Hydrogel Modification to Encapsulate and Release Exosomes for Targeted Delivery

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Mesenchymal stem cell (MSC) derived exosomes, or extracellular vesicles (EVs), possess stem-cell like therapeutic and regenerative capabilities while avoiding limitations of stem cell therapy. Exosomes are nanoparticles (50-150nM) that facilitate intracellular communications and transfer of miRNA and proteins between cells. Previous research reports MSC EVs accelerate wound healing by promoting cellular proliferation. Binding of exosomes to extracellular matrix proteins such as fibronectin and type I collagen has been previously reported. The goal of this project is to generate an exosome encapsulated hydrogel to 3D print wound dressings. This study investigates the binding capacity and release kinetics of exosomes to alginate modified with RGD or DGEA. To investigate this, exosomes were first isolated, characterized, and fluorescently labeled. Binding of exosomes to modified alginates was evaluated through fluorescent intensity. Release of exosomes from alginate RGD methacrylate (ARGDMA) was evaluated and compared to the release of exosomes from AMA (control). To assess cellular uptake of exosomes encapsulated in the RGD conjugated alginate hydrogel, immunofluorescent images were taken using confocal microscopy. Through this research, an effective design of a hydrogel that can encapsulate and release exosomes over a controlled, prolonged period has been developed. Exosomes effectively bound to both RGD and DGEA coupled alginate and did not reach a saturation point. Study of release kinetics demonstrated a slow, controlled release of exosomes in alginate RGD methacrylate. This confirms that the bound exosomes will remain available to migrating cells when implanted in vivo. Immunofluorescent images confirm cellular uptake and release of hydrogel encapsulated exosomes.

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