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Construction of an Ultrasound-Responsive Phase-Transition Liposomal Theranostic Platform for Targeted Enhanced Therapy of Ovarian Cancer.

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Objective:

Ovarian cancer is characterized by poor prognosis due to difficulties in early diagnosis and frequent peritoneal metastasis. This study aimed to develop a theranostic nanoplatform, FA-PEG-LIP@PFH/DOX, with ultrasound (US) responsiveness and active targeting capability.

Methods:

FA-PEG-LIP@PFH/DOX was prepared using the thin-film hydration method. Particle size distribution, surface charge, and morphology were characterized by dynamic light scattering (DLS) and transmission electron microscopy (TEM). Low-intensity focused ultrasound (LIFU) was applied to induce acoustic droplet vaporization (ADV) of the PFH core, and both in vitro and in vivo ultrasound imaging enhancement were assessed. The cellular uptake of the nanoplatform by SKOV3 ovarian cancer cells was evaluated using flow cytometry and confocal laser scanning microscopy, and cell proliferation inhibition under LIFU stimulation was determined by CCK-8 assay.

Results:

Nanoparticles of FA-PEG-LIP@PFH/DOX with a regular spherical shape and an average diameter of 185 nanometers were successfully prepared. Under LIFU irradiation, the liquid PFH in the liposomes rapidly evaporated to form microbubbles, significantly enhancing the ultrasonic signal intensity at the tumor site. In vitro drug release studies demonstrated a significant effect of ultrasound-triggered release. In vivo experiments showed that the FA-mediated active targeting and PEGylation, along with the long circulation property, led to the effective accumulation of the drug in tumors, significantly inhibiting the tumor growth in tumor-bearing mice, and causing minimal toxicity to major organs.

Conclusion:

The FA-PEG-LIP@PFH/DOX nanoplatform combines ultrasound imaging enhancement with temporally and spatially controllable chemotherapy delivery, achieving a "theranostic" approach for ovarian cancer and providing a promising strategy for the clinical translation of gynecological malignancies.