INVESTIGATION OF BIOCHEMICAL BASIS FOR DIFFERENTIATING NECROSIS FROM APOPTOSIS IN LEUKEMIC CELLS USING RAMAN SPECTROSCOPY

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Cell death is essential in maintaining the homeostasis in the biological system. Apoptosis and necrosis are two distinct modes of cell death in human body [1]. The disturbance of the fine balance between apoptosis and necrosis may contribute to the development of various diseases [2]. Rapid and accurate identification of apoptosis and necrosis are thus important in the development of therapeutic intervention. Current methods for identifying the different modes of cell death require fluorescent labeling, which is non-specific, labor intensive and invasive[3]. In this study, we demonstrate that single-cell micro-Raman spectroscopy can overcome these drawbacks in discriminating unfixed live, apoptotic and necrotic human chronic myelogenous leukemia cell based on their intrinsic Raman fingerprints. It is shown that Raman measurements are rapid and Raman spectra are highly reproducible for each cell type. Furthermore, the Raman spectra of cells are decomposed into seven basic biochemical components, mainly in protein, lipid, nucleic acids and glycogen groups, to analyze the changes in the composition of cells undergoing the different modes of cell death. The result of t-test shows significant differences in lipid, DNA and RNA concentrations between apoptotic and live leukemic cells (p < 0.05). Moreover, significant reductions in the levels of all basic biochemical components under investigation are observed in necrotic cells compared to both normal and apoptotic cells (p < 0.05). These results suggest the potential application of micro-Raman spectroscopy as a tool for investigating cell death based on intrinsic biomolecular signatures, therefore eliminating the need for exogenous fluorescent labeling.

Reference