Development of Nanoparticles for Esophageal Cancer Imaging and Therapy

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Abstract

Esophageal cancer is the 6th leading cause of cancer mortality worldwide. Since there are minimal symptoms during the early stages of esophageal cancer, most patients are diagnosed at late stages, which limits curative treatment options. Chemotherapy drugs, including epirubicin (EPI), are effective, but have significant toxicities limiting their administration. Therefore, there is an urgent need for effective treatments integrated with novel drug delivery strategies to minimize drug side effects.

Various types of nanoparticles have been proposed for targeted drug delivery, imaging, and tracking of therapeutic agents. Nanoparticles can be enriched in tumor tissues via enhanced permission and retention effects. Therefore, nanoparticles can prolong drug half-life, improve solubility of hydrophobic drugs, and reduce potential immunogenicity. It has been an active research area to fabricate nanoparticles with high biocompatibility and less toxicity, with desired imaging traits and surface properties for biomarkers and drugs conjugation. It is desirable to develop nanoparticles that can be conjugated with biomarkers and drugs for targeted delivery and imaging simultaneously.

This talk will be developed into two parts. I will first talk about a study using a new type of nanoparticles (f-PNPs) assembled by cyclic peptides for combined imaging and drug delivery for esophageal cancer. F-PNPs have demonstrated biocompatibility and exhibit both visible and near infrared (NIR) fluorescence. To achieve tumor targeting for both imaging and drug delivery, we conjugate the nanoparticles with RGD moieties to selectively target esophageal cancer cells as well as tumor neovasculature cells via αvβ3 integrin. They were then embedded with epirubicin (EPI), a common chemotherapeutic agent, via π-π stacking and electrostatic interactions between chemo-drugs and peptides. Both in vitro and in vivo experiments have confirmed that the RGD modified f-PNPs (RGD-f-PNPs) inherited bright, visible, and NIR fluorescence for tumor imaging and cancer cell targeting through RGD-αvβ3 integrin receptors interactions. The EPI loaded RGD-f-PNPs (RGD-f-PNPs/EPI) led to significantly reduced cardiotoxicity and improved antitumor activity compared to EPI alone. Moreover, the drug delivery to tumor sites and therapeutic responses could be monitored with NIR fluorescence using RGD-f-PNPs/EPI. In the second part, I will discuss our collaboration with Dr. Wei Chen at Department of Physics on a project combining his newly developed CuCy nanoparticles and an old FDA approved chronic alcoholism treatment drug, i.e. disulfiram for a novel targeted chemotherapy for esophageal cancer.

Refreshments will be served at 3:30 p.m. in the Physics Lounge