Developing a Polyethylene Glycol Hydrogel Based Controlled Delivery System Using the Alkyl Radical Initiator AIPH as an Antitumor Therapy

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Hydrogels are three-dimensional polymers that can serve as a strategy for sustained treatment of tumors by slowly releasing compounds into an area. By adding compounds such as AIPH and the nanozyme pyrite to a polyethylene glycol (PEG) based hydrogel, a potential therapy for breast cancer was investigated. It was hypothesized that if the molecule AIPH, an alkyl radical initiator, is combined with the nanozyme pyrite inside a hydrogel and exposed to near infrared radiation, then the hydrogel will release the free radicals and cause damage to the breast cancer cells. The hydrogels were fabricated using polyethylene glycol (PEG) and polyethylene glycol diacrylate (PEGDA), AIPH, and pyrite (FeS_2) nanozyme to suppress the tumor's ability to produce its own antioxidant glutathione. After treatment of the hydrogel, images were taken of the tumors to calculate the change in area. It could be concluded that the hydrogel did significantly reduce the size of tumors as there was a reduction in mean area after adding each hydrogel. The average decrease in area of the tumors was 98.7552 μm in the PEG 10000 hydrogel, 78.51675 μm in the PEGDA 4000 hydrogel, and 325.925 μm in the PEG 20000 hydrogel. In addition, the ThiolTracker and CellROX oxidative stress assays showed low levels of glutathione and a higher level of oxidative stress, indicating that the tumoral antioxidant was decreased in order to enhance the effect of the hydrogel. These results show that photodynamic hydrogel therapy can be a promising therapeutic strategy for breast tumors.

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