Presentation number: 4A16

Investigation of cellular heterogeneity in Glioblastoma: IR imaging study

Bhawana Singh [a], Vani Santosh [b], Kumaravel Somasundaram [c] and Siva Umapathy [a*]

a; IPC department, Indian Institute of Science, Bangalore, 560012
b; National Institute of Mental Health and Neuro Sciences, Bangalore, 560029
c; MCBL department, Indian Institute of Science, Bangalore, 560012

Introduction

Fourier transform infrared (FTIR) microspectroscopy has emerged as a potential technique for the analysis of biological samples (1 - 3). In our study, we report the application of FTIR imaging to study grade IV brain cancer. Even though WHO guidelines are available but still histopathological classification of brain cancer remains a challenging area. In medical community, increasing need has been felt for interdisciplinary methodologies to improve the diagnosis of difficult to determine cases in a shorter time frame.

Experiment

Normal and brain cancer tissue samples were collected from National Institute of Mental Health and Neuro Sciences (NIMHANS) Bangalore, India. Sample collection and experiments were approved by the human ethics committee of NIMHANS. Liquid nitrogen cooled FPA detector having 64 × 64 detector elements was used to collect IR spectroscopic images in reflection mode. Multiple IR images were recorded from a tissue section by moving the sample stage. FTIR hyper-spectral data images were recorded in the range of 950-4000 cm^{-1} at 4 cm^{-1} spectral resolution and data were analyzed using Cytospec, resolution pro (Varian) and Origin software programmes.

Results and Discussion

This study not only presents the characterization and classification of normal and grade IV brain cancer tissue specimen but also shows the potential FTIR microspectroscopy in identifying different cell types within grade IV brain cancer tissue samples. The advantage of this technique is that it is capable of bringing out the inherent chemical heterogeneity in conjunction with the morphology of the sample. At first, we characterized and classified normal and grade IV brain cancer (glioblastoma) tissue specimen and then within grade IV

brain cancer we identified different cell types. Imaging experiments gave idea about the inherent biochemical nature of the samples which directly co-related with the morphology of the samples. It is well known that grade IV brain cancer show large heterogeneity in tissue morphology. Based on this fact our aim was to take the maximum cellular heterogeneity into account and recognize spectral markers for them. Thus, in our study, within grade IV brain cancer, morphologically different cell types namely fibrillary, pleomorphic, small, giant and lipidized were differentiated spectroscopically.

In short, this study contributes towards improving our understanding towards possible future use of IR imaging in the field of biomedicine for diagnostic purposes, especially it can play an important role, in determining tumour margins or while dealing with frozen sections of soft tissues like brain which often lose their morphology at low temperature.

References:

(1) Fernandez, Daniel C., Bhargava, Rohit, Hewitt, Stephen M., and Levin, Ira W., *Nature Biotech*, **23**, 469 (2005).

(2) M. Diem, M. Romeo, S. Boydston-White, M. Miljkovic and C. Matthaus, *Analys,t* **129**, 880 (2004).

(3) A. Pacifico, Luis A. Chiriboga, P. Lasch and M. Diem, *Vibrational Spectroscopy*, **32,** 107 (2003).