Utilizing Indocyanine Green and Sodium Alginate With Microsphere Drug Delivery and Infrared Imaging: A Model to Create More Accessible Therapeutic and Diagnostic Tools for Cardiovascular Disease and Cancer

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Each year, cardiovascular disease(CVD) and cancer account for about 17,900,000 and 10,000,000 mortalities, respectively, worldwide. Both CVD and cancer involve invasive, costly, and dangerous forms of diagnosis and treatment that discourage patients from seeking healthcare. This project focuses on drug delivery and the use of benign/inexpensive materials to create healthcare options that prioritize accessibility and patient safety. Through extensive trial-and-error, the researcher developed a protocol for creating microspheres using a hydrogel, using Indocyanine-green(ICG), with diagnostic and therapeutic applications unique to this study. Experiments show that the microspheres can hold liposomes to deliver drugs to localized sites (tumors), while reducing toxic side-effects and reducing frequency of doses needed. A homemade imaging system was used to detect fluorescence of the microspheres through ex-vivo renal tissue, showing that the microspheres can be used for diagnosis through fluorescence imaging. In-vivo tests with D. melanogaster flies with upregulated cholesterol levels showed that the hydrogel significantly improved response to cardiac stress, suggesting that the hydrogel can be used as a noninvasive treatment for patients with coronary artery disease. In vitro tests show that photothermal therapy with the hydrogel and recycled parts of the imaging system have tumoricidal effects in MFM223 breast cancer cells, such as reducing cell viability and colony formation while promoting apoptosis. These findings suggest that the hydrogel/spheres created by the researcher have diagnostic and therapeutic abilities for the two deadliest diseases in our world, using inexpensive and benign materials to prioritize accessibility and safety unlike current healthcare options.