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Serial water changes in human skeletal muscles on exercise studied with proton magnetic resonance spectroscopy and imaging

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In vivo ^{1}H-magnetic resonance imaging (MRI) enabled us to study the distribution of water in living tissues and to document changes in human skeletal muscles during physical exercise. The purpose of the present study was to determine the total muscle water changes after exercise using water in ^{1}H-MR spectroscopy and to compare these changes to the signal intensity change on T_2*-weighted images and/or to the T_2 value change.

Seven young male volunteers were positioned in a 1.5 T Philips MR imaging system. They were then asked to dorsiflex their ankle joint against a 2 kg weight once every 2 seconds for 2 minutes. The peak height of water declined according to the clearance curve after exercise in all seven cases with the ^{1}H-MRS similar to the signal intensity. The increasing rate at peak height of total muscle water exceeded both the signal intensity and the T_2 value because the water peak height on the ^{1}H-MRS included the extracellular water. In addition, we measured the changes in signal intensity in both calf muscles after walking race exercise. The time intensity curves were used to draw a clearance curve for each muscle group after exercise. It was possible to discern which muscle was used most from the T_2*-weighted image that was obtained once after exercise.

Key words: proton, functional imaging, magnetic resonance spectroscopy, skeletal muscle, exercise