Modified PCR/ATP ratio in heart transplant patients with diffuse cardiac allograft vasculopathy: A 31P 3D-Chemical Shift Imaging study

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Introduction: Cardiac allograft vasculopathy (CAV) is a major limiting factor of heart graft life time at long term. The current diagnostic follow-up is based on annual coronary angiography. Clinically, *in vivo* ^{31}P MRS is a promising method to detect the potential modifications of high energy phosphate (HEP) concentrations related to CAV (2). The aim of this work was to assess whether optimized ^{31}P magnetic resonance spectroscopy (MRS) is able to detect variations in HEP concentrations related to CAV at rest in a population of adult heart transplant (HTx) recipients at a comparatively long delay after HTx.

Patient Groups: Group T (n=9): healthy volunteers. Group A (n=8): patients presenting signs of diffuse CAV as defined by the presence of diffuse coronary irregularities or of any amputation of coronary branches at the last coronary angiogram performed before ^{31}P MRS. Group B (n=18): patients with normal angiograms or non-significant lesions of main coronary vessels non specific for CAV.

Materials and Methods: All MR measurements were performed using a Siemens Magnetom Vision Plus 1.5 T MR system equipped with a broadband channel and a commercially available ^{31}P/^{1}H surface coil (Siemens). After acquisition of multi-slice reference proton images, ^{31}P MRS was performed using a Hanning acquisition-weighted 3D CSI sequence (FOV 240 x 240 x 200 mm^3, nominal spatial resolution 2.1 cm x 2.1 cm x 3.0 cm = 13 cm^3. The spatial resolution is equivalent to the voxel size at 64% maximum of the point spread function (3). The total duration of the entire protocol ranged from 40 to 55 minutes. Local spectra were obtained using voxel-shifting technique and integration over a volume covering the anterior and septal part of the left ventricle at a level between apex and base. These volumes were manually defined using the proton reference image data set. The PCr and ATP signal amplitudes were corrected for local partial saturation and blood contribution.

Results: Group characteristics are summarized in the table as averages ± SD. *significantly different from T (ANOVA Fisher PLSD). Group A showed significantly reduced PCr/ATP ratios with respect to the volunteer group T. This was not the case for group B.

Group	***T (n=9)***	***A (n=8)***	***B (n=18)***
Subject Age (a)	39 ± 6	62 ± 9	53 ± 10
Donor Age (a)	-	42 ± 15	35 ± 8
Time from HTx (a)	-	8 ± 3	6 ± 4
Fully corrected PCr/βATP	2.1± 0.3	1.4 ± 0.4*	2.0 ± 0.5
Fully corrected PCr/γATP	1.6 ± 0.3	1.2 ± 0.4*	1.7 ± 0.5

Discussion: This optimized CSI method has demonstrated a significantly altered metabolism in patient group A presenting diffuse coronary alterations. No differences between patient group B and the healthy volunteers were observed. Heterogeneous response of HEP metabolism in heart transplant patients has been demonstrated before under hand grip exercise, and the question of the influence of CAV has been raised (2). Previous experimental studies have shown that the kinetics of HEP are altered in a rat model of CAV (1). Here, we directly assessed the influence of CAV on HEP metabolism at rest. At this time, ^{31}P-MRS could strengthen the current diagnostics using coronary angiography. In future, it could help to reduce the number of patients needing coronary angiography.

References

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