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**QUESTION 1**

In the central auditory pathways, second-order neurons are located in which of the following?

- A. cochlear (spiral) ganglion
- B. cochlear nuclei
- C. inferior colliculi
- D. nuclei of lateral lemniscus
- E. superior olivary nuclei

Correct Answer: B

Section: Anatomy Second-order neurons in the central auditory pathways are located in the dorsal and ventral cochlear nuclei. They receive afferents from the first-order neurons located in the cochlear (spiral) ganglion (choice A). Secondorder fibers from the cochlear nuclei project in turn to the inferior colliculi (choice C), nuclei of lateral lemniscus (choice D), and superior olivary nuclei (choice E).

QUESTION 2

You are examining the biochemical characteristics of the liver dysfunction in your patient, who is exhibiting signs of a glycogen storage disease. You have isolated the microsomal fraction (contains the endoplasmic reticulum) of a liver biopsy homogenate from your patient and a control individual for your studies. Incubation with radioactive phosphate-labeled glucose-6-phosphate results in an increase in isotope associated with the microsomes from your control sample but no increase in association with the microsomes from your patient. These results are best explained by a defect in which of the following?

- A. glucose-6-phosphatase activity in the microsomes
- B. microsomal glucose-6-phosphate transporter
- C. cytosolic glucose-6-phosphatase
- D. microsomal glucose transport
- E. microsomal phosphate transporter

Correct Answer: B

QUESTION 3

A 48-year-old man had a long history of alcoholism (including alcoholic hepatitis and hallucinations) and was admitted to the ICU with hypotension and GI bleeding. He was given IV fluid and transfused with packed RBCs. He remained intubated and ventilator dependent for several weeks. He developed a high fever and was treated with broad-spectrum antibiotics. Culture of his tracheal aspirate initially grew *S. aureus*. After more antibiotic treatment, Gram stain of his aspirate showed PMNs and gram- negative rods. A chest x-ray demonstrated an infiltrate with possible small abscesses.



Tracheal aspirate then yielded a heavy growth of a gram-negative, nonfermenting rod that produced a greenish hue in the culture plates. Which of the following is the most likely organism causing this patient's problem?

- A. H. influenza
- B. L. pneumophila
- C. M. pneumonia
- D. P. aeruginosa
- E. S. pneumoniae

Correct Answer: D

Section: Microbiology/Immunology The pseudomonads are gram-negative, motile, aerobic rods that produce water-soluble pigments. They occur widely in soil, water, plants, and animals. *P. aeruginosa* is frequently present in small numbers in the normal intestinal tract and on the skin of humans. It is also commonly present in moist environments in hospitals. While a saprophyte on normal immune-competent humans, it is a most efficient opportunist in people with deficient host defenses. Choice D is the correct answer. *S. pneumoniae* (choice E) are gram-positive, and *Mycoplasma* species (choice C) have no cell wall but are so small that they would not be observed in a Gram stain preparation. *H. influenzae* (choice A) are extremely small gram-negative rods, much smaller than pseudomonads. *Legionella* (choice B) stain poorly by the Gram stain procedure and are not seen in clinical specimens.

QUESTION 4

The sinoatrial (SA) node initiates the heartbeat by giving off an impulse about 80 times per minute. It is located at the junction of the superior vena cava and right atrium. In about 60% of the cases, the SA node derives its vascular supply from which of the following?

- A. anterior interventricular artery
- B. left circumflex artery
- C. posterior interventricular artery
- D. right coronary artery E. right marginal branch

Correct Answer: D

Section: Anatomy In 60% of patients, the right coronary artery supplies the SA node. In a third of the population, the SA node is supplied by the left coronary artery and in some patients it receives branches from both the right and the left. The anterior interventricular (choice A) and left circumflex (choice B) arteries are distal branches of the left coronary artery, too distant to supply the SA node. The right coronary artery normally gives out its SA nodal branch in its proximal portion and then distally gives rise to the right marginal (choice E) and posterior interventricular (choice C) arteries. These are also too distant to supply the SA node.

QUESTION 5

Exhibit:



- A. calcium-ATPase
- B. GLUT2
- C. Na^+ , K^+ -ATPase
- D. Na^+ : Ca^{2+} countertransport protein
- E. SGLT-1

Please refer to the exhibit.

Which of the following proteins uses the sodium electrochemical gradient to actively transport a solute into the cell?

- A. A
- B. B
- C. C
- D. D
- E. E

Correct Answer: E

Section: Physiology SGLT-1 is a sodium-dependent cotransport protein that uses the sodium electrochemical gradient to actively move glucose into the cell. GLUT2 (choice B) does transport glucose, but it is a facilitated diffusion carrier that moves glucose down its concentration gradient. The Na, K-ATPase (choice C) is a primary active transport protein. It uses the energy liberated from ATP hydrolysis to actively transport sodium and potassium. It establishes and maintains the sodium electrochemical gradient. The sodium: calcium countertransport protein (choice D, also termed NCX) uses the sodium electrochemical gradient to move calcium ions out of, not into, the cell. The calcium ATPase (choice A, also termed PMCA) is a primary active transport protein that actively transports calcium out of the cell. Both NCX and PMCA serve to maintain a low intracellular calcium concentration.

QUESTION 6

Hormone-secreting chromophils in the pars distalis of the adenohypophysis are classified into acidophils and basophils. Which of the following hormones is secreted by the acidophils?

- A. adrenocorticotropin
- B. follicle-stimulating hormone
- C. luteinizing hormone
- D. prolactin
- E. thyrotropin (thyroid-stimulating hormone)

Correct Answer: D

Section: Anatomy Prolactin is secreted by one of the two types of hormone-secreting acidophils, the mammotrophs. The



other types of acidophils are the somatotrophs, which secrete growth hormone (somatotropin). The hormones listed in all the other choices are secreted by the basophils. Adrenocorticotropin (choice A) is secreted by the corticotrophs. The gonadotrophs secrete either follicle-stimulating hormone (choice B) or luteinizing hormone (choice C). Thyrotropin (choice E) is secreted by thyrotrophs.

QUESTION 7

A 4-month-old boy presents with painful progressive joint deformity (particularly the ankles, knees, elbows, and wrists), hoarse crying, and granulomatous lesions of the epiglottis and larynx leading to feeding and breathing difficulty. Biopsy of the liver indicates an accumulation of ceramides. The observed symptoms and the results of the liver biopsy are indicative of which disease?

- A. Farber lipogranulomatosis
- B. fucosidosis
- C. Gaucher disease
- D. metachromic leukodystrophy
- E. Sandhoff-Jatzkewitz disease

Correct Answer: A

Section: Biochemistry Farber lipogranulomatosis is characterized by painful and progressively deformed joints and progressive hoarseness due to involvement of the larynx. Subcutaneous nodules form near the joints and over pressure points. Granulomatous lesions form in these tissues and there is an accumulation of lipid-laden macrophages. Significant accumulation of ceramide and gangliosides is observed, particularly in the liver. If these compounds accumulate in nervous tissue there may be moderate nervous dysfunction. The illness often leads to death within the first few years of life, although milder forms of the disease have been identified. Fucosidosis (choice B) is characterized by the accumulation and excretion of glycoproteins, glycolipids, and oligosaccharides- containing fucoside moieties. Symptoms of fucosidosis include psychomotor retardation, dystosis multiplex (a term referring to multiple skeletal abnormalities), growth retardation, and coarse facial features. Gaucher disease (choice C) is characterized by an accumulation of glucosylceramide (glucocerebroside). Several forms of the disease have been identified and vary in severity. Typical symptoms include hepatosplenomegaly, bone lesions, and CNS involvement. Occasionally, the lungs and other organs may be involved. Metachromic leukodystrophy (choice D) is a disorder of myelin metabolism. It is characterized by the accumulation of galactosyl sulfatide (cerebroside sulfate). Symptoms may appear at any age and include mental regression, urinary incontinence, blindness, loss of speech, peripheral neuropathy, and seizures. Sandhoff- Jatzkewitz disease (choice E) is a disorder related to Tay-Sachs disease. It is characterized by a defect in the degradation of GM2 gangliosides with symptoms of severe mental retardation, blindness, and early mortality.

QUESTION 8

A 3-year-old child arrives at the hospital in severe respiratory distress. Periorbital edema is also noted. Blood analysis reveals decreased levels of C4 and decreased levels of C1 inhibitor. This complement deficiency is likely to lead to which of the following conditions?

- A. angioedema
- B. an increased susceptibility to pyogenic infections
- C. bacteremia



- D. decreased production of anaphylatoxins
- E. enhancement of antibody production

Correct Answer: A

Section: Microbiology/Immunology Deficiency in the inhibitor of the first component of complement (C1) is associated with angioedema, because this condition leads to the production of anaphylatoxins C3a, C4a, and C5a. These anaphylatoxins act on mast cells, which release large amounts of histamine. Production of histamine increases capillary permeability resulting in edema. Enhanced susceptibility to pyogenic infections has been attributed to C3 and C5C8 components of complement. Bacteremia is a term used to indicate the presence of bacteria in the blood. Thus it has nothing to do with the first component of complement (choice C). Inherited deficiencies of C3 and C5C8 have been associated with increased susceptibility to pyogenic infections, but not the first component of complement (choice B). Complement can act synergistically with antibody to modify its action, but not its production (choice E). The conversions of the third (C3) and fifth (C5) components of complement by the C3 and C5 convertases to C3a and C5a anaphylatoxins lead to the increased production of anaphylatoxins (choice D) seen with C1 inhibitor deficiency.

QUESTION 9

A middle-aged, markedly obese male patient presents to the emergency room with pain in the inguinal region. Examination reveals an abnormal bulge which increases in size when the patient performs the Valsava maneuver. The bulge can be reduced manually when the patient is lying supine. However, as soon as the patient stands up and coughs, the bulge reappears. The patient is diagnosed with an inguinal hernia. The chief resident in surgery asks for a determination of whether the hernia is direct or indirect. Which of the following is a useful landmark to distinguish an indirect from a direct inguinal hernia?

- A. anterior superior iliac spine
- B. inferior epigastric vessels
- C. inguinal ligament
- D. pubic tubercle
- E. umbilicus

Correct Answer: B

Section: Anatomy The inferior epigastric vessels lie medial to the deep inguinal ring. An indirect inguinal hernia leaves the abdominal cavity through the deep inguinal ring and is thus always localized lateral to the inferior epigastric vessels. A direct inguinal hernia results from weakness in the posterior wall of the inguinal canal and pushes through the conjoint tendon to reach the superficial inguinal ring. The direct inguinal hernia is thus always located medial to the inferior epigastric vessels. The anterior superior iliac spine (choice A) and pubic tubercle (choice D) are respectively located too far laterally or medially to be of use in distinguishing indirect from direct hernias. The inguinal ligament (choice C) is used to distinguish a femoral hernia which is always located inferior to this structure. The umbilicus (choice E) is the site for an umbilical hernia and not inguinal hernias.

QUESTION 10

A biopsy from a 55-year-old woman with breast cancer was submitted to an estrogen receptor assay. The binding of estrogen to the cancer cells below figure, solid line was plotted in the form of a Scatchard plot and compared to control cells below figure, dotted line). Which of the following would you conclude for the patient's estrogen receptors?

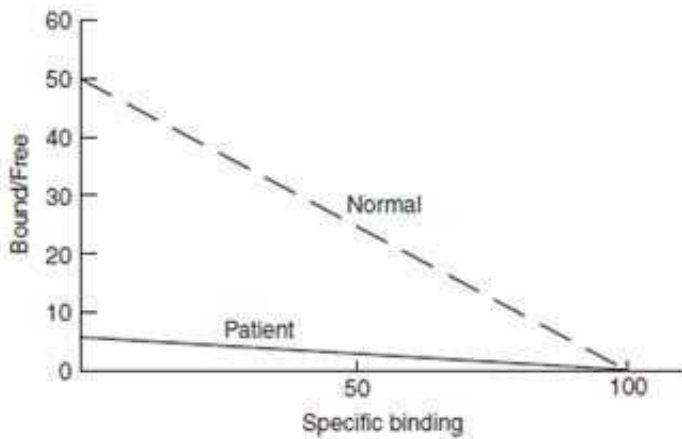


FIG. 2-4

- A. they are equal in number and have a higher affinity
- B. they are equal in number and have a lower affinity
- C. they are fewer in number and have a higher affinity
- D. they are fewer in number and have a lower affinity
- E. they are higher in number and have an equal affinity

Correct Answer: B

Section: Physiology The slope of the patient's line is decreased compared to normal. This indicates a low affinity of estrogen for the estrogen receptor, which makes choice B correct and choice A incorrect. The x-intercept is called B_{max} and represents the total number of estrogen receptors. This is unchanged in the patient compared to normal so that choices C, D, and E are excluded. The information about the numbers and status of estrogen and progesterone receptors on cancer cells is of high clinical value to determine the efficiency of consequent hormonal therapy.

QUESTION 11

A 38-year-old sexually-active woman developed symptoms of lower abdominal pain with adjacent tenderness. No gram-negative cocci were observed or isolated. The obligate intracellular organism causing the infection is unable to perform which of the following metabolic functions?

- A. form ATP
- B. form the intracellular, metabolically active, reticulate body
- C. produce polypeptides
- D. reproduce by binary fission
- E. synthesize DNA gyrase

Correct Answer: A

Section: Microbiology/Immunology Chlamydiae are obligate intracellular parasites because they cannot synthesize ATP. They are classified as bacteria because they divide by binary fission (choice D), form polypeptides (choice C), produce



RNA, DNA, and DNA gyrase (choice E). Finally, they synthesize two unique morphological forms. That is, the extracellular infective, metabolically inert elementary body, and the intracellular, metabolically active reticulate body (choice B).

QUESTION 12

A 75-year-old man has prostate cancer that has metastasized to bone. He is receiving hormonal therapy to slow progression of the neoplasm and codeine by mouth for pain when it is absolutely required, but still complains of severe pain. What should be given to this patient to address his symptom?

- A. a strong NSAID such as naproxen as needed to supplement his codeine therapy
- B. additional codeine when he complains
- C. aspirin, and he should be told that additional narcotics cannot be used because he would become tolerant of their analgesic action
- D. morphine in a long-acting oral preparation on a regular schedule and parenteral morphine when pain breaks through
- E. parenteral morphine when pain requires it

Correct Answer: D

Section: Pharmacology Pain of malignancy is still a badly undertreated condition, due to misunderstanding of the nature of opioid tolerance and addiction and an unwillingness to deal with the complications of prescribing controlled substances. Codeine has limited maximum efficacy, so additional doses of this drug (choice B) are unlikely to control this patient's pain. It was previously thought that regular use of strong opioids for any purpose inevitably led to tolerance and a loss of analgesic effect, as well as addiction (choice C). However, excellent clinical studies have shown that this is not the case. Regular use as opposed to as-needed use) of small to moderate doses of opioids effectively controls pain in most cases without causing tolerance or addiction. In fact, restricting opioids to use only when absolutely needed results in larger total analgesia requirements and greater toxicity. Use of NSAIDs (choice A) should be started early, when pain is mild and supplemented with oral opioids, such as codeine, as soon as it becomes necessary. NSAIDs are not adequate at this stage of this patient's disease. Parenteral morphine, given when necessary (choice E), is as not as effective as regularly scheduled morphine and leads to greater drug toxicity.

QUESTION 13

Opioid peptides are an important physiological mechanism of the body for relief from painful stimuli. Used as pharmacologic agents, they are highly valuable tools for pain management, although side effects are usually inevitable. Which of the following problems are most likely during opiate treatments?

- A. difficulty sleeping
- B. hypermotility of the GI tract
- C. placebo effects
- D. respiratory alkalosis
- E. tolerance (need for higher dosage to achieve the same therapeutic effect)

Correct Answer: E



Section: Physiology Tolerance is commonly observed with many pharmacologic agents, including opioids. Difficulty sleeping (choice A), hypermotility of the GI tract (choice B), and respiratory alkalosis (choice D) are opposite to the expected effect of opiates. The placebo effect (choice C) is, at least in part, likely due to the release of endogenous opioid peptides in anticipation of pain relief, but is not a complication or side effect of therapy.

QUESTION 14

A 48-year-old female patient is brought to the emergency room by her husband. He reports that his wife suffers from hypertension but, as a high-level executive with a lot of pressure at work, she has been neglecting to take her medication. This morning, as he entered the garage to leave for work, he found his wife lying on the ground next to her own car. She was experiencing uncontrolled flailing of the left arm and leg. What is the most likely site of brain lesion in this patient?

- A. anterior limb of the left internal capsule
- B. anterior limb of the right internal capsule
- C. cerebellum
- D. left subthalamic nucleus of Luys
- E. right subthalamic nucleus of Luys

Correct Answer: E

Section: Anatomy Hemiballismus is a movement disorder characterized by involuntary large amplitude movements of one or both limbs on one side of the body. It results from infarct damage to the contralateral subthalamic nucleus of Luys, in this case the right one. The left subthalamic nucleus (choice D) controls the limbs on the right side of the body, which are not affected in this case. The anterior limbs of the internal capsule (choices A and B) contain mainly thalamocortical and corticothalamic fibers and lesions in these areas do not result in hemiballismus. Lesions in the cerebellum (choice C) also do not result in hemiballismus.

QUESTION 15

A 23-year-old man sees his physician to ask about the recent appearance of several large closely spaced bumps on his elbows. Suspecting that these are fatty eruptions, the physician tests the man's blood for lipid, cholesterol, and lipoprotein levels. Results show elevated cholesterol and triglycerides and the presence of a variant form of very low-density lipoprotein (VLDL) identified as beta-migrating VLDL (VLDL). A more careful analysis of the biochemical properties of the apoproteins associated with the beta-VLDL particles identifies a form of apo E that has a more negative charge than apo E from normal individuals. These results indicate the individual is afflicted with which of the following hyperlipoproteinemias?

- A. type I (familial LPL deficiency)
- B. type II (FH)
- C. type III (dysbetalipoproteinemia)
- D. type IV (familial hypertriglycerolemia)
- E. Wolman disease

Correct Answer: C



Section: Biochemistry Familial dysbetalipoproteinemia (type III hyperlipoproteinemia) results from a genetic variant in the apo E gene that causes poor interaction of chylomicron remnants and VLDLs with the apo E receptor. This results in the presence, in the serum, of beta-migrating VLDL (- VLDLs), which are cholesterol- rich remnants of both intestinal chylomicrons and hepatic VLDL. Diagnosis of type III hyperlipoproteinemia is indicated by elevated plasma cholesterol and triglyceride, xanthomas (fatty eruptions under the skin), and of course the presence of -VLDL. Type I hyperlipoproteinemia (choice A) results from defects in the activity or activation of LPL and results in the massive accumulation of chylomicrons in the plasma. The disease is usually detected in childhood following recurrent attacks of abdominal pain, hepatosplenomegaly, and pancreatitis. Familial hypercholesterolemia (choice B) is the result of defects in the LDL receptor. The defects lead to characteristic elevation in LDL, deposition of LDL-derived cholesterol in the tendons and skin and in the arteries. Individuals homozygous for defective LDL receptors have severe hypercholesterolemia (6501000 mg/dL) and coronary heart disease begins early in childhood with death caused by myocardial infarct before the age of 20. Type IV hyperlipoproteinemia (choice D) is associated with overproduction VLDLs. An associated glucose intolerance and hyperinsulinemia are also seen in this disorder. Wolman disease (choice E) is caused by a deficiency in lysosomal acid lipase and results in massive accumulation of cholesteryl esters and triglycerides in most tissues. The disease is almost always fatal before the age of 1 year.

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