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PROCEEDINGS

Research on the Synergistic Mechanism of Photothermal-Chemotherapy-Immunotherapy of Multi-Functional Nanoparticles Against Gastric Cancer

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ABSTRACT

Objective

This study investigates the synergistic effects of a novel multifunctional nanoparticle on gastric cancer treatment through photothermal therapy, chemotherapy, and immunotherapy.

Method

Synthesize hollow mesoporous Prussian blue nanoparticles and load them with luteolin. Use exosomes to encapsulate the nanoparticles and modify the surface of the targeted peptide GX1. Detect the morphology of nanoparticles using a nanoparticle size analyzer and transmission electron microscopy. Use Coomassie Brilliant Blue to detect the effect of extracellular vesicle encapsulation. Detect the thermal conversion efficiency of nanoparticles under specific laser irradiation through infrared and ultraviolet spectroscopy, as well as the release rate of luteolin before and after irradiation. Using flow cytometry and confocal microscopy, multifunctional nanoparticles labeled with FITC fluorescent dye were co cultured with SGC-7901 cells to predict the ability of nanoparticles to target cancer cells. In the animal model of gastric cancer xenograft in nude mice, multifunctional nanoparticles labeled with FITC fluorescence were injected, and the distribution of nanoparticles in the nude mice and their enrichment effect at the tumor site over time were detected using a small animal live imaging instrument. Evaluate the therapeutic effect using immunohistochemistry staining and detect the activation of the immune system in tumor tissue through flow cytometry.

Results

Hollow mesoporous Prussian blue nanoparticles loaded with luteolin were successfully encapsulated on the outer surface by exosomes. Multifunctional nanoparticles exhibit excellent photothermal conversion performance under 808 nm laser irradiation, and laser irradiation can accelerate the release of luteolin from the nanoparticles. After co culturing multifunctional nanoparticles with SGC-7901 gastric cancer cells, the nanoparticles can significantly target and bind to gastric cancer cells. As the culture time increases, the number of nanoparticles swallowed by gastric cancer cells gradually increases. At the same time, laser irradiation can significantly improve the apoptosis rate of gastric cancer cells. In vivo experiments further confirmed that the multifunctional nanoparticles can significantly inhibit the growth of gastric cancer lesions under laser irradiation, and can activate killing T cells in tumor tissue, enhancing the efficacy of immunotherapy. Through the weight changes and blood routine indicators of nude mice, it has been proven that multifunctional nanoparticles have no significant toxic side effects and have high biological safety.

Conclusion

This study successfully constructed a multifunctional nanoparticle composed of hollow mesoporous Prussian blue nanoparticles loaded with luteolin, which were encapsulated in exosomes and modified with chimeric vascular targeting peptide GX1. This multifunctional nanoparticle can target and enrich gastric cancer cells SGC-7901, and achieve effective killing of tumor lesions through the photothermal effect of Prussian blue and the chemotherapy effect of luteolin. It can also bind with PD-L1 blockers to achieve photothermal chemotherapy immune synergistic therapy for gastric cancer.

KEYWORDS

Gastric cancer; exosomes; prussian blue nanoparticles; luteolin; photothermal therapy; chemotherapy; PD-L1; immunotherapy

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