Studies of alive normal and cancer cell lines and tissues in vitro with Positron Annihilation Lifetime Spectroscopy

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Positron Annihilation Lifetime Spectroscopy (PALS) allows examining structure of materials at nano and sub-nanometer level. It is mostly used for studies of inorganic materials, however it can be used for studies and imaging of the cell morphology as proposed in patent [1]. Cancer cells are characterized by an altered macro structure and activity in comparison to normal cells, thus the main aim of this studies is to compare if these differences can be detected on sub-nanometer level and therefore allows to distinguish between normal and cancer cells with application of PALS technique.

There exist few results, e.g. by group of Y. C. Jean [2-3] and J-PET [4-5] showing that morphology of cells is correlated with the PALS parameters. Preliminary studies shown significant differences in o-Ps lifetime between tumor (cardiac myxoma) and normal (lipid mediastinal) tissue and freeze-dried melanoma (cancer) and melanocytes (normal) cell lines.

Results of the first experiment with alive melanocytes and melanoma cell culture in vitro will be presented. PALS, viability and transcriptomic studies were performed on normal and cancer cells cultures, before and after measurement conducted in condition close to ones in human body (eg. in 37 C deg.). As a result, it was proved that PALS can be successfully used for studies of living organisms, their dynamics and its relation to the cells morphology. Second part of conducted studies were measurement of cells in presence of known antioxidants such as ascorbic acid and epigallocatechin gallate (EGCG) to check if changes of reactive oxygen species (ROS) level – free radicals present in higher concentration in cancer cells than normal ones, due to cell activity can be detected by PALS.

Results of studies with human tissue will also be presented. Research were conducted on two models: cardiac myxoma (benign hart tumour) with adipose mediastinal tissue as a control and colorectal cancer with normal colon (large intestine) tissue. All these studies shown significant differences in o-Ps lifetime between normal and cancer cells.

This result opens perspective for simultaneous determination of early and advanced stages of carcinogenesis by observing changes in biomechanical parameters between normal and tumour cells and standard PET examination. Such simultaneous PET imaging and PALS investigations can be performed with the Jagiellonian Positron Emission Tomograph (J-PET) [6-9] which is a multi-purpose detector used for investigations with positronium atoms in life-sciences as well as for development of medical diagnostics. J-PET is capable of imaging of properties of positronium produced inside the human body [1, 8].

References:

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