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Questions and Answers

1. Which of the following dietary items contain highest functional B12?
- Beef liver.
 - Edible algae.
 - Whole egg.
 - Whole milk.

Answer: A.

Explanation: B12 is produced mainly by microorganisms and is stored in high amounts in the liver in humans and animals. Beef liver contains up to 83 μg per measure. Edible algae contain much higher amounts but are pseudovitamin analogues and inhibit B12-dependent reactions. Whole egg and milk contains 0.64 μg and 1.4 μg per measure, respectively.

2. Which of the following diets contain highest folate?
- Lima beans (raw).
 - Beef liver.
 - Brewer's yeast.
 - Soybeans.

Answer: C.

Explanation: Folate content is higher in yeasts, leafy vegetables, beans, and legumes. Brewer's yeast contains the highest folate level at 1,888 μg per 100 g. For every 100 g of food, content of folate is: beef liver—274 μg , soybeans—661 μg , beans—283 μg , lima (raw)—130 μg , and lima (canned, drained)—13 μg of folate. Dietary folates have lower bioavailability than folic acid supplements from fortification. For this reason the term dietary folate equivalent (DFE) was introduced. Each DFE is equivalent to the amount of folate absorbed from natural dietary folates when consumed with food. 1 μg of folic acid supplement taken on empty stomach is equal to 2 μg of DFE.

3. Which of the following statements is true regarding B12 deficiency?
- Food-cobalamin malabsorption (FCS) is the most common cause of B12 deficiency manifestations.
 - Helicobacter pylori* causes pernicious anemia.
 - Pernicious anemia is the most common cause of B12 deficiency.
 - FCS is being more commonly diagnosed due to an increased awareness to check B12 levels.

Answer: D.

Explanation: FCS is the most common cause of subclinical deficiency of B12; most patients who have low B12 levels seen on laboratory data do not have manifestations from its deficiency. The majority are asymptomatic. FCS at this time is a diagnosis of exclusion. *H. pylori* causes B12 deficiency, but does not cause PA, or stimulation of auto antibodies. PA is an autoimmune disorder resulting from antibodies to IF. PA is not the most common cause of B12 deficiency, but some believe it to be the most common cause of classic symptomatic B12 deficiency.

4. 65-year-old vegetarian female with history of noninsulin requiring diabetes mellitus (25 years), hypertension, presented with tingling and numbness of her feet, and worsening gait for the past year. On examination the only significant findings were extensor plantar reflexes, along with loss of joint sensation, vibratory sensation, and proprioception. The diabetes is well controlled. She is on metformin, glyburide, hydrochlorothiazide, and lisinopril. Fasting glucose 100 mg/dL, B12 level is 110 pg/mL. What is the next step?
- Refer the patient to neurologist for brain imaging, electromyogram, and nerve conduction studies.
 - Check HbA1C, urine for protein, B12, MMA, and tHcy levels.

- C. Continue metformin, add calcium supplements, give 1,000 μg of B12 intramuscular injection, and check HbA1C, urine for protein, MMA, and tHcy levels.
- D. Stop metformin therapy and evaluate for a cause for B12 deficiency.

Answer: C.

Explanation: This patient was taking metformin for 2 decades; it is now well recognized that metformin decreases B12 absorption. As the patient is a vegetarian she is already at risk for vitamin B12 deficiency. Severe symptomatic B12 deficiency is a clinical diagnosis, supported by lab tests. The next best step for this patient is to add calcium supplements (as calcium depletion in the gut is the mechanism for B12 malabsorption with metformin therapy) and give intramuscular injections of B12. To further ascertain the laboratory parameters, check HbA1C, urine for protein, B12, MMA, and tHcy levels; as a diabetic, she may have additional reasons for neuropathy. There is no immediate necessity for imaging brain with CT scan or MRI, or electromyogram. Nerve conduction studies can be performed after B12 administration is initiated. One cannot disagree with stopping metformin therapy, but at this time, there may be additional causes possible; delineating a cause may not always be fruitful. Hence replacement of B12 is a priority in someone with neurological manifestations, as they become irreversible with delay in treatment.

5. 67-Year-old vegetarian male with no significant medical history comes for follow-up with generalized weakness, easy fatigue, and nonspecific complaints. He denies tingling or numbness. On examination no abnormalities detected; his gait and balance are intact, as also his cognition. His routine laboratory studies revealed; B12: 96 pg/mL ; MCV: 101 fL ; Hb: 10 g/dL ; serum ferritin: 110 ng/mL ; transferrin saturation: 35%; intrinsic factor antibodies: negative. What is the preferred mode of B12 supplementation in this patient?
- A. Prescribe intramuscular B12 1,000 μg once a week for 4 weeks and then monthly for life.
- B. Prescribe oral B12 at 1,000 μg every day for life.
- C. Initially give intramuscular B12 and then replete with oral B12.
- D. All of the above.

Answer: B.

Explanation: The most common cause for subclinical deficiency of B12 is food-cobalamin malabsorption syndrome. This patient most likely has FCS, with no neurological manifestations. Test for intrinsic factor antibodies is negative, although this does not rule out pernicious anemia. In this patient oral B12 is preferred over intramuscular B12

due to the lack of neurological manifestations or cognitive impairment, and at this time, one does not suspect poor adherence to therapy. It is also cost-effective. It has been shown that 1–2% of oral B12 is absorbed passively independent of intrinsic factor. To ensure adequacy of oral B12 therapy, B12 levels may be checked initially at 3 months and then annually. It would not be improper to give injections every month following meaningful provider-patient discussions, if the patient was truly symptomatic and wished to be certain of efficacy or the provider had questions about compliance.

6. Which one of the following statements regarding the medication B12 is a false statement?
- A. B12 can be exposed to air without losing its efficacy.
- B. B12 can be exposed to light without losing its efficacy.
- C. B12 is not lost following heating of food.
- D. All of the above.

Answer: B.

Explanation: B12 is a stable compound and remains so after heating and exposure to air. It loses its efficacy once exposed to light. This is the reason that B12 is provided in amber-colored bottles and to be stored in a dark environment. B12 vials are not to be stored in the refrigerator.

7. Which of the following statements regarding folate is false?
- A. Folate absorption is active and passive.
- B. Folate is secreted through bile and participates in enterohepatic circulation.
- C. Folate is filtered through renal glomerulus and absorbed in the proximal renal tubule.
- D. Folate is lipid-soluble and easily permeates through intestinal enterocytes

Answer: D.

Explanation: Folate is a water-soluble essential nutrient; it is absorbed in the small intestine by active and passive mechanisms. Up to 90 μg of folate is secreted into bile and participates in enterohepatic circulation. Folate is filtered through renal glomerulus and absorbed in the proximal renal tubule; this reabsorption is inhibited by alcohol causing folic acid deficiency.

8. Folic acid requirements do not increase in.
- A. Alcohol intake.
- B. Leukemia.
- C. Older adults.
- D. Hemodialysis.

Answer: C.

Explanation: Folic acid requirements do not increase in older adults without an underlying chronic condition; the requirements do not vary with age. Requirements and

replacement are similar in the young and old. Alcohol intake, smoking, and hemodialysis increase folic acid requirements. In cancers such as leukemias, rapidly dividing cells require more folic acid causing its deficiency. Hemodialysis patients lose folate on dialysis. Alcohol consumption causes deficiency by multiple mechanisms that are complex including impaired intestinal absorption and enterohepatic circulation and an increase in urinary excretion of folate.

9. Which of the following diets contain highest folic acid?
- A. Chicken liver.
 - B. Parboiled rice.
 - C. Beef liver.
 - D. Spinach.

Answer: A.

Explanation: Although leafy vegetables contain more folic acid in general, chicken liver contains the highest folic acid at 576 μg per 100 g. Parboiled rice contains 430 μg ; beef liver contains 260 μg ; spinach contains 190 μg . Other foods that contain high folic acid are bakers yeast, corn, turkey, wheat, beef, sunflower, etc. Folate is lost during various

ways of making food edible such as cooking, heating, boiling, and frying.

10. Which one of the following statements is true?
- A. Food folate bioavailability is greater than folic acid supplement.
 - B. Maximal folate absorption occurs in the ileum.
 - C. Folic acid participates in the enterohepatic circulation.
 - D. Folic acid is the natural form found in fruits and green vegetables.

Answer: C.

Explanation: Folic acid is the term for that found in supplements and has almost double the bioavailability of folate, the form in food sources and in the body. Each DFE is equivalent to the amount of folate absorbed from natural dietary folates when consumed with food. One microgram of folic acid as a supplement taken on an empty stomach is equal to 2 μg of DFE. Maximum folate absorption occurs in duodenum and jejunum. Folic acid participates in enterohepatic circulation similar to B12 and bile acids.

