Ferritin – diagnostics and therapeutics agent?

Oliver Strbak

Biomedical Center Martin, Jessenius Faculty of Medicine in Martin, Comenius University in Bratislava, Slovakia

oliver.strbak@centrum.cz

Abstract. Iron is a vital compound for living systems from all three life domains. It is involved in many fundamental metabolic processes, including respiration, photosynthesis, DNA synthesis, etc., which makes him an essential element for cell survival. However, on the other hand, excess of free iron is extremely toxic to the cell. It is generally accepted that the toxicity of iron results from the ability of ferrous ions to produce hydroxyl radicals through the Fenton reaction. In humans, the elevated level of iron is strongly associated with various pathological processes, including neuroinflammation, neurodegeneration, cardiovascular disease and even cancer. Unfortunately, we still do not know whether iron accumulation is the initial cause or the consequence of pathology. Nevertheless, ferritin has been proposed as a precursor of pathological iron accumulation and mineralization. Ferritin is an intracellular, nanosized iron-storage molecule with a protein envelope and central cavity with a mineral core inside. Based on the recent findings, the composition of the mineral core depends on the health condition. Whereas physiological ferritin consists mainly of a ferrihydrite-like mineral, the pathological ferritin contains mostly magnetite. Theoretically, it opens the possibility of non-invasive diagnostics of pathological processes associated with magnetite mineralization since it causes significant hypointensive artefacts in the MRI signal. Moreover, understanding the magnetite mineralization during pathology could reveal the background of pathology itself. Therefore, in this presentation, I will discuss the results related to the following questions:

- Allow the MRI relaxation properties of physiological and pathological ferritin to distinguish these two structures?
- What biochemical processes can lead to the mineralization of magnetite in ferritin's mineral core?

Oliver Strbak, Ph.D. received his M.Sc. degree from Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava, Slovakia, in 2004 (specialization: biophysics and molecular physics). From 2007 to 2010, he was a Marie-Curie fellow in the "FAST" project – Advanced Signal-Processing for Ultra-Fast Magnetic Resonance. He defended his dissertation thesis at Faculty of Science, Pavol Jozef Safarik University in Kosice, Slovakia, in 2010. His thesis and further research concerned MRI of biogenic as well as synthetic iron oxides-based magnetic nanoparticles. In 2015 he was awarded by the Slovak Academy of Sciences as part of a team of young researchers for results in Magnetic Resonance Imaging. He currently works as a research scientist at the Biomedical Center in Martin, Slovakia. He primarily focuses on the biochemistry of iron oxides mineralization and accumulation during pathological processes in humans, including neuroinflammation and neurodegeneration. The aim is to find the non-invasive biophysical diagnostic method of pathological processes associated with biogenic iron accumulation, as well as to reveal the therapeutic possibilities by understanding the biochemical "driving forces" of pathological iron mineralization.