Accuracy of Automatic Rotational Realignment Algorithm for Gated Perfusion SPECT Studies.

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Objective: The purpose of this study was to assess the accuracy of an automated realignment algorithm for SPECT perfusion studies, and its effect on inter-observer variability in perfusion quantification.

Methods: Stress rest gated Tc-99m perfusion studies of 31 consecutive patients with known or suspected coronary heart disease were employed, no exclusions for body habitus. The realignment algorithm uses the endocardial surfaces estimated by the 4D-MSPECT quantification program to automatically realign and center the LV to its long-axis. To assess the accuracy of the algorithm, rotations ranging from -30˚ to 30˚ (n=17) were induced about (i) the x axis only, (ii) y axis only, and (iii) both axes. Each of the 459 data sets with induced rotations was then realigned using the new algorithm. The rotation angles were noted and root mean square error (RMSE) were computed. To assess the effect on the inter-observer variability in estimating reversibility extent, the variance in the quantitative reversibility values were compared with and without automatic realignment.

Results: The algorithm failed in four patients with very small hearts for rotation angles >20˚ from reference. For the remaining patients, excellent linearity (slope=1.0, r=0.99) was demonstrated across the full range of induced angles (±30˚). The RMSE values were (1.16±1.27) degrees for x-axis rotations and (0.74±0.96) degrees for y-axis rotations. For the combination x,y axis rotations, RMSEx was (2.98±1.86) degrees and RMSEy was (1.47±1.35) degrees. The greater RMSE for the x axis compared to the y axis results from the reorientation sequence where the y-axis rotation is performed first and hence its error is propagated to the x-axis rotation. For global reversibility extent, the variability significantly ($p<0.001$) decreased from (3.3±2.7)% to (1.4±1.2)% when automatic realignment was employed. Regional differences by coronary territory were even greater than this global measure.

Conclusion: Automatic realignment and centering within 4D-MSPECT is highly accurate in correcting ±20˚ rotations for very small hearts and ±30˚ rotations in normal sized or larger hearts. Automatic realignment significantly improves the reproducibility of global and regional quantitative measures of LV perfusion reversibility.

Journal of Nuclear Medicine 2004; 45(5):221P.