Infrared imaging: a new tool to refine breast cancer prognosis

A. Bénard[1], C. Desmedt[2], V. Durbecq[2], G. Rouas[2] , D. Larsimont[3], C. Sotiriou[2] and E. Goormaghtigh[1]

1. Laboratory for Structure and Function of Biological Membranes, Center for Structural Biology and Bioinformatics, Université Libre de Bruxelles, Belgium
2. Functional Genomics and Translational Research Unit, Department of Medical Oncology
3. Department of Pathology Institut J. Bordet, Brussels, Belgium

Currently for breast cancer prognosis, clinical guidelines are based on lymph node status, tumor size, histological grade, age of the patient, as well expression of various cellular receptors (ER, PgR, HER2). However, the existing predictions remain unsatisfactory to identify the best treatment for the individual patient. Recently gene expression profiling based on DNA microarrays has brought promising results in the field [1]. Even though this approach may help to improve decision-making by the oncologist, it remains expensive and does not take into account the cellular heterogeneity of the tumor sample. The recently developed IR imaging systems allow the analysis of the different components of a tumor, taking into consideration the spatial resolution of the cells. Here, we applied for the first time these new IR imaging systems to breast cancer samples. IR spectroscopy is based on the absorption of infrared light by vibrational transitions in covalent bonds. While the intensities provide quantitative information, the frequencies relate to the nature of these bonds, their structure, and their molecular environment. In complex systems such as cells, an infrared spectrum is the sum of the contributions arising from proteins, lipids, nucleic acids, and all other chemical species present in the cells. IR spectroscopy provides a complete signature which can be correlated with the biological properties of the sample. Hundreds of biological applications of this technology have been published since it was demonstrated, in the eighties, that the FTIR spectrum of bacteria provides a unique fingerprint that allows the identification of bacteria species [2]. Here, we analyzed formalin fixed paraffin embedded (FFPE) tissues from breast cancer patients. Good quality imaging of the different types of molecules present in the FFPE tissue was obtained on 3 µm slices. This preliminary study has been made on Tissue Microarrays of invasive breast carcinomas. A supervised statistical analysis (Wilcoxon test) was computed between histologic grade 1 patients and grade 3 patients. All the significant differences were located in the spectral region characteristic of DNA and RNA. A non supervised statistical test (Principal Component Analysis) made on this region of the spectra allows the separation of the two groups of patients. It is the first principal component (CP1) which represents 80% of the variance that is discriminant. We show here in an exploratory study that IR imaging can be applied on FFPE samples, paving the way to retrospective studies. It should be possible in a near future to correlate the infrared features of the spectra to prognostic parameters.

References:

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