The Raman Spectroscopy Perspective In Human Skin Cancer Diagnosis

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Skin cancer is a growing source of concern due to its increasing incidence rate over the past decades. Early detection, followed by prompt surgery, represents the only curative management of patients affected by the disease. Improvements in diagnostic sensitivity have been reported with the application of dermatoscopy, nonetheless, whenever a suspicious skin lesion is recognized, an excisional biopsy is usually performed to provide the histological definitive diagnosis. Despite the certain efficacy of traditional methods, an accurate, non-invasive, and rapid early diagnostic tool is desirable.
Promising results derive from the application of Raman spectroscopy (RS) to the analysis of skin structure and biochemistry. This optical, marker-free technology provides molecular fingerprints of the different skin layers, reflecting their overall molecular composition. Its compatibility with water-containing materials, non-invasiveness and relative rapidity considering that no sample preparation is required, make RS a powerful non-destructive technique suitable for in vivo diagnosis.
The advantages of the technique for cancer diagnosis have already been reported [1] and attempts in detecting basal cell carcinoma and squamous cell carcinoma by RS have been previously published [2-4]. However, an accurate RS database with the main molecular fingerprints specific for multiple skin tumoral lesion is needed in order to characterize and set reliable parameters for skin cancer detection.
The aim of this study was the optimization of RS analysis of different types of skin cancer tissues outlining the correlation between spectral differences and histological observations.
Skin cancer fragments deriving from biopsies excised for diagnostic purposes were used to acquire Raman spectra. Samples of benign and malignant lesions were collected, formalin fixed, frozen and cryostat cut. The use of traditional paraffin embedding procedure was avoided to overcome wax interference during the spectral acquisitions.
Thick section (>25 μm) were lied on CaF_2 slides and used for Raman analysis with a near infrared laser line (785 nm). The Raman mapping of the skin cancer sections was performed with a confocal micro-Raman system (Aramis, Horiba) and spectra were collected in the 350-1800 cm^{-1} spectral region. Hierarchical clustering analysis was used to elucidate the biochemical features of skin layers of each considered cancer lesion, whereas results obtained from different benign and malignant tumors were compared by means of principal component analysis.
In parallel, for each biopsy, classical morphological analysis was carried out on adjacent sections to compare the histological and spectroscopic findings.
The resulting RS database provides information about the chemical composition of the neoplastic formations. The herein reported RS data improve our knowledge about the major morphochemical discrepancies of skin layers in benign and malignant lesions, providing hints for the development of new tools for early detection of skin cancer.

References

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