

Half-time gated myocardial perfusion SPECT processed with both OSEM with resolution recovery and wide beam reconstruction: clinical performance compared to full-time filtered backprojection

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Hypothesis: Compared to filtered backprojection (FBP), OSEM with resolution recovery (RR) and wide beam reconstruction (WBR), which additionally models noise during reconstruction and applies no post-processing filter, potentially allow for shorter acquisition times with preserved or improved SPECT visual and diagnostic quality.

Methods: 124 consecutive patients (pts) referred for the diagnosis of CAD underwent single-day low-dose rest/high-dose stress Tc^{99m} sestamibi SPECT using a 90°-angled dual-headed scintillation camera (Ventri®, GE Healthcare) with high resolution parallel-hole collimators. Both rest and stress SPECTs were acquired full-time (15 min) and half-time (7 min). Full-time SPECT was processed using FBP with Butterworth filters appropriate for low count density rest and high count density non-gated and gated post-stress scans. Half-time SPECT was processed with both OSEM-RR and WBR. Blinded to the acquisition/processing protocol, observers graded all scans for quality (1=poor, 4=excellent). For scans with perfusion defects noted on full-time FBP, SSSs, SRSs, and SDSs were determined by visual inspection, and post-stress EDV, ESV, and LVEF were calculated using automated Myometrix® (GE Healthcare) software. Regional wall motion abnormalities were scored visually (0=normal, 4=dyskinesis)

Results: For all 124 pts mean image quality for rest full-time FBP and half-time OSEM-RR and WBR was 3.1, 3.2, and 3.5 (p's NS); for non-gated post-stress SPECT: 3.4, 3.6, and 3.7 (p's NS). For 55 abnormal pts with FBP SSSs ≥ 2 , mean SSSs were FBP=12.7, OSEM-RR=14.4, WBR=13.2 (p's NS). FBP SSSs correlated well with OSEM-RR and WBR SSSs (r 's =0.91 and r =0.92). Cumulative scores (SSS, SRS, and SDS) also correlated well with FBP (OSEM-RR=0.79, WBR=0.78).

In contrast, for the 55 abnormal pts, image quality for post-stress 8-frame/cardiac cycle gated SPECT was 2.7, 2.9, and 3.8 (p =0.09 for OSEM-RR, 1.9×10^{-21} for WBR). Wall motion abnormality scores were significantly greater than FBP (1.9 ± 1.1) for WBR (2.8 ± 1.0 , $p=4.8 \times 10^{-8}$), but not for OSEM-RR (2.1 ± 1.3 , $p=0.55$). LVEFs determined by FBP, OSEM-RR, and WBR were 56.1 ± 14.3 , 52.5 ± 15.9 , and 48.7 ± 13.1 . LVEFs by OSEM-RR and WBR correlated well with FBP (r 's = 0.85 and 0.86) but were significantly lower (p 's=0.0001 and 3.4×10^{-14}), attributable to a smaller EDV with OSEM-RR ($p=7.3 \times 10^{-13}$) and a larger ESV with WBR ($p=9.2 \times 10^{-5}$).

Conclusions: For perfusion SPECT half-time OSEM-RR and WBR afford stress and rest image quality and diagnostic accuracy equivalent to full-time FBP. For post-stress gated SPECT, with lower count density and greater noise per frame, WBR improves image quality and highlights wall motion abnormalities better than full-time FBP. However, due to better image contrast and sharper delineation of the endocardial border, quantitative functional parameters differ from FBP significantly for both WBR and OSEM-RR.