Nuclear Cardiology in the Literature: A selection of recent, original research papers

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Received Dec 6, 2018; accepted Dec 7, 2018
doi:10.1007/s12350-018-01572-0

Sodium-fluoride PET-CT for the non-invasive evaluation of coronary plaques in symptomatic patients with coronary artery disease: a cross-correlation study with intravascular ultrasound

Li Li, Xiang Li, Yongping Jia, Jiamao Fan, Huifeng Wang, Chunyu Fan, Lei Wu, Xincheng Si, Xinzhong Hao, Ping Wu, Min Yan, Ruonan Wang, Guang Hu, Jianzhong Liu, Zhifang Wu, Marcus Hacker and Sijin Li

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European Journal of Nuclear Medicine and Molecular Imaging (2018) 45:2181–2189

Context: Coronary intravascular ultrasound (IVUS) allows for identification and quantification of intraplaque features. Coronary atherosclerosis imaging with ^{18}F-sodium fluoride (^{18}F-NaF) allows for assessment of intraplaque calcification, which is a feature of plaque vulnerability.

Methods and Results: The authors aimed to study the relationship between ^{18}F-NaF uptake in the coronary arteries and plaque composition on coronary intravascular ultrasound (IVUS) in patients with symptomatic coronary artery disease (CAD). Thirty-two patients with CAD (30 patients with unstable angina and 2 patients with stable angina), underwent both coronary IVUS and cardiac ^{18}F-NaF PET/CT within 2 days of each other. ^{18}F-NaF maximum tissue-to-blood ratios (TBRmax) were calculated for 69 coronary plaques and correlated with IVUS plaque classification. The authors noted a significantly increased ^{18}F-NaF uptake ratios in fibrocalcific lesions (meanTBRmax = 1.42 ± 0.28), thin-cap atheroma with spotty calcifications (meanTBRmax = 1.32 ± 0.23), and thick-cap mixed atheroma (meanTBRmax = 1.28 ± 0.38), while fibrotic plaques showed no increased uptake (meanTBRmax = 0.96 ± 0.18). The ^{18}F-NaF uptake ratio was consistently higher in atherosclerotic lesions with severe calcification (meanTBRmax = 1.34 ± 0.22). Coronary atherosclerotic regions with positive ^{18}F-NaF uptake showed increased high-risk anatomical features on IVUS in comparison to ^{18}F-NaF negative plaques. These included a significant greater plaque burden (70.1 ± 13.8 vs 61.0 ± 13.8, $p = 0.01$), a higher positive remodeling index (1.03 ± 0.08 vs 0.99 ± 0.07, $p = 0.05$), and a higher percentage of necrotic tissue (37.6 ± 13.3 vs 29.3 ± 15.7, $p = 0.02$) in ^{18}F-NaF positive plaques. Results of this unique study provide a molecular insight for the characterization of coronary atherosclerotic lesions with ^{18}F-NaF PET/CT.

Significance: Intraplaque microcalcifications have been identified as an important determinant of plaque vulnerability. The relationship between intraplaque ^{18}F-NaF uptake and characteristics of coronary plaque vulnerability confirmed on IVUS adds to the growing evidence of the applicability of ^{18}F-NaF PET/CT for not only diagnosing CAD but also for potentially predicting coronary events.

Improving the Diagnostic Performance of 18F-Fluorodeoxyglucose Positron-Emission Tomography/ Computed Tomography in Prosthetic Heart Valve Endocarditis

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J Nucl Cardiol 2019;26:27–9.
1071-3581/$34.00

Hesselink, Riemer H.J.A. Slart, Andor W.J.M. Glaudemans and Ricardo P.J. Budde

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Circulation. 2018;138:1412–1427. https://doi.org/10.1161/circulationaha.118.035032

Context: [18]F-Fluorodeoxyglucose (FDG) positron-emission tomography/computed tomography (PET/CT) is a novel diagnostic tool for evaluation of prosthetic heart valve endocarditis (PVE).

Methods and Results: This study was aimed to identify potential confounders of PVE on FDG PET/CT and the impact of removal of these cofounders on the diagnostic performance of FDG PET/CT for PVE. The authors conducted a multicenter retrospective study, which evaluated FDG PET/CT of 160 patients with a prosthetic heart valve (median age, 62 years [43–73]; 68% male; 82 mechanical valves; 62 biological; 9 transcatheter aortic valve replacements; 7 other) in whom there was a suspicion of PVE. FDG PET/CT from additional 77 patients with a PV (median age, 73 years [65–77]; 71% male; 26 mechanical valves; 45 biological; 6 transcatheter aortic valve replacements), who underwent FDG PET/CT for other indications, were used as a negative control. All scans were reviewed by two independent observers blinded to all clinical data, both visually and quantitatively on available European Association of Nuclear Medicine Research Ltd (EARL)-standardized reconstructions. Confounders of PET/CT results were identified by use of a logistic regression model and subsequently excluded. Analysis of the data showed that visual assessment of FDG PET/CT had a sensitivity, specificity, positive predictive value, and negative predictive value for PVE of 74, 91, 89, and 78%, respectively. Evaluation of data from false positive and false negative scans was used to identify potential confounders of FGD PET/CT. Low inflammatory activity (C-reactive protein < 40 mg/L) at the time of imaging and use of surgical adhesives during prosthetic heart valve implantation were significant confounders, whereas recent valve implantation was not a significant confounder of FDG PET/CT. After the exclusion of patients with significant confounders, diagnostic performance values of the visual assessment increased to 91, 95, 95, and 91%. As a semiquantitative measure of FDG uptake, an EARL–standardized uptake value ratio of ≥ 2.0 was a 100% sensitive and 91% specific predictor of PVE. Results of this study show that both visual and quantitative assessments of FDG PET/CT have a high diagnostic accuracy in patients in whom PVE is suspected. Use of surgical adhesives (false positive scans) and low inflammatory activity (false negative scans) result in confounding of the results, but recent valve implantations do not.

Significance: FDG PET/CT is a powerful technique to diagnosis of PVE and can provide diagnostic information even among patients with recent prosthetic valve implants. FGD PET/CT has the ability to provide additional diagnostic value to confirm PVE that is suspected based on the results of blood cultures and echocardiographic findings. However, false negative studies have been reported among those with prolonged antibiotic use, which result in a low inflammatory state, typified by low CRP levels. Utilization of FDG PET/CT early in the diagnosis of PVE is thus suggested, before a low inflammatory state sets in. Additionally, knowledge of the use of surgical glue is paramount and can limit false positive reads by nuclear medicine physicians.

Prospective Comparison of FFR Derived From Coronary CT Angiography With SPECT Perfusion Imaging in Stable Coronary Artery Disease: The ReASSESS Study

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J Am Coll Cardiol Img 2018;11:1640–50

Context: Prospective comparison of the diagnostic performance of coronary computed tomography angiography (CCTA)-derived fractional flow reserve (FFRCT) to that of single-photon emission computed tomography (SPECT) myocardial perfusion imaging (MPI), for the diagnosis of coronary artery disease (CAD) is lacking.

Methods and Results: The authors conducted a single-center prospective study to compare the accuracy of FFRCT and SPECT MPI for diagnosing hemodynamically significant coronary artery disease among those with intermediate anatomical stenosis on CCTA (40-90% stenosis or focal high coronary artery calcium). The authors evaluated 143 patients with stable angina, all of whom underwent FFRCT and SPECT MPI that were evaluated by core laboratories. FFRCT ≤ 0.80 distally in at least 1 coronary artery with a diameter ≥ 2 mm classified patients as having ischemia. Ischemia by SPECT was defined by a reversible perfusion defect (summed difference score ≥ 2) or transient ischemic dilation of the left ventricle (ratio > 1.19). Imaging based assessment of ischemia was compared against ischemia detected on invasive coronary angiography, defined as a FFR of ≤ 0.80 in at least one vessel. Following diagnostic characteristics for FFRCT and SPECT were noted for identifying ischemia on a per-patient basis—FFRCT vs SPECT, (a) sensitivity: 91%

vs 41%, $p < 0.001$; (b) specificity: 55% vs 86%, $p < 0.001$; (c) negative predictive value: 90% vs 68%, $p < 0.001$; (d) positive predictive value: 58% vs 67%, p = NS; and (e) accuracy of 70% vs 68%, p = NS, respectively. Additionally, there were no difference in between FFRCT and SPECT MPI for the diagnostic accuracy of revascularization based on the results of invasive FFR on ICA (63% vs 73%, $p = 0.067$). Results of this prospective study highlight that among patients with CAD, stable angina, and intermediate anatomical stenosis on CTA, both FFRCT and SPECT MPI have similar accuracy for diagnosing hemodynamically significant coronary stenosis.

Significance: FFRCT is a novel technology that allows for assessment of anatomical and physiological severity of coronary stenosis from a single study. However, its availability is limited and there are additional costs associated with determination of FFR from CCTA data, which is typically performed by a third party. The similar accuracy conferred by SPECT MPI, should be reassuring to the majority who do not have access to FFRCT. In this regard, SPECT MPI can be applied as the first test for determining hemodynamically significant CAD or to determine the physiologic significance of anatomical stenosis detected on CCTA. Additionally, given the known declining prevalence of inducible ischemia and the even lower prevalence of prognostically significant ischemia that aids in therapeutic decision making, the specificity of a test is of more clinical relevance than its sensitivity. Importantly, one must not forget that invasive FFR was developed against SPECT MPI as the gold standard, and thus is it not surprising that FFRCT and SPECT MPI have similar overall diagnostic performance.