Influence of Quercetin-loaded iron nanoparticles on epilepsy-induced behavioral and electrophysiological disturbances

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Epilepsy is one of the most common neurological disorder, characterized by repetitive seizures and various mental health problems. Currently more than 30% of epilepsy cases are resistant to the treatment. It is believed that the basic cause of the disease is the disbalance between the excitatory and inhibitory processes in neurons. In modern research one of the major candidates for new antiepileptic drug development are flavonoids-plant derived antioxidants. In our project we focused on Quercetin, which is the member of polyphenol flavonoid family with anti-inflammatory and antioxidant characteristics, but with low bioavailability. We studied Quercetins influence on the hippocampal electrophysiological activity and behavioral disturbances in the lab rats with status epilepticus caused by kainic acid (KA-SE). To overcome and increase the low bioavailability of quercetin we loaded it with magnetic nanoparticles (MNP) and after injection in the tail of the lab rat, animals were placed under the unilateral external static magnetic field (ESMF) directed on the temporal lobe. Behavioral experiments demonstrated that ESMF/MNPs alone do not change the behavior of animals. Quercetin/Q-MNPs facilitate the learning of the control rats. Only Q-MNPs targeted by ESMF showed statistically significant improvement of KA-SE-induced memory impairment. Quercetin alone/Q-MNPs without ESMF was ineffective against epilepsy-induced memory disturbance.

Electrophysiological recordings revealed that KA-SE alters the effectiveness of quercetin, which may be explained by a violation of the blood-brain barrier due to epileptic status. Injection of Q-MNP with the presence of hippocampus projected magnetic field significantly changes the amplitude and frequency of neuronal discharges in the hippocampus. The effect of Q-MNP in the CA1 field of the hippocampus was inhibitory, thus explaining its positive effect on behavioral disturbances caused by epileptic status.

(The work is supported by Shota Rustaveli National Science Foundation, grant FR17_629).