Smart Ultrasound-responsive Nanoparticles as theranostic agents for Treatment of Glioblastoma multiforme

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Abstract

Glioblastoma multiforme is a tumor of the central nervous system characterized by a poor prognosis in spite of modern treatment multimodalities. Recent advancements in nanomedicine led to the development of stimulus-responsive "smart" nanoparticles allowing spatial and temporal control in drug delivery especially in the treatment of cancers like glioblastoma. The present study applied dual-stimulus (pH and ultrasound) responsive liposomes, nose-to-brain drug delivery with the use of ultrasound for imaging. The smart ultrasound-responsive drug-loaded liposomes described herein can act as theranostic agents like ultrasound contrast agents while allowing controlled drug delivery for the treatment of glioblastoma multiforme. The liposomes developed leverage ultrasound to attain higher bioavailability of the drug across the blood brain barrier as well as for triggered delivery while pH acts as an intrinsic trigger in the tumor site. The liposomes prepared herein were characterized in terms of their size, stability, drug encapsulation and the potential to be administered intranasally. Drug release studies indicated preferentially drug release from the particles in the simulated cerebrospinal fluid as compared to the simulated nasal fluid, an effect that is accentuated in the presence of ultrasound. In addition to this, the liposomes exhibited high contrast *in situ* on B-mode ultrasound imaging in a tissue mimicking phantom. Besides, the nanoparticles were found to be safe and biocompatible on fibroblast (L929) cell lines while they also were cytotoxic to the tumor cells (U87MG cell line) as compared to free drug. The higher bioavailability in the brain was determined through *in vivo* administration intranasally in Wistar rats. Thus, the study proves that smart liposomes act as theranostic agents allowing targeted delivery of drugs at tumor sites while acting as ultrasound contrast agents.

Keywords— *nose-to-brain delivery, smart nanoparticles, theranostics, ultrasound-responsive.*

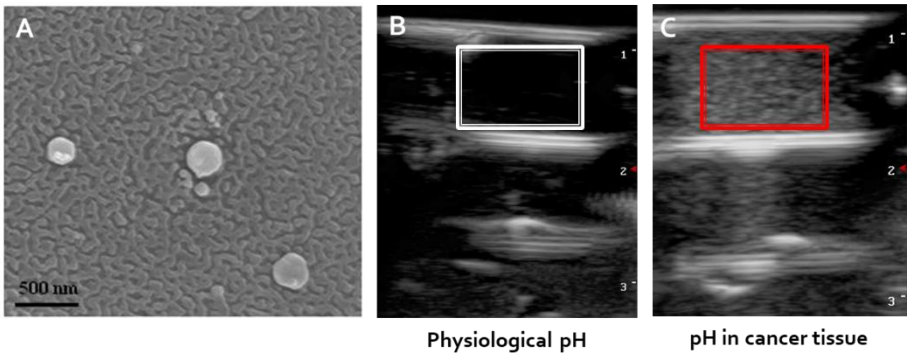


Figure 1: (A) CryoFEG-SEM of the liposomes (B-C)Contrast development in pH of cancer tissue.

Professional Biography

Rishi Rajat Adhikary is currently pursuing a Dual Degree (M.Tech.-Ph.D.) in Biomedical Engineering at the Indian Institute of Technology Bombay. He is a medical doctor and holds a Bachelor of Medicine and Bachelor of Surgery (MBBS). As a research scholar, he is exploring the use of smart nanoparticles to diagnose and treat various diseases as well as in the development of miniaturized organ systems for drug development. His area of research is focused on the development of novel technologies in the treatment of neurological diseases, low-cost diagnostics for healthcare and theranostics.



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Any Comments: