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Theranostic albumin nanocarrier loaded with nerve growth factor stimulates brain recovery after stroke

Nerve growth factor (NGF) is one of the most important neuropeptides involved in the regulation of growth and differentiation of cholinergic neurons. The biomolecule has great potential in the treatment of stroke. However, as many other biopharmaceuticals, the neurotrophic factor is not able to pass the blood-brain barrier. Human serum albumin (HSA) represents a promising candidate for the delivery of different types of contrast or therapeutic agents. In this work advanced theranostic nanocarrier was synthesized by co-desolvation of NGF and HSA in the presence of cerium ammonium nitrate (CAN)-stabilized superparamagnetic iron oxide nanoparticles. The surface was functionalized using apolipoprotein E (Apo E) via a bi-functional polyethylene glycol reagent to facilitate the active transport into the brain. The NGF-loaded nanocomposites had a particle diameter of 191 ± 2 nm (PDI 0.021 ± 0.017) with a particle yield of 71.5 % (m/m) and a zeta potential of -48.3 mV. The conjugation with ApoE resulted in a slight increase of particle size to 212 ± 1 nm (PDI 0.075 ± 0.022). The nanoparticles did not show any cytotoxic effect in rat embryonic pheochromocytoma cells (PC12). According to a SQUID magnetometer the normalized saturation magnetization value (54.1 emu/g) of the theranostic nanocomposites was comparable to those of pure CAN-maghemite (59.5 emu/g). The efficacy of NGF-loaded nanocarriers was tested in combination with the small-molecular MEK inhibitor U0126 in the transient middle cerebral artery occlusion in male Wistar rats. The infarct size was significantly reduced using the combination of NGF containing nanoparticles and U0126.

Biography

Dr. Tivadar Feczko has completed his PhD from University of Veszprém in 2004. Since 2014 he has been the leader of the Functional Nanoparticles Research Group jointly operated by the Hungarian Academy of Sciences Research Centre for Natural Sciences, Institute of Materials and Environmental Chemistry and the University of Pannonia, Research Institute of Biomolecular and Chemical Engineering (Hungary). He did research at the Goethe University Frankfurt (Germany) as an experienced researcher with the support of Alexander von Humboldt Foundation between 2016 and 2017. He has published 37 papers (with 590 independent citation, h-index 15) in peer reviewed journals.

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