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Intracardiac Metastases Detected by ^{18}F-FSPG-PET

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Abstract

PET/CT imaging is frequently utilized for cancer diagnosis and re-staging as metabolically active cells, including cancer, utilize glucose for proliferation. ^{18}F-FDG is the most commonly utilized radiopharmaceutical in PET/CT imaging. Limitations of ^{18}F-FDG imaging include intense physiologic uptake in benign tissues such as the brain and myocardium. We present a case of non-small cell lung cancer with myocardial and pericardial metastases obscured by physiologic ^{18}F-FDG cardiac uptake but detected with the investigational PET radiotracer (4S)-4-(3-(18)F-fluoropropyl)-l-glutamate (^{18}F-FSPG), which targets glutaminolysis, an alternative energy pathway for proliferation. This case demonstrates the added value of ^{18}F-FSPG PET/CT imaging.

Keywords

lung cancer; glutaminolysis; PET/CT; lung nodule

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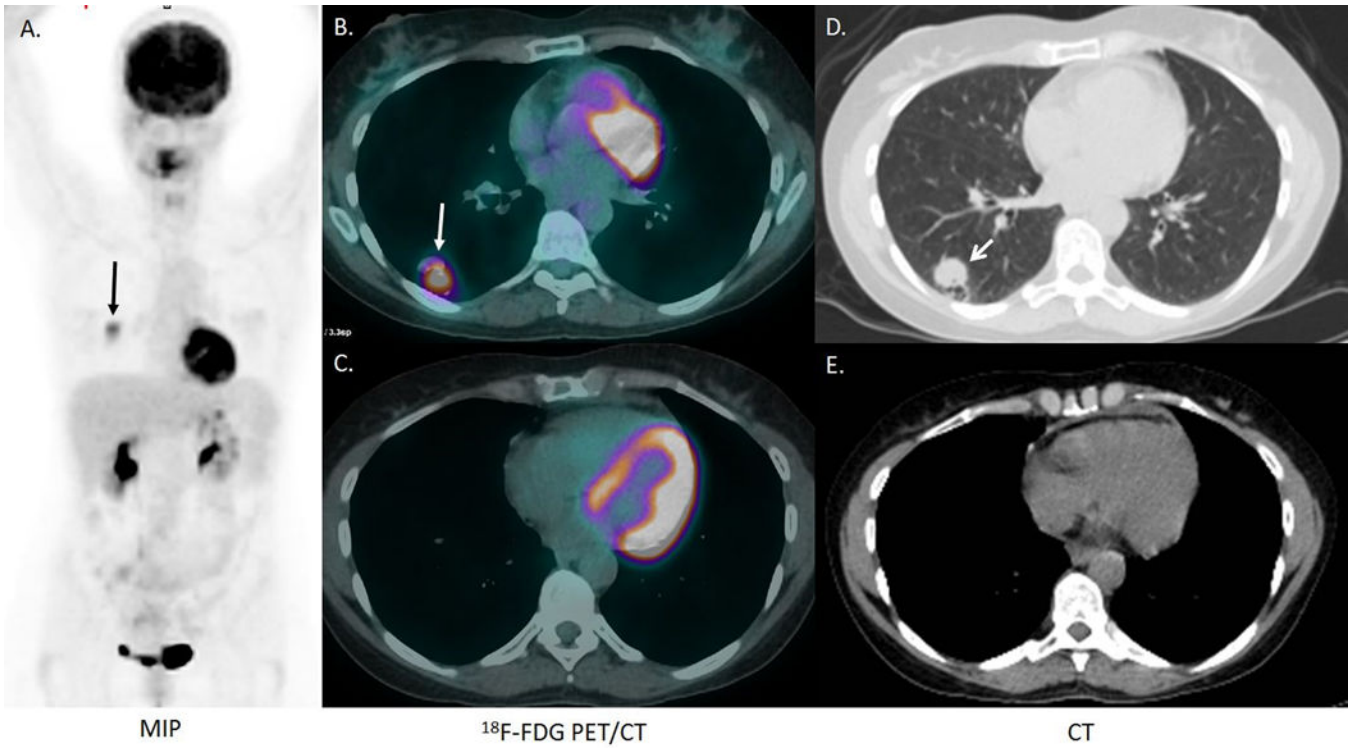

Figure 1.

A 54-year-old woman with a history of stage IV non-small cell lung adenocarcinoma, metastatic to the mediastinum and brain, was previously treated with chemoradiation with 4 cycles of carboplatin, paclitaxel, and bevacizumab, radiation and stereotactic radiosurgery to all metastatic brain sites was in remission for 5 years. A surveillance chest CT revealed a 2.0 × 1.6 cm right lower lobe indeterminate pulmonary nodule (not shown). ^{18}F-FDG PET/CT was performed 73 minutes after the intravenous injection of 395.9, MBq (10.7 mCi) of ^{18}F-FDG. The MIP image (A) and the fusion and CT images (B, C) demonstrate intense FDG uptake in the 2.0 × 1.6 cm right lower lobe nodule, and physiologic intense FDG uptake in the brain and myocardium (A, B, C). Intense FDG uptake was also detected in a 1.4 × 1.5 cm left adrenal nodule and 1.7 × 2.5 cm proximal right thigh soft tissue nodule (not shown). A brain MRI demonstrated no significant changes in the appearance of the treated brain metastases, and no new brain metastases (not shown). Pathology from an excisional biopsy of the right thigh nodule revealed metastatic sarcomatoid carcinoma most compatible with a lung primary. Immunohistochemical stains demonstrated that the tumor cells were diffusely and strongly positive for cytokeratins (AE1/AE3 and CAM 5.2), while negative for S100, muscle-specific actin, smooth muscle actin, h-caldesmon, and myogenin. Genetic analysis of the tumor revealed a KRAS mutation and a BRAF V600L mutation.

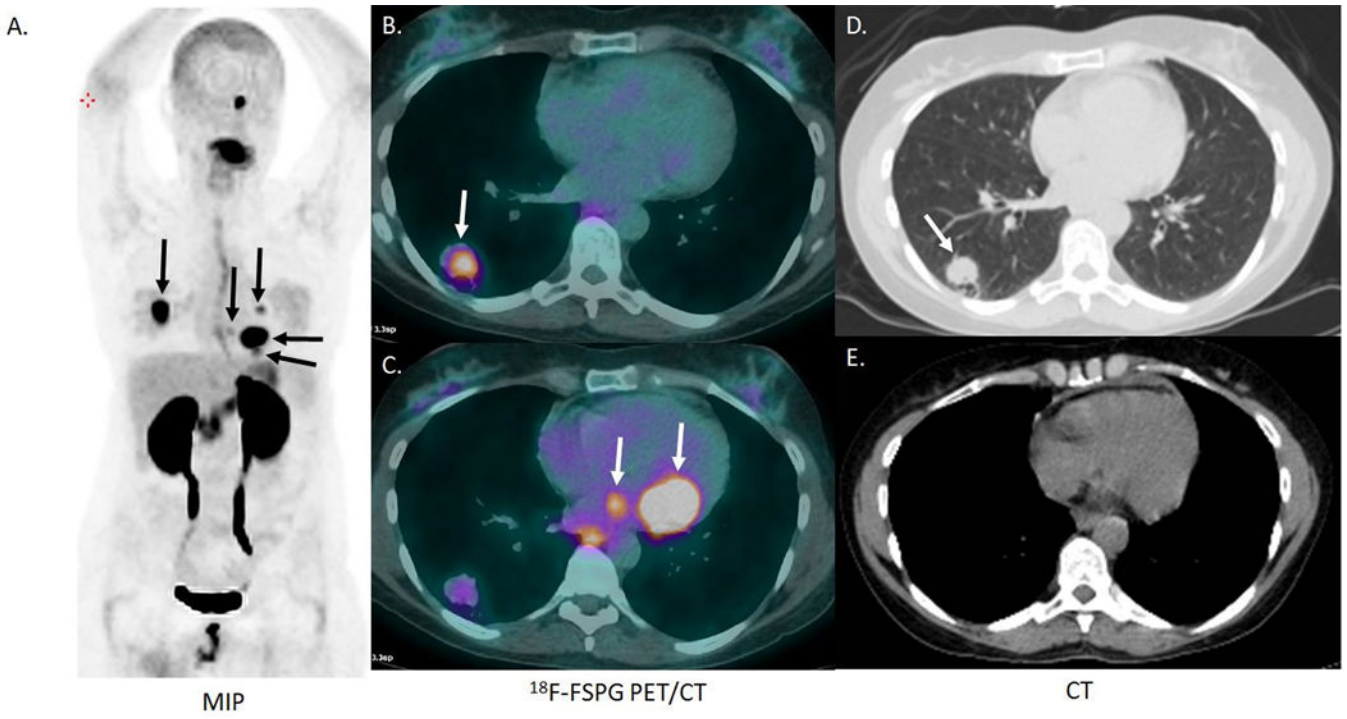

Figure 2.

^{18}F-FSPG imaging was subsequently performed as part of a clinical trial (NCT02448225), with local IRB approval and after informed consent. ^{18}F-FSPG PET/CT was performed 62 minutes after the intravenous administration of 300.8 MBq (8.13 mCi) ^{18}F-FSPG. Other than surgical excision of the right thigh metastasis, there was no intervening treatment in the 34 days between the ^{18}F-FDG and ^{18}F-FSPG PET/CT scans. The MIP image shows low physiologic uptake of ^{18}F-FSPG within the brain and heart (A). The ^{18}F-FSPG PET/CT images demonstrate intense uptake in the right lower lobe lung nodule (A, B, C, D) and left adrenal metastases seen with ^{18}F-FDG (not shown). This examination also revealed multiple intensely FDG avid cardiac metastatic lesions (A, C) and one metabolically active brain metastasis (A), which were not detected with ^{18}F-FDG PET/CT imaging. The patient had no symptoms related to these unsuspected cardiac and pericardial lesions.

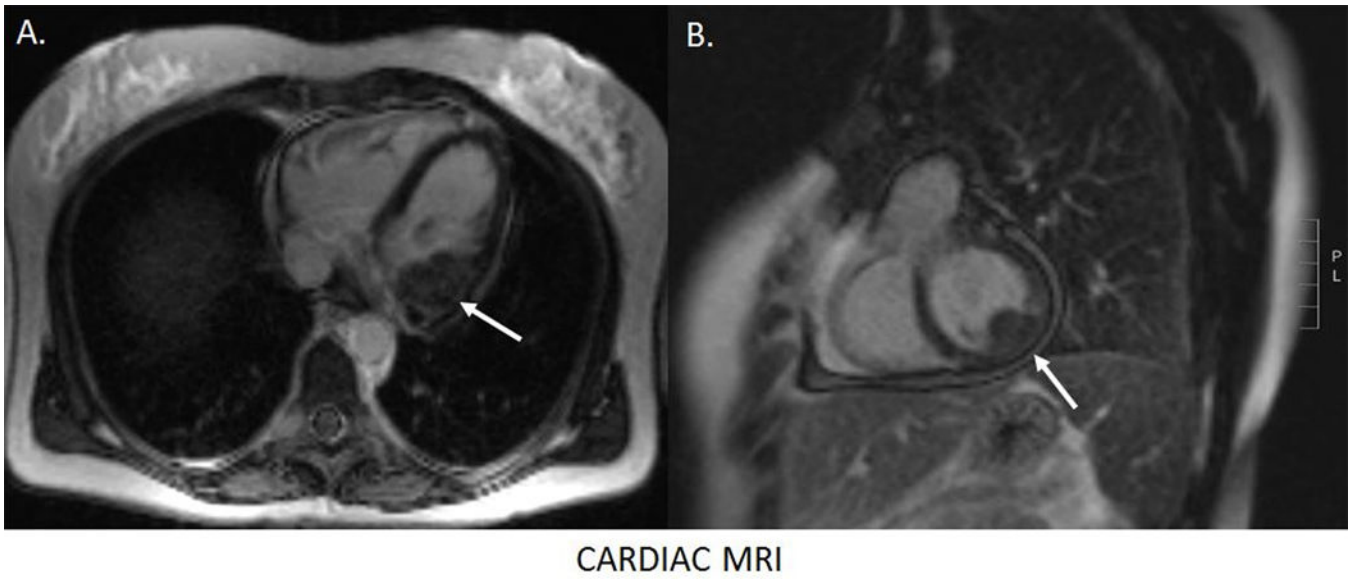

Figure 3.

Subsequently, a cardiac MRI with contrast was performed. Multiple cardiac metastatic lesions were identified, the largest in the basal inferolateral left ventricular wall (A, B). The patient's tumor progressed through treatment with Docetaxel and Gemcitabine with enlargement of the myocardial metastasis and development of a pericardial effusion. The patient developed complete heart block and decided to forego pacemaker implantation, passing away from metastatic lung cancer 6 months after the diagnosis of the cardiac metastases by ^{18}F-FSPG PET/CT. This case highlights the unique advantage of ^{18}F-FSPG PET/CT in tumor imaging. ^{18}F-FSPG is taken up by metabolically active cells via the xC^- cystine/glutamate antiporter.[1–4] ^{18}F-FSPG has a more favorable biodistribution profile than ^{18}F-FDG for detecting malignancy in the liver, bowel, myocardium and brain.[5–8] Further investigations in the use of ^{18}F-FSPG in lung cancer and other malignancies are needed to further establish the sensitivity and specificity as well as the role of ^{18}F-FSPG PET/CT in clinical imaging.[8–9]