BME Master assignment

Title:

Raman spectroscopic imaging of breast tissue and breast cancer: clinical possibilities for novel imaging technology.

Naam indieners:

Prof. Dr. L.F. de Geus-Oei, nucleair geneeskundige, Lioe-Fee.deGeus-Oei@radboudumc.nl

Dr. C. Otto, Medical Cell BioPhysics, c.otto@utwente.nl

Background information on the project:

Clinical background:

In breast care, differentiation of benign and malignant lesions is essential.

When a woman presents with a breast complaint, a palpable mass, or a referral from the national breast cancer screening program, breast imaging and diagnostics are mandatory and often include a core needle biopsy to obtain histopathological information. Pathological examination of the obtained specimen is then used to determine the nature of the lesion and the need for surgery.

In case of breast cancer at surgery a second problem occurs, because it is often very difficult to see and to determine the boundary of the tumour in the breast tissue. The success of the resection is subsequently determined by pathologic examination, but this cannot be performed in detail during the operation. Consequently, there is an urgent need to develop methods that can a) non-invasively or minimally invasive determine the nature of a breast lesion in order to be able to remove the whole malignant lesion and to preserve the benign breast tissue, and b) determine intra-operatively the quality of the resection margins. In order to prepare for such challenging clinical research questions studies will be performed that aim to establish proof-of-principles results (see below).

Technical background:

Molecular Imaging with Raman microscopy is light-based optical spectroscopic technique that enables identification of tissues on the basis of naturally occurring biochemical differences. This technique is in principle able to offer minimally invasive lesion characterisation and intraoperative margin assessment. Raman microscopy is an integration of Raman spectroscopy with an optical microscope system that enables to generate “biochemical” contrast in images. This contrast can be used to visualize for instance microscopically small organelles, micro-crystallizations and tumor vs healthy cells in tissue. The Raman micro-spectrometer at the Medical Cell BioPhysics group is a home-built state of the art system, which is based on a laser and a sensitive detection platform that enables Raman optical microscopy. You will use the existing instrument and develop methods to optimize measurements from tissue acquired with biopsies. A typical measurement approach leads to large Raman datasets, so-called hyperspectral datasets,, which may contain 10 to 100 hundred 1000’s of spectra with 1600 frequency components. The data has been acquired at a microscopic resolution and will enable to actually look inside the cells of the tissues. Such datasets can presently be measured in minutes and extended or repeated over large areas of the tissue. The information of these datasets will be converted into images that contain biochemical information. These images must be matched with histopathological findings. A suite of software tools in

Matlab is available to analyse the datasets, but progress in data analysis is a potential outcome of the project.

Objectives students project:

- To prepare core needle biopsies prospectively for Raman microscopy at the pathology department of the Radboudumc.
- To obtain Raman spectra and images of biopsied lesions, including benign and malignant tumours and healthy tissue.
- To correlate Raman spectral images with histopathologic findings, differentiating between healthy tissue and benign and malignant breast tumours.
- To correlate Raman spectroscopy in detail with findings of the corresponding digitized histopathology slides to gain understanding of the Raman spectra for specific histopathological structures on a microscopical basis.
- To investigate and optimize approaches in data analysis with the aim to extract maximal clinical relevance from Raman datasets.
- You can also think for instance about the combination of Raman spectroscopy findings with imaging findings (mammography and ultrasound) to assess whether this combination can obviate the need for biopsy in specific benign lesions.