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Case report

Diagnostic value of ^{18}F-FDG-PET/CT for monitoring myelofibrosis after allogeneic stem cell transplantation

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Abstract

Myelofibrosis is a rare hematopoietic stem cell neoplasm leading to marked bone marrow fibrosis and ineffective hematopoiesis. We report a case highlighting the potential role of ^{18}F fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) for therapy monitoring. A 62-year-old man with myelofibrosis underwent FDG-PET/CT for evaluation of the extent of disease before and after allogeneic stem cell transplantation (SCT). PET after SCT demonstrated complete normalization of initially increased bone marrow tracer uptake, consistent with bone marrow biopsy showing complete remission. ^{18}F-FDG-PET/CT may become a valuable diagnostic tool in myelofibrosis, enabling both sensitive initial staging and therapy monitoring.

KEY words: myelofibrosis, bone marrow, stem cell transplantation, therapy monitoring, FDG, PET/CT

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Case report

Primary myelofibrosis (PMF) and the clinically indistinguishable secondary forms of myelofibrosis (post-essential thrombocythemia and post-polycythemia vera myelofibrosis) are *BCR-ABL1*-negative hematopoietic stem cell neoplasms leading to marked bone marrow fibrosis and inefficient bone marrow blood formation [1, 2]. PMF is a rare disease with a reported incidence of 1.5 per 100,000 per year [3]. Patients with myelofibrosis may present with various symptoms including marked hepatosplenomegaly, severe anemia, thrombotic events, fatigue and night sweats. PMF is associated with reactive bone marrow fibrosis due to abnormal deposition of collagen and proliferation of hyperactive bone marrow fibroblasts, replacing normal myelopoiesis and causing cytopenias [2]. Patients with symptomatic forms of PMF have a median survival of less than 5 years [4]. The only curative treatment approach in PMF is currently allogeneic hematopoietic stem cell transplantation leading to 5-year survival rates between 51% and 61% [4]. Bone marrow fibrosis shows rapid regression after stem cell transplantation. An imaging-derived surrogate parameter for bone marrow fibrosis would be desirable not only for initial staging of the extent of disease, but also for therapy monitoring and potential adjustment of therapy, given that sampling errors on bone marrow biopsies are a frequently encountered problem since fibrosis may be an inhomogeneous process with variable distribution [2].

We herein present the case of a 62-year-old man with a history of JAK2-V617F-negative primary myelofibrosis who underwent whole-body ^{18}F-fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (PET/CT) for evaluation of the extent of disease 1 week before and 12 months after allogeneic stem cell transplantation (Figure 1). PMF had been diagnosed 6 months before the first PET/CT, and he presented with anemia and thrombocytopenia. He received an allogeneic stem cell transplantation from a related donor without major complications. Complete histo-hematological remission was achieved at the time of the follow-up PET/CT.

This report highlights the potential usefulness of ^{18}F-FDG-PET/CT to visualize the extent and activity of bone marrow fibrosis in PMF, and — more importantly — to monitor normalization of tracer uptake after successful stem cell therapy. In recent years, PET/CT using tracers like ^{18}F-FDG or ^{18}F fluorodeoxythymidine (FLT) has been increasingly used as a morphofunctional imaging modality for both initial evaluation and therapy monitoring in various hematologic malignancies including several types of lymphoma and leukemia [5–9].

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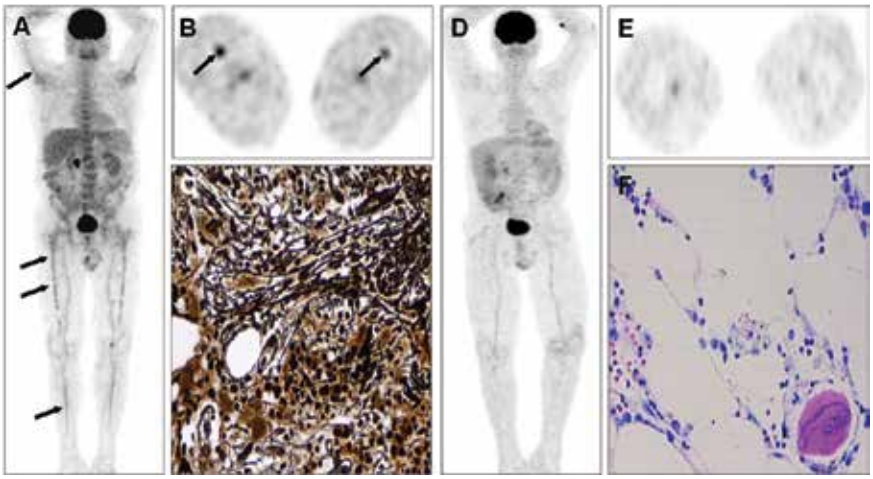

Figure 1. Whole-body maximum intensity projection (MIP) FDG-PET image before stem cell transplantation (**A**) demonstrating inhomogeneous tracer uptake in the bone marrow of the axial skeleton (SUVmax 3.5) and the long bones (arrows). Corresponding transversal PET (**B**) image showing marked bilateral tracer uptake in femoral bone marrow (arrows). Corresponding bone marrow biopsy microphotograph (**C**) demonstrating marked bone marrow fibrosis (Gomori's silver impregnation, ×250). Whole-body MIP FDG-PET image after allogeneic stem cell transplantation (**D**) showing complete resolution of abnormal bone marrow uptake. Corresponding transversal PET (**E**) image demonstrating unremarkable femoral bone marrow tracer accumulation. Corresponding bone marrow biopsy microphotograph (**F**) showing hypoplastic bone marrow without residual fibrosis (Giemsa stain, ×250)

Apart from malignant diseases including lymphoma [5], increased bone marrow ^{18}F-FDG uptake has been reported in a variety of benign conditions, e.g. after administration of granulocyte colony stimulating factor (G-CSF) or following erythropoietin therapy, which may cause false-positive results [10, 11]. Hyperplastic bone marrow is usually advocated as the main mechanism to explain tracer uptake in these patients. In contrast, myelofibrosis is characterized by marked inflammation of the bone marrow compartment [12] and uptake is likely caused by active inflammatory cells. Although quantitative values for normal bone marrow uptake have been published [13] they are not used in clinical routine because Standardized Uptake Values (SUVs) may be incalculably influenced by a variety of technical and biological factors [14]. Bone marrow FDG uptake has to be regarded as pathologic if there is non-homogeneous focal uptake [15], or a bone marrow metabolism pattern which is not to be expected in the patient's age group like in the present patient who demonstrated atypical bone marrow expansion into the tibial bones.

This is a case of primary myelofibrosis with marked pre-therapeutic and absent post-therapeutic tracer uptake on ^{18}F-FDG-PET/CT.

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