New Technologies - Bioengineering I

Micro-robot for tissue repair and cancer therapy

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Presentation abstract: Precise delivery of therapeutic cells to targeted sites in vivo represents an emerging and promising approach in the field of precision medicine. Microscale biodegradable robots have been identified as a potential solution for targeted cell therapy. In the context of transvascular treatment for liver cancer, whether for downstaging or bridging to surgery, a biomaterial capable of loading therapeutic cells and blocking the tumor's blood supply is crucial for exerting dual anti-cancer effects. Our research team has developed a magnetically-driven, image-guided, and biodegradable microrobot designed to precisely deliver engineered cells for orthotopic liver tumor treatment. The microrobot features a burr-like porous sphere structure, composed of a synthesized composite material that simultaneously fulfills requirements for degradability, mechanical strength, and magnetic actuation capability. The optimized microrobot structure enables spontaneous release of the loaded cells upon reaching the target site. Actuation of the microrobot is achieved through a gradient magnetic field, while guidance is provided by a novel photoacoustic imaging technology. In preclinical experiments conducted on nude mice, microrobots carrying therapeutic cells were injected through the portal vein, resulting in a significant inhibition of tumor growth upon the release of cells from the microrobots. This study represents the first demonstration of using biodegradable microrobots for the precise delivery of therapeutic cells in vascular tissue, showcasing their therapeutic potential in a preclinical setting.