Atlantoaxial joint involvement in rheumatoid arthritis: Insights from ^{18}F-NaF and ^{18}F-FDG PET

Abstract

Rheumatoid arthritis (RA) is a leading cause of cervical spine morbidity and neurological dysfunction. Atlantoaxial joint involvement is frequently observed on computed tomography (CT) or magnetic resonance imaging (MRI), yet structural imaging alone cannot visualize inflammatory or osteogenic changes characteristic of active disease. Fluorine-18-fluorodeoxyglucose (^{18}F-FDG) positron emission tomography (PET)/CT enables the in-vivo assessment of glucose metabolism while ^{18}F-sodium fluoride (^{18}F-NaF) reflects osseous metabolism. In combination, these tracers offer complementary insights that may facilitate detection of RA-related pathophysiology. In this report, we present active bone turnover of the atlantoaxial joint without evidence of inflammation identified on PET/CT in a 59-year-old woman with RA.

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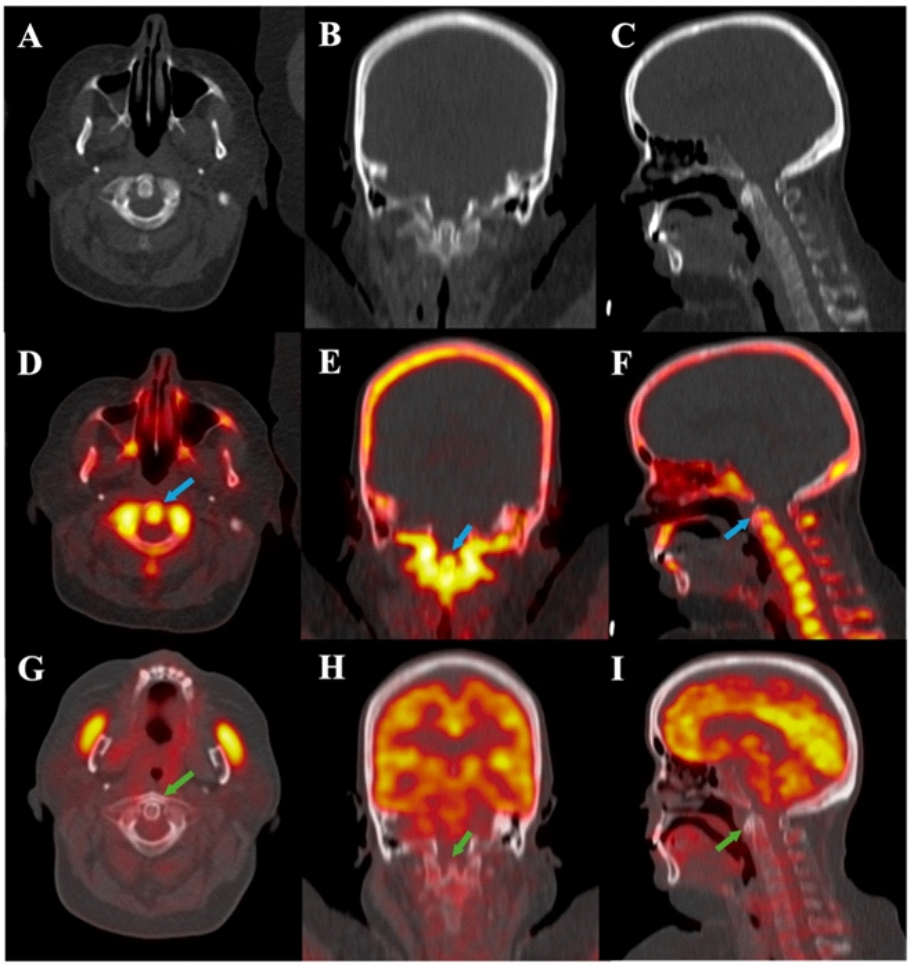

Figure 1. A 59-year-old white female with rheumatoid arthritis underwent dual-tracer PET/CT for systemic disease evaluation. Her medical history was significant for obesity, hypertension, and a smoking history. Serologically, she was anti-CCP positive with a normal ESR (13mm/hour) and elevated CRP (1.6mg/L). Clinically, she demonstrated high disease activity (DAS28-CRP of 5.4), a patient global assessment score of 75, and reduced hand grip strength. (A-C) Axial, coronal, and sagittal CT images demonstrate preserved alignment of the atlantoaxial joint without gross structural abnormality. (D-F) Fused ^{18}F-NaF PET/CT images show focal periarticular uptake at the atlantoaxial articulation (SUVmean 6.56, SUVmax 11.99) (blue arrows). (G-I) Fused ^{18}F-FDG PET/CT images show minimal uptake in the same region (SUVmean0.75, SUVmax 0.89) (green arrows), underscoring discordant osteogenic and inflammatory processes.

Atlantoaxial joint involvement in RA is clinically significant, as cervical spine disease is a major predictor of neurological complications including instability and myelopathy [1]. Long disease duration, seropositivity, and systemic inflammation, all present in this patient, are established risk factors for cervical joint pathology [2, 3]. The atlantoaxial joint is the most frequently affected site

in the rheumatoid cervical spine. Computed tomography and MRI, routinely used to assess bony erosion and ligamentous disruption, are limited to advanced structural disease [4, 5]. In contrast, ^{18}F-NaF PET provides a molecular biomarker of early osteogenic activity, preceding overt radiographic damage [6, 7]. However, ^{18}F-NaF PET has not entered routine RA imaging, largely due to the absence of standardized acquisition protocols, validated uptake thresholds, and prospective studies demonstrating clinical utility and prognostic value. Fluorine-18-NaF PET/CT may thus serve a role in identifying subclinical cervical spine involvement in RA, enabling earlier recognition of patients at high risk for instability and neurological morbidity.

While ^{18}F-FDG activity reflects glycolytic inflammation in soft tissues such as synovium, bursae, and tendons, ^{18}F-NaF provides a distinct signal by localizing to areas of microcalcification and osseous remodeling, emphasizing the complementary and non-redundant biological information provided by the two tracers in RA [8]. In this case, high ^{18}F-NaF avidity at the atlantoaxial joint may indicate subclinical pathological bone turnover and damage prior to the onset of overt structural changes.

In conclusion, dual-tracer ^{18}F-NaF and ^{18}F-FDG PET/CT provides complementary and non-redundant metabolic information in RA, enabling detection of subclinical atlantoaxial osteogenic activity preceding structural damage on conventional imaging, and may improve early identification of patients at risk for cervical spine instabilityand prevention of neurological morbidity.

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