

THALLIUM - 201 IMAGING IN OSSEOUS METASTATIC DISEASE SECONDARY TO GLIOBLASTOMA MULTIFORME

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ABSTRACT

Thallium^m 201 whole body scintigraphy was performed in a 30 year old patient with diffuse osseous metastatic disease secondary to glioblastoma multiforme. Multiple sites of Thallium uptake correlated with the findings on serial bone scans and radiographs. Bone biopsy of a lower lumbar vertebra confirmed that the metastases were of glial origin. Iranian J Nucl Med. Summer, 1996.

Key words: thallium-201 chloride; glioblastoma multiforme; bone metastasis

INTRODUCTION

Numerous reports of extracranial metastasis of glioblastoma multiforme have emerged in the medical literature. Sites of metastasis in order of frequency of occurrence include the lungs, liver, lymph nodes, bone, pleurae and kidneys (1). Skeletal involvement with glioblastoma multiforme may be osteolytic (2-4) or osteoblastic (5-7). We recently evaluated a patient with diffuse osteolytic metastases from glioblastoma multiforme. Rapid progression of skeletal metastases was noted on serial whole body bone scans. Whole body imaging with thallium-201 (Tl-201) also was performed. Multiple foci of thallium uptake correlated with the majority of the bone scan findings.

Tl-201 has been used to quantitate the grade of malignancy of gliomas prior to treatment and to determine the presence of residual or recurrent tumor following surgery, radiation or chemotherapy (8,9). Tl-201 uptake by metastatic scalp lesions from glioblastoma multiforme

has recently been reported (10). To our knowledge, this may be the first report of thallium avid distant osseous metastases secondary to glioblastoma multiforme.

CASE REPORT

A 30 year old white male presented with severe headache of several months duration. Physical examination was unremarkable except for a right homonymous hemianopsia. CT of the brain showed a large right posterior parieto-occipital mass. Tumor debulking was performed. Histopathologic examination proved to be glioblastoma multiforme. Postoperatively, he received 40 Gy (4,000 rads) whole brain external beam irradiation with a 20 Gy (2,000 rads) boost to the tumor bed. Two months following surgery and radiation therapy, the patient was referred to our institution. Repeat CT of the brain showed a large right posterior craniotomy but no discrete mass (Fig. 1A.). Single photon emission

computed tomography of the brain performed with 138 MBq Tl-201 (3.7 mCi) during this same time interval showed increased activity at the right posterior parietal lobe (Fig. 1B.). Calculated thallium tumor index was 2.5 which is consistent with residual high grade malignancy. This value was obtained by drawing a region of interest in the area of increased activity and a mirror image region of interest in the contralateral hemisphere and determining the count ratio.

The patient underwent a repeat surgical debulking two months following initial resection. The pathological diagnosis was consistent with residual glioblastoma multiforme and extensive radionecrosis. Postoperatively antibiotic treatment was required for osteomyelitis at the bone flap site. He subsequently received 5.7 GBq (150 mCi) I-125 radiolabeled anti-epidermal growth factor monoclonal antibody treatments in three divided doses.

For 3 months following radioimmunotherapy, he was without complaints. He subsequently developed low back pain with radiation to the right lower extremity and pain in the left shoulder. Due to increasing pain, a bone scan was performed with 777 MBq Tc-99m-HDP (21 mCi) which showed abnormalities throughout the spine, the left shoulder, both scapulae, posterior ribs, the right ilium, both proximal femurs (Fig. 2A, B). One month following the bone scan, a whole body tumor imaging was performed 30 minutes following the intravenous administration of 138 MBq Tl-201 (3.7 mCi). Abnormal activity was noted at left shoulder, posterior ribs and both femurs. (Fig. 2C, D). Unenhanced CT of the lower lumbar and sacral spine was obtained for bone biopsy localization. Diffuse lytic lesions were noted in these areas as well as throughout all bones visualized on a CT of the abdomen and pelvis. No organ involvement was reported. Bone biopsy of the L5 vertebra was consistent with metastatic glioblastoma multiforme. Phenotypic resemblance to the tumor of glial origin was corroborated with focal anti-glial fibrillary acid protein and S100 protein immunochemical staining. Interestingly, during this same time interval, repeat brain imaging with 136 MBq Tl-201 (3.7 mCi) showed abnormal activity in the posterior right parietal lobe with a calculated tumor index of 1.5. Both the size of the abnormality and the index had decreased in comparison to the initial study despite the presence of extensive osseous metastatic disease (Figure 2E). He expired 2 months later with advanced disease.

DISCUSSION

Extraneural metastasis of glioblastoma multiforme once thought to rarely occur has increasingly been

reported. Hoffman and Duffner in a review of the literature in 1984 noted 282 cases of metastasis of central nervous system origin. Seventy-nine of these were due to astrocytoma / glioblastoma multiforme (11). Additional cases have been reported since that time. The usefulness of Tl-201 in the evaluation of brain tumors has received considerable attention in the medical literature. It has been shown to concentrate in primary brain tumors including gliomas, meningiomas and pituitary adenomas (12) as well as cerebral metastases secondary to bronchial, breast and renal carcinomas (13). Thallium accumulation by skeletal metastases originating from breast and thyroid carcinoma also has been described (14,15).

Our case documents thallium avid osseous lesions due to glioblastoma multiforme. Although these metastases were osteolytic on the radiographic studies, the majority of the abnormalities on serial bone scans correlated with these findings suggesting an osteoblastic component as well. Tl-201 whole body scintigraphy demonstrated most of these lesions. However, thallium activity noted at the osseous metastatic sites in our patient was considered mild. Several explanations are possible.

Greater thallium accumulation may have occurred if imaging time was delayed. The whole body thallium scintigram in our patient was performed 10 minutes postinjection. In a recent study by Chen et al., the optimal imaging time for thallium whole body scans in patients with lymphoma was evaluated. Tumors were equally well visualized on both 30 minute and 4 hour images. Tumor/heart and tumor / liver ratios were improved on the 4 hour image, however (16). Ochi et al. have suggested early and delayed imaging to differentiate malignant from benign thyroid lesions. Ninety-four percent of patients with malignant lesions exhibited activity on both early and delayed imaging. Only 12 percent of patients with benign nodules had abnormal delayed images suggesting there may be delayed washout of thallium in malignancy (17).

A larger thallium dose may have better demonstrated the abnormalities on the whole body images. However this may further limit tumor identification. Intense organ activity may have contributed to our inability to detect the spinal abnormalities in our patient.

Tumor affinity for this agent is thought to be multifactorial. Variables include blood flow, the sodium-potassium-ATPase pump and tissue viability (18-20). Waxman et al. showed that more aggressive tumors such as large cell lymphoma exhibited less thallium accumulation than slow growing low grade lymphomas (21). Could this be true for highly aggressive gliomas? This may account for the mild thallium activity seen in our patient.

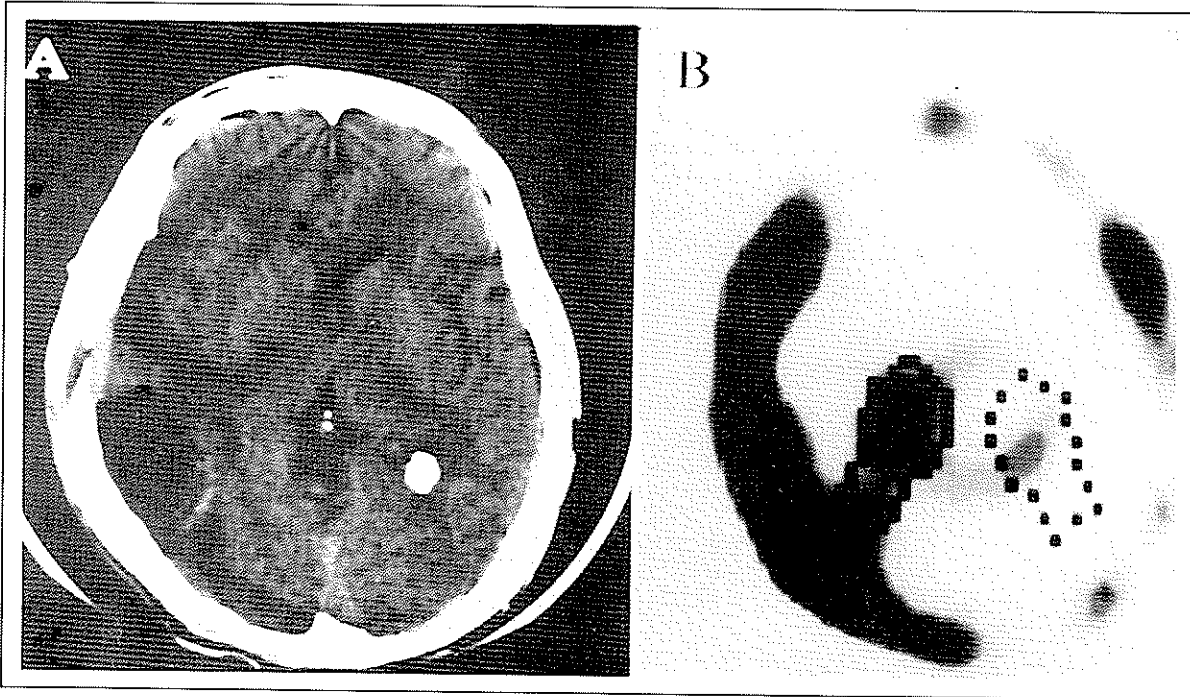


Fig. 1. Space occupying lesion in the right posterior parietal brain. A: CT of the brain post craniotomy shows no discrete mass. B: Thallium-201 Chloride SPECT imaging of the brain shows a mass in right posterior parietal lobe. The Thallium-201 tumor index was 2.5.

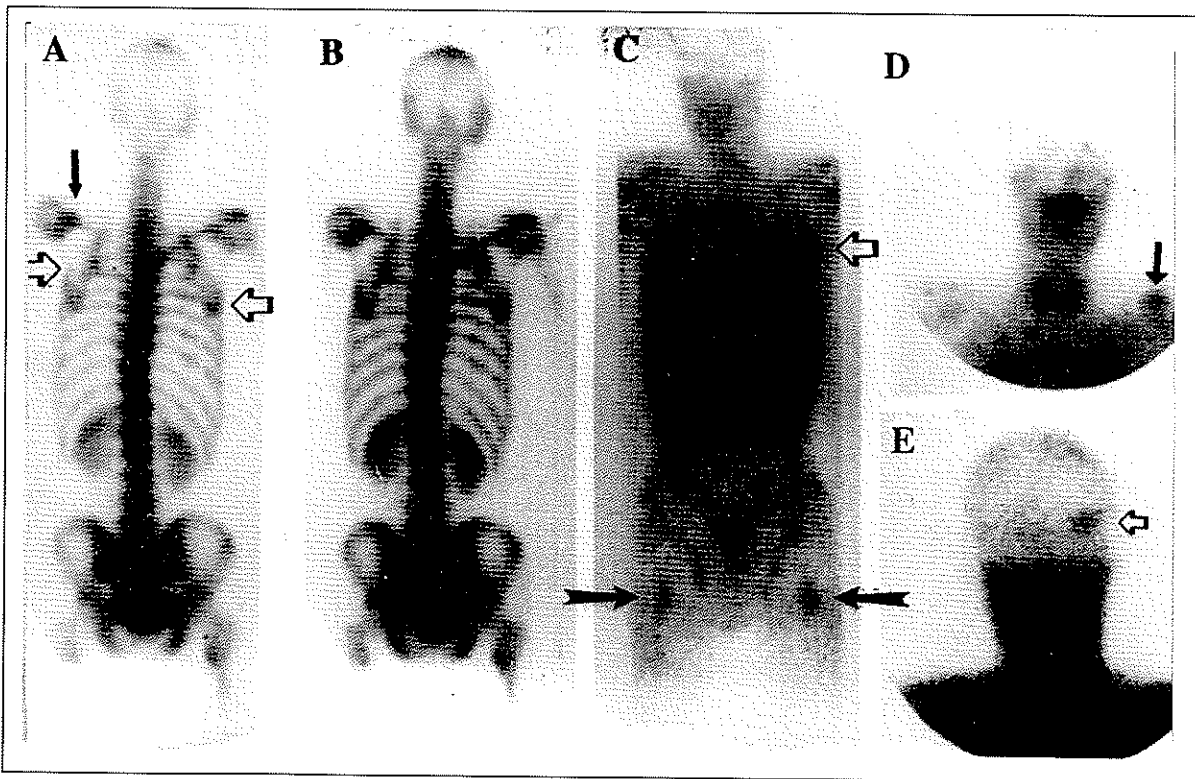


Fig. 2. Metastatic bone disease from glioblastoma multiforme. A, B: Whole body posterior bone scan with Tc-99m HDP: Abnormal uptake in left shoulder, posterior upper ribs, thoracic and lumbar spine, right ilium and both proximal femora (Arrows). C, D: Whole body posterior Thallium-201 imaging: Abnormal uptake in left shoulder, posterior ribs and both proximal femora (Arrows). E: Thallium-201 imaging of the posterior brain: Increased uptake in right posterior parietal brain (Arrow).

Tl-201 may prove to be increasingly valuable in the management of patients pre-and post-surgery, radiotherapy and brachytherapy. It may provide a relatively inexpensive and rapid means for assessing both osseous and non-osseous metastatic disease in a growing number of tumor types. Greater information is necessary regarding optimal dose and imaging time when evaluating various tumor types as well as tumor size and extent of metastases.

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