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United States Medical Licensing Step 1

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QUESTION 1

Which of the following apoproteins is found exclusively associated with chylomicrons?

A. apo A

B. apo B48

C. apo CII

D. apo D

E. apo E

Correct Answer: B

QUESTION 2

Which of the following drugs exerts its effects through inhibition of cyclic GMP phosphodiesterase?

A. hydralazine

B. minoxidil

C. nitroprusside

D. prazosin

E. sildenafil

Correct Answer: E

Section: Pharmacology Vasodilators act by one of three mechanisms: increasing cyclic GMP (cGMP) levels in vascular smooth muscle cells; opening potassium channels; or blocking calcium channels. The organic nitrates and nitroprusside (nitrovasodilators) increase cGMP synthesis by generating nitric oxide (NO), which subsequently activates a soluble form of guanylyl cyclase. Activation of muscarinic receptors on vascular endothelial cells results in formation of NO (earlier identified as endothelium-derived relaxing factor) that diffuses to smooth muscle cells and relaxes them through increased cGMP levels. Erection of the penis involves neuronally regulated formation of NO, increased cGMP levels in the corpus cavernosum, and relaxation of cavernosal and vascular smooth muscle in erectile tissue. Rather than stimulating guanylyl cyclase, sildenafil (Viagra) acts as a selective inhibitor of cGMP phosphodiesterase type 5 to increase the half-life of cGMP in the tissues. The fact that sildenafil acts downstream of NO stimulation of guanylyl cyclase accounts for the toxic interactions between it and nitrovasodilators. The mechanism for relaxation of vascular smooth muscle by hydralazine (choice A) is unknown, but may involve NO. Minoxidil (choice B) is metabolized to minoxidil sulfate, which activates an ATP-sensitive potassium channel in smooth muscle. Nitroprusside (choice C) is a nitrovasodilator that spontaneously releases NO by a mechanism distinct from that of the organic nitrates. Prazosin (choice D) produces vasodilation by inhibiting alpha-1adrenoreceptors on arteriolar smooth muscle.

QUESTION 3

During maturation of the oocytes, which of the following structures retain almost all of the cytoplasm after the first meiotic division?

A. first polar body

B. ovum

C. primary oocyte

D. second polar body

E. zygote

Correct Answer: B

Section: Anatomy The first meiotic division results in two secondary oocytes: the ovum retains almost all of the cytoplasm whereas the first polar body (choice A) does not. Primary oocytes (choice C) are the cells undergoing the first meiotic division. The second polar body (choice D) is formed after the second meiotic division. The zygote (choice E) is the fertilized ovum.

QUESTION 4

The change in elimination rate after hour 12 when sodium bicarbonate was administered is expected if drug W is which of the following chemical types?

A. nonelectrolyte

B. strong acid

C. strong base

D. weak acid

E. weak base

Correct Answer: D

Section: Pharmacology By inspection of the graph, it is observed that administration of sodium bicarbonate increases the rate of elimination of the drug (the slope of the line increases and the half-life is shortened). Sodium bicarbonate causes alkalinization of the urine. Alkalinization causes increased ionization of weak acids and accelerates their urinary excretion because the ionized (charged) forms cannot be easily reabsorbed through the tubular epithelium, whereas the uncharged forms of many weak acids are readily reabsorbed. Urinary alkalinization is a strategy sometimes used to hasten the excretion of weak acids, such as aspirin, in overdose situations. Excretion of a nonelectrolyte (choice A) is unaffected by changes in urinary pH because the polarity of nonelectrolytes is insensitive to pH. A strong acid (choice B) is fully ionized (unprotonated) at all attainable urinary pH values so that alteration of urinary pH has no effect on its excretion. A strong base (choice C) is similarly fully charged at all attainable urinary pH values so that alteration of urinary pH has no effect on its excretion. Excretion of a weak base (choice E) is slowed by alkalinization of urinary pH because the uncharged form of a base is readily reabsorbed from the tubular urine predominates.

QUESTION 5

A 4-month-old Caucasian male infant with a temperature of 38.4°C is examined by his pediatrician. His mother indicates that he has had the fever for the past 4 days, been listless, vomiting, and has watery stools. Blood work

indicates the infant is hypoglycemic but this condition does not respond to either epinephrine or glucose administration. In addition, his blood pH is slightly acidic and shows reduced bicarbonate. Other untoward blood chemistry includes elevated triglycerides, cholesterol, and liver enzymes. The child has a protruberant abdomen, thin extremities, and a doll-like face. The pediatrician suspects a specific condition and orders a liver biopsy to test for the activity of which of the following enzyme activities?

A. glucose-6-phosphatase

B. glycogen synthase

C. muscle phosphofructokinase

D. muscle phosphorylase

E. pyruvate kinase

Correct Answer: A

Section: Biochemistry Deficiency in glucose-6-phosphatase (choice A) is one cause of glycogen storage disease type I (specifically type Ia, von Gierke disease). Hallmarks of the disease are hypoglycemia, lactic acidosis, hyperuricemia, and hyperlipidemia. If symptoms do not appear until the third or fourth month they include hepatomegaly and hypoglycemic seizures. Afflicted children have a protruberant abdomen due to the massive hepatomegaly. Outward physical signs also include extremely thin extremities, short stature, and chubby doll-like faces. Liver glycogen synthase deficiency (choice B) presents with morning fatigue and ketotic hypoglycemia on fasting--both of which rapidly disappear on feeding. Symptoms can be rapidly relieved and chemical signs corrected by introducing frequent protein-rich meals and nighttime feedings of suspensions of uncooked corn starch. Adeficiency in muscle phosphofructokinase (choice C) results in glycogen storage disease type VII (Tarui disease). Clinically, the symptoms seen in Tarui disease are very similar to those seen in muscle phosphorylase deficiency (choice D), glycogen storage disease type V (McArdle disease) such as exercise-induced cramping and early fatigue. There are five clinical characteristics allowing distinction betweeen Tarui and McArdle disease: exercise intolerance is evident in childhood and more severe and is associated with nausea and vomiting; the intolerance is particularly acute following meals rich in carbohydrates; hyperuricemia is more severe; compensated hemolytic anemia is evidenced by increased serum bilirubin and reticulocyte count, and lastly; an abnormal polysaccharide is present in muscle fibers. Deficiency in PK (choice E) is the most common enzyme deficiency leading to hemolytic anemia and the disorder is characterized by lifelong episodes. The most severe deficiency will result in embryonic lethality.