CANCER PREVENTION & RESEARCH INSTITUTE OF TEXAS

Award ID:
RP160770

Project Title:
Optical opening of blood-brain barrier for brain tumor drug delivery by plasmonic nanobubbles

Award Mechanism:
High Impact/High Risk

Principal Investigator:
Qin, Zhenpeng

Entity:
The University of Texas at Dallas

Lay Summary:

Brain tumors are known to be lethal, with a median survival of 14.6 months for glioblastoma multiforme. A major and unique obstacle for brain tumor drug delivery is the presence of blood-brain barrier. The blood brain barrier is a sophisticated structure that gives an optimal environment for brain function but also severely limits the penetration of anti-cancer drugs. The goal of our project is to develop a novel approach to optically open the blood-brain barrier thus allowing the access of a wide range of therapeutic drugs to brain tumor cells. Specifically, we will design and synthesize plasmonic nanomaterials to target the tight junction proteins, a critical component of the blood-brain barrier. By using tissue-penetrating near-infrared pulsed laser, we will generate plasmonic nanobubbles by activating targeted plasmonic nanomaterials. These nanobubbles will then act as “nano-sonicators” to locally disrupt the tight junction thus temporarily compromising the blood-brain barrier. We will test our hypothesis both in vitro using a cell culture model and in vivo with implanted brain tumor in mice. Success of this proposed work will significantly advance the field of brain tumor drug delivery. Specifically, the optically triggered blood-brain barrier opening will allow the use of more effective chemotherapy drugs from a large pool of anti-cancer drugs, previously unavailable due to the blood-brain barrier. With more effective therapy to the tumor cells, we expect substantially reduced side effects that the brain tumor patients currently suffer from chemotherapy treatment, and eventually improved survival and quality of life.