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

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Quantitative Myocardial Perfusion Positron Emission Tomography and Caffeine Revisited with New Insights on Major Adverse Cardiovascular Events and Coronary Flow Capacity. *European Heart Journal - Cardiovascular Imaging* (2019) 20, 751–762

Danai Kitkungvan, Linh Bui, Nils P. Johnson, Monica B. Patel, Amanda E. Roby, Pimprapa Vejpongsa, Asim K. Babar, Mohammad Madjid, Angelo Nacimbene, Sachin Kumar, Alexandra DeGolovine and K. Lance Gould

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Context: The impact of caffeine on myocardial perfusion metrics and their association with clinical outcomes is not well studied.

Methods and Results: To evaluate the effects of caffeine on quantitative myocardial perfusion by positron emission tomography (PET) and its relationship with clinical outcomes, the authors conducted a retrospective review of 6087 vasodilator stress PET studies. Serum caffeine was measured for all patients, as a part of the institutional protocol, of which 328 were positive (5.4%). Among these 328 patients, 84 patients (median caffeine 1.6 mg/L) came back for a repeat PET within 3 months, after a longer strict caffeine abstinence. In addition, 25 volunteers underwent paired regadenoson PET evaluation with caffeine (median caffeine 7.4 mg/L) and without caffeine (strict no caffeine for 36 h). Patients were followed for occurrence of major adverse cardiovascular events (MACEs) for and average duration of 3 years. When comparing caffeine vs no caffeine paired groups, respectively, stress flow was 1.74 ± 0.55 vs 2.14 ± 0.53 for dipyridamole and 1.82 ± 0.61 vs 2.33 ± 0.49 mL/min/g for regadenoson, and coronary flow reserve (CFR) was 2.26 ± 0.67 vs 2.67 ± 0.72 for dipyridamole and 1.84 ± 0.33 vs 2.31 ± 0.41 for regadenoson (all $P < 0.001$). Subjects were reclassified from high-risk CFR $< -$ 2.0 with caffeine to low-risk CFR > 2.0 without caffeine in 66.7% and 80% of dipyridamole and regadenoson caffeine-no-caffeine pairs, respectively. While relative images showed no differences, caffeine significantly altered coronary flow capacity (CFC) to false-negative and false-positive severity in 2.1% and 5.5% of the 328 caffeine positives, respectively (0.1% and 0.3% of 6087 PETs) but without change in severity-guided management in most patients (92.4% of 328 caffeine or 99.6% of total 6087 PETs). Even low serum caffeine levels reduce quantitative perfusion during vasodilatory stress with false-positive or false-negative results minimized by empathic instruction, CFC analysis, or repeat PET after strict caffeine abstention for definitive individualized risk stratification and management.

Significance: Results of this retrospective analysis highlight the fact that even small amounts of caffeine can result in alterations in myocardial flow and CFC, with erroneous reduction in defect severity. While this can potentially influence accurate diagnosis of coronary artery disease, in this report however, presence of caffeine would have resulted in alteration in decision for referral for coronary angiography in only 0.4% of all PET studies. Additionally, there was poor correlation of caffeine level with coronary flow parameters limiting the ability of routine measurement of caffeine levels to predict inadequacy of vasodilator stress PET. The study does underscore the importance of strict caffeine abstinence, though the ideal duration of caffeine restriction is still not known.

Assessment of Myocardial CZT SPECT Recording in a Forward-Leaning Bikerlike Position. *J Nucl Med* 2019; 60:824–829

Mathieu Perrin, V ´eronique Roch, Marine Claudin, Antoine Verger, Henri Boutley, Gilles Karcher, C ´edric

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1071-3581/$34.00

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Context: Upright and supine positions are employed to account for inferior attenuation on SPECT imaging with a D-SPECT (Spectrum Dynamics®) camera. A leaning-forward (''bikerlike'') position may potentially confer an advantage for reducing attenuation artifacts.

Methods and Results:: To determine the advantage of a bikerlike position, the authors conducted a prospective randomized study of 80 patients referred for a clinically indicated myocardial perfusion SPECT. All SPECT images were acquired on a D-SPECT camera using stress–rest 99mTc-sestamibi protocol. All patients underwent imaging in a seated, forward-leaning biker-like position on the D-SPECT camera-head at 35° from vertical. Additional imaging was immediately performed in either supine position (n = 40) or sitting position with the back rearward at 30° from vertical (n = 40). The authors defined segments with attenuation artifacts as those with $< 65\%$ uptake but with normal contractility on gated SPECT and no reversible defect on stress images. Analysis of data from this randomized study showed that the biker position was associated with lower heart-to-detector distance (18.3 ± 2.3 cm) than the supine (20.2 ± 2.5 cm) or sitting (20.1 ± 2.4 cm) positions (both $P < 0.001$); lower cardiac motion amplitudes, assessed on panograms, than the supine position (1.3 ± 0.6 vs 2.5 ± 1.6; $P < 0.001$); and fewer segments with attenuation artifacts than the supine position (on average, 1.10 ± 1.01 vs 1.90 ± 1.74, $P < 0.010$) or the sitting position (0.75 ± 0.93 vs 1.38 ± 1.60, $P < 0.011$). Results of this interesting study indicate an improvement in image quality with D-SPECT images acquired in a forward-leaning bikerlike position compared to sitting or supine positions.

Significance: Lack of attenuation correction is a limitation of the D-SPECT system, necessitating imaging in two positions to separate attenuation from true perfusion defects. Reduction in attenuation artifact, along with reduced longitudinal cardiac motion and greater proximity to the detectors with a bikerlike position may all result in enhanced image quality, when compared image quality compared to the standard upright imaging. Whether the bikerlike position improves reader's confidence in image interpretation and alters patient management, when compared to upright imaging, needs to be evaluated.

The Impact of Revascularization on Myocardial Blood Flow as Assessed by Positron Emission Tomography. ***European Journal of Nuclear Medicine and Molecular Imaging*** **(2019) 46:1226–1239**

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Context: It is unclear whether artery-specific thresholds for coronary flow capacity (CFC) or relative perfusion predict improved stress perfusion after revascularization.

Methods and Results: To determine the impact of revascularization on artery-specific, relative perfusion defects, and severity size thresholds for coronary flow capacity (CFC), the authors studied 50 patients who underwent PET imaging before revascularization. All patient also underwent repeat imaging within 90 days after revascularization. All PET studies were performed with Rubidium-82, with dipyridamole as the stress agent. Changes in regional myocardial blood flow (MBF) were stratified based on baseline perfusion abnormalities, baseline-reduced CFC, and whether revascularization was performed in that region. Severe baseline perfusion defect was defined as ischemic myocardium $> 10\%$, and severely reduced CFC as a severe reduction in stress myocardial blood flow (sMBF; ≤ 0.91 cm^3/min/) and severe reduction in coronary flow reserve (CFR; < 1.74) in at least 10% of the LV myocardium. During the study period, 41 patients underwent percutaneous revascularization, 7 underwent coronary artery bypass grafting, and 2 underwent hybrid revascularization. The authors found that following angiographic stenosis-directed revascularization, in regions with relative perfusion abnormalities and decreased CFC, sMBF increased by 0.51 cm^3/min/g (59%) from baseline ($P < 0.001$). In regions without baseline perfusion abnormalities but with decreased CFC, sMBF increased by 0.35 cm^3/min/g (40%) from baseline ($P < 0.001$). In regions without perfusion abnormalities and normal CFC, sMBF did not increase significantly (+ 0.07 cm^3/min/g, $P = 0.56$). Patients in whom revascularization was concordant with abnormal PET findings showed increased whole-heart sMBF (+ 0.22 cm^3/min/g, $P < 0.001$), but in patients in whom revascularization was targeted only to regions without perfusion abnormalities or low CFC, sMBF did not change significantly (−0.06 cm^3/min/g, $P = 0.38$). Results of this study show that revascularization targeted to regions with reduced CFC and relative perfusion abnormalities on baseline PET resulted in significant improvements in sMBF, while this was not the case for regions without reduced CFC.

Significance: This unique study underscores the value of perfusion-based guidance of revascularization. The improvement in quantitative perfusion metrics post revascularization, even in the absence of relative

perfusion defects, highlights the additive therapeutic value of metrics of myocardial blood flow quantification. It remains to be seen whether perfusion-based guidance of revascularization, as suggested by this study, results in symptomatic improvement—specifically in 84% of the patients who underwent percutaneous revascularization.