USMLE-STEP-1 Q&As

United States Medical Licensing Step 1

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QUESTION 1

Metformin is one of the most prescribed hypoglycemia-inducing drugs in the treatment of Type II diabetes. One of the effects of metformin is a reduction in adipose tissue lipolysis, which is effected via the activation of AMP-activated kinase (AMPK). Which of the following actions of AMPK explains the adipose tissue benefits of metformin?

A. activation of ACC

B. activation of FAS

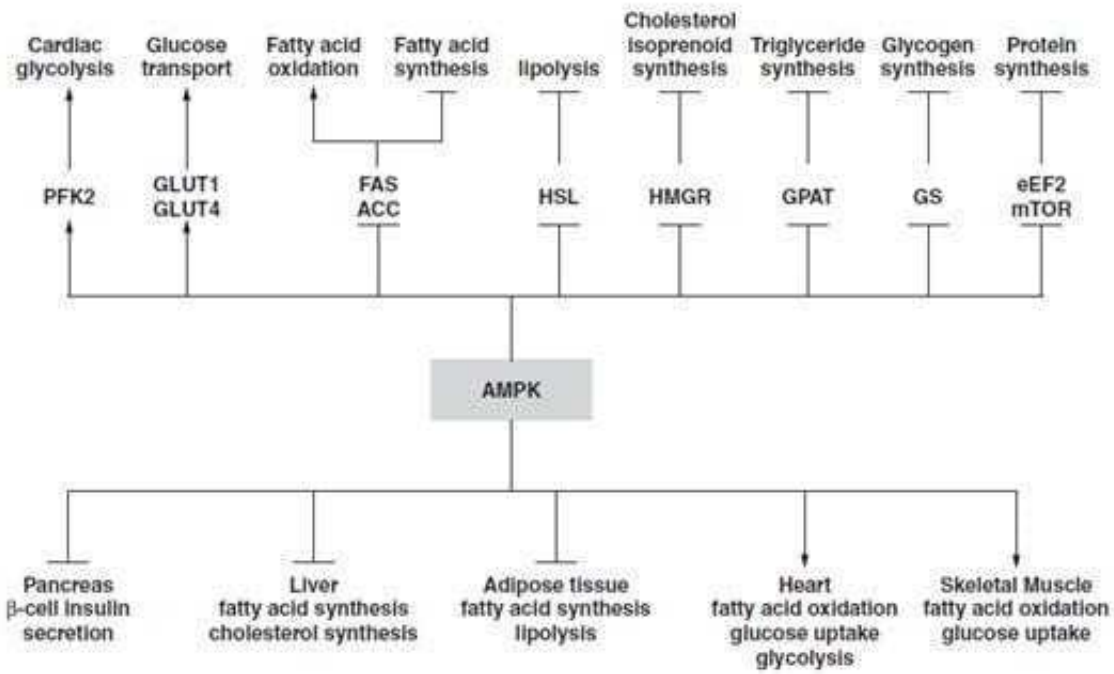
C. inhibition of hormone-sensitive lipase

D. inhibition of mammalian target of rapamycin (mTOR)

E. inhibition of 6-PFK-2

Correct Answer: C

Section: Biochemistry AMP-activated protein kinase (AMPK) was first discovered as an activity that inhibited preparations of ACC and 3-hydroxy-3-methylglutaryl- CoA reductase (HMG-CoA reductase, HMGR) and was induced by AMP. AMPK induces a cascade of events within cells in response to the ever changing energy charge of the cell. The role of AMPK in regulating cellular energy charge places this enzyme at a central control point in maintaining energy homeostasis (see below figure). Once activated, AMPK- ediated phosphorylation events switch cells from active ATP consumption (e.g., fatty acid and cholesterol biosynthesis) to active ATP production (e.g., fatty acid and glucose oxidation). Other important activities attributable to AMPK are regulation of insulin synthesis and secretion in pancreatic islet beta-cells. As shown in AMPK inhibits (not activates) both ACC (choice A) and FAS (choice B). Activation (not inhibition) of PFK-2 (choice E) occurs in response to AMPK. Although AMPK does indeed inhibit mTOR (choice D), this inhibition does not have any influence on adipose tissue lipolysis.



QUESTION 2

Correct targeting of newly synthesized hydrolytic enzymes to the lysosomes requires which of the following modifications?

A. attachment of mannose-6-phosphate to the enzymes

B. gamma-carboxylation of glutamate residues in the enzymes

C. O-linkage of carbohydrate to the enzymes

D. prenylation of the enzymes

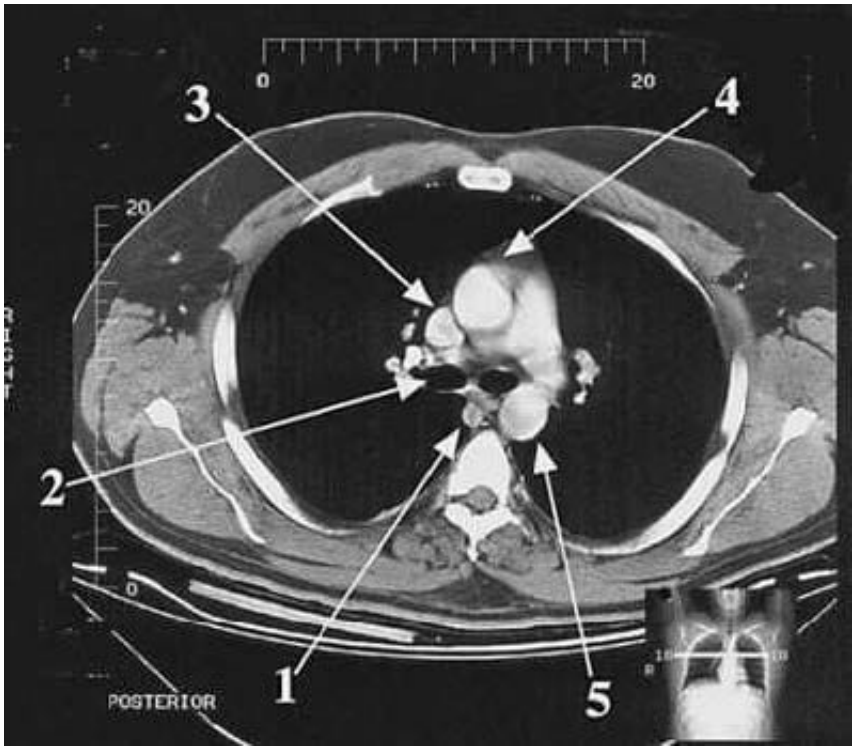
E. proteolytic activation following transport to the lysosome

Correct Answer: A

Section: Biochemistry Enzymes that are targeted to the lysosomes undergo a specific two-step modification in the Golgi complex. The first step in the modification involves the attachment of an alpha- acetylglucosamine 1- phosphate residue to the six position of a mannose residue on the high man-nose carbohydrate portion of lysosomal enzymes. The second step involves removal of the N-acetylglucosamine residue exposing the mannose-6phosphate marker. The presence of mannose-6-phosphate is necessary for targeting lysosomal enzyme to the lysosomes and deficiencies in the enzyme responsible for the first reaction in the modification lead to severe developmental abnormalities. Carboxylation of glutamate residues (choice B) is necessary to the function of several enzymes of the coagulation cascades. Lysosomal enzymes are not modified by attachment of carbohydrate through O-linkage (choice C). Many membraneanchored proteins undergo lipid modification by prenylation (choice D) such as the protein product of the protooncogene RAS. Although many enzymes are activated by proteolytic processing (choice E), this is not required for targeting lysosomal enzymes to the lysosome.

QUESTION 3

A fourth-year medical student is learning to place a central line. To prepare for this procedure, she reviews X-rays and CT scans in order to gain a proper three-dimensional relationship of the structures involved. In following figure what is the structure pointed to by arrow 1?



A. Ascending aorta

B. Azygos vein

C. Descending aorta

D. Right bronchus

E. Superior vena cava

Correct Answer: E

Section: Anatomy Arrow 1 points to the superior vena cava. The central venous catheter is inserted into the subclavian vein and threaded into the superior vena cava. The ascending aorta (choice A) is labeled by arrow 4 and its counterpart, the descending aorta (choice C) by arrow 5. The azygos vein (choice B) is indicated by arrow

1. Arrow 2 indicates the right bronchus (choice D) just as it leaves the carina.

QUESTION 4

Apatient is admitted to the hospital following a knife wound to the abdomen which results in extensive bleeding into the abdomen. The arterial pressure at admission is 65/30 mm Hg with a rapid, weak pulse. Compared to normal, the nerve impulses in the carotid sinus nerves and in the sympathetic nerves are changed in what way?

A. both show decreased nerve impulse rates

B. both show increased nerve impulse rates

C. carotid sinus nerve impulses are decreased, sympathetic are increased

D. carotid sinus nerve impulses are increased, sympathetic are decreased

E. the patient is unconscious so there are no changes in nerve impulse rates

Correct Answer: C

Section: Physiology The carotid sinus baroreceptors signal the magnitude of arterial pressure to the brainstem which then causes reflex inhibition of sympathetic nerves to the body. Thus, a decrease in arterial pressure will cause a reduced carotid sinus nerve impulse rate, which reflexly increases sympathetic nerve impulse rates. Hence, choices A, B, and D are directionally incorrect. Choice E is incorrect because the arterial baroreflexes function at the level of the brainstem, which does not require the conscious mind for its action.

QUESTION 5

A 67-year-old woman complains of gradually increasing fatigue. On physical examination, she is found to be anemic and has a peripheral neuropathy characterized by loss of position and vibratory sense. Laboratory studies document a macrocytic anemia and decreased WBC and platelets counts. What pathological mechanism accounts for these findings?

A. a diet deficient in folate

B. autoantibodies against parietal cells or intrinsic factor

C. chronic blood loss

D. diabetes mellitus E. myelodysplastic sideroblastic anemia

Correct Answer: B

Section: Pathology and Path physiology The clinical and laboratory findings suggest a diagnosis of pernicious anemia. Almost all cases are due to autoantibodies against parietal cells or intrinsic factor. These autoantibodies disrupt the normal absorption of vitamin B12. The inability to absorb vitamin B12 leads to a macrocytic pancytopenia and peripheral neuropathy. A diet deficient in folate (choice A) can cause a macrocytic anemia, but there are no concomitant neurological findings. Chronic blood loss (choice C) usually results in microcytic hypochromic anemia due to iron deficiency. Anemia and peripheral neuropathy commonly occur with diabetes mellitus (choice D). However, the anemia is normocytic and the neuropathy is sensory. Myelodysplastic sideroblastic anemia (choice E) may present hematologically with a macrocytic pancytopenia. A peripheral neuropathy is not seen.