Is fluorine-18-fluorocholine PET/CT suitable for the detection of skeletal involvement of multiple myeloma?

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Hell J Nucl Med 2018; 21(3): 167-168 *Epub ahead of print: 10 November 2018* *Published online: 5 December 2018*

Abstract

Our limited experience suggests that fluorine-18-fluorocholine (^{18}F-FCH) may perform better in the detection of skeletal involvement by multiple myeloma compared to fluorine-18-fluorodeoxyglucose (^{18}F-FDG) and that standard uptake ratio (SUR) might be considered in the semi-quantitative comparison of tracer uptake.

The diagnosis of active multiple myeloma according to the current International Myeloma Working Group criteria is based on the presence of clonal bone marrow plasma cells and evidence of end organ damage including the presence of bone lesions [1]. The distinction of active myeloma from other less serious plasma cell dyscrasias influences the initiation of targeted therapy and prognosis of the patient [1].

The contribution of cross-sectional imaging to the detection of multiple myeloma has been acknowledged in the Durie-Salmon PLUS staging system in 2006 and studied extensively in comparison with other imaging methods with regard to staging, prognosis, and treatment response [2]. Compared to plain radiography, low dose whole body computed tomography (CT), whole body magnetic resonance imaging (MRI), or fluorine-18-fluorodeoxyglucose positron emission tomography/CT (^{18}F-FDG PET/CT) detect up to four times as many lesions [1, 3, 4].

The value of PET/CT with ^{18}F-FDG as a marker of glucose cell metabolism in myeloma staging, evaluation of treatment response and prognosis has already been studied extensively [2, 5, 6]. Only a limited number of studies evaluated the benefit of other tracers in mostly untreated patients including ^{11}C-4'-thiothymidine (marker of cell proliferation), ^{11}C-methionine (protein synthesis), ^{68}Ga-Pentixafor (chemokine C-X-C Receptor 4), ^{18}F-NaF (osteogenic activity), ^{11}C-choline or ^{11}C-acetate (lipid metabolism), ^{68}Ga-DOTA-TATE (somatostatin receptor) especially in the number and conspicuity of bone lesions and prognosis rather than the net benefit in the diagnosis of multiple myeloma [7]. Because of its short physical half-life, ^{11}C-choline has been replaced by ^{18}F-FCH, which also has high uptake in malignant tissue, in patients with prostate and breast cancer and is available in most centers.

The use of ^{18}F-FCH in patients with multiple myeloma has been reported only recently by Cassou-Mounat et al. (2016) [8]. In a heterogeneous study group of patients with relapse or disease progression the authors analyzed ^{18}F-FDG and ^{18}F-FCH scans in terms of lesion detection and standardized uptake value maximum (SUVmax) and found that in ^{18}F-FCH scan the detection rate increased by 75% with greater SUVmax or target/non-target ratio in matched lesions. However, the selection of lesions by their uptake was different for ^{18}F-FDG (compared to the liver) and ^{18}F-FCH (compared to adjacent tissue or contralateral bone) because of higher uptake of ^{18}F-FCH in liver parenchyma compared to ^{18}F-FDG, which introduces bias.

In our center, we compared the performance of ^{18}F-FCH and ^{18}F-FDG PET/CT in the detection of skeletal involvement by multiple myeloma in 5 patients in a pairwise fashion. We found that skeletal lesions were detected in all ^{18}F-FCH scans compared to 4 of 5 ^{18}F-FDG scans. Fluorine-18-FCH detected a total of 134 bone lesions compared to 64 lesions detected by the ^{18}F-FDG scan. In the skull, axial, and appendicular skeleton, the ^{18}F-FCH scan detected 5, 106, and 23 lesions compared to 1, 47, and 16 lesions detected by ^{18}F-FDG, respectively as shown in Figure 1. Altogether in four patients, the ^{18}F-FCH scan identified more lesions compared to ^{18}F-FDG and 63 (93%) of the 70 missed lesions were in the axial skeleton including the skull vault. Bone lesions in the skull were more difficult to visualize in ^{18}F-FDG because of its high accumulation in the brain.

The average SUVmax for lesions detected by ^{18}F-FCH scan was 6.6±1.6 compared to 6.5±1.8 in the ^{18}F-FDG scan. We additionally compared the standard uptake ratio (SUR) introducing some degree of standardization in terms of the background metabolic level noise [9]. The average SUR for lesions detected by ^{18}F-FCH was higher (6.9±1.8) compared to ^{18}F-FDG (3.5±0.8) due to higher background metabolic activity in the ^{18}F-FDG scan.

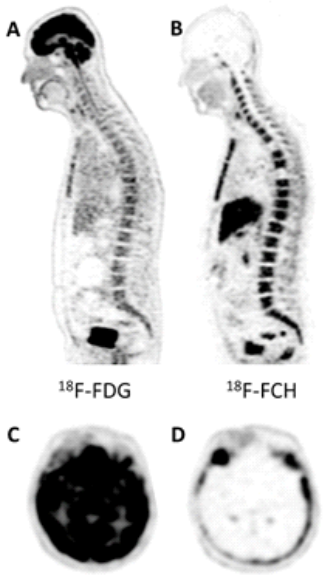

Figure 1. Superior performance of ^{18}F-FCH in MIP projection (b, d) to ^{18}F-FDG (a, c) in PET/CT scans in a 59 years old patient.

Our limited experience as that of others, suggests that ^{18}F-FCH may perform better in the detection of skeletal involvement by multiple myeloma compared to ^{18}F-FDG and that SUR might be considered in the semi-quantitative comparison of tracer uptake.

Acknowledgments: This work was supported by Progres Q28/ Lf1.

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