LESSON ASSIGNMENT

LESSON 6
Vitamins and Minerals.

TEXT ASSIGNMENT
Paragraphs 6-1 through 6-4.

LESSON OBJECTIVES
After completing this lesson, you should be able to:

6-1. Given the name of a vitamin or mineral and a list of body functions select the body function of that vitamin or mineral.

6-2. Given the name of a vitamin or mineral and a list of diseases and/or conditions, select the disease and/or condition associated with a deficiency of that vitamin or mineral.

6-3. Given the term water-soluble or lipid soluble select the vitamins that fall into each of these categories.

6-4. Given the name of a vitamin or mineral and a list of toxicities/adverse reactions select the toxicities/adverse reactions associated with that vitamin or mineral.

SUGGESTION
After completing the assignment, complete the exercises at the end of this lesson. These exercises will help you to achieve the lesson objectives.
LESSON 6
VITAMINS AND MINERALS

6-1. INTRODUCTION

a. Vitamins have great biochemical importance because they are essential for maintenance of normal metabolic function, growth, and health. The name vitamin means “vital for life.” Only a few vitamins are synthesized in the body. Thus, most vitamins must be ingested in food or in their pure form as dietary supplements. Only small amounts of vitamins are necessary for growth and health, and an adequate and varied diet will provide all the vitamins needed, except during pregnancy and infancy. Restricted diets as a result of cultural or idiosyncratic beliefs, alcoholism, poverty, ignorance, or disorders of the GI tract that interfere with absorption will lead to vitamin deficiency. In these cases, vitamin preparations are therapeutic.

b. Oral sources of minerals may be found commercially, individually, or combined within a multivitamin and mineral combination. These minerals are inorganic constituents of foods and biological fluids and play a specific role as nutrients. The absence from the diet of only a few of these minerals has been shown to produce specific deficiency problems. A few are known to be involved in metabolic functions and are therefore possible dietary essentials.

c. Vitamins fall into two categories, lipid (fat) soluble or water-soluble. The lipid soluble vitamins are A, D, E, and K. Vitamins C and B complex are examples of water-soluble vitamins.

d. Most problems associated with excessive vitamin intake are related to fat-soluble vitamins because of retention in the body. Problems with excessive water-soluble vitamin intake are minimal because they are rapidly excreted in the urine.

6-2. LIPID-SOLUBLE VITAMINS

a. Fat-soluble vitamins are well absorbed from the normal GI tract. Bile is essential for absorption; therefore, biliary obstruction or hepatic disease may cause impairment of absorption.

b. In general, fat-soluble vitamins will be stored in fatty deposits throughout the body. They may be excreted in the urine as water-soluble metabolites or in the feces, by biliary excretion.
c. Vitamin A.

   (1) Vitamin A is essential for growth, especially in bone, reproduction, and embryonic development. It appears to be essential for the integrity of epithelial cells. It functions in the rods of the retina to form rhodospin that is necessary for night vision.

   (2) Natural sources of vitamin A are milk, butter, eggs, green vegetables, liver, and kidney.

   (3) Common deficiency states are night blindness, keratinization (scales), and dryness of the epithelium, particularly in the extremities, cornea, and conjunctiva. Toxicities seen in overdoses are relatively nonspecifics including irritability, vomiting, dry skin, pruritis, and loss of appetite, headache, gingivitis, and mouth fissure. Diagnosis of overdose is usually made following the appearance of tender, deep tissue swelling on the extremities and in occipital region of the head. Acute intoxication in infants is seen by an increase in intracranial pressure.

d. Vitamin D.

   (1) Vitamin D facilitates the absorption of calcium from the small intestine, which is essential in the mineralization of bone and maintaining normal plasma calcium levels.

   (2) A few natural sources of vitamin D are liver dairy products and fish. In adults, vitamin D deficiency is most likely to occur in times of increased calcium requirements (pregnancy and lactation). This results in “adult rickets” or osteomalacia, which is a decrease in bone density. Gross bone deformities occur only in advanced stages of the disease.

   (3) In children, because of reduction in absorption of calcium and phosphate, the bones do not mineralize properly. Therefore, the bones are not able to support the body weight-giving rise to the deformities of rickets.

   (4) Toxicity or overdose is usually the result of “mega vitamin” therapy. Initial signs and symptoms are those associated with hypercalcemia (weakness, fatigue, headache, nausea, vomiting, and diarrhea). Prolonged hypercalcemia may result in deposition of calcium salts in the soft tissues, most significantly in the kidney.

e. Vitamin E.

   (1) There is much controversy over vitamin E therapy, but it appears to be essential for normal growth maintenance. A biological antioxidant protects unsaturated fatty acids and membrane structures. Natural diet sources include vegetable oils and wheat germ.
(2) Signs of edema and anemia have been seen in infants fed with commercial formulas low in vitamin E.

(3) Overdose toxicity appears as gastrointestinal distress. Two reports have shown possible thrombophlebitis, which was resolved after discontinuation of high dose vitamin E.

f. Vitamin K (phytonadione, menadione, menadiol).

(1) Vitamin K promotes the hepatic biosynthesis of prothrombin, a component necessary for blood clotting. Sources of vitamin K are green leafy vegetables and vitamin K producing bacteria in the intestinal tract.

(2) In adults and infants, the chief clinical deficiency is increased bleeding tendencies. You should note that newborns have no intestinal bacteria and should be administered vitamin K. Prolonged use of broad-spectrum antibiotics or prolonged diarrhea may reduce the level of GI flora and result in a deficiency.

(3) In adults, K1 (phytonadione) overdoses, if given IV, may cause anaphylactic like reactions. K3 (menadione), in excess, can cause nausea, vomiting, and allergic reactions.

(4) K1 overdose in infants causes an increased level of bilirubin in the blood and severe hemolytic anemia. K3 overdose causes an increase in circulating blood in the brain with resultant brain damage or death. It is particularly hazardous in premature infants.

6-3. WATER-SOLUBLE VITAMINS

a. Water-soluble vitamins are well absorbed from the small intestine by active transport in physiologic doses and by diffusion in large doses.

b. In physiologic doses, these vitamins are distributed throughout the body with limited tissue storage. They are excreted as metabolites. In large doses, tissue saturation levels are rapidly reached, and the excess is excreted unchanged in the urine.

c. Vitamin B1 (thiamine).

(1) Vitamin B1 is essential in the oxidation of keto-acids. Natural sources of vitamin B1 are lean meats, milk, fish, poultry, and grains.

(2) A deficiency of thiamin results in beriberi, which is characterized by GI disturbances, peripheral neurologic changes, and CNS depression. If cardiovascular effects (tachycardia, dyspnea on exertion, ECG abnormalities) occur, the condition is referred to as “cardiac beriberi.”
d. Vitamin B2 (riboflavin).

(1) Vitamin B2 acts as a coenzyme for a variety of proteins and is found in milk, lean meats, egg, and yeast.

(2) A lack of this vitamin can cause sore throat and inflammation at the corner of the mouth. Later, inflammation of the tongue and seborrheic dermatosis may appear. B2 deficiency is difficult to recognize because it is similar to other vitamin deficiencies, and the symptoms are common signs of many diseases.

e. Vitamin B6 (pyridoxine).

(1) Vitamin B6 acts as a coenzyme for metabolic transformation of amino acids, particularly the sulfur containing amino acids. Sources are meats, seafood, vegetables, and yeast.

(2) Deficiencies can cause seborrheic-like lesions about the eyes, nose, and mouth. Convulsive seizures may also be seen.

(3) Patients on INH (isoniazid) therapy require B6 supplementation because INH enhances its excretion.

f. Vitamin B12 (cyanocobalamin).

(1) Vitamin B12 is essential for cell growth, replication, and maintenance of myelin throughout the nervous system. Meats, milk, and salt-water fish can provide Vitamin B12 through the diet.

(2) B12 deficiency causes pernicious anemia and may result in nerve damage due to inadequate myelin production.

g. Folic acid (folate) acts as a coenzyme in metabolic reactions in which there is a non-carbon unit transfer. Sources of folic acid are vegetables, meats, and yeast.

h. Niacin (nicotinic acid, nicotinamide).

(1) Niacin acts as a coenzyme in the breakdown of glycogen, fat synthesis, and tissue respiration. Sources are bread, lean meat, liver, and yeast.

(2) Deficiency causes pellagra, which affects the skin, GI tract, or CNS. Reddening of the skin, like sunburn, first appears on the back of the hands. Other areas exposed to light are later affected and become widespread.
(3) Symptoms of the GI tract are inflammation of the mouth and stomach, causing diarrhea. The tongue becomes red and swollen (beefy tongue) and may ulcerate. Headache, dizziness, insomnia, depression, and loss of memory are signs of deficiency in the CNS.

i. Pantothenic acid is a precursor of coenzyme A, an enzyme that transports two-carbon groups in metabolism of fats, protein, and carbohydrates. Pantothenic acid is found in most food, so deficiency states are hard to demonstrate.

j. Biotin.

(1) Biotin acts as a coenzyme in the transport of carbon dioxide in fatty acid synthesis. Sources are meats, vegetables, and cereals.

(2) A deficiency state is difficult to demonstrate in man, but does include loss of hair, dermatitis, and loss of muscular control.

k. Vitamin C (ascorbic acid).

(1) Vitamin C plays a role in cellular respiration, the synthesis of collagen and aids in the absorption of iron from the gut. A few sources are citrus fruits, tomatoes, potatoes, and leafy foods.

(2) The deficiency state, scurvy, is mainly seen as a result of the failure to synthesize collagen. The gums become spongy and bleed easily. Capillary walls increase in fragility and hemorrhage when subjected to mechanical stress or trauma. Lesions of growing bones lead to disunion, freedom of movement, and traumatic fragmentation. Wound healing is also impaired.

6-4. MINERALS

a. As with vitamins, mineral needs vary from patient to patient, depending on their age, condition, and nutritional state. Some are needed in doses more than 100 mg a day, while others are needed in small amounts.

b. Iron is essential for oxygen transport and in enzyme systems concerned with electron transfer (cytochromes). Food sources that contain iron are organ meats, yeast, and wheat germ. A deficiency of iron results in anemia.

c. Fluoride occupies the anionic spaces in the enamel apatite crystal surface of teeth. How it retards dental caries (cavities) is not known. Sources of fluoride include plants and water. People who are deficient in fluoride suffer from excessive dental caries.
d. Calcium is the fifth most abundant mineral in the body. It is present in more than 98 percent in the extracellular fluid and soft tissue. Calcium is essential in the formation of bone and for the coagulation of blood. It plays a central role in muscle contraction.

(1) Lack of calcium (hypocalcemia) may result in muscle cramps, tetany, convulsions, dyspnea, and personality changes.

(2) Excess calcium (hypercalcemia) may result in muscle weakness, thirst, anorexia, vomiting, constipation, stupor, and coma. Severe hypercalcemia may result in calcium deposits in the soft tissue of the body.

e. Other essential minerals include phosphorus, sodium, zinc, sulfur, chlorine, copper, magnesium, potassium, and iodine.

Continue with Exercises

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EXERCISES, LESSON 6

INSTRUCTIONS: Answer the following items by marking the lettered response that best answers the item or best completes the incomplete statement.

After you have completed all of these items, turn to "Solutions to Exercises" at the end of the lesson and check your answers with the solutions. For each exercise answered incorrectly, reread the material referenced after the solution.

For exercises 1 through 6, select the letter of the category on the right that corresponds to the vitamin on the left.

1. __ Vitamin A               a. Water-soluble vitamin
2. __ Vitamin B12             b. Lipid (fat) soluble vitamin
3. __ Vitamin C
4. __ Vitamin D
5. __ Vitamin E
6. __ Vitamin K

7. Which of the following conditions is the result of niacin deficiency?
   a. Scurvy.
   b. Rickets.
   c. Pernicious anemia.
   d. Pellagra.
For exercises 8 through 12, select the letter of the function on the right that corresponds to the vitamin/mineral on the left.

8. __ Iron  
   a. Embryonic development

9. __ Fluoride  
   b. Blood clotting

10. __ Vitamin A  
    c. Absorption of calcium

11. __ Vitamin E  
    d. Normal growth maintenance

12. __ Vitamin K  
    e. Tooth enamel
    f. Oxidation of Keto acids
    g. Oxygen transport

13. Which of the following conditions is the result of Vitamin C deficiency?
   a. Scurvy.
   b. Rickets.
   c. Pernicious anemia.
   d. Pellagra.

14. A toxicity associated with an overdose of Vitamin D is:
   a. Loss of appetite.
   b. Thrombophlebitis.
   c. Hypercalcemia.
   d. Alopecia.

Check Your Answers on Next Page
SOLUTIONS TO EXERCISES, LESSON 6

1. b (para 6-1c)
2. a (para 6-1c)
3. a (para 6-1c)
4. b (para 6-1c)
5. b (para 6-1c)
6. b (para 6-1c)
7. d (para 6-3h(2))
8. g (para 6-4b)
9. e (para 6-4c)
10. a (para 6-2c(1))
11. d (para 6-2e(1))
12. b (para 6-2f(1))
13. a (para 6-3k(2))
14. c (para 6-2d(5))