MYOCARDIAL THICKNESS BY GATED PET AND SPECT: VARIABILITY AND BIAS

S. L. Bacharach, M. Bartlett, J.J. Vaquero, D.Y. Mok, V. Dilsizian. National Institutes of Health, Bethesda, MD

It has been suggested that myocardial thickness can be measured by observing changes in counts from end-diastole to end-systole in gated PET or SPECT images. We have examined the validity of this hypothesis in detail by using gated magnetic resonance images (MRI) from 9 normal volunteers to simulate PET and SPECT images. Three different methods of measuring thickness were tested: peak counts; mean counts; and a model based method: fitting a count profile across the myocardium to a square wave (SQ) convolved with the resolution of the PET/SPECT device, and solving for the SQ thickness. Thickness was measured at 16 myocardial sectors, and compared to values from a standard area based fv1RI method. We found that gated peak or mean counts were related to MRI thickness in a highly non-linear way, with greater non-linearity for PET (7mm FWHM) than for SPECT (14 mm FWHM:). In contrast, the SQ. model gave highly linear results (for PET, MRI thickness vs. SQ thickness: r=0.89, slope=0.86, std. est. error (SEE) =15%). The influences of non-homogeneous transmural activity distributions z axis blurring, and noise were also studied.

The SQ method was insensitive to transmural inhomogeneities – a 100% activity change from endo-epicardium produced <5% bias in thickness. Axial blurring caused less than 3% bias in thickness by the SQ model. In the presence of noise (20% SO), the slope of MRI thickness vs. SQ (PET) thickness fell to 0.82, while r fell to 0.73, and SEE was 28%. At a given noise level, the SEE of measured thickness increased as the resolution of the imaging system worsened. The SEE of thickness increased roughly linearly with FWHM resolution, increasing by a factor of 1.9 at 10% noise and of over 2 at 20% noise as FWHM increased from 7mm (PET) to 14mm (SPECT). We conclude that the model based method can produce unbiased estimates of thickness even with transmural inhomogeneities, but if image noise is >10%, the SEE of *thickness* may degrade the clinically utility of thickening estimates, especially for low resolution modalities.