distal end of long bones on bone scintigraphy, the diagnosis of primary pachydermoperiostosis should be considered once other causes of hypertrophic osteoarthropathy have been eliminated.

ACKNOWLEDGMENT

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SELF-STUDY TEST

Skeletal Nuclear Medicine

Questions are taken from the *Nuclear Medicine Self-Study Program I*, published by The Society of Nuclear Medicine

DIRECTIONS

The following items consist of a heading followed by numbered options related to that heading. Select the options that you think are true and those that you think are false. Answers may be found on page 1914.

True statements regarding prostatic carcinoma include which of the following?

1. Osseous metastatic disease is manifested by bone pain in nearly 90% of patients.
2. Elevation of the serum acid phosphatase level indicates metastatic disease to bone.
3. The finding of new areas of increased uptake on serial bone scintigrams has little prognostic importance in patients with known osseous metastases.
4. Radiography and bone scintigraphy are equally sensitive in demonstrating improvement in metastatic disease following therapy.
5. Bone scintigraphy often demonstrates progression of disease in advance of changes in the serum acid phosphatase level.

True statements regarding osteosarcoma include which of the following?

6. The peak incidence is in the second decade of life.
7. It is the most common malignant primary bone tumor.
8. In elderly patients, most osteosarcomas arise either in sites of Paget's disease or after radiation therapy.
9. For radiation-induced osteosarcoma, the average latent interval between irradiation and diagnosis of the tumor is 15 yr.
10. Osseous metastases rarely, if ever, occur before pulmonary metastases.

True statements regarding Ewing's sarcoma include which of the following?

11. Osseous metastases at presentation occur in less than 5% of patients.
12. Most occur in patients between the age of 5 and 20 yr.
13. It most commonly arises in the long bones of the extremities.
14. Pain and swelling are uncommon as presenting symptoms.
15. The diagnosis can be made reliably by radiographic findings alone.

True statements regarding Paget's disease include which of the following?

16. The prevalence varies with geographic location.
17. The tibia is the most frequent site of involvement.
18. A common site of sarcomatous degeneration is the humerus.
19. The most common complication of skull involvement is trigeminal neuralgia.
20. Affected bones are frequently enlarged.
21. The most common tumor complicating Paget's disease is fibrosarcoma.

True statements regarding solitary abnormalities detected by bone scintigraphy in patients with known cancer include which of the following?

22. They should be considered benign when radiographs are normal.
23. The probability of metastasis varies with location of the lesion.
24. Photon-deficient lesions are most often due to metastases.
25. Those in ribs are due to metastasis in more than 50% of cases.
26. They rarely are due to trauma.

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SELF-STUDY TEST
Skeletal Nuclear Medicine
ANSWERS

ITEMS 1–5: Prostatic Carcinoma

ANSWERS: 1, F; 2, F; 3, F; 4, F; 5, T

Patients with prostatic carcinoma metastatic to bone may present with bone pain; however, in at least one series, 43% of patients presented with no pain. Patients may complain of mild arthralgias or other discomforts without accurate localizing signs. The absence of bone pain does not exclude metastatic disease nor does elevation of serum acid phosphatase necessarily imply metastatic disease to bone. Patients with elevated serum acid phosphatase levels and normal bone scintigrams were shown by Pollen et al. to have developed no evidence of bony metastases on mean follow-up of 17 mo. The authors concluded that the elevated serum acid phosphatase levels were caused by extension of the carcinoma through the prostatic capsule in these patients. Patients in whom serial scintigrams show progression of metastatic disease have a significantly shorter mean survival time than those who show improvement or stable scintigrams. Levenson et al. found that radiography and scintigraphy were equally sensitive for documenting progression of disease, but the radiographic abnormalities rarely resolved when the metastatic disease improved or healed. Scintigraphy provided evidence of progression of disease in advance of detectable changes in serum acid phosphatase levels in 74% of patients in one series.

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ITEMS 6–10: Osteosarcoma

ANSWERS: 6, T; 7, F; 8, F; 9, T; 10, F

The most common malignant primary bone tumor is multiple myeloma. Osteosarcoma is the second most common malignant primary bone tumor. Although osteosarcoma can occur anytime between the first decade and the eighth decade of life, the peak incidence is in the second decade.

When sarcomas occur in bones that have been subjected to irradiation, the average latency period is 15 yr, with a range of 2.8–55.0 yr. It is less than 5 yr in only 8% of patients and is more than 20 yr in 30% of patients. Although osteosarcomas do occur with increased frequency in foci of Paget's disease and at sites exposed to radiation therapy, only 19% of the "older" patients with osteosarcoma had preexisting conditions in Dahlin's series.

In patients with osteosarcoma, pulmonary metastases predominate; however, bone metastases can occur alone or can develop before pulmonary metastases occur. Recent studies suggest that the pattern of metastatic disease in patients who are not cured by primary therapy is changing, with a greater frequency of extrapulmonary disease.

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ITEMS 11–15: Ewing's Sarcoma

ANSWERS: 11, F; 12, T; 13, T; 14, F; 15, F

Ewing's sarcoma, on average, occurs in a younger age population than any other primary malignant tumor of bone. Although Ewing's tumors have been seen in patients in the seventh decade of life, the majority of cases occur before the end of the second decade. The most common sites are the long bones of the extremities (femur 22%; tibia 11%; humerus 10%; fibula 9%); however, all bones of the body can be involved with Ewing's sarcoma. The lower extremities and pelvic girdle accounted for approximately 60% of cases in Dahlin's series. Ribs are involved in about 8% of cases.

The most common presenting symptoms of Ewing's tumor are pain and swelling, with pain as the primary symptom in more than 50% of the patients. Swelling in the region of the tumor is common by the time the patients come to medical attention, although swelling alone is rarely a first symptom.

The typical roentgenographic appearance of Ewing's sarcoma is that of a lesion involving a long bone characterized by permeative lytic destruction and periosteal elevation with an "onionskin" appearance. However, these features can be seen in a variety of other primary osseous malignancies, including malignant lymphoma, eosinophilic granuloma, and osteosarcoma, and in acute and chronic osteomyelitis. Pathologic evaluation is always required to establish the diagnosis.

In a recent article, unsuspected sites of skeletal metastasis were demonstrated on bone scintigraphy in approximately 39% of patients. In 53 patients presenting with Ewing's sarcoma, 25 had metastatic disease, and in 20 this was not suspected clinically. Other series have reported a frequency of osseous metastatic disease varying from 11% to 21% at the time of initial presentation.

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ITEMS 16–21: Paget's Disease

ANSWERS: 16, T; 17, F; 18, T; 19, F; 20, T; 21, F

The incidence and prevalence of Paget's disease throughout the world is quite variable. It is common in the United States, Central Europe, England, Australia, and New Zealand, but rare in the Middle East, Asia, and Africa. Although this may be partially racial in origin, the prevalence in the black population in United States cities seems to be similar to that in the white population.

The lumbar spine and pelvis are involved in a majority of patients, followed by the femur and skull. Tibial involvement is less common but often shows the characteristic "blade of grass" radiographic appearance. All

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SELF-STUDY TEST
Skeletal Nuclear Medicine
ANSWERS

bones, including the auditory ossicles, however, can be involved by Paget's disease.

Although the humerus is not one of the more common sites of Paget's disease, it is a relatively common site for sarcomas. In one series the femur was the most common site of sarcoma (33%), followed closely by the humerus (27%). Neoplastic changes within Pagetic bone probably occur in fewer than 1% of the cases. The most common type of sarcoma encountered is osteosarcoma (50%–60%). Less often, the lesion is a fibrosarcoma, chondrosarcoma, or malignant fibrous histiocytomas. Giant cell tumors also arise in Pagetic bone.

Although trigeminal neuralgia and blindness can occur as secondary changes in Paget's disease of the skull, they are much less common than deafness.

One of the roentgenographic hallmarks of Pagetic bone is enlargement of the affected bone. This enlargement of vertebral bodies helps distinguish Paget's disease from the changes caused by metastases. The bone enlargement is probably responsible for deafness and the other neurologic complications of Paget's disease involving the skull.

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ITEMS 22–26: Solitary Scintigraphic Abnormalities in Patients with Cancer

ANSWERS: 22, F; 23, T; 24, F; 25, F; 26, F

A number of studies have been reported on solitary bone scan abnormalities in patients with known extraosseous malignancies or primary bone tumors. Although there is variability between the series, it is clear that the likelihood that a solitary bone scan abnormality is a metastasis will vary with its location in the skeleton. Vertebral lesions are likely metastatic, whereas, rib and periarticular lesions are likely benign in nature.

A solitary metastasis appears quite often as a focus of increased uptake on the bone scan in association with normal radiographic findings. Photon-deficient lesions may be due to metastases that interrupt the vascular supply to the affected bone or to very aggressive metastatic disease with large lytic lesions but relatively little reparative response. The lesions of multiple myeloma typically have little or no reparative response. Most photon-deficient lesions, however, are due to benign causes, such as benign tumors, avascular necrosis, artifacts, or surgical defects.

Solitary abnormalities of the ribs most often are benign. In one series they were due to malignancy in only 10% of the cases. The overall likelihood that a single focus of increased uptake in a rib is due to metastasis is only 31%. Very commonly, a solitary focus of increased uptake on the bone scan is secondary to trauma; this is particularly true of a rib lesion.

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Note: For further in-depth information, please refer to the syllabus pages included at the beginning of *Nuclear Medicine Self-Study Program I: Part I.*