MONITORING KEY BIOMARKERS BY RAMAN IMAGING OF BIOMEDICAL SAMPLES AND USING ADVANCED STATISTICAL ANALYSIS

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KEY WORDS: Raman spectroscopy, cancer cell, tissue, metabolites, biomarker.

Raman spectroscopy (RS) is non-invasive, rapid and sensitive. Thus, RS represents a promising technique for studying biomedical samples. However, although RS has the maximum specificity among all optical techniques for detecting molecular changes, the interpretation of Raman spectra is complex. Biomolecules have many Raman bands and some of them have similar molecular structures. Consequently, they share groups of bands, making difficult to deconvolve the contributions of pure molecular components from the Raman spectra. During the past decades applications of Raman spectroscopy have been focused to discriminate several groups of samples by means of multivariate analysis. However, little information can be obtained from those methods to extract meaningful molecular components from the Raman spectra that could be assigned to pure molecules constituting the sample. For this reason we proposed to apply Multivariate Curve Resolution (MCR) to deconvolve pure molecular components from the Raman spectra and monitor its content in the tissue or cell over the illness or biological process under study. MCR requires minimal a priori knowledge of the system providing objective and chemically meaningful information.

We present two successful biomedical applications of our approach. First, retinal tissue is damaged during inflammation in Multiple Sclerosis. We assess molecular changes in murine retinal cultures suffering inflammation by RS [1]. By using MCR analysis, we deconvolved 6 molecular components suffering dynamic changes along inflammatory process. Those include the increase of immune mediators, changes in molecules involved in energy production and decrease of Phosphatidylcholine. RS combined with MCR allows monitoring the evolution of retina inflammation based in a number of molecular components sensible to inflammation.

Second, we study the metabolic composition of cancer cells in the Epithelial to Mesenchymal transition (EMT) and in the bone metastasis progression [2]. Our approach permitted to deconvolve and track biomarkers for cancer cell aggressiveness and prognosis.

Thus, the combination of RS and MCR represents a novel methodology that will push forward the applicability of RS for non-invasive monitoring of the biochemical content in vivo.
