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Photoacoustic System Utilizing Functionalized Nanoparticles for Ovarian Cancer Detection

Ovarian cancer is the second most common gynecological malignancy in the United States and the most fatal. Although ovarian cancer treatments have advanced, approximately 85-90% of patients will experience recurrence with a median survival prognosis of only 12-24 months. While there are some indicators of disease recurrence they are detected with varying success.

Circulating tumor cells (CTCs) are cells that have detached from a primary tumor and circulate throughout the body. Ovarian CTCs typically detach and disseminate into intraperitoneal fluid as well as the peripheral blood supply. Some ovarian CTCs have been shown to precede primary tumor growth and are associated with poorer patient outcomes, making CTC identification an attractive tool for diagnostic as well as prognostic information. Unfortunately, current systems for detecting ovarian CTCs aren't sensitive enough for clinical utilization.

Researchers at Arizona State University have developed a photoacoustic flow cytometry (PAFC) system for detecting ovarian CTCs. This system utilizes folic acid functionalized copper sulfide (FA-CuS) nanoparticles which bind to folate receptors that are overexpressed on the surface of ovarian cancer cells. This system could be used for in vivo CTC detection and analysis as well as in vitro detection and analysis. For utilization in vivo, the FA-CuS nanoparticles are an ideal contrast agent in photoacoustic (PA) applications because of their easy synthesis, low toxicity, biocompatibility and biodegradability. Further, they exhibit excellent NIR absorption and PA signal at depths of about 5 cm in biological tissue. These nanoparticles could also act as a guide for photothermal ablation therapy.

This novel system enables the accurate detection and identification of ovarian CTCs for clinical diagnostic as well as potential therapeutic applications.

Potential Applications

- Sensitive detection of ovarian CTCs
  - Early diagnosis of ovarian cancer metastasis
  - Indicators of patient prognosis

- Guide for photothermal ablation therapy

Benefits and Advantages

- Sensitivity – detects down to 1 cell/sample (physiologically relevant concentrations)
- Noninvasive when used to detect in vivo ovarian CTCs
- Can be used on patient samples for in vitro detection
- Able to detect CTCs more accurately in whole blood and tissue
- Easy synthesis of nanoparticles having low toxicity
- The FA-CuS nanoparticles exhibit excellent NIR absorption and PA signal at depths of 5 cm in biological tissue
- Enhanced biodegradability and biocompatibility compared to traditional gold contrast agents

For more information about this opportunity, please see

Lusk et al - ACS Biomater. Sci. Eng. - 2019

For more information about the inventor(s) and their research, please see

Dr. Smith's departmental webpage