Optical device for in vivo assessment of tissues

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Publication(s)

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External Link(s)

• From the lab of Dr. Nimmi Ramanujam
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• From the lab of Dr. Gregory Palmer

Value Proposition

Fluorescence and diffuse reflectance spectroscopy in the ultraviolet-visible (UV-VIS) spectrum are increasingly being investigated for tissue characterization. These biological scatterers, absorbers, and fluorophores may be used to indicate the existence of certain diseases. Optical spectroscopy can therefore be used to provide early diagnosis of diseases, such as Alzheimer's disease, cardiovascular disease, breast cancer, and the like. The use of such technology for early detection of diseases is invaluable. For example, each year in the United States, numerous women are diagnosed with breast cancer. While this disease takes many lives, the likelihood of survival is greatly increased with early treatment of abnormalities that are discovered via breast examinations and mammograms. Despite the advances in the area of optical spectroscopy, there still remains a need for an effective method and apparatus for an in vivo optical probe that combines fluorescence and diffuse reflectance spectroscopy to improve biopsy procedures. Difficulties involved with providing an optical probe access to the tumor, form factor considerations, and the like have presented problems that hinder the implementation of such medical devices or methods. These difficulties may also present obstacles for other applications of optical spectroscopy in the medical arena, such as diagnostic monitoring, therapeutic monitoring, drug discovery and analysis, tissue oxygenation monitoring in surgical procedures, and the like. Thus, there remains a need for an improved system and method for conducting spectral analysis of a tissue mass.

Technology

Duke researchers have developed an optical toolbox, which consists of an optical spectrometer, fiber-optic probe, and inverse Monte Carlo algorithms for collecting, processing, and reporting tissue biochemical and morphological properties in vivo. This technology is intended to be used to detect pre-cancers and cancer, assess tumor response to therapy in patients and in mice models, quantify tissue oxygenation in vivo, and quantify drug uptake in vivo. The optical spectroscopic technology provides concentrations of absorbers and fluorophores over the wavelengths used and the bulk tissue scattering properties which reflect tissue morphology. This technology can provide maps of tissue composition, metabolism, vascularity and oxygenation. The inventors have demonstrated this technology in a number of clinical studies including breast biopsy diagnosis, cervical cancer diagnosis, breast cancer margin assessment, monitoring response to therapy, and drug discovery and pharmaceutical testing.

Other Applications

The device can also be used to image exogenous sources of absorption (organic dyes) and scattering (nanoparticles) and thus can provide the concentration and distribution of these agents in tissue. This technology will have utility in basic science and clinical applications, including drug discovery and assessment (in small animal models), tissue oxygenation monitoring (in reconstruction surgery for example), assessing tumor response to chemoradiation therapy in a variety of different sites including chest wall disease, cervical and head and neck cancers, intraoperative margin assessment in a variety of organ sites including the breast, brain and prostate and in epithelial cancer detection and diagnosis (skin, cervix, oral cavity for example). For applications involving internal body cavities, the technology can gain access to these sites via an endoscope and/or catheter.

Advantages

- Quickly and non-destructively quantifies tissue composition in vivo
- The information gained can be used to quantify tissue physiology, metabolism and composition
- This technology could also be used to quantify drug uptake as well as optical contrast agents