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Nanozyme technique applied to antioxidant enzyme, SOD, has high potential in the treatment of diseases related to oxidative stress

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Numerous diseases ranging from neurodegenerative to some types of cancers are associated with overproduction of reactive oxygen species. Injection of antioxidants could decrease oxidative stress. Antioxidant enzymes, such as superoxide dismutase (SOD) and catalase, are the most effective antioxidants in nature and could be used to slow oxidative stress. Unfortunately, injection of native enzymes is not effective due to their rapid elimination and instability in blood. Nanoparticles called "nanozymes" based on block-ionomer complexes of negatively charged proteins with positively charged block-copolymers (in particular, polylysine-polyethyleneglycole, PLL-PEG) were previously developed to encapsulate SOD. These cross-linked particles – nanozymes-1 have nanoscale size and preserve specific activity. However, fast release of enzyme from complexes leads to fast elimination from the body. In this presentation, novel type of nanozymes-2 will be discussed. Second negatively charged block-copolymer (poly(glutamic acid)-polyethyleneglycole (PGlu-PEG) was used, and protamine was used instead of PLL-PEG. We were able to increase the reaction yield from 5% to 45%. Developed particles have neutral charge, 50 nm hydrodynamic diameter while nanozymes-1 have slightly positive charge and 40 nm hydrodynamic diameter. Pharmacokinetic experiments showed remarkably increased T1/2 and AUC of double nanozymes versus both standard nanozymes and native SOD. To evaluate therapeutic efficiency of nanozymes, rat spinal cord injury model was used. Recovery of rats was investigated with MRI imaging and BBB-test. Animals that were injected with nanozymes-2, had significant higher scores in BBB-test and lower volume of damage. Thus, easy, scalable method to encapsulate antioxidant enzyme, SOD, was developed.

Biography

Anton Aleksashkin has completed his Master's degree from Lomonosov Moscow State University (MSU). He is a PhD student of Lomonosov MSU in the Faculty of Chemistry and a Research Fellow in BIND RUS.

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