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Raman spectroscopic analysis of ovarian cancer tissues and normal ovarian tissues

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Abstract

Fourier transform (FT) Raman spectra of normal and malignant ovarian tissues were measured in the 350 cm^{-1} to 3500 cm^{-1} region. The measured spectroscopic features, which are the spectroscopic fingerprints of the tissues, contain vital information about the malignant and normal tissues. FT Raman data on 15 cases of ovarian tissue from patients of different age groups were analyzed. Raman spectra demonstrated significant spectral differences between the normal and cancerous ovarian tissues. In particular, the changes in frequency and intensity in the spectra of protein, nucleic acids and glycogen vibrational modes were observed. It was evident that the sample to sample or patient to patient variations were small and the spectral differences between normal and diseased tissues were reproducible. These results demonstrate that Raman spectroscopy has great potential for cancer detection based on the subtle differences between normal and tumor tissues in terms of proteins, lipids, and DNA.

Keywords: ovarian cancer, Fourier transform (FT) Raman spectroscopy, proteins, lipids, DNA

(Some figures may appear in colour only in the online journal)

1. Introduction

Ovarian cancer is often called the 'silent killer', because many times there are no symptoms until the disease has progressed to an advanced stage. It is the second most common gynecological malignancy and accounts for 4% of all female cancers worldwide, with >200 000 new diagnoses/year [1]. More than 90% of ovarian cancer is of the epithelial type and the majority of cases are diagnosed at a late stage when the metastatic disease is advanced and resists treatment, resulting in a dismal 5 year survival rate of less than 30%. Hence, it is crucial to depend on alternative methods to (1) confirm malignancy, (2) detect latent or early mitotic changes before gross appearance of abnormal tissue, and (3) extend its application to *in vivo* or *in situ* conditions. Frozen section pathology is sensitive, specific but interpretation is often subjective, time consuming and requires highly skilled personnel. Alternative methods based on optical spectroscopic detection are cost-effective and can provide biochemical information from living cells and tissue with sub-cellular resolution and in near-real time. The identification and further understanding of these changes would allow improved diagnosis and treatments, as well as overall management and disease survival. All diseased states, without exception, are caused by fundamental alterations in cellular and/or tissue biochemistry, which inevitably lead to specific changes in concentrations and/or structure of proteins, lipids, nucleic acids and carbohydrates. These changes in the quantity and conformation manifest themselves in vibrational spectra as changed intensities and frequencies of observed bands. The qualitative interpretation of spectra relies upon a visual assessment of often subtle changes in such variables as peak position, peak height, bandwidth and relative changes in these parameters [2].

Raman spectroscopy is a very versatile optical technique that has been recognized as a powerful tool for bio-analytical and biomedical applications. Raman spectra contain information on vibrations that provide a highly specific fingerprint of the molecular structure and biochemical composition

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