EDITORIAL POINT OF VIEW

Current Status of Myocardial Blood Flow Quantification by CT and MR

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In this issue of *the Annals of Nuclear Cardiology*, there are two review articles related to myocardial blood flow assessment (MBF; ml/g-myocardium/min). One is using dynamic perfusion CT by Manabe et al., and the other is using dynamic perfusion MR by Ichikawa et al. (1, 2). MBF measurement has been mainly performed by dynamic positron emission tomography (PET) imaging with ^{13}N-NH_3, ^{15}O-H_2O, and ^{82}Rb (3, 4). PET MBF assessment is a gold standard for non-invasive quantification of MBF, however, there are limited number of facilities where dynamic perfusion PET can be available in the clinical settings. Recently, there are trials to quantify MBF using semi-conductor detector single photon emission computed tomography (SPECT) (5) and the PET MBF quantification methodology using ^{99m}Tc-MIBI, ^{99m}Tc-tetrofosmin or ^{201}Tl-TlCl. In addition to the limited number of facilities where semi-conductor or high sensitivity SPECT systems are installed, there are limitations of SPECT MBF quantification such as underestimation and accuracy when using ^{99m}Tc-agents, and low counts or noisy data.

If non-invasive MBF assessment is available with widely used modalities such as CT and MR, it would be of beneficial for many coronary artery disease (CAD) patients in the clinical setting.

CT perfusion imaging

At the early stage of MBF measurements using CT, MBF quantification with dynamic perfusion CT, MBF values were not so accurate, suffering from low and noisy counts due to low amount of iodine contrast medium, low radiation dose and limited cover range (6). Although there are still some limitations, most of these issues are now resolved, and the MBF measurement by dynamic perfusion CT has become ready for clinical use by using wide-detector CT (7) covering whole myocardium in one rotation. Manabe et al. reviewed current status of MBF assessment by whole heart dynamic perfusion CT in detail with instructive figures and representative cases (1). CT can provide information of coronary anatomy (stenosis/plaque by coronary CT angiography) and absolute MBF value, which are useful to make therapeutic strategy of the CAD. Image fusion of coronary CT angiography and whole heart regional MBF values is quite useful to make treatment strategy of the individual coronary stenosis. By acquiring both stress and rest data, myocardial flow reserve (MFR; [MBF atstress–MBFatrest] / MBF atrest) can also be measured. Readers can reference this review article to start MBF assessment with dynamic perfusion CT.

Myocardial MR perfusion

Cine MR and Gd-delayed enhancement MR are widely used in the clinical setting. Cine MR can assess cardiac or valvular function. Late Gd enhancement MR can highlight myocardial damage such as myocardial infarction and insured myocardium reflecting increased interstitial volume. In addition to these two techniques, myocardial perfusion MR can visualize myocardial ischemia as low attenuation area during the Gd first pass through the myocardium with the pharmacological stress. Therefore, stress dynamic perfusion MR has been increasingly used to visualize myocardial ischemia. In addition to the high contrast visual assessment, dynamic MR can also quantify MBF. By acquiring both stress and rest dynamic data, MBF reserve can also be quantified. Since most of the coronary or myocardial flow returns to left right atrium through coronary sinus, global myocardial flow can be measured through coronary sinus flow measurement by phase contrast MR (8). This method is for global MBF measurement, therefore, regional MBF cannot be assessed. In this review

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article, Ichikawa et al. addressed current status of regional MBF assessment by dynamic perfusion MR (9). Since the relationship between the measured blood signal and high Gd blood contrast concentration during the first pass is not linear, its correction is essential for the accurate measurement of the MBF using MR. In this review, this important issue is addressed in detail (2). Readers of the ANC can understand the points and refer this article to apply the promising MBF quantification by dynamic perfusion MR. By acquiring both stress and rest data, MFR can also be measured without radiation exposure.

Future directions

Although there are limited sophisticated softwares to quantify MBF by CT and MR, its development and widely use will promote their use. In dynamic perfusion MR, slice numbers are limited such as around 3 short axial slices for dynamic acquisition. When new technique, “compressed sensing”, is used, slice number can be increased around 6–8 short axial slices, which means whole heart imaging.

The two review articles nicely address current status of the MBF/MFR assessment by CT and MR.

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Conflicts of interest

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