Study of Amyotrophic Lateral Sclerosis Brain Tissue With FTIR Microspectroscopy

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Amyotrophic lateral sclerosis (ALS) is a progressive, lethal neuromuscular disease that is associated with the degeneration of motoneurons [1] leading to muscle atrophy, progressive paralysis, and death, commonly by respiratory failure [2]. Large motoneurons of the ventral horns of the spinal cord and motor nuclei of the brainstem as well as large pyramidal neurons of the motor cortex and/or large myelinated axons of the corticospinal tracts are affected by the disease [3]. Presently, there is no specific biological marker for ALS and the diagnosis depends on the recognition of a characteristic clinical constellation that includes the presence of both upper and lower motor neuron findings and progressive motor dysfunction [3].

Synchrotron FTIR microspectroscopy data has been collected on post-autopsy tissue sections from Amyotrophic Lateral Sclerosis and control brain. Tissues samples were found to contain “dark spots” detectable microscopically under visible illumination (Figure 1). The spots were heterogeneous in shape, some being rounder and others more elongated; overall the ALS samples were observed to contain more dark spots that controls. The IR signature of creatine has been identified in many of the dark spots in ALS brain tissues (Figure 2): spinal cord, cortex and brainstem, but not in the control samples. Preliminary X-Ray Fluorescence results show that Fe and Zn may be co-localized with these dark spots. We hypothesize that the presence of creatine is an indicator of disturbed energy homeostasis, possibly associated with mitochondrial dysfunction in ALS.

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References: