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QUESTION 1

You are tending to a patient with a high tendency to bleed. He bruises easily and has bleeding from his gums. Analysis of coagulation factors in his blood shows normal levels of factor V but low levels of factor

VIII.

Injection of factor VIII provides only minimal benefit and you find that the injected protein is rapidly degraded. Using a platelet aggregation test, you find that combination of your patient\\'s serum with normal platelets results in only 20% of the platelet aggregation seen with both samples from a normal individual. Based on these findings, you determine that your patient is deficient in which of the following factors of coagulation?

A.

factor X

B.

factor XII

C.

fibrinogen

D.

thrombin

E.

von Willebrand factor

Correct Answer: E

Section: Biochemistry The von Willebrand factor is associated with subendothelial connective tissue and serves as a bridge between platelet glycoprotein GPIb/IX and collagen. This activity ensures that platelets can adhere to the exposed subendothelial surfaces at the site of tissue injury. In addition, von Willebrand factor and factor VIII exist in a noncovalently bound complex in the plasma. The interaction of factor VIII and von Willebrand factor greatly stabilizes factor VIII. For example, following infusion of factor VIII into patients with hemophilia A (caused by loss of factor VIII) the protein exhibits a serum halflife of around 12 hours. Conversely, when infused into patients with severe von Willebrand disease, VWD (lack of von Willebrand factor), the half-life of factor VIII is less than 2 hours. Therefore, individuals suffering from VWD will also have significantly reduced levels of circulating factor VIII. This fact results in the observation that patients with VWD exhibit symptoms of both platelet dysfunction and hemophilia. Deficiency in any of the other coagulation factors (choices AD) would not result in decreased stability of factor VIII observed as a reduction in circulating levels of this protein.

QUESTION 2

A retired policeman who received a kidney transplant developed a generalized infection by an enveloped double-stranded DNA virus. This organism formed owl\\'s eye inclusions in cells found in urinary sediments. Which of the following viruses is the most likely etiological agent?

A. adenovirus

B. coronavirus

C. cytomegalovirus

D. papillomavirus

E. variola virus

Correct Answer: C

Section: Microbiology/Immunology Cytomegalovirus (CMV) is an enveloped, double-stranded DNA virus, which causes formation of giant cells with intranuclear inclusion bodies that have an oval owl\\'s eye shape. CMV can cause a generalized infection, which is associated with immunosuppression. This can occur with organ transplantation or AIDS and result in central nervous system involvement, pneumonia, retinitis, colitis, and organ rejection. Adenoviruses (choice A) are also double-stranded DNA viruses but do not have an envelope. Coronaviruses (choice B) contain an RNA genome and do have an envelope. Papillomaviruses (choice D) contain doublestranded DNA and have no envelope. Variola virus (choice E) is a poxvirus, having doublestranded DNA. The largest virus group by size, poxviruses, does contain an "envelope" but it is constructed of multiple membranes closely attached to the virions, unlike lipid envelopes seen in herpes viruses, for example.

QUESTION 3

"Executive monkeys" as described by Brady tended to develop bleeding ulcers. Which of the following statements best characterizes them?

A. Alpha monkeys that have the highest level of testosterone in the colony.

B. Beta-male monkeys having too many decisions to make.

C. Male monkeys that had too many available females.

D. Monkeys that had to keep pressing bars to avoid shock.

E. Monkeys that had to press a bar to get a pellet of food.

Correct Answer: D

Section: Behavioral Science and Biostatics Monkeys that were placed in a highly complex operant conditioning program to avoid electric shock developed bleeding gastric ulcers, while yoked controls who received the same amount of shock, but did not have to perform the complex task, did not. The lack of a confirmatory feedback (such as a safe light or food to indicate a shock-free interval) seems to be especially ulcerogenic in Brady\\'s "executive monkeys." Choices A, B, C, and E are incorrect.

QUESTION 4

below figure illustrates uptake of two gases (nitrous oxide and carbon monoxide) from alveolar air to

pulmonary capillary blood. Based on this information what can we conclude about carbon monoxide?

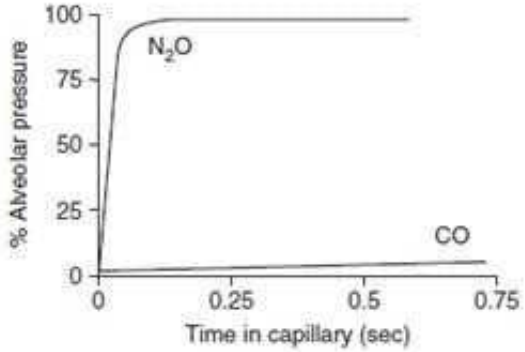

FIG. 2-13

A. it does not dissolve in blood

B. it does not interact with hemoglobin

C. it has equilibrated with pulmonary capillary blood

D. it is a diffusion-limited gas

E. it is a perfusion-limited gas

Correct Answer: D

Section: Physiology The plot shows that carbon monoxide fails to equilibrate with pulmonary capillary blood during the time that blood is exposed to alveolar air. Since pulmonary partial pressure rises to only a few percent of alveolar partial pressure, carbon monoxide is a diffusion-limited gas. In contrast, nitrous oxide, which does equilibrate, is a perfusion-limited gas (choice E). Carbon monoxide does cross the respiratory membrane (choice C), dissolve in pulmonary capillary blood (choice A), and binds with hemoglobin (choice B). In fact, its affinity for hemoglobin is about 250-fold greater than that of oxygen.

QUESTION 5

A 55-year-old male with a history of smoking presents with a chronic cough with expectoration. He exhibits dyspnea on exertion, has a stocky build, and shows some cyanosis. Which of the following receptors is involved in the cough reflex?

A. carotid body chemoreceptors

B. central chemoreceptors

C. irritant receptors

D. lung stretch receptors

E. muscle spindles

Correct Answer: C

QUESTION 6

Numerous cancers are caused by a genetic phenomenon termed "loss of heterozygosity," LOH. This phenomenon led to the identification of genes termed tumor suppressors, because it is the loss of their function that leads to cancer. Which of the following has been shown to result from defects in a tumor suppressor gene as a consequence of LOH?

A. Creutzfeldt-Jakob disease (CJD)

B. Crouzon syndrome

C. HD

D. Li-Fraumeni syndrome (LFS)

E. Prader-Willi syndrome

Correct Answer: D

Section: Biochemistry LFS is a rare inherited form of cancer that involves breast and colon carcinomas, softtissue sarcomas, osteosarcomas, brain tumors, leukemia, and adrenocortical carcinomas. These tumors develop at an early age in LFS patients. The tumor suppressor gene found responsible for LFS is p53. Mutant forms of p53 are found in approximately 50% of all tumors. The normal p53 protein functions as a transcription factor that can induce either cell-cycle arrest or apoptosis (programmed cell death) in response to DNA damage. CJD (choice A) encompasses three forms: infectious, sporadic, and inherited, with the vast majority of cases being sporadic. Clinical abnormalities of CJD are confined to the CNS and result from a pathogenic protein identified as prion protein (PrP). Crouzon syndrome (choice B) is haracterized by craniosynostosis (midface hypoplasia and ocular proptosis) and is the result of a mutation in one of the receptors for fibroblast growth factor (FGFR2). HD (choice C) is an autosomaldominant disorder resulting from expansion of the triplet CAG within the huntingtin gene. The exact function of the huntingtin protein is still unclear. Symptoms of HD include personality changes, memory loss, and involuntary leg and arm movements (chorea). The average age of onset is 37 years. PWS (choice E) is a relatively common cause of genetic obesity and mental retardation. Symptoms of severe hypotonia and poor suckling are evident at birth. PWS is caused by a deletion of a portion of the long arm of chromosome 15 [del(15q11q13)].

QUESTION 7

In adults, lack of vitamin D gives rise to the disease osteomalacia characterized by progressive softening and bending of the bones. This is due to a defect in the mineralization of the osteoid. Under normal conditions, the osteoid is found along which of the following locations?

A. the interface between osteocytes and bones

B. the interface between osteoprogenitor cells and bone marrow

C. the interface between the fibroblasts in the periosteum

D. the interface between the osteoblast and bone

E. the ruffled border of osteoclasts

Correct Answer: D

Section: Anatomy

Osteoid is the unmineralized organic matrix formed by osteoblasts and found at the interface between

these cells and bone. Osteocytes (choice A) are surrounded by bone and no longer manufacture osteoid.

Osteoprogenitor cells (choice B) are similar to stem cells and do not manufacture bone material.

Fibroblasts (choice C) are cells of connective tissue forming the periosteum and not bone. Osteoclasts

(choice E) are bone-resorbing cells.

QUESTION 8

Sputum from a patient with a respiratory infection reveals bacteria that resist engulfment by phagocytic WBCs. Which of the following factors is most likely responsible for this virulence?

A. A capsule

B. fimbriae

C. flagella

D. lipid A

E. peptidoglycan

Correct Answer: A

Section: Microbiology/Immunology Capsules (choice A) are usually made of polysaccharides and allow bacteria to resist phagocytosis by PMNs and macrophages. Since the capsule contributes to the invasiveness of pathogenic bacteria, it is considered a virulence factor. If the host produces an antibody against the capsule materials, phagocytosis and destruction of the organism can occur. Fimbriae (choice B) are also called pili and attach to cell surfaces to promote microbial colonization. While some bacteria (N. gonorrhoeae, for instance) produce pili and are able to resist phagocytosis if firmly attached, fewer kinds of bacteria produce pili than those capable of producing capsules. Flagella (choice C) are organelles of locomotion and do not resist phagocytosis. Lipid A(choice D) is a component part of endotoxin from gram- negative cell walls. It is considered to be the toxic component of endotoxin, capable of causing inflammation, but does not resist phagocytosis. Peptidoglycan (choice E) is part of gram-positive cell walls. Peptidoglycans do not resist phagocytosis directly but do contain techoic acid residues that allow bacteria to adhere to cells.

QUESTION 9

The terminal ileum was removed from a 50-year-old woman during excision of a tumor. About 3 years later, the patient was admitted to the hospital. She is very pale. Hemoglobin is 9 g/dL, MCV (mean corpuscular volume) has increased to 110 (110 fL). The provisional diagnosis is a vitamin

m^3

deficiency. Which of the following vitamins is the most likely one causing the symptoms?

A. A

B. B1

C. B6

D. B12

E. K

Correct Answer: D

QUESTION 10

A patient has begun exhibiting signs of paranoia and psychosis within the past week. In considering the diagnosis of schizophrenia, which of the following is a crucial piece of information?

A. The patient does not smoke.

B. The patient has a history of similar psychotic episodes in the past.

C. The patient has a history of substance abuse.

D. The patient is a toxicologist.

E. The patient is single.

Correct Answer: B

Section: Behavioral Science and Biostatics Although all the other items (choices A, C, D, and E) may be significant, schizophrenia cannot be diagnosed if the patient has never had an episode of psychotic symptoms lasting for at least 6 months.

QUESTION 11

Which of the following drugs is used to accelerate pulmonary maturation in the fetus in women with premature labor?

A. aminoglutethimide

B. betamethasone

C. mifepristone

D. misoprostol

E. prostacyclin

Correct Answer: B

Section: Pharmacology Glucocorticoids help accelerate maturation of the lungs in the fetus at the end of term. In preterm labor, these drugs help prevent respiratory failure in the newborn. Betamethasone is the preferred corticosteroid for this purpose because it is poorly bound in the maternal serum and transfers into the fetal circulation more readily. The other drugs listed (choices A, CE) are of no value in this setting.

QUESTION 12

After recovery from the surgical removal of the thyroid gland, the quality of the voice in a patient changed to a monotone. It was discovered that the cricothyroid muscle in this patient was paralyzed. The cricothyroid muscle is innervated by which of the following?

A. accessory nerve

B. ansa cervicalis

C. external laryngeal nerve

D. hypoglossal nerve

E. internal laryngeal nerve

Correct Answer: C

Section: Anatomy The external laryngeal nerve, a branch of the superior laryngeal nerve from the vagus, innervates the cricothyroid muscle. Normally, the cricothyroid muscle varies the length and tension of the vocal cord, and in its absence, the voice acquires a monotonous quality. The accessory nerve (XI, choice A) only innervates the sternocleidomastoid and the trapezius muscles in the neck. The ansa cervicalis (choice B) supplies motor branches to the infrahyoid muscles. The hypoglossal nerve (XII, choice D) innervates intrinsic and extrinsic muscle fibers of the tongue. The internal laryngeal nerve (choice E) provides sensory innervation to the interior of the larynx.

QUESTION 13

A 79-year-old female patient was admitted to the hospital, presenting with fever, vomiting, dehydration, and distension of the abdomen. An X-ray reveals ileus and exploratory surgery reveals occlusion of vasa recta of the jejunum. Which of the following arteries supply branches to the involved vasa recta?

A. ileocolic artery

B. inferior pancreaticoduodenal artery

C. right colic artery

D. right gastroepiploic artery

E. superior mesenteric artery

Correct Answer: E

Section: Anatomy Ileus is obstruction of the intestine, in this case due to paralysis resulting from ischemia. The jejunum receives its vascular supply from jejunal branches arising from the superior mesenteric artery. The ileocolic artery (choice A) supplies the ileum, ileocolic junction, and the appendix. The inferior pancreaticoduodenal artery (choice B) provides vascular innervations to the pancreas and duodenum, and forms the anastomosis between the foregut and midgut. The right colic artery (choice C) supplies the ascending colon and the right gastroepiploic artery (choice D) the greater curvature of the stomach and greater omentum.

QUESTION 14

A patient has been admitted for hematemesis (vomiting of blood). Endoscopic examination reveals bleeding esophageal varices resulting from portal obstruction. These varices represent anastomoses between branches of which of the following?

A. inferior vena cava with a patent ductus venosus

B. left gastric, azygos, and hemiazygos veins

C. right gastric vein and the inferior vena cava

D. superior, middle, and inferior rectal veins

E. veins running on the ligamentum teres and the epigastric veins

Correct Answer: B

Section: Anatomy Obstruction of the portal vein results in an increase in the collateral circulation between veins that normally drain to the portal vein and those that drain to the systemic veins. Choices A, B, D, and E all represent possible collateral venous circulation in case of portal obstruction. Choice Ais rare because the ductus venosus closes after birth. Choice B is correct because varicose veins in this region give rise to esophageal varices. Choice D results in varicose veins in the rectal region. Choice C is incorrect because there is no connection between the right gastric vein and the inferior vena cava. In choice E, enlargement of the epigastric veins results in varicose veins radiating from the umbilicus, the caput medusae.

QUESTION 15

In an assay for the presence of a specific disease gene alelle in several individuals, you isolate genomic DNA from each and perfom polymerase chain reaction (PCR) using gene-specific primers. The PCR product is expected to have a recognition site for the restriction endonuclease BamHI. Following PCR and BamHI digestion, the products are separated by gel electrophoresis and the results are shown in below figure. Which lane corresponds to the individual demonstrating heterozygosity for the BamHI site?

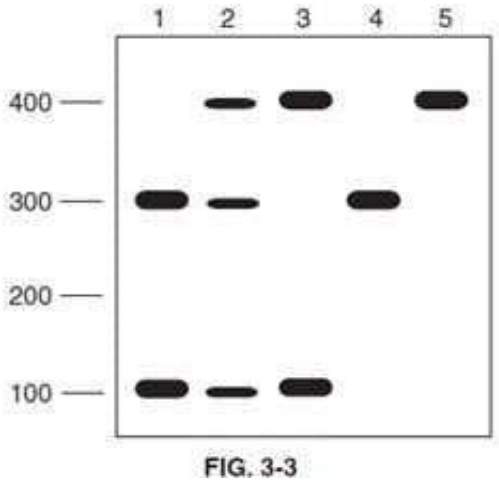

FIG. 3-3

A. 1

B. 2

C. 3

D. 4

E. 5

Correct Answer: B

Section: Biochemistry Someone who exhibits heterozygosity would harbor two distinct alelles. In the case of this analysis, they would be identified as containing a copy of the gene that does not harbor the BamHI site and a copy that does harbor the site. The presence of the BamHI site in the PCR product in this example would result in the generation of 300 and 100 bp fragments. The lack of the site would yield a product of 400 bp. Thus, following PCR amplification and BamHI digestion of DNA from a heterozygote, one would be able to observe three bands of equal intensity. A person who was homozygous for having the BamHI-containing sequence would result in two bands (choice A) whose intensities would be greater than the three of the heterozygote. A person homozygous for the lack of the BamHI site would yield a single 400 bp band (choice D). The banding patterns observed in lanes 3 (choice C) and 5 (choice E) would not be possible from this analysis.