Engineering Macroporous Hydrogels to Recapitulate Aspects of the Tumor Microenvironment

Jayram, Diya (School: American Heritage School)

The complex, dynamic tumor microenvironment consists of live tissues that directly influence the progression of a tumor, including the extracellular matrix: a mesh of water, minerals, proteoglycans, and fibrous proteins secreted by resident cells, similar to the architecture of a PEG-based hydrogel (Walker, Mojares & Hernandez, 2018). The purpose of this study was to engineer a macroporous three-dimensional PEG-based hydrogel to recapitulate aspects of the tumor microenvironment by encapsulating alginate microparticles for templates for extracellular matrix porosity into a PEG-based hydrogel and observing their degradation. The optimal alginate microparticles had to have the most uniformity, smallest diameter, and greatest dissolvability. To design the most ideal alginate microparticle, concentration of alginate, crosslinking agent, type of alginate, needle gauge, and stir plate speed was varied. The most uniform, smallest microparticles were the 1.5% sodium alginate microparticles that were crosslinked in BaCl2 with a 29 gaage needle at 50 rpm and the 1.6% calcium alginate microparticles that were crosslinked in CaCl2 with a 29 gauge needle at 50 rpm. These particles were encapsulated into a PEG-hydrogel and polymerized and were dissolved successfully using a chelator buffer to create a macroporous three-dimensional recapitulation of a porous extracellular matrix in the tumor microenvironment. All in all, these hydrogels can have a great impact on our current understanding of the tumor microenvironment, and lead to the advancement of cancer immunotherapies and drug delivery.

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