USMLE-STEP-1 Q&As

United States Medical Licensing Step 1

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QUESTION 1

A 23-year-old Caucasian male is admitted to the hospital following a motorcycle accident. On examination, no bones appear to be broken, but there is extensive muscle bruising resulting in tissue swelling from increased capillary permeability. His arterial blood pressure is 80/40. He is awake and able to walk with assistance. Based on this information, it is likely that which of the following will be decreased from normal?

A. circulating levels of catecholamines

B. left atrial pressure

C. plasma aldosterone concentration

D. plasma lactate concentration

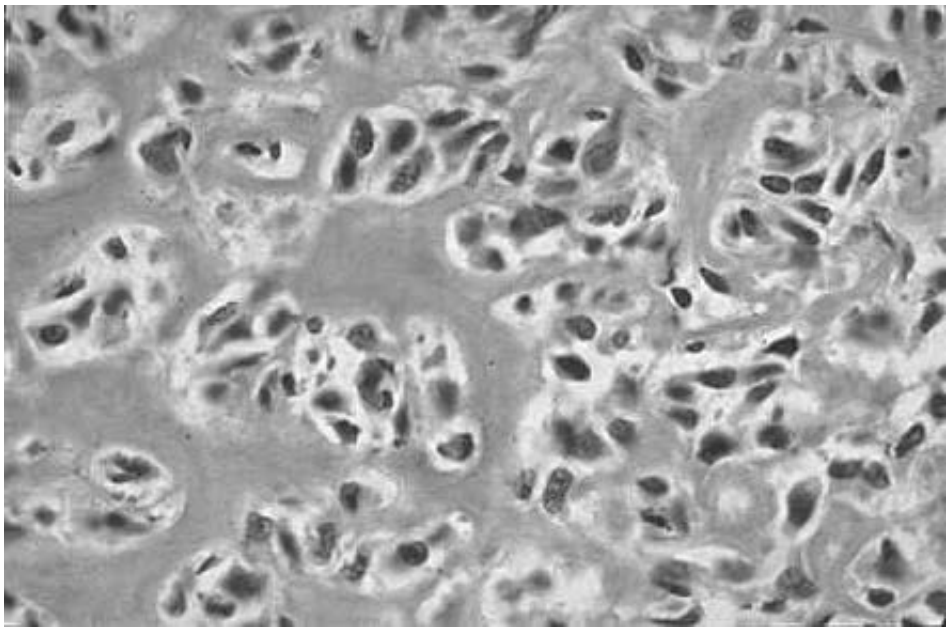
E. plasma renin activity

Correct Answer: D

Section: Physiology The accident trauma produces extensive loss of fluid from the vasculature into the interstitial fluid space. Hence venous return to the heart, and thus left atrial pressure will be reduced. The decrease in arterial pressure will trigger arterial baroreflexes which will activate the sympathetic nervous system and increase catecholamine release (choice A). Likewise the fall in pressure will cause increased renin/angiotensin/ aldosterone (choices C and E). Finally, the reduced perfusion of the tissues will generate increased lactate formation (choice D).

QUESTION 2

A 16-year-old boy fractured his leg while running track at school. X-ray studies revealed an abnormality at the lesion site indicating that this was a pathological fracture. Abiopsy of the area was taken and a photomicrograph of the tissue is shown in below figure. The most likely diagnosis is which of the following?



A. chondroblastoma

B. chondrosarcoma

C. osteoid osteoma

D. osteoblastoma

E. osteochondroma

F. osteosarcoma

Correct Answer: F

Section: Pathology and Path physiology This section in figure shows many large, hyperchromatic, pleomorphic cells that are producing osteoid, typical of an osteosarcoma. A chondroblastoma (choice A) would display sheets of primitive chondroblasts within a cartilage matrix that is irregularly calcified. Chondrosarcoma (choice B) most typically occur in the age range of 4060 with the most common locations being the pelvic girdle, ribs, shoulder girdle, and to a lesser extent the long bones, vertebrae, and sternum. Microscopically, the lower grade tumors will show chondroid differentiation whereas a grade 3 tumor may appear as a spindle cell tumor with little chondroid differentiation. Osteoid osteoma (choice C) and osteoblastoma (choice D) have a very similar microscopic appearance consisting of a random pattern of woven bone with many osteoblasts in evidence within a stroma of granulation-like tissue. Osteoid osteomas are small, very painful tumors that are found in teenagers and young adults and respond very well to aspirin. It usually occurs in the long bones of the leg. Osteoblastomas are larger tumors that more usually affect the vertebrae. Osteochondromas (choice E) (or exostoses) are mushroom-like growths that usually bud from the metaphysic of long bones but may occur, less frequently, at many other sites. Microscopically, one sees irregular trabecular bone covered by a cartilaginous cap.

QUESTION 3

Some viruses, for example, poliovirus, contain a protease that cleaves one of the eukaryotic initiation factors allowing for cap-independent translational initiation of viral RNAs at internal ribosome entry site (IRES). Which of the following factors is the target of these viral proteases?

A. eIF-2

B. eIF-2B

C. eIF-4A

D. eIF-4E

E. eIF-4G

Correct Answer: E

Section: Biochemistry Eukaryotic viral RNAs are not capped and the host 40S ribosome interacts with these viral RNAs at an IRES. Capped eukaryotic mRNAs are recognized by the complex of eIF- 4E and eIF-4G, which in turn allows for interaction of the 40S ribosome with the mRNA (see below figure).

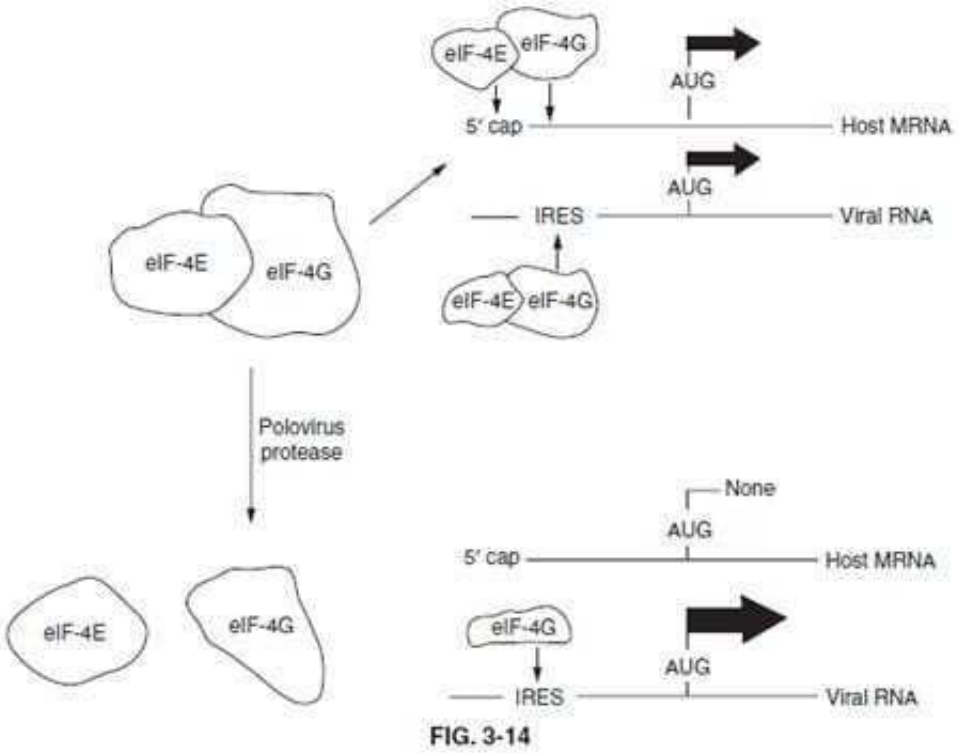


FIG. 3-14

Initiation factor eIF-4E physically binds the cap structure in eukaryotic mRNAs and this function is facilitated by interaction of eIF-4E with eIF-4G. Thus, loss of the interaction of eIF-4E with the protease cleaved eIF- 4G results in loss of translational initiation from capped mRNAs. However, the binding of 40S ribosomes to viral RNAs does not require eIF-4E, only eIF-4G. The protease encoded by the poliovirus cleaves the eIF- 4E binding site on eIF-4G. None of the other translation factors (choices AC, E) are targets for poliovirus protease.

QUESTION 4

Infants exhibiting profound metabolic ketoacidosis, muscular hypotonia, developmental retardation, and who have very large accumulations of methylmalonic acid in their blood and urine suffer from a disorder known as methylmalonic acidemia. This disorder results from a defect in which of the following enzymes?

A. alpha-keto acid dehydrogenase

B. homogentisic acid oxidase

C. methylmalonyl-CoA mutase

D. phenylalanine hydroxylase

E. tyrosine aminotransferase

Correct Answer: C

Section: Biochemistry Defects in methylmalonyl-CoA mutase activity comprise four distinct genotypes whose clinical symptoms are remarkably similar. Characteristic findings in methylmalonyl-CoA mutase deficiency include failure to thrive leading to developmental abnormalities, recurrent vomiting, respiratory distress, hepatomegaly, and muscular hypotonia. In addition, patients have severely elevated levels of methylmalonic acid in the blood and urine. Unaffected individuals have near undetectable levels of methylmalonate in their plasma, whereas, affected individuals have been found to have levels ranging from 3 to 40 mg/dL in their blood. Deficiency in alpha-ketoacid dehydrogenase (choice A)

results in MSUD, so named because of the characteristic odor of the urine in afflicted individuals. Mental retardation in the MSUD is extensive. Deficiency in homogentisic acid oxidase (choice B) results in alkaptonuria. Alkaptonuria results from the accumulation of homogentisic acid, a byproduct of tyrosine catabolism, in the urine and tissues. Oxidation of homogentisate in the urine causes it to turn dark and in the tissues results in ochronosis, which refers to the ochre color of the deposits in connective tissue, bones, and other organs. Deficiency in phenylalanine hydroxylase (choice D) results in PKU which results in severe mental retardation if not detected and treated properly. Deficiency in tyrosine aminotransferase (choice E) results in eye, skin, and neurologic symptomology. The neurologic symptoms are similar to those seen in PKU.

QUESTION 5

Which of the following symptoms can occur frequently in infants suffering from mediumchain acyl- CoA dehydrogenase (MCAD) deficiency if periods between meals are protracted?

A. bone and joint pain and thrombocytopenia

B. hyperammonemia with decreased ketones

C. hyperuricemia and darkening of the urine

D. hypoglycemia and metabolic acidosis with normal levels of ketones

E. metabolic alkalosis with decreased bicarbonate

Correct Answer: D

Section: Biochemistry In infants, the supply of glycogen lasts less than 6 hours and gluconeogenesis is not sufficient to maintain adequate blood glucose levels. Normally, during periods of fasting (in particular during the night) the oxidation of fatty acids provides the necessary ATP to fuel hepatic gluconeogenesis as well as ketone bodies for nonhepatic tissue energy production. In patients with MCAD deficiency there is a drastically reduced capacity to oxidize fatty acids. This leads to an increase in glucose usage with concomitant hypoglycemia. The deficit in the energy production from fatty acid oxidation, necessary for the liver to use other carbon sources, such as glycerol and amino acids, for gluconeogenesis further exacerbates the hypoglycemia. Normally, hypoglycemia is accompanied by an increase in ketone formation from the increased oxidation of fatty acids. In MCAD deficiency there is a reduced level of fatty acid oxidation, hence near normal levels of ketones are detected in the serum. None of the other choices (A, B, C, and E) reflect symptoms related in any way to MCAD deficiency and are not in themselves indicative of any specific disorder per se.