**T₂ Relaxation in Lower Limb Muscles as Examined by Proton Spectroscopy in Boys with Duchenne Muscular Dystrophy**

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**Introduction**

Approximately 1 in 3,500 newborn boys are affected with Duchenne muscular dystrophy (DMD), a recessive x-linked form of muscular dystrophy. Boys with DMD have a mutation in the gene which codes for the sarcolemmal protein dystrophin. The lack of functional dystrophin leads to an increased susceptibility to contraction induced damage. Magnetic resonance spectroscopy (MRS) takes advantage of proton content and the relaxation properties of tissue in order to generate a biochemical makeup of a localized area of the muscle. Proton relaxation rates can be calculated by varying spectroscopic acquisition parameters which in turn can be used to observe and quantitatively assess tissue characteristics. Indeed we found that MRI and MRS can be used to monitor gene correction in preclinical models of muscular dystrophy using facilities within the NHMFL. In this study we address the transverse relaxation properties of the tissue to characterize whether the observed signal comes from healthy, damaged, and edematous tissue in children with muscular dystrophy. MR measures in children with DMD are complicated due to the overwhelming amount of fatty tissue infiltration that does not occur in rodent models. As a result, MR images that do not visibly demonstrate fat infiltration may still demonstrate elevation in T₂ values independent of changes in muscle T₂. The purpose of this study was to examine differences in the transverse relaxation properties (T₂) of the lower leg muscles of DMD affected boys and healthy controls using ¹H-MRS in order to examine muscle T₂ relaxation rates independent of lipid contamination. The ability to detect and characterize these differences is important for determining the condition of the muscle and providing an indication of possible functional deficiencies that may occur as a result of muscle damage and disease progression.

**Methods**

25 boys with DMD (8.7 +/- 2.6 yrs) and 10 aged-matched healthy controls (9.6 +/- 3.0 yrs) participated in this study. ¹H magnetic resonance spectroscopy (¹H-MRS) was performed for T₂ measurements in the soleus (SOL), tibialis anterior (TA), and medial gastrocnemius (GAS) muscles. Positioning of the voxel was chosen based on the largest area of the muscle where there was no overlap with areas of subcutaneous fat, bone or neighboring muscle groups. ¹H-MRS was performed using a single-voxel volume selective STEAM sequence. A repetition time of 9 seconds was used to ensure complete T₁ relaxation of the signal from water. Sixteen echoes were acquired for the SOL muscle (10, 13.5, 18, 27, 36, 45, 54, 63, 81, 90, 108, 135, 162, 198, 243, and 288 msec). Four echoes were acquired for the TA and the MG (10, 27, 54, and 288 msec). Spectra were acquired using a bandwidth of 2498 Hz into 2048 complex data points and averaged 4 times.

**Results and Discussion**

Boys with DMD demonstrated T₂ values (determined by MRS) of 31.8 +/- 1.8, 30.0 +/- 2.9, and 30.5 +/- 3.4 for the SOL, TA, and GAS respectively. Control boys had T₂ values of 28.6 +/- 0.9, 9.0 +/- 2.8, and 28.0 +/- 2.6 for the SOL, TA, and GAS. Significant increases in T₂ (p<0.05) were found for children with DMD in both the SOL and GAS relative to the healthy control subjects.

**Conclusions**

Being able to accurately determine muscle characteristics in boys with DMD is crucial for determining potential targets for therapeutic interventions.

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