Fluorescence image-guided photodynamic therapy of cancer cells using a scanning fiber endoscope

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Abstract:
The National Cancer Institute estimated that there will be approximately 72,570 new cases of bladder cancer in the United States during the year 2013, and 15,210 deaths due to the disease. The high recurrence rate of 50-70% of treated bladder cancer creates a necessity for life long surveillance, which in turn makes bladder cancer the most expensive cancer for a per-patient cost—89,000 to 202,000 USD per patient—from diagnosis to death. This research aims to combine the cancer specific biomarker 5-Aminolevulinic acid (5-ALA) and the Scanning Fiber Endoscope (SFE) to fluorescently detect and treat cancerous legions in a controlled setting within the bladder, and to find any correlations that might exist between our dependent and independent variables, allowing us to optimize cell death. The Scanning Fiber Endoscope (SFE) created in the Human Photonics Lab (HPL) at the University of Washington was used to apply therapy at 405 nm to A549 cancerous cells previously administered with 5-ALA. Cells were stained with LIVE/DEAD® stain and analyzed under a confocal microscope. The results show that PDT of A549 cancer cells with 405nm light and 5-ALA induces Protoporphyrin IX (PpIX) was successful. Varying sizes in cell death were produced when varying combinations of duration of therapy and light intensity were applied. A correlation between light intensity and duration of therapy was found. An increased time of exposure and a decreased light intensity yields a larger area of cell death than a decreased time of exposure and an increased light intensity. Recurrence of cancers is mediated by cancerous cells that are overlooked in the treatment process, therefore optimizing cell death will allow for a decrease in costs associated with bladder cancer due to a decrease in recurrence rate.