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Multifunctional fluorescent nanoparticles for cancer surgery show promise

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Even with pre-operative imaging techniques, surgeons still rely on visual inspection to locate malignant tissues during surgery. New research released today at the 2017 American Association of Pharmaceutical Scientists (AAPS) Annual Meeting and Exposition may help surgeons better view and treat these tumor cells with engineered naphthalocyanine-based nanoparticles (SiNc-PNP) injected 24 hours before surgery, which then light up when they connect with the cancerous tumors.

In the study, "Single Theranostic Agent for Image-Guided Surgery and Intraoperative Phototherapy for Cancer Treatment," researchers developed an activatable theranostic nanoplatform that can be used for two purposes: tumor delineation with a real-time near-infrared (NIR) fluorescence signal during surgery, and an intraoperative targeted treatment to further eliminate hard-to-remove tumors by non-toxic phototherapy.

"You can relate these nanoparticles like a light switch, they are off until the tumor cells turn them on," said the study's lead researcher Oleh Taratula, Ph.D., assistant professor of pharmaceutics, Oregon State University. "Tumor cells can be close to healthy tissue, blood vessels and more, making them challenging to remove. The surgeon can shine the near-infrared light on the now-glowing cells and these nanoparticles will absorb the light transferring it to a heat to eliminate the tumor cells."

The developed nanoparticles were successfully delivered to, accumulated at, and even penetrated into the core of tumors in animal models.

Subsequently, these activatable SiNc-encapsulated polymeric nanoparticles turned on the NIR fluorescence at the tumor site, offering high cancer-to-tissue contrast imaging.

The feasibility of activatable SiNc-PNP in the application of real-time intraoperative image-guided surgery was demonstrated using Fluobeam 800, an FDA-approved intraoperative NIR imaging system, during which sensitive fluorescence detection of cancer tumors was observed for tumor resection.

Phototherapy during surgery in mice demonstrated successful removal of the subcutaneous tumor guided by the fluorescence signal from SiNc. The NIR light was shown on the tumor 24 hours after injection (10 minutes) of the nanoparticles. Chemoresistant tumors, when treated with this single dose of phototherapy, were completely eradicated from the mice, with no tumor recurrence detected during the experiment.

Taratula added, "We think these nanoparticles could be a powerful diagnostic and treatment tool to enhance surgical outcomes and patient prognosis for a variety of cancers in the future."

The next step for the researchers is to confirm the efficacy of the phototheranostic nanoplatform by conducting image-guided surgery in combination with phototherapy in additional animal models.

More information: Single Theranostic Agent for Image-Guided Surgery and Intraoperative Phototherapy for Cancer Treatment will be presented Tuesday, Nov. 14, noon - 1:00 p.m. (PST), Poster Forum 5 in the San Diego Convention Center: annual.aapsmeeting.org/poster/member/102491