Assessment of diffuse ventricular fibrosis in atrial fibrillation using extracellular volume fraction mapping: initial study

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Target audience: Those interested in AF disease and MR imaging research, physicians, radiologists, scientists, MR engineers.

Objectives: In atrial fibrillation (AF), diffuse myocardial fibrosis may be induced by arrhythmia or reflect pre-existing cardiomyopathy. The presence of concurrent AF and diffuse myocardial fibrosis has been associated with an increased risk of heart failure progression. The extracellular volume fraction (ECV) mapping may provide new insights to the understanding of AF. Unlike focal fibrosis, diffuse myocardial fibrosis is not visualized on delayed enhancement magnetic resonance imaging (MRI), but can be quantified with extracellular volume fraction (ECV) mapping [1]. Therefore, the purpose of this study was to evaluate diffuse myocardial fibrosis of the left ventricle (LV) in patients with AF.

Methods: Ten subjects underwent MRI using a clinical 3 T scanner (Magnetom Verio, Siemens Healthcare): 8 persistent AF patients and 2 controls. Left-atrial volume was evaluated from MR cine imaging. A validated Look-Locker T1 Mapping Siemens prototype sequence [2] was used to generate T1 maps as an index of diffuse myocardial fibrosis. The imaging parameters were: TE/TR = 1/295.33ms, FOV = 360mm, Slice Thickness = 8mm, image matrix = 192. 3 short axes of pre and post T1 maps were acquired as shown in Figure 1. Global ECV values were calculated from T1 maps acquired pre- and post-contrast calibrated by blood hematocrit. The ECV value was calculated as:$ECV = (1 - hematocrit)(\frac{1}{T1my\ post} - \frac{1}{T1myopre})/(\frac{1}{T1blood\ post} - \frac{1}{T1bloodpre})$

Results: AF patients had larger left atrial volume (115.8±36.5 ml) than controls (75.85.1 ml) and published normal values [3]. Mean ECV of AF patients was 32.7±4.5% in the basal segments, 30.0±4.8% in the mid-cavity segments, 33.3±5.3% in the apical segments, which were higher than the controls (basal: 26.1±0.0 %, mid-cavity: 26.0±1.5 %, apical: 27.9±1.8 %).

Discussion: ECV of AF patients were higher than healthy controls in the left ventricle from basal to apical levels. ECV is higher in patients with heart failure [4]. AF patients demonstrated diffuse fibrosis suggesting that AF itself may play an independent role in adverse prognosis. The mean left-atrial volume of AF patients was larger than in controls, which is in line with other studies [5].

Conclusion: ECV mapping could help to identify the diffuse LV fibrosis in patients with AF. The quantification could be a better solution for clinicians in diagnosing diffuse LV fibrosis. Our findings need to be validated by enrolling more subjects.

Reference: [1] Ugander M, et al. Eur Heart J. 2012 May; 33(10):1268-78. [2] Messroghli DR, et al. JMRI. 2007; 26(4):1081-6. [3] Caudron J, et al. Radiographics. 2011 Jan-Feb; 31(1):239-59. [4] Su MY, et al. JACC Cardiovasc Imaging. 2014 Oct; 7(10):991-7. [5] Qureshi W, et al. Am J Cardiol. 2014 Nov 1; 114(9):1368-72.

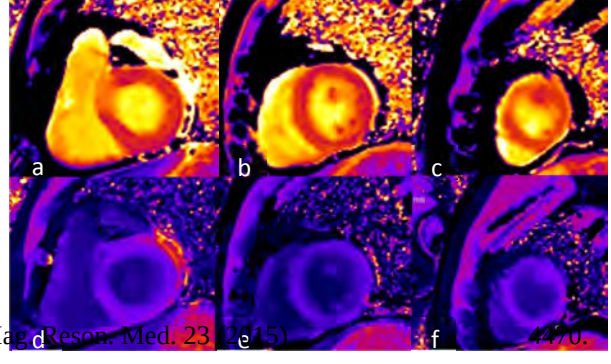

Fig 1. T1 mapping images from AF patient. **Figure a~c:** pre-contrast T1 maps from bottom of heart to apical level; **Figure d~f:** post-contrast T1 maps from basal to apical level