Detection of Circulating Melanoma Cells Using Photoacoustic Flowmetry

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We have developed a system for detecting single melanoma cells *in vitro* by inducing photoacoustic waves in such cells suspended in saline. This system was designed to detect small numbers of circulating melanoma cells (CMC's) in blood samples of advanced cancer patients. Such a method may detect metastasis months or years before the CMC's form secondary tumors large enough to show up using conventional imaging, such as CT or PET. Previously, we detected melanoma cells in microcuvettes. In order to quantify CMC's in the blood samples of cancer patients, we designed and tested a photoacoustic flowmetry system capable of counting individual melanoma cells. Clinical implementation of this device would entail separating the blood sample by centrifuge and extracting the lymphocytes. If there are CMC's present, they would reside among the lymphocytes because of similar densities. Putting the cell suspension under flow in a custom flow chamber, we irradiated them using a tunable laser system with a pulse duration of 5 ns. In order to detect the photoacoustic waves induced in the melanin of any CMC's residing among the lymphocytes, the flow chamber was coupled to an optical detector of acoustic waves, as piezoelectric films were often damaged within the miniature flow chamber. Lymphocytes, having limited optical absorption, generated no appreciable acoustic waves. We tested the system on dilute suspensions of CMC's, finding a detection threshold of a single melanoma cell. This method will allow early detection of melanoma metastasis and monitoring of disease state in cancer patients.