Automated Separation of Radiation Damaged Cells

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Identification/Significance of Innovation:

- Deep-space exploration flights carry with them a high risk to human health, particularly from exposure to space radiation (even low doses)
- Diagnosis of exposure, development of protectants/countermeasures depend on the ability to accurately identify and separate rare genetically altered and damaged cells
- Current methods for identification and separation of these cells are manual, labor intensive, often sample destructive and require central laboratories. There is a clear need for a simple, compact, low-cost device to sort radiation damaged cells maintaining viability

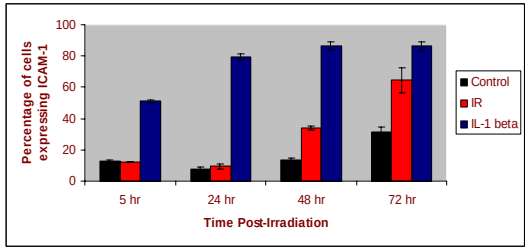
Technical Objectives:

Our overall objective is to develop and demonstrate a novel microfluidic device for non-destructive identification, sorting and counting of radiation damaged cells. Specifically we will

- Identify and verify novel cell surface markers indicating radiation-induced DNA damage, using state-of-the-art molecular biological tools
- Design, fabricate and demonstrate a (non-optical) electrically actuated microfluidic platform for separation and counting of bead-labelled damaged cells from overall population of cells.

Work Plan:

- Endothelial and epithelial cells will be radiated over a range of dosage using gamma/X-ray sources
- Gene expression studies will be performed at different time points post radiation to identify candidate receptors.
- Flow cytometry and Comet assays will be used to verify receptor expression and DNA damage respectively
- The demonstrated cell sorter will be optimized for throughput and efficiency. A counting component, using the same architecture, will also be developed.
- Integrated prototypes using plastic laminate technology will be fabricated along with systems components
- Technology platform will be demonstrated in the successful sorting of cells with DNA damage due to exposure to both terrestrial and space radiation (NSRL).



Expression of ICAM-1 following radiation

Integrated microfluidic cartridge

NASA and Non-NASA Applications:

- The proposed approach will benefit both NASA and medical applications in field sorting of diagnostic cell populations (damaged cells, circulating tumors, etc.)

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