Spectral Differentiation of Breast Cancer Cell Lines in 2D and 3D Cultures by Infrared Imaging

M. Smolina*, E. Goormaghtigh

Structure and Function of Biological Membranes Laboratory, Faculty of Sciences, Université Libre de Bruxelles, Boulevard du Triomphe, 1050 Brussels, Belgium
*e-mail: msmolina@ulb.ac.be

Breast cancer is a very heterogeneous illness, both at clinical and biological levels. This heterogeneity makes the full characterization of individual cancer cells impossible. Fourier Transform Infrared (FTIR) imaging of tissue sections allows obtaining for each pixel of an image hundreds of independent potential markers, which makes this technique a particularly powerful tool to distinguish cell types and their sub-types. During a histopathological specimen examination, the IR spectroscopic approach is able to provide molecular descriptors allowing us to recognize signatures of different breast carcinomas found within the same tumor and possibly revealing features relevant to diagnosis, prognosis and treatment personalization.

Yet, interpretation of IR spectra on histological sections requires a well-established calibration. The goal of the present project is to demonstrate that IR imaging allows a precise identification of a collection of well-characterized human breast cancer cell lines after formalin-fixation and paraffin-embedding (FFPE), a processing routinely applied to tissue samples. For this purpose, breast tumor epithelial cell lines have been grown in three-dimensional laminin-rich extracellular (3D lrECM) matrix where their phenotypes are very similar to the ones observed in real tissues. The 3D gel-like matrix was then processed as biopsies. Sections of the paraffin-embedded samples were obtained using a rotary microtome, deparaffinized and observed by IR imaging.

We found previously that FFPE-induced modifications of the FTIR spectra of cancer cells grown as monolayers are identical for all tested cancer cell lines and that hierarchical cluster analysis of the FTIR spectra from the various cancer cell lines form identical grouping before and after FFPE processing [1]. Furthermore, a supervised statistical analysis resulted in an almost perfect separation of spectra of cells grown in 2D and 3D lrECM cultures [2]. Our results on 3D lrECM cultures indicate that the breast cancer cell lines are recognized as epithelial by a supervised statistical model trained on tissue sections [3]. This suggests that breast cancer cell lines grown in 3D lrECM matrix could be useful to create a spectral database relevant of the variety of tumor types present in real tissues.

References

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