THE
INDIAN JOURNAL OF
CANCER

ISSN 0019-509X
Volume 44 | Issue 3 | July–September 2007

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Case Report

18F-FDG uptakes in leptomeningeal metastases from carcinoma of the breast on a positron emission tomography/ computerized tomography study

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Abstract

Leptomeningeal metastases (LM) are most commonly observed in hematological malignancies. With prolonged survival in solid tumors, an increased frequency of metastases is noted in these tumors too. Early diagnosis, when the patient has minimal neurological disability, is associated with prolonged survival and improved functional outcome although the therapy is palliative. The diagnosis of LM is difficult, and the demonstration of tumor cells in the cerebrospinal fluid remains the gold standard. This can also be done by definitive neuroimaging. MRI is routinely used in this aspect. We discuss here a case where 18F-FDG PET/CT (Fluoro-de-oxy glucose positron emission tomography/computerized tomography) study helped us in the diagnosis of LM. Whole-body PET/CT imaging could be a useful tool in identifying the possibility of metastases of breast carcinoma in the usual sites and the not-so-usual sites of metastases..

Key words: Breast carcinoma, FDG, leptomeningeal metastases, positron emission tomography/computerized tomography

Introduction

Leptomeningeal metastatic tumors can arise from CNS and non-CNS sources.[1] Solid tumors with leptomeningeal spread include breast, small-cell lung cancer, melanoma, genitourinary, head and neck. These may occur with or without the involvement of brain parenchyma. Small-cell lung cancer involves the meninges, but non-small-cell lung carcinoma manifests only as brain metastases with no involvement of subarachnoid space. Breast carcinoma and melanoma spread to both.[2,3]

The diagnosis of leptomeningeal metastases (LM) is traditionally dependent on the identification of malignant cells in the cerebrospinal fluid (CSF), which is considered the gold standard. The first lumbar puncture reveals positive cytology in only up to 50% of patients, and the yield increases to 90% only after three lumbar punctures.[4]

With the advent of MRI, there has been a considerable improvement in the diagnosis of this subarachnoid tumor. The spectrums of findings that clinch the diagnosis include (a) enhancement of cranial nerves, (b) nodules on cauda equina or (c) thickened enhancement along the surface of brain or spinal cord.

Due to increased glycolysis and cell turnover, there is increased glucose uptake by the tumor cells. The sites of metastases would also show this property. FDG studies make use of this property of malignant cells to help identify areas of increased metabolism, indirectly locating areas of metastases. LM also retains this property.

We report a case to demonstrate the potential of FDG PET/CT (Fluoro-de-oxy glucose Positron Emission Tomography/Computerized Tomography) to highlight this fact.

Case Report

A 49-year-old lady, with a history of left breast carcinoma, underwent a radical left mastectomy followed by six cycles of chemotherapy and local radiation to the chest. She developed brain metastases after 8 months of the above treatment, for which she was treated with external radiotherapy to the brain.

Four months later, she came with complaint of severe generalized backache. Relevant investigations such as bone scan and non-contrast MRI spine were negative.

She was referred for PET/CT study to identify the presence of metastases, if any.

PET/CT images were obtained 60 min after an I.V. injection of 370 MBq of 18F-FDG in the patient fasting for a minimum of 6 h. The images were acquired using a full-ring BGO-based PET/CT scanner (GE Discovery ST, GE Medical Systems, Milwaukee, WI, USA).

CT-based attenuation correction was done (110 mA low-dose CT). The images were reconstructed using the standard iterative method with OSEM algorithm.

Three sets of images were reformatted into transaxial, coronals and sagittal sections of 3.27-cm thickness. Fusion images of the PET and CT were obtained using the inbuilt hardware.

Areas of focal-increased FDG concentration other than the physiological sites were considered abnormal. The standardized uptake value (SUV) was obtained using the inbuilt software.

The PET images were interpreted by a nuclear medicine physician while the fused images were interpreted with the help of radiologists. The findings were then analyzed with respect to the patient's history and disease process.

The PET/CT images showed increased tracer uptake in the left chest wall region correlating to the postoperative bed region on the CT images [Figure 1]. The few pleural-based nodules in the right lung showed increased FDG concentrations [Figure 2].

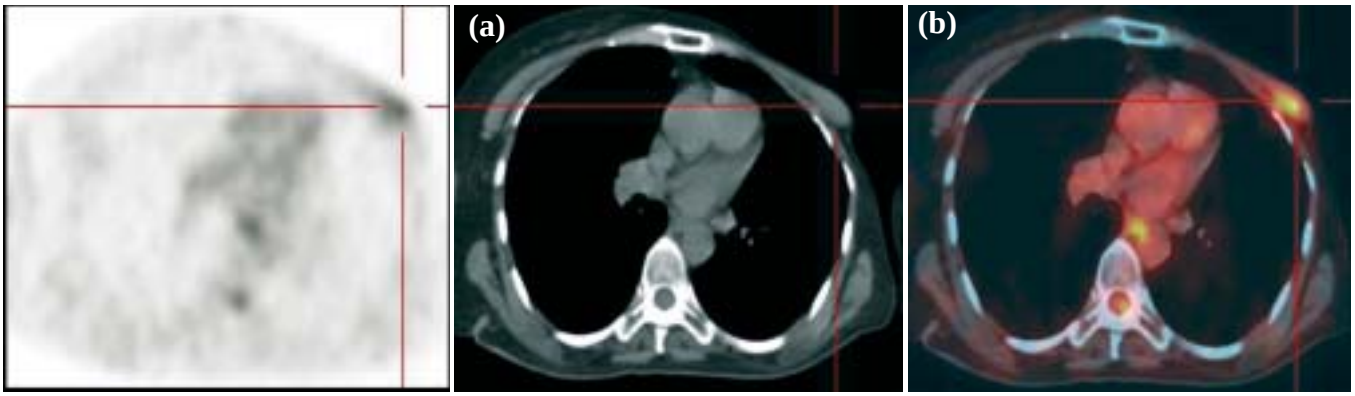

Figure 1: The images show an increased FDG uptake in the left chest wall region on PET image: (a) CT component of the study shows the breast region; (b) left chest wall region fused image

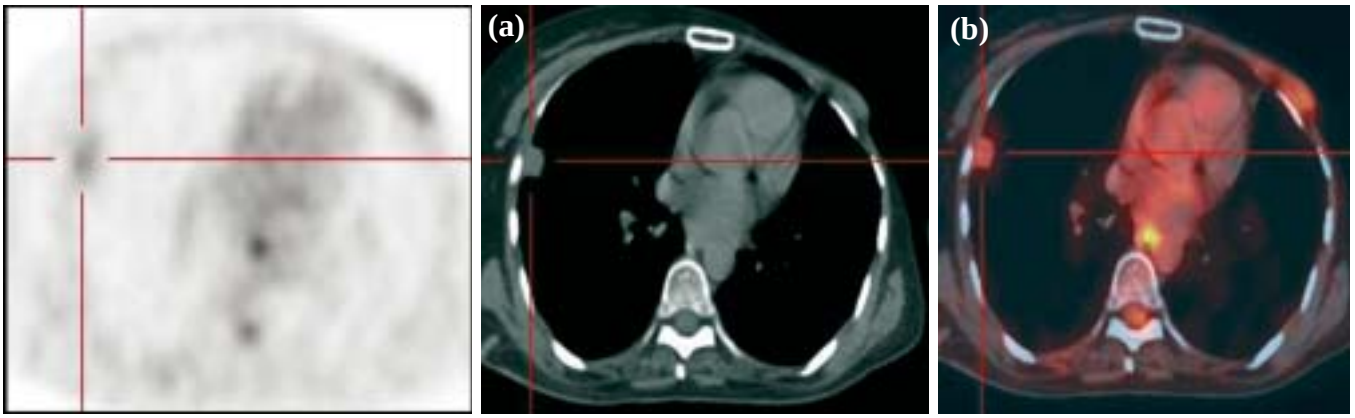

Figure 2: This image shows a right pleural nodule: (a) correlating CT image of right pleural nodule; (b) fused image of right pleural nodule

Another interesting finding the images revealed was a curvilinear area of increased tracer uptake posteriorly in the dorsolumbar region. The SUV was 6 (g/ml). This uptake correlates with the ventral surface of the cord on the CT images [Figure 3].

In view of a past history of breast carcinoma with treated brain metastases, the possibility of LM was raised, and a contrast-enhanced MRI was requested.

The contrast images showed focal nodular enhancement and thickening on the surface of the cord, suggestive of LM [Figure 4].

Discussion

LM is one of the most devastating complications of certain solid cancers of the breast, lung and colon.

About 2-5% of patients with breast cancer may develop LM, usually late in the course of the disease.[5,6] Tumor cells reach the leptomeninges by direct extension or hematogenous spread and disseminate throughout the neuraxis by the flow of CSF. The most common sign is multiple cranial nerve palsies, but headache, backache, polyradiculopathies, incontinence, confusional state; lower motor neuron weakness and sensory abnormalities may be the principal manifestation. Focal neurological signs and seizures may be seen, and about half the patients may develop hydrocephalus.[6] The prognosis is poor with a median survival of 2-4 months; therefore, most treatment interventions are palliative.

Early diagnosis of this condition is important because neurological dysfunction is preventable with treatment. Diagnosis must be considered when patient's symptoms and signs are minimal and a high index of suspicion is raised.

Predisposing high-risk groups like patients with brain metastasis especially in the posterior fossa or multiple superficial tumors are more prone to develop leptomeningeal spread due to the seeding of the subarachnoid spaces.

Routinely, a contrast-enhanced MRI scan is used as the gold standard for the diagnosis of this condition. Enhancement of the metastatic lesion is dramatic as even small nodular metastases enhance strongly and are easily detected on post-contrast T1-weighted sequence images. If plain MRI is performed, the condition could be missed, as in our case study, the lesions were not identified.

Literature search has identified one case report of increased FDG uptakes at the site of LM with spinal cord metastases in a patient of lung carcinoma.[7] Another case report mentions the use of 11C methionine uptake in the patient of breast carcinoma, showing increased uptakes at the site of leptomeningeal carcinomatosis.[8]

The evaluation of post-treatment cases of carcinoma of the breast during the follow-up periods with FDG

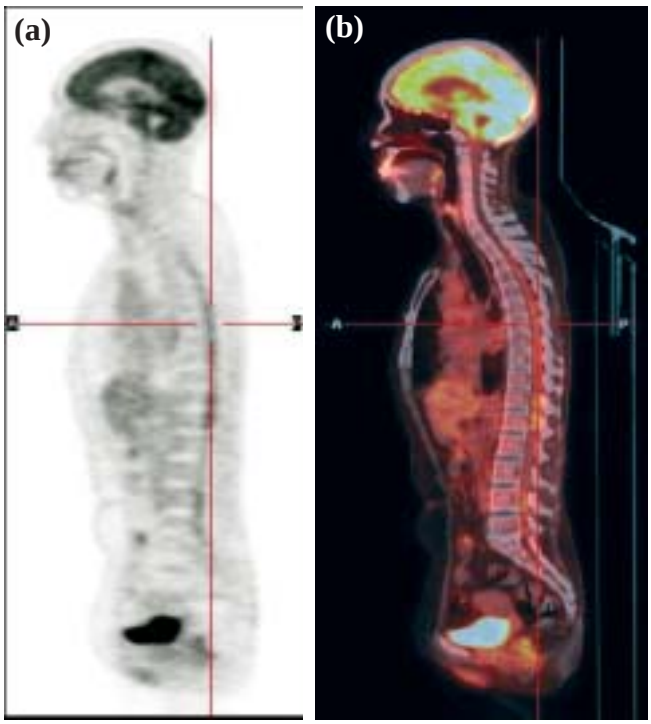

Figure 3: (a) Curvilinear uptake in the posterior aspect of body; (b) fused image correlates with ventral surface of spinal cord

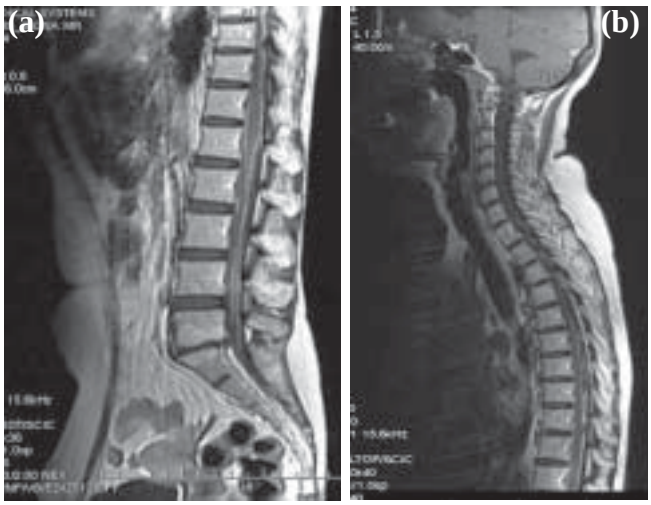

Figure 4: Contrast MRI images of spine of the same patient showing enhancing nodular thickening on the cord surface, suggestive of (a) leptomeningeal metastases - lumbosacral region; (b) leptomeningeal metastases - dorsal spine

PET/CT would help in identifying the possibility of metastatic involvement of the skeletal, pulmonary and hepatic systems in a single study. We could also propose the advantage in picking up LM, although further studies are needed to justify this.

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Source of Support: Nil, **Conflict of Interest:** None declared.