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Instructions

1. After carefully reading this lesson, study each question and select the one answer you believe to be correct. Circle the appropriate letter on the attached reply card.
2. Complete the card and mail, or fax Mayra Ramos at (416) 764-3937.
3. Your reply card will be marked and you will be advised of your results in a letter from *Tech Talk*.
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Minerals and the role of the pharmacy technician

By Dragana Skokovic-Sunjic, R.Ph., BScPhm.

Statement of objectives

Upon completion of this lesson, the pharmacy technician should be able to:

1. Understand the recommended daily requirements and correct dosing of common minerals.
2. Understand the need to refer at risk patients to the pharmacist.
3. Recognize the potential for overdosing if the patient is taking multiple vitamin/mineral products.

Introduction

Many people are concerned that they do not get sufficient minerals from their diet. These concerns are largely due to reports that the soil in which our food grows is depleted of essential minerals and that food processing destroys minerals. These claims are false. Many developed countries, including Canada, closely monitor the mineral content of the soil used for commercial crops and any deficiencies are corrected. Furthermore, minerals are the least fragile nutrients in our food and processing does not destroy them.^{1,2}

As the interest in mineral supplements continues to expand, it is important for pharmacy staff to be proactive in providing patients with correct information. Pharmacy technicians therefore must recognize when referral to the pharmacist is needed, as minerals taken in amounts larger than the Recommended Nutrient Intake (RNI) may cause serious harm.

Minerals are inorganic substances that occur naturally in all foods and are essential for the functioning of our body. Many

enzymes and proteins require minerals to maintain their structure and perform their functions. The human body needs seven macro minerals in relatively large amounts (calcium, magnesium, potassium, chlorine, phosphorus, sodium and sulphur) plus several micro minerals in very small amounts (e.g., iron, chromium, selenium and zinc).¹

Calcium

Calcium (Ca) builds bones and teeth, helps regulate heartbeat and is involved in blood clotting and muscle contraction.³ Supplementation is needed for patients with inadequate intake or increased dietary needs, including children, adolescents, pregnant and post-menopausal women, and the elderly.^{2,3}

Calcium supplements are available as calcium carbonate (1,250 mg contains 500 mg elemental calcium), calcium citrate (950 mg contains 200 mg elemental calcium²) and calcium gluconate (1,000 mg contains only 90 mg elemental calcium).

Calcium citrate and calcium gluconate have better solubility but lower amounts of ele-

mental calcium. Which calcium salt to take depends on the total amount of calcium needed, potential for side effects, concomitant diseases and patient preferences. The most common and the most affordable calcium supplement is calcium carbonate. Ensure that the calcium dose is based on the amount of elemental calcium. The active transport for calcium in the small bowel is easily saturated, so in order to maximize absorption, this supplement should be taken in single doses containing no more than 500 mg elemental Ca, preferably with meals, three times a day.

Taking with food can minimize gastrointestinal disturbances (bloating, gas, constipation).

Absorption of calcium can be decreased due to vitamin D deficiency, low parathyroid hormone and low stomach acid production. High protein or high fibre diets, foods rich in oxalic acid (spinach, rhubarb), carbonated beverages, caffeine and alcohol can lead to decreased absorption and/or faster elimination of calcium.⁴

Calcium deficiency can lead to stunted growth, rickets, osteoporosis, osteopenia (early stages of bone loss) and convulsions.

Consuming excessive amounts of calcium for prolonged periods should be avoided due to its interference with iron absorption, risk of milk-alkali syndrome (soft tissue calcification and renal impairment) or interactions with medical conditions such as kidney disease.^{2,4}

Dietary sources: Dairy products, sardines, salmon, shellfish, dark green vegetables and calcium-fortified juices.

Interactions: Calcium can interfere with absorption of many drugs and may form insoluble complexes with some. To prevent this interaction, many drugs (including tetracyclines, quinolones, alendronate, levothyroxine) should be administered three to six hours apart from calcium. Thiazide diuretics reduce calcium excretion, increasing calcium levels. Calcium supplementation can increase the risk of hypercalcemia and renal failure in these patients.^{4,5}

Magnesium

Magnesium (Mg) plays an important role in bone and teeth formation, growth, function of nerves and muscles, and regulation of normal heart rhythm.² The kidneys maintain an appropriate concentration of magnesium; therefore, deficiency is rare.

As well as being found in many multivitamins and mineral supplements, magnesium

is an active ingredient in many antacids and laxatives. The amount of magnesium from these sources must be taken into consideration when assessing total daily intake.

Magnesium can cause diarrhea, nausea and stomach upset. Large amounts could cause hypermagnesemia resulting in thirst, hypotension, drowsiness, heart block, and respiratory failure and death.^{2,4,5}

Patients with reduced kidney function should not take magnesium supplements, as this can lead to increased levels of magnesium and possible toxicity.

Dietary sources: Whole grains, raw leafy green vegetables, almonds, cashews, seafood, cocoa, hard and mineral water.

Interactions: Magnesium can form insoluble complexes with tetracyclines, ACE-inhibitors, nitrofurantoin and phenytoin. Potassium-sparing diuretics can increase magnesium levels. Calcium channel blockers and magnesium can have a potential additive effect.^{4,11} Magnesium might increase the effects of oral hypoglycemics (from sulfonylurea family), increasing the risk of hypoglycemia (low blood sugar).^{4,5} Cisplatin and cyclosporine may increase urinary excretion of magnesium and lead to magnesium deficiency.

Iron

Iron (Fe) is essential for the formation of hemoglobin, a component of red blood cells that carry oxygen. Iron is more readily absorbed from

animal sources than from plant sources, and taking it with dietary or supplemental vitamin C increases absorption of iron by improving its solubility.^{2,5}

Iron deficiency can lead to anemia (low iron stores, low hemoglobin), weakness, reduced resistance to infection, fatigue, soreness of the tongue, dystrophy of the nails and skin, fissuring of the angles of the lips.^{2,4,5} Iron deficiency is frequent in infants, children and adolescents, the elderly, patients with chronic ASA use, patients with chronic intestinal disease, women of childbearing age, frequent blood donors and burn victims are also at risk.^{4,5}

The Canadian Paediatric Society states that infants who are not breast-fed should receive iron-fortified formula from birth and breast-fed infants require supplemental iron after six months of age.⁴

Liquid iron preparations can stain the teeth with continuous use. Drinking these products through a straw can prevent this problem.^{4,5}

Adverse effects to supplemental iron include nausea, constipation and, in some patients, diarrhea and dark stools. These can be minimized by taking iron with meals and starting with a low dose then gradually increasing it. Chronic use of doses higher than the RNI can lead to liver cirrhosis and skin discoloration.^{2,4}

Toxicity is rare in adults; however, there is a potential for serious problems with even

low doses in children. Deaths have occurred in children with single oral doses as low as 400 mg of elemental iron.⁴ Tell patients to keep iron supplements out of the reach of children.

Dietary sources: Liver, kidneys, red meat, egg yolks, beans, dried fruits and green vegetables.

Interactions: Iron may decrease absorption of many medications and should be administered at least two hours apart. These include biphosphonates, tetracyclines, quinolones, penicillamine, levodopa, methyl dopa and levothyroxine.^{4,5} Antacids containing magnesium, aluminum or calcium carbonate and cholestyramine can decrease the absorption of iron.^{5,11}

Zinc

Zinc (Zn), a constituent of digestive enzymes, plays an important role in maintaining the integrity of the skin and in wound healing.⁵

Short-term treatment with large doses of zinc (up to 100 mg per day) might decrease some symptoms and shorten the duration of the common cold; however, more studies are needed to confirm this.^{5,7}

There is also some evidence that the combination of 80 mg elemental zinc, 500 mg vitamin C, 400 IU vitamin E and 15 mg to 17 mg beta-carotene daily might reduce the risk of vision loss associated with age-related macular degeneration and slow progression in patients with advanced disease. Zinc alone does not seem to have the same effect.^{5,8}

Doses above 40 mg per day, however, might increase the risk of copper deficiency because zinc competes with copper for protein-binding sites that regulate their absorption.^{1,4} Other potential adverse effects of high zinc intake include nausea, vomiting, diarrhea and immunosuppression.^{3,4} There is preliminary

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Pharmacy
PRACTICE

Minerals: Daily dosing at a glance

Mineral	Recommended nutrient intake (RNI)	
	For men	For women
Calcium (elemental Ca)	1,000-1,200 mg	1,000-1,300 mg (pregnant, lactating, post-menopausal: 1,500 mg) For prevention of osteoporosis: 1,000-1,500 mg
Magnesium (Mg)	420 mg	320 mg (pregnant: up to 400 mg)
Iron (elemental iron; Fe)	9 mg For deficiency: 50 mg-100 mg three times a day	13 mg (pregnant: 18 mg) For deficiency: 50 mg-100 mg three times a day
Zinc (Zn)	12 mg	9 mg (pregnant: 15 mg)
Selenium (Se)	55 mcg	55 mcg (pregnant: up to 60 mcg)
Chromium (Cr)	30 mcg	20 mcg
Potassium (K)	Usual dietary intake 40 mEq - 80 mEq daily; supplementation must be individualized. To prevent hypokalemia in patients receiving diuretics: an additional 20 mEq daily is recommended. For the treatment of hypokalemia: 40 mEq-100 mEq	See dosing guidelines for men.

evidence that high dietary zinc intake might increase the risk of an enlarged prostate and that taking more than 100 mg of supplemental zinc per day or taking zinc supplements for 10 or more years can double the risk of prostate cancer.⁵

Zinc deficiency is uncommon in the developed world.

Dietary sources: Lean meat, shellfish, oysters, whole grains and legumes. Zinc from animal sources is better absorbed than that from plant sources.^{4,12}

Interactions: Tetracycline, quinolones and penicillamine form insoluble complexes with zinc, preventing its absorption. Coffee can decrease zinc absorption by 50 per cent. Potassium-sparing diuretics (amiloride, spironolactone) can lead to zinc accumulation and increase the risk of adverse effects. Thiazide diuretics (hydrochlorothiazide) can increase urinary zinc elimination leading to deficiency.^{4,5}

Selenium

Selenium (Se) is a component of enzymes involved in

antioxidant protection as well as thyroid hormone metabolism.⁵

The amount of selenium in our diet depends largely on the concentration of selenium in the soil. Canada, the U.S., Japan and Norway are the only countries in the world with adequate concentrations of selenium in the soil; as a result, the average Canadian diet contains sufficient selenium to meet daily requirements.^{2,5,9} Deficiency is rare in North America.

Increased intake of dietary selenium decreases the risk of prostate cancer.⁵ Selenized yeast (brewer's yeast grown in a selenium-rich medium) seems to have a similar effect, especially when taken along with an adequate dietary intake of vitamin E.⁹

In high doses (more than 400 mcg per day) selenium can cause hair and nail brittleness, hair loss, fatigue, irritability, nausea, garlic-breath and metallic taste.^{5,10}

Dietary sources: Fish, shellfish, red meat, eggs, poultry,

garlic, onions, tomatoes, broccoli and nuts.

Interactions: There are reports that selenium might decrease the effectiveness of simvastatin and niacin combinations that are used to lower cholesterol.⁵

Chromium

Chromium (Cr) is an active component of glucose tolerance factor. This complex (composed of amino acids and chromium) potentiates insulin and ensures normal glucose tolerance.^{5,11} The common form found in supplements and food is trivalent chromium (Cr III). It might be of value in improving glucose tolerance in patients with type 2 diabetes, but further studies are required to assess its efficacy and safety.¹²

Chromium supplements are generally well tolerated. Patients with kidney dysfunction should avoid chromium supplements as they might exacerbate renal insufficiency.^{5,13}

A popular belief is that chromium will increase athletic performance and increase

lean body mass. However, studies show that chromium does not promote strength or decrease body fat.¹⁴

Deficiency is rare but may occur in malnutrition, stress and pregnancy.

Dietary sources: Meat, animal fat, fish, whole grains, nuts, legumes, brown sugar, coffee, tea, brewer's yeast and canned foods (due to chromium leaching into the contents of the can).

Interactions: Concomitant use of insulin and chromium can increase the risk of hypoglycemia. Non-steroidal anti-inflammatory drugs such as ibuprofen and ASA might increase chromium levels. Corticosteroids (e.g., prednisone) can increase chromium excretion, which can lead to chromium deficiency and corticosteroid-induced hyperglycemia.^{4,5}

Potassium

Potassium (K) is essential for nerve impulse transmissions, muscle contractions (heart, smooth and skeletal muscle), and stomach and kidney function.^{2,4}

Potassium levels are critical as deficiency or excess can cause serious health consequences. High serum potassium levels (hyperkalemia) can cause weakness, flaccid paralysis, vertigo, confusion, low blood pressure, blood in the stool, irregular heartbeat, heart block and death.⁵ Low potassium levels (hypokalemia) can cause muscle weakness, constipation, irregular heartbeat, low blood pressure, frequent urination and cardiac arrest.^{2,4,5} Hypokalemia can be brought on by the use of diuretics, long-term use or high doses of stimulant laxatives such as senna or bisacodyl, or the use of sodium phosphate laxatives (e.g., Oral Fleet PhosphoSoda).^{4,5} Patients receiving drugs that can alter serum potassium usually have their potassium levels monitored by their doctor.⁵

Adverse reactions to potassium supplements include stomach upset, nausea, diarrhea, vomiting and flatulence. Taking the dose with food may help to minimize gastrointestinal side effects.^{2,4,11}

Dietary sources: Bananas, oranges, dried fruits, cereals, beans, milk, green leafy vegetables and low-sodium salt substitutes.^{4,5}

Interactions: Angiotensin-converting enzyme (ACE) inhibitors (captopril, ramipril) and angiotensin receptor blockers (ARBs) (losartan, valsartan) can increase the risk of hyperkalemia in patients taking potassium supplements.^{2,4}

Loop diuretics (furosemide) or thiazide diuretics (hydrochlorothiazide, indapamide) will increase urinary potassium excretion and cause hypokalemia. Diuretics known as potassium-sparing diuretics (amiloride, spironolactone, triamterene) will increase the risk of hyperkalemia in patients supplementing with potassium.^{4,5}

The technician's role

Minerals, like vitamins, are commonly sold in pharmacies, either as individual products or as part of a multiple ingredient supplement. Technicians must recognize the ingredients in these products and be aware that they can sometimes pose health risks to patients. Although most minerals are safe when taken in doses that do not exceed the RNI, there are a number of situations where the patient may be taking insufficient or excessive quantities. Also, a number of medications can interact with minerals. The pharmacy technician can play a critical role in ensuring that these at risk individuals have an opportunity to speak to the pharmacist.

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QUESTIONS

1. Absorption of calcium can be decreased due to which of the following?

- a) Vitamin E deficiency.
- b) Vitamin C deficiency.
- c) Vitamin D deficiency.
- d) Folic acid deficiency.

2. Magnesium can be found in:

- a) Certain laxatives.
- b) Antacids.
- c) Multiple vitamin and mineral supplements.
- d) All of the above.

3. Iron is essential for:

- a) Formation of hemoglobin.
- b) Production of stomach acid.
- c) Prevention of birth defects.
- d) All of the above.

4. Which of the following is TRUE about high dietary zinc

intake?

- a) It can prevent prostate cancer.
- b) It increases the risk of breast cancer.
- c) It increases the risk of enlarged prostate.
- d) None of the above

5. Which statement is TRUE about selenium?

- a) Canadian soil is deficient in selenium.
- b) High dietary selenium can increase the risk of prostate cancer.
- c) Deficiency can cause increased red blood cell fragility.
- d) Selenium increases the cholesterol lowering effect of simvastatin and niacin.

6. What is a good dietary

source of chromium?

- a) Canned foods.
- b) Coffee and tea.
- c) Brewer's yeast.
- d) All of the above.

7. Hypokalemia is used to define:

- a) Low levels of vitamin K.
- b) Low levels of sodium.
- c) Low levels of potassium.
- d) High levels of potassium.

8. Which of the following minerals plays an important role in insulin function and blood glucose regulation?

- a) Selenium.
- b) Iron.
- c) Chromium.
- d) Zinc.

9. Which statement about potassium is FALSE?

- a) Dried fruits are a rich source of potassium.
- b) Potassium supplementation must be individualized.
- c) Patients taking potassium-sparing diuretics should take supplemental potassium.
- d) Deficiency can increase the risk of cardiovascular disease and stroke.

10. What is the recommended daily calcium dose for prevention of osteoporosis in women?

- a) 1,000 mg to 1,500 mg calcium carbonate.
- b) 2,500 mg to 3,750 mg calcium carbonate.
- c) 1,000 mg to 1,500 mg calcium gluconate.
- d) None of the above.

TECH TALK • CE

JULY/AUGUST 2004

Minerals and the role of the pharmacy technician

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Are you a certified technician?

- Yes No

Please help ensure this program continues to be useful to you by answering these questions.

1. Do you now feel more informed about minerals and the role of the pharmacy technician?
 Yes No
2. Was the information in this lesson relevant to you as a technician? Yes No
3. Will you be able to incorporate the information from this lesson into your job as a technician?
 Yes No N/A
4. Was the information in this lesson... Too basic Appropriate Too difficult
5. How satisfied overall are you with this lesson? Very Somewhat Not at all
6. What topic would you like to see covered in a future issue? _____

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