Validation of MRI Myocardial Perfusion in Humans with PET

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Introduction

A non-invasive method for quantitative evaluation of myocardial perfusion would be important in evaluating of ischemic heart disease (IHD). Our group has previously shown that the perfusion reserve measured by MRI could identify patients with coronary stenosis(1). The objective of this study was to compare MRI quantitative perfusion measurements with Positron Emission Tomography (PET) as a gold standard in order to validate the modified Kety principle using Gadolinium-DTPA as flow tracer.

Methods

Thirteen healthy volunteers were examined at rest and during stress induced by dipyridamole (0.54 mg/kg). A midventricular slice position comparable to the orientation of the PET images were used for evaluation. Five regions in the myocardium were selected and the perfusion reserve (difference between stress and rest) from PET and MRI was compared. Statistical analysis was performed using a three way ANOVA analysis considering p<0.05 as statistically significant.

MRI: The perfusion model has been described in details previously(2): C(myo)=C(ventricle)(t-T)*Ki exp(-k2t) k2 = Ki (1-Hct)/v and * denotes convolution. Thus parameters involved in the evaluation of the myocardial circulation is: Ki (ml 100g-1 min-1) the unidirectional transfer constant, v (ml/100g) the interstitial volume. An ECG-triggered IR-TurboFLASH was used on a Siemens Vision system (1.5T) : TR/TE/TI/α:6.5ms/3.0ms/15ms/12 degrees, matrix FOV/thickness :128x128/250/10mm. Concentration curves in the left ventricle and in the myocardium were calculated(2) using the linear relationship: R1(t) - R1(0) = β[Gd-DTPA]. These concentration curves were evaluated by Eq. [1].

PET: Regional myocardial blood flow was quantified at rest and after administration of intravenous dipyridamole(3) with N-13 ammonia and positron emission tomography (Advance, General Electric Systems, Milwaukee, WI).

Results

No significantly differences were found in blood pressure or heart rate (p>0.059 and no differences was found between regions (p>0.05). Mean perfusion values were: MRI: rest: 78±21; stress: 183±56 ml/100g/min and PET: rest: 72±15; stress: 204±65 ml/100g/min. The perfusion reserve is shown in Fig 1. Results of the linear regression was: y=0.67x+15; R=0.79. The three way ANOVA analysis gave a p-value>0.58 showing no significantly differences between the two methods.

Discussion

A linear relationship between the methods has been shown and there was no significantly differences between quantitative MRI and PET used as a gold standard. These results indicates that noninvasive nonionised quantification of the myocardial perfusion can be performed by MRI using Gadolinium-DTPA as flow tracer.

References