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Role of FDG PET-CT in Takayasu Arteritis

Sensitive Detection of Recurrences

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OBJECTIVES The aim of this study was to investigate whether the maximum standardized uptake value (max SUV) of ^{18}F-fluorodeoxyglucose (FDG)-positron emission tomography (PET)/computed tomography (CT) provides a quantitative indication of disease activity in Takayasu arteritis (TA) cases.

BACKGROUND The clinical value of FDG-PET for assessing TA has been investigated. Clinical evaluation of disease activity is often difficult, because most patients develop recurrent inflammation while receiving corticosteroid treatment.

METHODS Thirty-nine TA patients underwent FDG-PET/CT at Tokyo Medical and Dental University from 2006 to 2010 (35 women and 4 men; median age, 30 years). Disease activity was defined according to National Institutes of Health criteria. Biomarkers including C-reactive protein and erythrocyte sedimentation rate were measured. Forty subjects without vasculitis served as control subjects.

RESULTS The max SUV was significantly higher in active than in inactive cases and control subjects (active [n = 27], median value, 2.7 vs. inactive [n = 12], 1.9; control [n = 40], 1.8; $p < 0.001$ each). Given a max SUV cutoff of 2.1, sensitivity for active-phase TA was 92.6%, specificity 91.7%, positive predictive value 96.2%, and negative predictive value 84.6%. In receiver-operating characteristic curves comparison, max SUV was superior to C-reactive protein ($p < 0.05$) and erythrocyte sedimentation rate ($p < 0.05$). Max SUV was significantly higher in relapsing on treatment cases (n = 17) than in stable on treatment cases (n = 12) (median value, 2.6 vs. 1.9; $p < 0.001$).

CONCLUSIONS FDG-PET/CT is useful for detection of active inflammation not only in patients with active TA before treatment but also in relapsing patients receiving immunosuppressive agents. The max SUV is useful for assessing subtle activity of TA with high sensitivity. (J Am Coll Cardiol Img 2012; 5:422–9) © 2012 by the American College of Cardiology Foundation

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Takayasu arteritis (TA) is a chronic vasculitis, mainly involving large vessels, including the aorta, pulmonary artery, and their major branches (1). Major diagnostic criteria used by the American College of Rheumatology include clinical symptoms caused by inflammatory or stenotic lesions in these arteries (2). Another important aspect of TA is the chronic inflammatory nature of this disease. Disease activity is assessed with National Institutes of Health (NIH) criteria on the basis of 4 elements of clinical status (3).

Even in patients receiving corticosteroid treatment, recurrences are common. Estimation of disease activity in TA patients, particularly those receiving treatments, is a significant clinical management issue. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) are the biological markers generally used to assess disease activity in TA patients. However, these markers do not allow differentiation between active and inactive TA, because they are nonspecific inflammatory markers (4).

Research has focused particularly on the diagnostic role of ^{18}F-fluorodeoxyglucose (FDG)-positron emission tomography (PET) in patients with TA, because this modality can estimate the degree as well as the site of inflammation (5,6). Meller et al. (7) reported that FDG-PET is more reliable than magnetic resonance (MR) imaging for monitoring disease activity during immunosuppressive therapy. In addition, the maximum standardized uptake value (max SUV) increases as inflammatory reactions spread, and max SUV can thus serve as a quantitative marker of FDG uptake. However, problems with studies using FDG-PET include study designs for determining activity in TA and low sensitivity for diagnosing TA (8).

Thus, the diagnostic utility of max SUV from FDG-PET has not been established. Therefore, we investigated whether max SUV, as a quantitative marker, can be used to determine TA activity in a relatively large number of patients in a single center.

The first aim of this study was to compare the accuracies of max SUV, CRP, and ESR for assessing disease activity in TA. The second aim was to investigate whether max SUV of FDG-PET/computed tomography (CT) can serve as an activity marker in patients with recurrent TA being treated with steroids or other immunosuppressants.

METHODS

Study patients. The consecutive TA cases that underwent FDG-PET/CT at Tokyo Medical and Dental University from 2006 to 2010 were retrospectively reviewed. Forty TA patients and 40 control subjects without vasculitis were enrolled. One TA patient was excluded, because infectious disease was noted when FDG-PET/CT was performed. The 39 TA cases (35 women, 4 men; median age, 30 years; range, 13 to 71 years) underwent FDG-PTE/CT for diagnosis or clinical needs with suspicion of recurrence. The TA had been diagnosed with American College of Rheumatology criteria in all cases (2). We also diagnosed patients with the Guideline for Management of Vasculitis Syndromes (Japanese Circulation Society 2008) (9), including the criteria of the Ministry of Health, Labour and Welfare of Japan. We generally used the latter criteria in clinical diagnosis. In this study, we confirmed TA patients satisfied with both of the 2 diagnostic criteria. The 40 control subjects (36 women, 4 men; median age, 38 years; range, 13 to 70 years) were selected by sex and age as a case-matched study population. Thirty-one control subjects had malignant diseases in remission after therapy and underwent FDG-PET/CT to assess recurrence. The other 9 subjects were healthy and underwent FDG-PET/CT for cancer screening. All of these subjects showed no evidence of inflammation or vasculitis, and FDG-PET showed negative study.

The study protocol was approved by the institutional ethics review committee of Tokyo Medical and Dental University. All patients provided informed consent and agreed to the use of their data for this study.

Disease activity. We assessed disease activity by adopting NIH criteria (3), which define clinical status on the basis of 4 elements: systemic features, elevated ESR, vascular ischemia, and angiographic changes. The active phase is defined as new onset or worsening of 2 or more of these features. The NIH criteria were scored within 1 month before or after FDG-PET/CT.

In all 39 cases, serum CRP and ESR levels were measured and recorded within 3 days of FDG-PET/CT. We divided active cases into 2 groups: untreated cases, and relapsing on treatment cases. Untreated cases were defined as active TA patients without previous treatment with steroid or immunosuppressant. Relapsing on treatment cases were

ABBREVIATIONS AND ACRONYMS

AUC = area under the curve
CRP = C-reactive protein
CTA = computed tomography angiography
ESR = erythrocyte sedimentation rate
FDG-PET/CT = ^{18}F-fluorodeoxyglucose-positron emission tomography/computed tomography
max SUV = maximum standardized uptake value
MR = magnetic resonance
NIH = National Institutes of Health
NPV = negative predictive value
ROC = receiver-operating characteristics
PPV = positive predictive value
SE = sensitivity
SP = specificity
TA = Takayasu arteritis