Fat Fractions and Spectral T2 Values in Vertebral Bone Marrow in HIV and non-HIV Infected Men: A 1H Spectroscopic Imaging Study

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Synopsis: A Carr-Purcell-Meiboom-Gill (CPMG) based spectroscopic imaging technique was used to determine a reduced mean vertebral fat fraction in a group of HIV-infected men undergoing anti-retroviral therapy compared to an age matched control group. The water and fat T2 values did not show systematic differences between the two groups but were a) independent of fat fraction and b) substantially longer than literature values (1) reported using alternative spectroscopic methods based on STEAM or PRESS.

Introduction: Treatment for HIV with anti-retroviral therapies can cause diabetes-like complications and changes in fat distribution referred to as lypodystrophy (2). The purpose of this study is to utilize proton spectroscopic methods to assess potential differences in the fat fractions and spectral T2 values of vertebral marrow of HIV infected men vs age-matched non-HIV infected men.

Methods: A total of 35 men, 15 non-HIV (age 37 ± 8 years) and 20 HIV infected (age 39 ± 5 years) were studied. Inclusion criteria for the HIV-infected men were HIV infection, normal testosterone levels and stable antiretroviral regimen. Non-HIV infected men had no known illnesses which might affect bone or fat mass. A 1.5 T scanner was used to perform measurements of relative fat fractions and spectral T2 values with an inner volume CPMG technique using a TR of 2 s and 8 echo times from 40 to 320 ms, as described previously (3). Three separate vertebrae, L3, L4, and L5 were sampled with 0.6 ml voxels. Unpaired, two-tailed t-tests were performed to determine the statistical significance of population differences of the mean fat fractions and spectral T2 values with P < 0.05 considered significant.

Results: The fat fractions of the HIV and non-HIV infected men (mean ± SD) were 0.29 ± 0.08 and 0.40 ± 0.12, respectively. The lower fat fraction of the HIV group was statistically significant. The figure below shows the spectral T2 values as a function of fat fraction for both groups. No systematic dependence of the T2 values on fat fraction over the wide range found is observed. The mean spectral T2 values did not differ significantly between groups and the total population (N = 35) means ± SDs for fat and water were 119 ± 13 ms and 81 ± 12 ms, respectively.

Discussion: The reduced fat fraction in HIV infected men undergoing anti-retroviral treatment reported herein confirms our earlier result (4) in a subgroup (N = 15 HIV, 9 non-HIV) of the present population. The result is interesting in the light of other reported differential fat depot changes in antiretroviral treated HIV patients such as increased visceral fat (5) and reduced abdominal and subcutaneous fat (6). The previously unreported spectral T2 values are of interest in that they do not vary between groups and are 60 to 80 % longer than those reported by others in vertebral marrow who have used PRESS and STEAM based methods. The similarity in water T2 values between groups suggests that the cellular environment comprising the water signal in HIV-infected men does not differ markedly from non-HIV infected men, in contrast with other pathologies which accompany marrow fat reductions such as leukemias or metastatic disease. The longer T2 values obtained with CPMG techniques vs PRESS and STEAM methods is attributed to multiple refocussing pulses of the CPMG train. The T2 prolongation mechanisms include stimulated echo formation, reduced water diffusion/susceptibility gradient effects and reduced J-coupling effects from fat.

References: