

include hormonally mediated vascular relaxation, intimal hyperplasia and fragmentation of reticulum fibers (progesterone increases noncollagenous protein deposits and estrogen decreases elastin-collagenous content). Also, we can observe increased blood volume and increased cardiac output, and vascular strain due to compression of the inferior vena cava and aorta by the gravid uterus, especially in late pregnancy (7,23,26,28). Therefore, removal of renal artery aneurysms in women of child-bearing age is largely recommended, especially if pregnancy is considered. Surgery is also preferred in patients with aneurysms larger than 1.5 cm, uncalcified aneurysms, lesions increasing in size with time and in symptomatic or uninephric patients (2,6,7,19).

CONCLUSION

Captopril renal scintigraphy with differential assessment of various portions of an ischemic kidney is useful to evaluate the significance of segmental renal artery disease. In this particular case, a renal artery aneurysm was responsible for renovascular disease in one-third of the left kidney.

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Bone Scintigraphy in Hungry Bone Syndrome Following Parathyroidectomy

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A 59-yr-old man with chronic renal failure was admitted for evaluation of generalized skeletal pain and frontal bone mass, which was lytic on radiography. Bone scintigraphy demonstrated several foci of moderately increased uptake, without involvement of the skull mass. Radiographs of these lesions were compatible with brown tumors. Serum parathormone level was elevated and CT demonstrated a lower right cervical mass, consistent with parathyroid tumor. Following the removal of the mass and decrease in parathormone levels, the patient suffered from a prolonged period of hypocalcemia and his bone pain worsened. Repeat bone scintigraphy showed an increase in the number and intensity of the areas of focal uptake, consistent with hungry bone syndrome. This flare-up phenomenon is due to an increase in bone metabolism and is an uncommon finding following parathyroidectomy for primary hyperparathyroidism.

Key Words: hyperparathyroidism; brown tumor; bone scintigraphy;

parathyroidectomy; hungry bone syndrome

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CASE REPORT

A 59-yr-old man in moderate chronic renal failure of unknown etiology complained of generalized bone skeletal pain and recent development of a mass in his forehead. On physical examination, a solid mass with bone consistency, as well as a large neck mass, were palpated. Radiography revealed a large lytic lesion in the left frontal bone (Fig. 1). Bone scintigraphy with ^{99m}Tc-MDP demonstrated diffuse tracer activity in the skull with questionable uptake above the left orbit. Several foci of faint to moderately increased uptake in the sternum, ribs, left shoulder and right sacroiliac joint were visualized (Fig. 2), and were lytic on radiography. Relevant laboratory tests included hemoglobin 10.1 g/liter, WBC 8540/mm³, blood urea nitrogen 40 mg/dl, serum creatinine 3.5 mg/dl, creatinine clearance

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FIGURE 1. Skull radiograph of our patient shows a large lytic lesion in the left frontal bone.

25 ml/min, serum calcium 10.1 mg/dl, serum phosphate 2.7 mg/dl and serum alkaline phosphatase 446 IU/liter (normal range 70–120 IU/liter). Parathormone (PTH) level was markedly elevated (770 ng/liter, normal range: 8–64 ng/liter).

CT of the neck demonstrated a large localized right lower



FIGURE 2. Bone scintigraphy at presentation demonstrates several foci of faint to moderately increased uptake in the sternum, ribs, left shoulder and right sacroiliac joint. Kidneys are visualized only faintly. Radiographic skull lesion is nonvisualized, but a small area of increased activity is visualized above the left orbit.

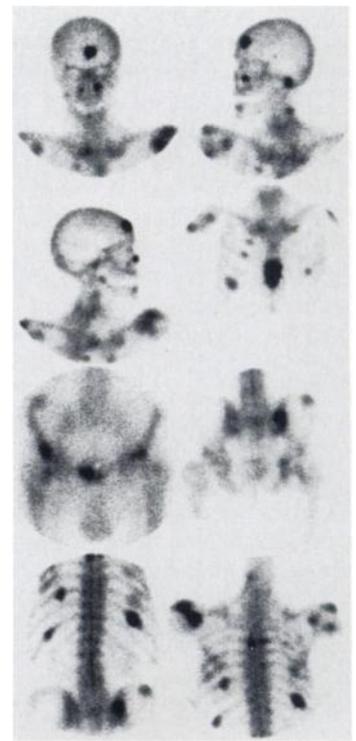


FIGURE 3. Postoperative repeat bone scintigraphy shows intense increased multiple bone uptake in the pelvis, ribs, thoracic vertebrae, shoulders and sternum. The area of the radiographic frontal bone lesion demonstrates intense tracer uptake.

cervical mass with multiple cystic and necrotic areas displacing the thyroid gland anteriorly. Fine-needle aspiration of the skull lesion showed a large number of osteoclasts, some of which contained hemosiderin, which is characteristic of brown tumor. Bone biopsy from the iliac crest revealed similar findings. No evidence of malignant transformation was observed in either specimen.

On neck exploration, an ill-defined mass adherent to surrounding tissue was removed and was diagnosed as parathyroid carcinoma. The patient had a prolonged period of postoperative hospitalization due to protracted symptomatic hypocalcemia requiring large doses of calcium and vitamin D supplements. Two weeks after surgery, the patient complained of severe pain in his ribs, shoulders and pelvis, and his serum calcium level was 7 mg/dl. Repeat bone scintigraphy performed 3 wk following surgery demonstrated multiple foci of intense bone uptake in the pelvis, ribs, sixth and seventh thoracic vertebrae, as well as in both shoulders, the sternum and the skull. The area of the brown tumor in the frontal bone showed prominent uptake this time (Fig. 3). The newly increased uptake was attributed to hungry bone syndrome associated with recent parathyroidectomy. The patient was treated with larger doses of vitamin D and with symptomatic analgesics. PTH decreased to 55 ng/liter, while calcium, phosphate and magnesium levels were maintained at 7.9 mg/dl, 4 mg/dl and 2.02 mg/dl, respectively. Renal function was stable throughout the clinical course and the bone pain gradually subsided.

DISCUSSION

Metabolic bone disease due to hyperparathyroidism caused by adenoma, hyperplasia or rarely by carcinoma, is characterized by increased bone resorption and new bone formation (1–3). Chronic exposure of the skeleton to excessive serum levels of PTH results in bone demineralization, bone marrow fibrosis, expansion of osteoid surface area and an increase in the number of osteoblasts and osteoclasts (4). As the disease progresses, bone cysts and subperiosteal resorption of the long bones become radiographically evident (5). These so-called “brown tumors” are large fibrous scars containing osteoclastic

cells and hemosiderin deposition (6). The radiographic pattern of these lesions consists of lytic areas located in or adjacent to the bone cortex. These lesions may be painful and can continue to grow if hyperparathyroidism remains untreated. Parathyroid carcinoma, which accounts for less than 1% of primary hyperparathyroidism, rarely metastasizes but does tend to recur locally (7).

Bone scan patterns of metabolic bone disease include faint or absent kidney visualization, prominent uptake in the calvaria and the mandible, as well as in the axial skeleton, long bones, periarticular areas, costochondral junctions ("beading") and the sternum ("tie sternum"). These patterns, however, are nonspecific and may appear in healthy subjects (8). The degree of skeletal uptake is related to the serum PTH levels (9), resulting in bone scans that show normal to full patterns of metabolic bone disease (10,11). Occasionally, a bone scan that appears normal in hyperparathyroid patients may be associated with whole-body increased diphosphonate retention (12). Focal abnormalities on bone scans are uncommon and may be associated with brown tumors (13). In severe renal osteodystrophy associated with secondary hyperparathyroidism, the most common scintigraphic findings, besides faint or absent kidney visualization, are markedly increased uptake in the axial skeleton, calvaria and mandible.

Hungry bone syndrome is considered to be present if serum calcium levels are below 8.5 mg/dl and if serum phosphate levels are below 3 mg/dl on the third day after parathyroidectomy (14). The syndrome is caused by severe persistent hypocalcemia and may be found in primary and more commonly in secondary hyperparathyroidism (15). Abrupt lowering of serum PTH levels following surgery causes a decrease in bone resorption as well as an increase in bone formation and in the uptake of minerals such as calcium, phosphate and magnesium, resulting in low serum mineral levels. The degree of fall in serum calcium level is related to the preoperative bone turnover and to the degree of PTH elevation (14-16). Higher preoperative serum calcium and alkaline phosphatase levels are markers of PTH activity; thus, higher levels are predictive of increased risk of the syndrome (14).

Our patient suffered both from chronic renal failure and from primary hyperparathyroidism due to parathyroid carcinoma. While his presurgical bone scintigraphy did show several focal areas of increased uptake, the scintigraphic pattern of metabolic bone disease was not prominent. Following surgery, a flare-up of previously faintly visualized or nonvisualized lesions was noted, indicating the "hungry bone state" and increased bone formation. This phenomenon is similar to the flare-up observed in treated bone metastases where areas of bone resorption, which are not evident on the pretreatment bone scintigraphy, are

replaced by bone formation following treatment and become evident on post-treatment scintigraphy (17). The presence of long-standing severe metabolic bone disease in our patient resulted in the hungry bone syndrome with flare phenomenon following tumor resection, whereas in patients previously reported who had only hyperparathyroidism and no hungry bone syndrome, there was decrease in diphosphonate uptake and no flare-up following parathyroidectomy (18).

Since bone scintigraphy is not routinely performed following parathyroid surgery, the prevalence of this phenomenon cannot be adequately assessed.

CONCLUSION

This case demonstrates the scintigraphic increase in bone uptake following parathyroidectomy in a patient with brown tumors and long-standing hyperparathyroidism. This finding is related to the decrease in serum PTH, which results in an increase in bone formation. Scintigraphic flare-up has to be recognized and not misinterpreted as bone metastases.

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