

Comparison between Radio-water PET and Model Based Quantitative Analysis of Myocardial Perfusion Magnetic Resonance

Jussi P Pärkkä, Turku Univ Hosp, Turku, Finland; Masaki Ishida, Mie Univ Hosp, Tsu, Mie, Japan; Hajime Sakuma, Motonori Nagata, Nanaka Ishida, Yoko Mikami, Takashi Ichihara, Kan Takeda, Mie Univ Hosp, Tsu, Mie, Japan; Hisato Maeda, Fujita Health Univ, Toyoake, Aichi, Japan; Yasuaki Goko, AZE Ltd., Chiyoda-ku, Tokyo, Japan; Juhani Kunuuti, Turku Univ Hosp, Turku, Finland; Jaakko J Hartiala, Turku Univ Hosp, Turku, Finland

Aim: Radio-water positron emission tomography (PET) has been shown to be the most accurate and established method in quantifying myocardial blood flow (MBF). Model based analysis of first-pass perfusion MRI with corrections of blood saturation and flow-dependent alteration in extraction fraction of Gadolinium-DTPA (Gd-DTPA) may permit quantification of absolute MBF. The aim of this study was to determine the accuracy of MR measurements of rest and stress MBF by using radio-water PET as a reference method.

Methods: Twelve subjects (mean age 25 ± 2 years) without coronary artery disease underwent perfusion MRI and radio-water PET studies. First-pass perfusion MR images were obtained with a saturation recovery balanced TFE sequence following administrations of 0.05 mmol/kg of Gd-DTPA at rest and during adenosine stress (0.14 mg/kg/min). Dual bolus method was used to correct blood saturation. Two-compartment model based approach using Patlak plot was employed in quantifying MBF, and myocardial unidirectional influx constant (K1) was determined from blood input and myocardial output functions in 16 myocardial segments. Absolute MBF was calculated from K1 by using Gd-DTPA extraction fraction versus MBF curve previously determined in 16 volunteers. ^{15}O labeled water was injected in the resting state and during adenosine stress, and MBF was quantified from dynamic PET data.

Results: Mean MBF in the resting state was 0.99 ± 0.32 ml/min/g by perfusion MRI and 0.92 ± 0.18 ml/min/g by radio-water PET. Mean MBF during stress was 4.42 ± 1.36 ml/min/g by MRI and 4.66 ± 1.37 ml/min/g by PET. MBF measured by MRI showed a good linear correlation with the results by PET ($r=0.84$, $p<0.001$). In addition, excellent agreement was found in myocardial perfusion reserve (MPR) between MRI (4.8 ± 1.7) and PET (5.1 ± 1.6). The measurement bias between MR and PET was found to be minimal in measuring MBF (-0.09 ± 1.18 ml/min/g) and MPR (-0.4 ± 2.6). The inter-observer variability in MR measurement of MBF was 6.9%.

Conclusion: In this study that employed radio-water PET as a gold standard, we found that model based analysis of first-pass perfusion MRI with corrections of blood saturation and flow-dependent alteration of extraction of Gd-DTPA allows for accurate quantification of MBF both in the resting state and during stress.