Ultrasound- and Protein-Receptor-Targeting in Cancer Treatment

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Abstract
The main disadvantage of chemotherapy for cancer treatment is that the drug is delivered throughout the body, causing various side effects. A plausible solution to overcome these unwanted effects is to use “smart” molecular vehicles to sequester the therapeutic drug in a package and release it to the specific tumor site at the appropriate time. In so doing, the drug will have minimal interactions with healthy cells in the body, thus reducing many of the unwanted side effects associated with conventional chemotherapy, increasing the efficacy of the drug, and greatly improving the quality of life for cancer patients. The “smart” drug delivery system that we envision encapsulates the chemical drug in a nano-sized capsule which is tagged with a molecular recognition moiety specific for cancer cells. Once it reaches the tumor site, ultrasound is applied to release the chemotherapeutic agent directly to the cancer site. We have synthesized new chemotherapy carriers with conjugated target proteins. These target molecules (including Albumin and plasminogen) have a higher affinity towards cancerous tissues than normal healthy cells and thus will lead the cancer drug to the tumor site. In particular, Albumin targets prostate cancer cells, while plasminogen molecules target certain types of colorectal cancers. Both of these cancers are currently among the most prevalent in the world. After synthesis, our research group used different ultrasound parameters (frequency, power intensity, pulse duration) to release the carriers’ contents. Figure 1 shows the release of calcein (a model drug mimicking the action of the anti-neoplastic agent doxorubicin) from albumin liposomes using low frequency ultrasound and three different power densities. All power densities released at least 85% of the calcein load within 200 seconds of applying ultrasound.

Using targeted liposomes and ultrasound, a multimodal drug delivery system, capable of improving the lives of patients worldwide, is envisioned.

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