V Kongres Młodej Nauki

Księga abstraktów

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On–Off Magnetic-Triggered Drug Delivery via Hybrid Hydrogel for Advanced Cancer Therapy

We developed and evaluated a UV-crosslinkable and thermoresponsive hydrogel nanocomposite based on Gelatin methacrylate (GelMA), Poly(N-isopropylacrylamide) (PNIPAM), and folic acid-functionalized superparamagnetic iron oxide nanoparticles (FAS) for targeted and stimuli-responsive delivery of 5-Fluorouracil (5-FU) in soft tissue cancer therapy. The hybrid system was synthesized via in situ incorporation of SPIONs into the polymeric matrix and loaded with varying drug concentrations to assess their influence on release kinetics and cytocompatibility.

Scanning electron microscopy (SEM) confirmed an interconnected porous microarchitecture, with pore sizes increasing alongside GelMA content, resembling the extracellular matrix (ECM) and promoting cell interaction and nutrient diffusion. The swelling behavior of the GelMA/PNIPAM hybrids showed a dynamic thermal response, with enhanced swelling and deswelling behavior in line with temperature-sensitive characteristics.

Drug release studies demonstrated thermally triggered on–off behavior, with a significant increase in 5-FU release at 41 °C. Notably, the presence of SPIONs endowed the hydrogel with the potential for pulsatile drug release under external stimuli, enabling up to 70% cumulative release over 28 days.

In vitro cytocompatibility tests with L929 fibroblasts revealed cell viability exceeding 80% at all time points, indicating excellent biocompatibility of the hybrid system. The maintenance of healthy cell morphology and proliferation further supports its suitability for biomedical applications.

Altogether, the engineered hydrogel nanocomposite combines structural porosity, thermal and magnetic responsiveness, and cytocompatibility, making it a promising platform for targeted, on-demand cancer therapy and soft tissue regeneration.

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