

Calcium and Bone Metabolism: Review Questions

Catherine Anastasopoulou, MD, FACE

QUESTIONS

Choose the single best answer for each question.

Questions 1 and 2 refer to the following case study.

A 55-year-old woman with a history of sarcoidosis and Graves' disease who is taking corticosteroids and antithyroid medication is hospitalized because of hemoptysis. Results of initial laboratory measurements show a serum calcium level of 10.9 mg/dL (normal, 8.8–10.2 mg/dL); further testing reveals an intact parathyroid hormone level of 50 pg/mL (normal, 10–65 pg/mL).

- 1. Which of the following is the most likely cause of hypercalcemia in this patient?**
 - (A) Hyperthyroidism
 - (B) Lung cancer
 - (C) Medications
 - (D) Primary hyperparathyroidism
 - (E) Sarcoidosis
- 2. When the patient is questioned about symptoms, she reports no fatigue, constipation, or weakness. Results of further biochemical blood tests are normal, including indicators of renal function. Which of the following tests should be ordered next in the evaluation and management of hypercalcemia in this patient?**
 - (A) Bone scan
 - (B) Computed tomography of the chest
 - (C) Dual-energy x-ray absorptiometry bone density measurement
 - (D) Lung biopsy
 - (E) Measurement of vitamin D levels
- 3. A 45-year-old man is brought to the hospital with a hip fracture following a minor fall. Bone density measurement of the patient's spine and hip reveals osteoporosis. Which of the following serum levels should be measured in this patient?**
 - (A) Growth hormone
 - (B) Magnesium
 - (C) Sodium and potassium
 - (D) Vitamin B₁₂ and folic acid
 - (E) Vitamin D and calcium
- 4. Which of the following statements is true regarding the bisphosphonate medications used for the treatment of patients with osteoporosis?**
 - (A) The newest of these medications are completely safe for patients with gastrointestinal problems
 - (B) They are contraindicated in patients with renal impairment
 - (C) They are safe to use during breast feeding, because they are not secreted into the breast milk
 - (D) They can cause osteomalacia when used continuously
 - (E) They increase bone mass by stimulating osteoblasts to form new bone
- 5. A 70-year-old woman with no significant medical history presents with severe back pain. Radiography of her spine and pelvis shows diffusely decreased bone mass, and general laboratory measurements reveal a low calcium level. Which of the following is the most likely cause of this patient's hypocalcemia?**
 - (A) Multiple myeloma
 - (B) Osteoporosis
 - (C) Primary hyperparathyroidism
 - (D) Renal failure
 - (E) Vitamin D deficiency
- 6. Which of the following statements is true regarding Paget's disease?**
 - (A) It can be complicated by osteosarcoma
 - (B) It is characterized by a uniform pathology pattern
 - (C) It occurs commonly after chemotherapy for lymphoma
 - (D) It occurs more frequently in women than in men
 - (E) It presents with abnormal calcium and phosphorus levels

(turn page for answers)

Dr. Anastasopoulou is a housestaff endocrinologist at Albert Einstein Medical Center, Philadelphia, PA.

EXPLANATION OF ANSWERS

1. **(D) Primary hyperparathyroidism.** Compared with this patient's high serum calcium level, her intact parathyroid hormone level (PTH intact) is inappropriately high.¹ Primary hyperparathyroidism presents with hypercalcemia and a high PTH intact level. Hyperthyroidism, lung cancer, medications, and sarcoidosis all are associated with low or suppressed PTH intact levels.
2. **(C) Dual-energy x-ray absorptiometry bone density measurement.** Certain findings in patients with primary hyperparathyroidism influence the physician's decision of whether or not to perform surgery. Aside from a symptomatic patient, especially one in hypercalcemic crisis, other indications for surgery include kidney stones, osteoporosis, renal impairment, and young age.¹ To determine the first 3 of these factors, general biochemical tests and ultrasonography of the kidneys, as well as a dual-energy x-ray absorptiometry bone density measurement, are usually performed.
3. **(E) Vitamin D and calcium.** This patient is quite young to be presenting with senile osteoporosis; he should be evaluated for secondary causes of this problem. Basic tests should include a complete blood count, kidney and liver function tests, vitamin D and calcium level measurements, and measurement of testosterone and thyroid hormone levels.² Vitamin B₁₂ and folic acid deficiency have not been associated with osteoporosis, nor have electrolytic abnormalities of sodium, potassium, or magnesium. Although growth hormone abnormalities could indicate a pituitary disorder, the patient would have earlier presented with many other problems, including hypogonadism, thyroid, and/or cortisol problems.
4. **(B) They are contraindicated in patients with renal impairment.** Bisphosphonates are most commonly used to treat patients with osteoporosis, because they are antiresorptive agents and act on osteoclasts to decrease or stop the resorption of the bone. They can pass into breast milk and, therefore, should not be used by patients who are breast-feeding. They also cause esophageal erosions and should be used

with caution in patients with gastrointestinal diseases. The older generation of bisphosphonates (eg, etidronate) caused osteomalacia when used in continuous mode and in high dosages; however, the newest medications in this class (eg, alendronate, risedronate) are safer and have not been shown to cause this complication.

5. **(E) Vitamin D deficiency.** As the elderly population increases, vitamin D deficiency is becoming more and more common and is usually related to poor nutrition combined with limited exposure to sunlight; the 2 sources of vitamin D are the diet and cutaneous synthesis after ultraviolet irradiation. Although the patient's back pain could be explained by any of the suggested diagnoses, osteoporosis is not usually accompanied by calcium abnormalities. Multiple myeloma and primary hyperparathyroidism more frequently present with hypercalcemia; renal failure should have manifested other signs, apart from the hypocalcemia.
6. **(A) It can be complicated by osteosarcoma.** The incidence of osteosarcoma is increased in patients with Paget's disease, although it is still less than 1%. When osteosarcoma does occur, it is highly malignant, and the prognosis is poor. Paget's disease is equally represented in both men and women and is characterized by different patterns of abnormal bone architecture. The only biochemical test with results out of the normal range in patients with the disorder is measurement of alkaline phosphatase level (which is increased).³ Patients can experience bone pain and bowing of the peripheral bones, but these findings are usually unrelated to other medical problems, including chemotherapy for any cancer.

REFERENCES

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3. Delmas PD, Meunier PJ. The management of Paget's disease of bone. *N Engl J Med* 1997;336:558–66.

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