Myocardial Fat Deposition in Segments with Infarction Detected with Water-Fat Separation Imaging

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Introduction: Past autopsy studies have shown that a percentage of left ventricular (LV) myocardial scars associated with chronic ischemic heart disease have fatty replacement and a recent observational imaging study showed that 78% percent of LV myocardial infarctions showed fat deposition. MR imaging with its excellent soft tissue contrast generating abilities represents a promising noninvasive method for the study of changes in structure and tissue composition in addition to function of the heart after myocardial infarction.

The major aim of this study was to prospectively investigate the prevalence of fat deposition in chronic myocardial infarction using magnetic resonance water-fat separation imaging with sampling of the entire LV myocardium

Materials and Methods: Twenty-five patients (patient age: 64±11yrs, infarct age: 12±9yrs) with documented prior myocardial infarctions underwent MR imaging on a clinical 1.5T scanner. The study consisted of left ventricular cine functional imaging, fat sensitive and late gadolinium enhanced infarct imaging. For each part of the study identical slice locations were used consisting of 7-10 parallel 8 mm thick short-axis slices with a 4 mm slice gap spanning the LV myocardium from the base to apex of the heart. Three long axis views of the left ventricle were acquired with identical imaging parameters. A steady-state free-precession (SSFP) sequence (repetition time, 2.8 ms, echo time 1.4 ms; in-plane spatial resolution, 1.6 x 1.3 mm^2) was used for cine imaging. A dark blood double inversion recovery multiple-gradient echo sequence (repetition time, 20 ms; echo times, 2.4-15.5 ms (1.2 ms spacing); in-plane spatial resolution, 2.5 x 1.7 mm^2) was used to acquire fat sensitive images at matching cine image slice locations. Raw k-space data were saved to the scanners hard disk and transferred to a personal computer. Fat and water images were then reconstructed using and a three-point DIXON reconstruction method. Raw data from echo times of 4.8, 7.2 and 9.6 ms, corresponding to fat and water being in-phase, opposed-phase and then again in-phase, were used for the three-point reconstruction method. A phase sensitive inversion recovery gradient-echo pulse sequence (repetition time, 10 ms; echo time, 4.2 ms; in-plane spatial resolution, 1.7 x 1.3 mm^2) was used for late gadolinium enhanced (LGE) infarct imaging.

Results: Subjects with prior myocardial infarction had a 68% prevalence of fat deposition (17/25). In the patients with fat deposition, the fat volume was 19.6±19 ml (range: 1.7-62.6 ml) vs late gadolinium-enhancement volume of 30±15 ml (range: 9.6-59.2 ml). The volumes of late gadolinium-enhancement and fat deposition were statistically different (p=0.01). Of the 425 myocardial segments, 156 (37%) had late gadolinium-enhancement and 76 (18%) had fat deposition. 65 segments (15%) had both fat deposition and late gadolinium-enhancement, while 91 segments (21%) had late gadolinium-enhancement and no fat deposition. 11 segments (2.6%) had fat deposition and no late gadolinium-enhancement, but all 11 segments had adjacent myocardial segments with late gadolinium-enhancement.
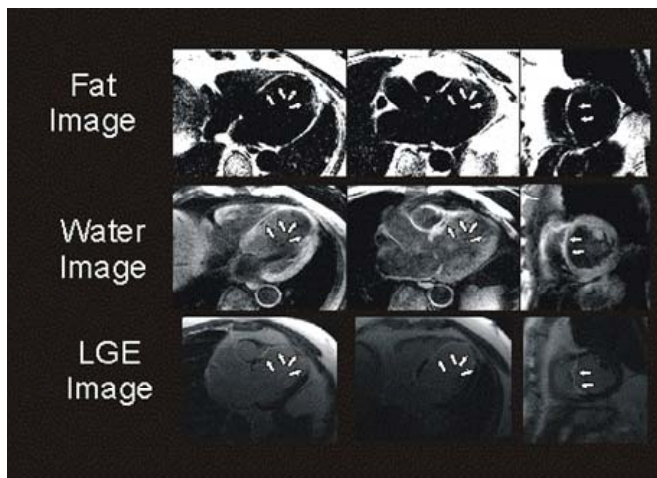
Images from a patient with a chronic apical-septal myocardial infarction. LGE images show hyperenhancement of the myocardial infarct. Fat and water images show fatty deposition in the same segments.
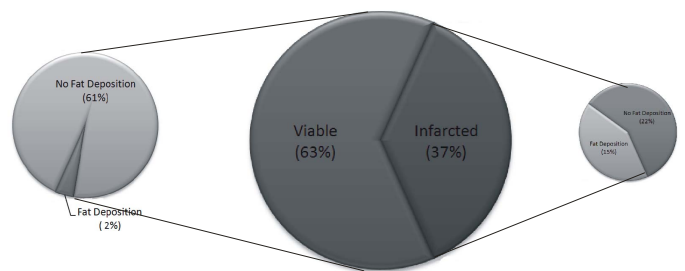
Segmental analysis of water-fat separated and LGE images showed that fat deposition was present primarily in infarcted myocardial segments.

Conclusions: There is a high prevalence of fat deposition in chronic myocardial infarction detected by water-fat separation MR imaging. MR imaging is capable of fat and infarction detection and could be useful in determining the functional cause and significance of fatty deposition after left ventricular myocardial infarction.