SCREENING OF GASTRIC CARCINOMA CELLS IN THE MALIGNANT GASTRIC MUCOSA BY CONFOCAL RAMAN MICROSPECTROSCOPY

J. M. Hu[1*], A. G. Shen[1], Y. Ye[1], J. W. Zhang[2] and X. H. Wang[1]

[1]College of Chemistry and Molecular Sciences, Wuhan University, Wuhan, 430072, P. R. China; E-Mail: jmhu@whu.edu.cn

[2] Department of Oncology, Zhongnan Hospital, Wuhan University, Wuhan, 430072, P. R. China

Keywords: *confocal Raman microspectroscopy, gastric carcinoma, screening, single cell, SGC7901*

Abstract: The high SNR•Signal-to-Noise) spectra from both gastric mucosa and cultured cells (SGC7901) were obtained by confocal Raman microspectroscopy. Spectral features of some spots in malignant tissue were similar to those of single cells and Raman spectroscopy might be used as a potential screening tool in the clinical diagnosis of gastric carcinoma.

Medical diagnostic techniques, which include barium meal, gastric endoscopy examination, and pathological examination, are used for gastric carcinoma screening. While histopathological analysis is recognized as a gold standard method, which provides valuable clinical information but requiring time-consuming tissue processing. However, due to the continuing advances in instrumentation, Raman microspectroscopy is establishing itself as a valuable research technique for cell biology [1]. Hawi firstly applied Raman microspectroscopy to characterize normal and malignant hepatocytes in both cultured and human liver tissues [2]. They suggested that screening of gastric carcinoma cells in the malignant gastric mucosa by Raman spectroscopic technique is a feasible method to diagnose the stomach cancer. Here we describe the research concerning studies of cultured carcinoma cells and gastric mucosa tissues.

For Raman scattering experiments, cryosections (25μm thickness) of gastric mucosa and suspension of cultured gastric carcinoma cells (SGC7901) were both placed in the gold plate which show a very flat baseline with fairly low noise. Spectra of both tissues and cells were taken in point illumination with Renishaw Raman system RM1000. The 514.5nm laser beam was focused manually on individually spots by means of ×20 microscope objective to a spot of 1μm diameter. Scattered light was collected in a back scattering geometry and then detected by air cooled 578×385 pixel CCD detector.

Gastric mucosa tissue, being composed of gastric mucosa epitheliums as well as other types of cells and intercellular material, give rise to a more complex Raman spectrum. The Fig.1 (a) shows the Raman spectra of a certain spot of malignant gastric mucosa. In comparison with the spectra of single cells (SGC7901), Raman spectra of malignant gastric tissue possess two extra peaks near 1525 cm^{-1} and 1156 cm^{-1} which were assigned to multiple chain "-C-C-" stretching and conjugated polyene of carotinoid respectively [3]. Raman bands of gastric mucosa tissues result primarily from protein vibrations, such as amide• at •1660 cm^{-1}, amide • in the 1220-1300 cm^{-1} region, CH_2 (or CH_3) deformation vibration of protein at •1450 cm^{-1}, CH_2 twisting and wagging vibration at 1342 cm^{-1} and 1314 cm^{-1}. In addition, the other bands, such as 1360 cm^{-1}, 1032 cm^{-1}, and 1005 cm^{-1} etc, were attributed to certain vibration of side chain of protein. For example, the peak at 1360 cm^{-1}

is attributed to tryptophan and peak at 1032 cm^{-1} and 1005 cm^{-1} are attributed to phenylalanine which is present in all protein-containing samples. A series of bands are also found at 1620 cm^{-1}, 1609 cm^{-1}, 1405 cm^{-1}, 1210 cm^{-1}, 1175 cm^{-1}, and 1128 cm^{-1}. According to the literature, those bands may be from the characteristic vibration of hemoglobin molecule.

Comparing the spectra of malignant (a) with normal (b) tissues (as shown in Fig. 1), there are obvious changes for amide□, amide □, and band at 1587 cm^{-1}. In detail, vibration of amide• is divided into two peaks at •1665 cm^{-1} and 1640 cm^{-1}. These variances are suggested to be owing to the changes of structure of proteins, which the main component of protein in normal tissues is collagen, but elastin in cancerous tissues [4]. Otherwise, with the onset of malignancy there is a decrease in the relative intensity of the band at 1587 cm^{-1}. Based on biology of cancer, the content of lipid is more in normal tissues than that in cancerous one, so this band should be assigned to "C=C" stretching of lipids.

Fig.1. Raman spectra of (a) malignant and (b) normal human gastric mucosa tissues.

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