Molecular pathology via Infrared spectral imaging for skin cancer diagnosis

Cassio Lima
IPEN-CNEN/SP, Universidade de São Paulo

Hugh Byrne
FOCAS Research Institute, Dublin Institute of Technology

Luciana Correa
Faculdade de Odontologia, Universidade de Sao Paulo

Denise Zezell
IPEN-CNEN/SP, Universidade de São Paulo

Fourier Transform Infrared (FTIR) spectroscopy is a rapid and label-free analytical technique that provide information about the overall biochemical profile of biological samples based on the vibrations of its basic molecular components (carbohydrates, proteins, lipids and nucleic acids) that are infrared active. The potential biomedical applications of FTIR spectroscopy as a tool for cancer diagnosis have been well demonstrated over the last years. However, most studies have focused on evaluate the diagnostic ability of FTIR by comparing healthy tissue to cancers on advanced stage and few studies have centered on evaluating the early stages of cancer. Thus, the present study aims to demonstrate the ability of FTIR spectroscopy to discriminate healthy skin from advanced skin cancer (squamous cell carcinoma) as well as from early stages of malignancy using the information retained by spectral data. Cutaneous neoplastic lesions were chemically-induced on Swiss mice using a well-stablished two-stage carcinogenesis protocol. Healthy tissue was collected from animals non-exposed to chemicals and different disease stages were obtained by varying the exposure time of animals to carcinogenenic factors. Tissue sections were obtained from formalin-fixed paraffin-embedded (FFPE) and placed on calcium fluoride substrates. FTIR hyperspectral images were acquired in transmission mode over mid-infrared spectral region and compared using Principal Components Analysis (PCA) associated to Linear Discriminant Analysis (PC-LDA). Satisfactory data discrimination (accuracy, sensitivity and specificity) was achieved by PC-LDA and the variables responsible by classification were evaluated in order to assess the spectral changes of skin components during the transition of healthy into diseased state. Our findings demonstrate the potential of FTIR spectroscopy not only for skin cancer diagnosis, but also to evaluate the biochemical events triggered by cancer without requiring laborious and time-consuming procedures or expensive labeled probes as biomarkers.
Acknowledgements This work was supported by: CNPq (INCT 465763/2014-6, PQ: 309902/2017-7, PhD-grant: 141629/2015-0), FAPESP-CEPID-05/51689-2, CAPES (PROCAD: 88881.068505/2014-01, PDSE: 88881.132771/2016-01)