

Heterogeneous Distributions of Myocardial Steatosis – An Ex-Vivo Evaluation

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Introduction:

Heterogeneity of myocardial fat accumulation could occur in diseased hearts. The degree of heterogeneity is unknown because accurate depiction is difficult using conventional ¹H-MRS techniques in a beating heart. In the current study, we exploited the existence, extent, and distribution of myocardial steatosis in autopsy specimens. The ex-vivo assessments circumvent the putative methodological pitfalls of ¹H-MRS in in-vivo experiments. We evaluated data collected using ¹H-MRS at various positions of each sample and correlated these features with the patients' demographics and the presence of cardiovascular disease.

Methods:

The heart slices from 55 human subjects were scanned on a 3.0T MR scanner (Verio, Siemens). Among which 11 slices were from native transplant hearts and 44 samples were postmortem examinations. Specimens were removed from formalin and remained in tap water for 24 hours before scanning. Two to four positions (septum, lateral wall, posterior wall, and anterior wall, depended on the accessibility), of each sample were scanned with ¹H-MRS. We avoided those regions with apparent scars (eye examinations by a pathologist) to assess the diffused myocardial fat. Myocardial ¹H-MRS spectra were obtained using PRESS sequence, TR/TE = 3000ms / 30ms, with and without water suppression of 24 averages. Spectral analysis was done offline using jMRUI.

Results:

Scatter plots of the highest and the lowest fat measured on each sample is depicted in Figure 1a. These two values were strongly correlated, but the highest fat percentage was three-fold higher than the lowest fat percentage. Figure 1b and 1c show the percentages of the regions with the lowest and highest fat content measured in each slice. 31% and 29% of the samples have the lowest and highest fat measured in septum, respectively.

Examining the medical records and the death reports, we divided the study cohort into five disease groups. Table 1 lists the disease categories, their corresponding ages and the averaged fat percent from all samples. Those who died from cardiovascular disease (G2), including acute myocardial infarct, atherosclerosis, and stroke, had significantly higher fat fraction than those of G1 (transplant) and G5 (died from non-cardiovascular related disease). G3 (leukemia) and G4 (HIV) were also distinct for their exceptional high fat fractions.

Conclusion:

The supportive evidence in our ex-vivo studies validated that the myocardial fat distribution could be heterogeneous. The heterogeneity is increased with the presence of cardiovascular disease in the aging hearts.

Table 1. Myocardial fat percents stratified by disease affected.

Group	N/Women	Age (years)	Mean fat percent(%)
1. Transplant	11/5	43±21	0.39±0.4
2. Cardiovascular disease	17/8	69±14	1.62±1.1
3. Leukemia	3/1	56±12	1.83±0.9
4. HIV	3/0	57±7	2.67±1.5
5. Other: Lung disease, cancer...	21/11	61±16	0.59±0.4

Figure 1.

