrocardiographic changes suggest the possibility of focal myocardial damage involving the left lateral ventricular wall. Which of the following laboratory tests on the patient's serum is most useful in this situation?

A Total cholesterol

B Creatine kinase

C Triglyceride

D Amylase

E Sedimentation rate

(B) CORRECT. The CK will be elevated with myocardial ischemic injury. The CK-MB isoenzyme fraction is most specific for cardiac muscle, while CK-MM is most specific for skeletal muscle. Another very specific analyte for cardiac striated muscle injury is troponin. Myoglobin is a sensitive, but not specific marker for myocardial injury, because it could also be released from skeletal muscle.

Question 40

A 42-year-old previously healthy woman notes that over the past week her eyes have developed a yellowish appearance. She has had mild nausea and vomiting over the past week. On physical examination she has scleral icterus. She has no other major physical examination findings except for mild right upper quadrant tenderness. Which of the following underlying conditions is most likely to contribute to development of her icterus?

- A Hypercholesterolemia
- B Thrombocytopenia
- C Metastatic carcinoma
- D Viral hepatitis**
- E Diabetes mellitus

(D) CORRECT. Hepatitis, most often an infectious viral hepatitis, leads to liver cell dysfunction with impaired uptake, conjugation, and excretion of bilirubin. As a result there is an increasing serum bilirubin that produces the jaundice (icterus).

Question 41

A 56-year-old woman has smoked 2 packs of cigarettes per day for the past 35 years. She has had a chronic cough for the past 8 years, but recently has noted increased sputum production. On physical examination she has a few crackles auscultated best over the lung bases. Bronchoscopy with biopsy is performed. The biopsy reveals bronchial epithelium with squamous metaplasia. Which of the following statements represents the best interpretation of these findings?

- A This is a physiologic process of aging
- B This process is irreversible, even if she stops smoking
- C She has metastases to lung from a primary somewhere else
- D She has an increased risk for pulmonary infection**
- E A pulmonary thromboembolus caused pulmonary infarction

(D) CORRECT. The loss of normal functioning respiratory epithelium means that the normal barrier to infection has been weakened.

Question 42

A 90-year-old woman dies from pneumonia complicating Parkinson disease. At autopsy her heart is normal in size. On microscopic examination, there is increased lipochrome (lipofuscin) seen adjacent to the nuclei within the myocardial fibers. This microscopic finding is most likely to result from which of the following cellular mechanisms?

A Nuclear pyknosis

B Myocardial fiber hypertrophy

C Coagulative necrosis

D Autophagocytosis

E Anaerobic glycolysis

(D) CORRECT. The lipochrome represents the residual debris of organelles and appears with increased frequency with aging, particularly in heart and liver.

Question 43

An experiment is conducted to determine if cell membrane injury is lessened by the effects of vitamin E ingestion. Which of the following cellular components is primarily involved in generation of lipid peroxides, the formation of which is inhibited by the vitamin E?

A Glutathione

B Ionized calcium

C Lactate

D Ferric iron

E Lipase

(D) CORRECT. Ferric ion is needed for reduced oxygen species to injure cells. Hydroxyl radicals initiate lipid peroxidation.

Question 44

A 35-year-old woman has had headaches and abdominal pain worsening for 3 months. There are no remarkable physical examination findings. On radionuclide scanning of the neck, she is found to have a

mass involving one of her parathyroid glands. An abdominal CT scan suggests extensive nephrocalcinosis along with urinary tract calculi. Which of the following laboratory test findings is most likely to accompany her disease?

A CO₂ of 30 mmol/L

B Phosphorus of 2.2 mg/dL

C Uric acid of 15.1 mg/dL

D Sodium of 121 mmol/L

E Calcium of 4.5 mg/dL

(B) CORRECT. Metastatic calcification occurs as a result of a high serum calcium, which in the case of hyperparathyroidism is accompanied by a low serum phosphorus.

Question 45

A 21-year-old woman has a routine Pap smear performed for a health screening examination. The pathology report indicates that some cells are found cytologically to have larger, more irregular nuclei. A follow-up cervical biopsy microscopically demonstrates disordered maturation of the squamous epithelium, with hyperchromatic and pleomorphic nuclei extending nearly the full thickness of the epithelial surface. No inflammatory cells are present. Which of the following descriptive terms is best applied to these Pap smear and biopsy findings?

A Dysplasia

B Metaplasia

C Anaplasia

D Hyperplasia

E Aplasia

(A) CORRECT. Disordered growth of an epithelium is seen in dysplasia, which can be a precursor to neoplasia. When the term 'dysplasia' is used in pediatric conditions, it refers to disordered development of a tissue, including cell types that ordinarily are not present. In adults, dysplasia refers to an abnormal change in an epithelium, beyond physiologic alteration, that is starting down the road to cancer.

Question 46

A 38-year-old man has a health screening examination. He has a routine chest x-ray that shows a 2 cm nodule in the right lower lobe. The nodule has focal calcifications. A wedge resection of the nodule is

done. On microscopic examination the nodule shows caseous necrosis and calcification. Which of the following processes explains the appearance of the calcium deposition:

- A Dystrophic calcification
- B Apoptosis
- C Hypercalcemia
- D Metastatic calcification
- E Excessive ingestion of calcium

(A) CORRECT. Calcium is deposited in and around the granuloma as a reaction to injury with necrosis. Most pulmonary granulomas are the result of infection, typically tuberculosis.

Question 47

A 3-year-old child has been diagnosed with ornithine transcarbamylase deficiency and has developed hepatic failure. The left lobe of an adult donor liver is used as an orthotopic transplant. A year later, the size of each liver in donor and recipient is greater than at the time of transplantation. Which of the following cellular alterations is most likely to explain this phenomenon?

- A Metaplasia
- B Dysplasia
- C **Hyperplasia**
- D Anaplasia
- E Neoplasia

(C) CORRECT. After removal of part of the liver, remaining liver can undergo hyperplasia to compensate. Hepatocytes are stable cells that are able to re-enter the cell cycle.

Question 48

A morbidly obese 51-year-old woman dies from complications of heart disease. At autopsy, her heart weighs 600 gm (normal up to 300 gm) with all the chambers enlarged. Microscopically, there is increased fibrous connective tissue seen in the interstitium between myocardial fibers. The fibers are increased in size. Beneath the epicardium can be seen adipocytes interdigitating with the myocardial fibers. Which of the following terms best describes the presence of the adipocytes in her myocardium?

- A Steatosis

- B Lipid degeneration
- C Fatty infiltration
- D Cholesterolosis
- E Xanthomatosis

(C) CORRECT. The adipocytes are normal fat cells. Obese persons just have more of them, and the individual cells are larger, making them more obvious and prominent on examination. Their presence in the superficial myocardium is more a marker of obesity than a risk for myocardial failure.

Question 49

A 48-year-old man has an episode of severe substernal chest pain radiating to his left arm. Four months later he has increasing dyspnea and orthopnea. On physical examination there are rales heard over all lung fields. An echocardiogram shows a left ventricular aneurysm. He has decreased cardiac output with an ejection fraction of 29%. Which of the following findings is most likely to be indicative of the original acute event at the time he presented with chest pain?

- A Troponin I release from myofibers
- B Collagenous scar tissue in the myocardium
- C Chronic passive congestion of the liver
- D Organizing mural thrombus in left ventricle
- E Recanalization of a coronary artery thrombosis

(A) CORRECT. Elevations in troponin I or T and in the creatine kinase (CK) enzymes, particularly CK-MB fraction, as well as serum myoglobin, are going to be seen acutely with a myocardial infarction.

Question 50

A 53-year-old man suffers a cardiac arrest and his wife calls emergency services. The paramedics arrive a few minutes later and begin life support measures. A regular heart rate is established after about 40 minutes of resuscitative efforts as he is being transported to the hospital. A thrombolytic agent (tPA) is administered. Which of the following cellular processes is most likely to occur in his myocardium following administration of the tPA?

- A Apoptosis
- B **Free radical injury**
- C Heterophagocytosis

D Squamous metaplasia

E Accumulation of cytokeratins

(B) CORRECT. The ischemia during the cardiac arrest followed by reperfusion established following successful resuscitation will generate activated oxygen species to produce free radical injury.

Question 51

A 38-year-old woman has severe abdominal pain with hypotension and shock that has developed over the past 36 hours. On physical examination, her abdominal muscles are rigid and her abdomen is extremely tender. An abdominal CT scan reveals fluid density in the region of the pancreas, which appears to be enlarged. Which of the following laboratory test findings in her serum is most likely to be present?

A Alanine aminotransferase of 1123 U/L

B Total cholesterol of 324 mg/dL

C Creatine kinase of 869 U/L

D Urea nitrogen of 110 mg/dL

E Lipase of 1134 U/L

(E) CORRECT. There is evidence for acute pancreatitis with edema and necrosis. The necrosis is typically fat necrosis with grossly visible focal chalky-white deposits representing areas of saponification as a consequence of release of pancreatic enzymes (lipase and amylase) with acute inflammation.

Question 52

A 45-year-old man has noted scleral icterus for the past 4 days. He has been feeling tired and "run down" for about a month. On physical examination, other than mild tachycardia, his vital signs are normal. No other physical examination findings are of noted other than scleral icterus. Laboratory studies show a hematocrit of 25%. Which of the following conditions is most likely to account for these findings?

A Systemic hypertension

B Excessive iron absorption

C Diabetes mellitus, type I

D Intravascular hemolysis

E Pulmonary squamous cell carcinoma

(D) CORRECT. The increased turnover of red blood cells leads to increased bilirubin production to cause the icterus, as the amount of bilirubin generated exceeds the capacity of the liver to conjugate and excrete it into the bile. This also explains his anemia

Question 53

A 49-year-old man with a history of alcohol abuse has increasing abdominal girth. On examination his liver edge is firm. A liver biopsy shows cirrhosis, and individual hepatocytes contain red, globular inclusions positive for cytokeratin with immunohistochemical staining. Which of the following structural elements are these intracellular globules most likely to contain?

- A Actin and myosin
- B Cholesterol esters
- C Fatty acids
- D Fibronectin
- E Intermediate filaments
- F Microtubules

(E) CORRECT. Intermediate filaments may collect in the damaged hepatocytes as the globular hyaline known as Mallory hyaline. It is characteristic for alcoholic liver disease, but not pathognomic for it.