Thallium-201 Uptake in Eosinophilic Granuloma of the Frontal Bone: Comparison with Technetium-99m-MDP Imaging

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An 11-yr-old female presented with a 6-wk history of left upper lid tenderness and left eye lacrimation. Left lateral supraorbital mass and left preauricular lymph node were the only significant physical examination findings. On skull x-ray, a left frontal bone defect was noted. CT and MRI showed a soft-tissue mass in the area of the bone defect. Bone scintigraphy exhibited peripheral uptake within the central photon deficient area. With $^{201}$TI SPECT, high uptake was noted on early and delayed images. Diagnosis of eosinophilic granuloma was performed by biopsy. Since thallium uptake was seen in the area where photon deficiency was exhibited by $^{99m}$Tc-MDP scintigraphy, we speculate that thallium SPECT could detect eosinophilic granuloma when radiographic skeletal survey or radionuclide bone scan are equivocal. It could also rule out multiple bone involvement and recurrence or regrowth after therapy.

Key Words: eosinophilic granuloma; thallium-201 SPECT; technetium-99m-MDP bone scan


Conventional radiologic features, computed tomography scan (CT) and magnetic resonance imaging (MRI) findings of eosinophilic granuloma are well documented (1-3). The role of $^{99m}$Tc-MDP scintigraphy in detection of single or multifocal involvement of eosinophilic granuloma has also been assessed (4). We present our initial report on the role of $^{201}$TI in the diagnosis and follow-up of eosinophilic granuloma as compared to $^{99m}$Tc-MDP scintigraphy.

CASE REPORT

An 11-yr-old female without any significant past ophthalmic history presented with a 6-wk history of recurrent left upper outer eye lid and temporal fossa tenderness, nocturnal lacrimation and early morning lid edema with ptosis of her left eye. The only significant physical examination findings were a mass about 4 cm in diameter at the superolateral aspect of the left orbit and a nontender, mobile, left preauricular lymph node about 0.6 cm in diameter. Clinical laboratory findings were within normal limits. Conventional roentgenographic studies displayed an osseous defect in the frontal bone (Fig. 1). Plain CT showed a soft-tissue density mass at the site of bony defect (Fig. 2). MRI showed a mass with low signal intensity on T1WI (Fig. 3A), high signal intensity on T2WI and was well enhanced on Gd-DTPA enhanced study (Fig. 3B). Bone scintigraphy with 740 MBq of $^{99m}$Tc-MDP exhibited peripheral high and central low uptake (Fig. 4). SPECT with 148 MBq of $^{201}$TI using a ring-type gamma camera SET-030 (Shimadzu, Kyoto, Japan) exhibited high accumulation on early, 20 min postinjection (Fig. 3A) and delayed, 4 hr postinjection (Fig. 5B) images at the site of tumor.

An incision directly below the left brow was made and a friable, capsulated, submuscular, white to yellowish mass circumscribed by CSF-like fluid was partially excised. Histology of the specimen revealed infiltration of histiocytes cells accompanied by eosinophils, multinucleated giant cells, foam cells and areas of fibrosis that confirmed the diagnosis of eosinophilic granuloma (Fig. 6). There has been no regrowth of the residual tumor during follow-up.

FIGURE 1. Radiograph of the skull in the left lateral view shows a punched-out lesion in the frontal bone.

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FIGURE 2. Axial CT scan with the bone window setting shows a homogeneously soft-tissue mass causing irregular destruction in left side of the frontal bone.

DISCUSSION

Eosinophilic granuloma (unifocal eosinophilic granuloma) is a benign lymphoreticular disorder which together with Letterer-Siwe disease and Hand-Schüller-Christian syndrome (multifocal eosinophilic granuloma) is designated as histiocytosis X and accounts for 60% of such cases. Etiology is unknown but various factors have been implicated. It is common in infants, children, young adults and a slight predominance in males. Although skeletal involvement is common, single infiltrative lesion in the skin, liver, spleen and lungs can also occur (5-7). Local pain could be the presenting symptom associated with a palpable tender mass, but it could also present as a pathologic fracture or with neurologic symptoms when the vertebra is involved (1). Clinical differential diagnosis in children varies from primary to metastatic bone tumors (6).

More than 50% of the lesions occur in the skull, spine, pelvis, ribs and mandible (1). In the calvarium, single or multiple lesions in the frontal bone is common (8). Pathology is due to destruction by granulation tissue forming areas of osteolysis that may involve any portion of any bone (9). Radiologic features in the skull vary from a punched-out appearance, a double-contour or beveled edge appearance to a button sequestrum (1). On CT, a soft-tissue mass with a well marginated intradiploic destructive lesion, having a central density, could be demonstrated (2). With MRI, intermediate to high signal intensity on a T1-weighted image, high signal intensity on a T2-weighted image and marked enhancement were found (3). Since a single-skull lesion could be the only presenting symptom of a multifocal eosinophilic granuloma, radionuclide imaging should be used to rule out multifocal involvement; this would have a marked effect on its management and prognosis (5). Gallium accumulates in bone tumor because of its incorporation into the dynamic metabolism of calcium and its tumor affinity (9). Gallium imaging cannot distinguish tumor from inflammation and is inconsis-

FIGURE 3. MR image shows a heterogeneous mass in the left side exhibiting low signal intensity on a T1-weighted image [TR/TE = 600/13] (A). With gadolinium-DTPA enhanced study, a heterogeneous enhancement of a well delineated mass on the left side with peripheral high signal intensity is demonstrated (B).

FIGURE 4. Technetium-99m-MDP bone scintigraphy of the skull in the left lateral position shows a central photon deficient area surrounded by a rim of increased uptake in the frontal bone.
tent in accurately defining the extent of bone lesion and assessing treatment responses (10). While \(^{99m}\text{Tc}\)-MDP scintigraphy is sensitive to alterations in bone metabolism induced by tumors, the reactive response or healing after therapy for such lesions is indistinguishable from tumor progression (11). In eosinophilic granuloma, \(^{99m}\text{Tc}\)-MDP scintigraphy has a relative efficacy (4). At times high uptake may be shown, but since bone destruction may result in inadequate residual bone to produce uptake, areas of normal distribution or photon deficiency are exhibited (12). The mechanism of uptake of thallium in bone could be affected by factors such as blood flow, cell viability, grade of malignancy and density of viable tumor cells (11,13). It is probably the relative hyperemia which is important in the delivery of thallium and degree of cellularity and metabolism which are more critical determinants of preferential accumulation within malignant tumors that allows it to be differentiated from benign lesion (14). It is the same process that probably causes benign hypercellular or hypervascular tumor to have high uptake on both early and delayed studies (14). Thallium scintigraphy is simple, fast, relatively inexpensive and could resolve malignant potential with significant sensitivity. This makes it preferable over more expensive and invasive diagnostic procedures (11).

The management of unifocal eosinophilic granuloma includes excision or debulking of tumor, low-dose radiotherapy or chemotherapy for recurrent tumors and for lesions that becomes multifocal. Prognosis is good unless recurrence is noted or the unifocal lesion is just a part of a multifocal process. Careful and continued follow-up with imaging procedures or selected skeletal x-ray studies is therefore an essential component of management (5). Since thallium uptake is related more to viability of tumor and accumulates less in bone, it could be useful in follow-up by ruling out recurrence or regrowth (10).

In eosinophilic granuloma, conventional radiography is still the most effective initial screening procedure. CT and MRI could give additional information on the local extent of tumor. Technetium-99m-MDP scintigraphy should be used for screening for other foci of involvement and for follow-up of recurrence but has relative success in eosinophilic granuloma. Since uptake was noted on early and delayed thallium studies, it could complement conventional radiologic findings when bone scintigraphic findings are equivocal. Thallium-201 is a useful method not only in the diagnosis but also in the follow-up of eosinophilic granuloma. Further studies with a larger group of patients is recommended to support this preliminary finding.

**REFERENCES**