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„Biomolecular and elemental micro-analysis of the skeletal muscle in the quest of new tissue markers of neuromuscular diseases.”

Abstract

Muscle diseases, in which the dysfunction in the tissue is due to pathology in the muscle cell itself rather than damage of the nervous system, are collectively known as myopathies. Thus, the most general statement is that myopathy is a condition involving muscle tissue with different etiopathogenesis, different distribution scheme of muscle disfunction and diverse clinical course, and the consequences for the affected person. As muscle tissue also undergoes age-related processes - 'sarcopenia' - this tissue can also become an indicator of health status. It is therefore not out of the question that a biopsy of muscle, a tissue that is relatively easy to access, may have broad indications. Consequently, it is advisable to gain much more knowledge about the observable even tiniest elemental and biomolecular changes in muscle tissue. One of the aims of this thesis was to provide a basis for such input.

In order to study the differences resulting from the elemental composition of muscle fibres, the synchrotron radiation X-ray fluorescence (SR-XRF) technique was used, which is a type of qualitative and quantitative method for imaging the spatial distributions of elements in biological samples. It is a multi-element analysis method, the great advantage of which is the possibility of determining not only the elements necessary for muscle function, but also those whose importance is less well known and whose content in muscle fibres is lower. Fourier transform infrared spectroscopy (FTIR) was used to investigate the differences resulting from the biomolecular composition of muscle fibres. This is a method that allows one to visualise the distribution of biomolecules in muscle tissue, as well as to characterise and compare their content in individual samples. Since elemental as well as biomolecular changes can reflect biochemical processes in muscle fibres, studying them at different stages can lead to an understanding of disease development at an early stage.

The obtained results showed that there is a difference in both the elemental and biomolecular compositions between the tissue defined as the reference group and the tissues diagnosed as having changes through pathological processes - the group of dystrophies and myopathies. The greatest differences for fibers can be observed for elements such as: P, K, Ca and Cr, however, for all analyzed elements, a decrease in their content can be seen for the dystrophy group. For measurements of the biomolecular composition using FTIR, it can be seen that the value of net area under the analyzed peak was highest for the dystrophy group compared to the other two groups. A higher protein content can be observed in hypertrophic fibres, while atrophic fibres show a conversion of muscle tissue into fat tissue.