

Research Highlights

Highlights from the latest articles in cardiac nuclear imaging



Can two-slice SPECT/CT in myocardial perfusion imaging be used for both coronary artery calcium score and attenuation correction?

Evaluation of: Wenning C, Rahbar K, Vrachimis A *et al.* Myocardial perfusion imaging and coronary calcium scoring with a two-slice SPECT/CT system: can the attenuation map be calculated from the calcium scoring CT scan? *Eur. J. Nucl. Med. Mol. Imaging* doi:10.1007/s00259-013-2360-8 (2013) (Epub ahead of print).

Several centers use hybrid SPECT/CT for the acquisition of myocardial perfusion imaging (MPI) with CT-attenuation correction (AC). Coronary artery calcium scoring (CACS) is usually obtained from spiral CT acquisition on devices with a minimum of 16 slices. Many hybrid SPECT/CT machines contain CT devices with a lower number of slices; two in the authors' institution [1]. These devices can perform acquisition of data in a nonspiral method only, suitable to obtain attenuation maps for correction of MPI, but are not optimal for the measurement of CACS as they are obtained over several respiratory cycles and without ECG gating. The authors evaluated whether the CT studies obtained on a two-slice SPECT/CT for CACS can be also used for AC. This would permit all data to be obtained in a single, practical session with less radiation exposure to the patient. Ninety-nine consecutive patients underwent a 1 day stress–rest MPI with a hybrid two-slice SPECT/CT device. The patients were almost equally divided into two groups performing CT acquisitions for CACS and for standard AC at stress or

rest. The accuracy of the AC images was qualitatively and quantitatively analyzed and compared with the nonattenuation corrected images. Post-stress AC-MPI studies obtained with CACS-CT showed regional artifacts in 14 of 51 studies (27.5%) compared with 12 of 48 studies (25%) for standard AC-CT. At rest, AC artifacts occurred in five of 48 (10%) versus one of 51 (2%) studies, respectively. This led to larger variability in the interpretation of AC-MPI studies and higher differences in the summed stress scores and summed rest scores in the group who performed CACS-CT. The authors conclude that the same CT scan can be used for CACS and AC when the non-AC images are included in the image review process to detect artifacts and avoid misinterpretation of AC-induced perfusion defects. According to their results, the authors consider that a single CT acquisition protocol for CACS measurements and AC is feasible. The major limitation of this study is the fact that the authors do not assess whether the low-dose CACS-CT is accurate. They do not compare the CACS measured by their technique with values obtained using a diagnostic CT. A previous study has performed a visual estimate of the CACS obtained from a low dose CT-AC using hybrid devices of superior quality than the one used in the current study, thus not allowing the extrapolation and comparison of the data between the two studies [2].

References

- 1 Wenning C, Rahbar K, Vrachimis A *et al.* Myocardial perfusion imaging and coronary

Gad Abikhzer*¹ & Ora Israel^{1,2}

¹Department of Nuclear Medicine, Rambam Health Care Campus, Haifa, Israel

²Bruce & Ruth Rappaport School of Medicine, Technion, Israel, Institute of Technology, Haifa, Israel

*Author for correspondence:

Tel.: +972 485 43 009

gad101@hotmail.com

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calcium scoring with a two-slice SPECT/CT system: can the attenuation map be calculated from the calcium scoring CT scan? *Eur. J. Nucl. Med. Mol. Imaging* doi:10.1007/s00259-013-2360-8 (2013) (Epub ahead of print).

- Einstein AJ, Johnson LL, Bokhari S *et al.* Agreement of visual estimation of coronary artery calcium from low-dose CT attenuation correction scans in hybrid PET/CT and SPECT/CT with standard Agatston score. *J. Am. Coll. Cardiol.* 56, 1914–1921 (2010).

Fluorodeoxyglucose PET evaluation of the right heart

Evaluation of: Wang L, Zhang Y, Chaowu Y *et al.* Evaluation of right ventricular volume and ejection fraction by gated ^{18}F -FDG PET in patients with pulmonary hypertension: comparison with cardiac MRI and CT. *J. Nucl. Cardiol.* 20(2), 242–252 (2013).

Pulmonary hypertension (PH) is characterized by high pulmonary artery pressures followed by development of right ventricular (RV) dilatation and failure. It has already been demonstrated that PH is associated with increased uptake of fluorodeoxyglucose (FDG) in the RV. Higher FDG uptake is associated with increased severity of PH and can be of prognostic significance. In the present paper, the authors prospectively compare RV function and volumes with

the novel use of gated PET and cardiac CT (CCT) and MR (CMR) in 23 patients with PH [1]. The RV/left ventricular standardized uptake value was also calculated. Following an overnight fast and 50 g glucose load, 185 MBq (5 mCi) of ^{18}F -FDG were injected into the patients. PET/CT acquisition was gated, with the cardiac cycle divided into eight equal intervals. Data were processed using commercially available software. The results showed a mean RV ejection fraction (RVEF) of 32, 24 and 26% for PET, CMR and CCT, respectively. Statistical analysis showed a good correlation for RVEF measurements between the three techniques; however, with overestimation of RVEF by gated PET. RVEF measured by CMR (considered the gold standard) and CCT were not significantly different. RV end-diastolic and end-systolic volume measurements showed moderate-to-good

correlation, with underestimation of RV end-diastolic volumes when compared with CMR and CCT. There was an interesting negative correlation between higher RV glucose uptake (measured by RV/left ventricular standardized uptake value) and RVEF on CMR. In addition to reporting on the value of FDG PET in the evaluation of PH, this study also demonstrates that measurements of RV function can be also obtained by gated PET with moderate-to-high correlation with other imaging modalities.

Reference

- Wang L, Zhang Y, Chaowu Y *et al.* Evaluation of right ventricular volume and ejection fraction by gated ^{18}F -FDG PET in patients with pulmonary hypertension: comparison with cardiac MRI and CT. *J. Nucl. Cardiol.* 20(2), 242–252 (2013).

How low can the injected dose go in cardiac imaging with a solid-state camera?

Evaluation of: Nakazato R, Berman DS, Hayes SW *et al.* Myocardial perfusion imaging with a solid-state camera: simulation of a very low dose imaging protocol. *J. Nucl. Med.* 54(3), 373–379 (2013).

Solid state cardiac cameras using cadmium–zinc–telluride crystals have led to the implementation of novel MPI protocols. It has been demonstrated that, due to their high sensitivity and superiority over traditional SPECT cameras, the injection dose and imaging time can be significantly reduced without compromising on

the image quality. Since these solid state cameras use list-mode acquisition, reconstruction of myocardial perfusion studies simulating gradually lower doses and counts can be performed. The authors used these simulation methods to determine the minimal count level and dose in the myocardium required to produce accurate MPI [1]. A total of 79 patients with a mean BMI of 30.0 kg/m² who underwent single day stress–rest MPI with $^{99\text{m}}\text{Tc}$ -sestamibi as clinically indicated were included in the study. An average of 200 MBq (21.7 ± 5.4 mCi) MPI with $^{99\text{m}}\text{Tc}$ -sestamibi was injected at stress and imaging time was 14 min. Six stress-only datasets were reconstructed from the raw list-mode data

(8 million counts over the myocardium) to simulate 3.6, 2.0, 1.3, 1.0, 0.7 and 0.5 myocardial counts. Using automated quantitative commercially available software, total perfusion deficit and ejection fraction were determined for all datasets. Patients with abnormal MPI were divided into low-, moderate- and high-risk subsets based on total perfusion deficit and analyzed separately. The authors found excellent correlation ($r \geq 0.95$; $p < 0.0001$) for perfusion and functional parameters (total perfusion deficit and ejection fraction) between all reconstructed datasets when compared with the reference 8000 kcounts. In the separately evaluated dataset of patients who had perfusion defects, the correlation

was also excellent. Based on previous studies regarding the repeatability of same day MPI on standard Anger cameras, the authors used a cutoff value of 1.7 and 3.6% of standard deviation differences as acceptable parameters for reproducibility. These values allow the minimum use of the 1000 myocardial kcount reconstructed data set in this study. On cadmium–zinc–telluride devices with high sensitivity, the authors calculated that in order to achieve this count level, the injection of 92.5 Mbq (2.5 mCi) of MPI with ^{99m}Tc -sestamibi for a 14-min acquisition or, alternatively,

125.8 Mbq (3.4 mCi) for a 10-min acquisition would be required, resulting in an average effective radiation dose of less than 1 mSv. These results provide the technical basis to allow prospective multi-center clinical studies to evaluate sub-mSv stress-only MPI.

Reference

- 1 Nakazato R, Berman DS, Hayes SW *et al.* Myocardial perfusion imaging with a solid-state camera: simulation of a very low dose imaging protocol. *J. Nucl. Med.* 54(3), 373–379 (2013).

