Developing a Hyaluronic Acid Coated Mesoporous Silica Nanoparticle Based Controlled Delivery System as an Antitumor Therapy

Deshpande, Aishwarya (School: American Heritage School of Boca Delray)

Mesoporous silica nanoparticles are sub-microscopic particles that contain numerous pores, allowing for the loading of drugs for therapeutic uses. By developing mesoporous silica nanoparticles coated with polydopamine and hyaluronic acid, a potential targeted therapy for esophageal cancer was investigated. It was hypothesized that if mesoporous silica nanoparticles are loaded with the chemotherapeutic drug doxorubicin and coated with polydopamine and hyaluronic acid, then it will significantly reduce the proliferation of cancer cells. Tetrapropyl orthosilicate was used as the silica source, hexadecyltrimethylammonium bromide was a surfactant that acted as a template for the mesoporous structure, and sodium hydroxide served as a base to maintain the pH necessary for hydrolysis and condensation of the silicate precursors. Polydopamine coating allows for surface modification so that the nanoparticle could be coated with hyaluronic acid. Hyaluronic acid can specifically bind to CD44 receptors overexpressed on cancer cells. After testing on esophageal cancer cells to determine the efficiency of the selective drug release, the hyaluronic acid and polydopamine coated nanoparticle treated cancer cells significantly lowered cell viabilities as compared to even the free drug and just polydopamine coated nanoparticles. In addition, the nanoparticles were tested in a phosphate buffered saline solution of pH 6.4, similar to tumor microenvironments, and a pH of 7.5 to simulate a healthy cell microenvironment. The drug release was more sustained over a period of time in pH 6.4. These results show that hyaluronic acid coated mesoporous silica nanoparticles can provide a promising therapeutic strategy for cancer cells.

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