Investigation of Accuracy of Dynamic Myocardial Perfusion 201-Thallium SPECT in comparison to Conventional Static Imaging

Zohreh Shahpouri1, Ahmad Bitarafan-Rajabi2, Alireza Kamali Asl1, Jakir Hossain3, Arman Rahmim3, Seyed Mohammad Entezarmahdi1, Samane Mohseni1, Nahid Yaghoobi2
1 Department of Nuclear Engineering, Shahid Beheshti University, Tehran, Iran
2 Cardiovascular interventional research center; Department of nuclear medicine, Rajaei Cardiovasular, Medical & Research Center; Tehran University of medical sciences, Tehran, Iran
3 Departments of Radiology and Radiological Science, Johns Hopkins University School of Medicine
z.shahpouri@gmail.com

Abstract: Clinical cardiac Single Photon Emission Computed Tomography is commonly performed using static imaging protocols. Dynamic SPECT (D-SPECT) imaging has the potential to provide both kinetic and perfusion information for evaluation of coronary artery disease. The objective of this study was to evaluate the accuracy of the D-SPECT methodology in myocardial perfusion assessment in comparison to the conventional method in the context of Thallium imaging. The simulation dynamic studies were performed for normal organs using the time activity curves of the myocardium, blood pools and body, utilizing the 4D NCAT Phantom, and including dual-head gamma camera SPECT via the SIMIND simulator, Respectively. Thirthy-two second acquisition times were used to track these dynamic changes. Different summations of the six time frames of dynamic imaging were performed to create each dataset, which were also compared to a single static dataset with consistent projections as reference. Also, the effect of different algorithms (FBP, Wallis, OSEM, FLASH-3D) and delay times after injection (0:32:448 sec) were assessed. In both cases, twenty-segment analysis of myocardial perfusion percent (MPP) was performed by QPS (Cedars-Sinai Quantification Perfusion SPECT). Dynamic data were successfully acquired at rest in two patients using the optimal serial scanning protocol as extracted in the simulation studies. Conventional imaging was subsequently performed. According to the QPS computation (the normal database), for different summations of the time frames MPP mean values in the 6 basal and mid regions in the case of D-SPECT revealed 14.4% and 7.3%,while the distal and apical segments did not show noticeable changes in comparison to conventional method. Specifically, the imaging with 3 to 6 time frames yielded more accurate quantitative values related to the usage of less time frames in comparison to conventional method (r=0.957). In all cases, the Wallis algorithm reconstruction (iteration=2) showed higher correlation with conventional image (r=0.996). The summing procedure that produced the best correlation with conventional image consisted of the data acquired from 128 to 224 sec post-injection (r=0.982 to r=0.988). Overall, comparison of static and dynamic imaging demonstrated the high capability of dynamic SPECT protocol in myocardial perfusion assessment. D-SPECT may provide high accuracy functional information for the detection of coronary artery disease, and could be used to extract kinetic parameters of interest. The validation of these results require future research and clinical studies.

Key Words: dynamic single photon emission computed tomography; Cardiac perfusion imaging; Time activity curve.