Abstract: P311

Minimization of temporal sampling for myocardial blood flow quantification using Rubidium-82 PET

Authors: S Koenders¹, JD Van Dijk¹, PL Jager¹, JP Ottervanger², CH Slump³, JA Van Dalen⁴, ¹Isala Clinics, Nuclear Medicine - Zwolle - Netherlands (The), ²Isala Clinics, Cardiology - Zwolle - Netherlands (The), ³University of Twente, MIRA: Institute for Biomedical Technology and Technical Medicine - Enschede - Netherlands (The), ⁴Isala Clinics, Medical Physics - Zwolle - Netherlands (The),

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Introduction: Dynamic images are required to quantify myocardial blood flow (MBF) using Rubidium-82 (Rb-82) PET myocardial perfusion imaging (MPI). These dynamic scans are reconstructed from list-mode data using multiple time frames. Both the duration and the number of time frames can influence the measured activity concentrations in the left ventricle (LV) and myocardium and the thereof derived MBF values. Short time frames are crucial to accurately capture the activity concentration peak during the first-pass phase. However, an increasing number of time frames results in time-consuming reconstructions which may hamper clinical throughput.

Purpose: To determine the minimum number of time frames that still results in reliable MBF quantification using Rb-82 PET.

Methods: We retrospectively included 30 consecutive patients (15 with an ejection fraction (EF) <45% and 15 with an EF =45%) who underwent pharmacological induced (regadenoson) stress Rb-82 PET (Discovery 690, GE Healthcare). Data were reconstructed using 26 time frames (12x5s, 6x10s, 4x20s, 4x40s). Activity concentrations during stress were determined for the LV and whole myocardium for each time frame using Corridor4DM software (INVIA, v2016). Next, we simulated the time activity curves for twelve additional temporal sampling protocols varying between 9 and 20 frames, as shown in Figure 1. MBFs were quantified with TracerRkinetic software using using Lortie's one-tissue compartment model. Absolute MBF values where corrected for systemic biases. Temporal sampling protocols were considered reliable if the SD of the relative MBF difference (SD of ?MBF) was =5% compared to that of the reference scan using 26 frames.

Results: Seven protocols were considered reliable as illustrated in Figure 1: the protocols with 20 (12x5s, 6x10s, 2x120s), 18 (12x5s, 2x10s, 2x20s, 2x120s), 17 (12x5s, 3x20s, 2x120s), 16 (12x10s, 2x30s, 1x60s, 1x120s), 14 (9x10s, 3x30s, 1x60s, 1x120s), 14 (12x10s, 2x120s) and 12 (9x10s, 1x30s, 2x120s) frames resulted in a SD of ?MBF =5%.

Conclusion: Temporal sampling protocols with less than 26 frames seem to result in reliable MBF quantification using Rb-82 PET. The minimal number of time frames that can be considered for clinical validation is 12. Moreover, to obtain reliable MBF measurements, the first pass phase (0 to 60 seconds) can be sampled using frame durations of 5 to 10s, the intermediate phase (60 – 120 seconds) with 10 to 20s frames and the tissue phase (120 – 360 seconds) with frame-durations of 120s.
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