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Assessment of Diffuse Myocardial Fibrosis Using Small-Animal Look-Locker Inversion Recovery T1 Mapping

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Background and Objectives:

Myocardial fibrosis is an important determinant of heart failure. Patchy focal fibrosis can be visualized by late-enhancement techniques of gadopentetate dimeglumine. We hypothesized that diffuse myocardial fibrosis can be quantified by measuring myocardial extracellular volume (ECV) of gadopentetate dimeglumine in a small-animal model using Look-Locker inversion recovery T1 mapping.

Methods and Results:

Sprague-Dawley rats (n=10) were subjected to continuous angiotensin-2 (AT2) infusion for 2 weeks via a subcutaneously implanted minipump system. Magnetic resonance imaging (MRI) was performed both before and after AT2 infusion. The MRI protocol included multislice cine imaging and before-and-after contrast small-animal Look-Locker inversion recovery T1 mapping and late gadolinium enhancement imaging. Myocardial ECV was calculated from hematocrit and T1 values of blood and myocardium. During the course of AT2 infusion, the mean SD systolic blood pressure increased from 122±10.9 to 152±27.5 mm Hg (P<0.003). Normalized heart weight was significantly higher in AT2-treated animals than in control littermates (P<0.033). Cine MRI documented concentric left ventricular hypertrophy. Postcontrast myocardial T1 times were shortened after treatment (median [interquartile range], 712 [63] versus 820 [131] ms; P<0.002). Myocardial ECV increased from 17.2% (4.3%) before to 23.0% (6.2%) after AT2 treatment (P<0.031), which was accompanied by perivascular fibrosis and microscarring on myocardial histological analysis. There was a moderate level of correlation between ECV and collagen volume fraction, as assessed by histological analysis (r=0.69, P<0.013).

Conclusions:

In a small-animal model of left ventricular hypertrophy, contrast-enhanced T1 mapping can be used to quantify diffuse myocardial fibrosis.