

Nanochemistry and Nanobiotechnology.

Influence of carbon nanomaterials on 3D culture of tumor cells.

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Due to wide opportunities of possible applications of carbon nanostructured materials (CNM) for biological and medical purposes, their biocompatibility and safety deserves for special attention. Local bioavailability of CNM and the possibility of their modification, particularly in proliferating cells can be considered as a target of antitumor effects. In the proposed study, we compared the properties of CNM, such as fullerenes, onion-like carbon (OLC), nanotubes (NT) and ultra dispersed diamonds (UDD) as synthetic extracellular matrix and their influence on the tumor cells in multicellular spheroids (3D model).

To investigate the effect of nanoscale structures on tumor cells were selected cell line MCF- 7 (human breast cancer), which is characterized by extremely high clonogenic and invasive properties [1]. We have established a model system where tumor cells can form multicellular microaggregates - spheroids [2]. Microtumors or in model systems in vitro – tumor spheroids can be considered as a model of tumor growth, which reflects the main properties of tumors, such as: growth kinetics, cell heterogeneity, induction of proliferative gradients, dormancy, development of specific histological structures, receptors or antigens expression [3, 4]. In our work we determined the dependence of the size and number of multicellular spheroids on the concentration and type of carbon nanostructured materials. For this aim we generated multicellular spheroids in the presence of various concentrations of CNM. Generation conducted by our patented technology during 24 hours in 24- well plates coated with 1% agar. For the next step we took images of all samples by "dark field" - technology. Then, for all cell aggregates were measured two dimensions and calculated the volume [5].

Our results indicated that the structure of aggregates of OLC, fullerenes C₆₀, NT and UDD had strong affect on adhesion properties of tumor cells in culture, formation of multicellular aggregates and may determine further development of the cell population. OLC units and UDD reduced cell adhesion to substrate and stimulate increasing the number of small cell spheroids with volume up to $1 \cdot 10^{-3} \text{ mm}^3$. Fullerenes C₆₀ and NT, conversely, created the conditions for the formation of bigger cell aggregates with volume up to $5 \cdot 10^{-3} \text{ mm}^3$. These findings also confirmed by statistical calculations correlation between the concentration of CNM and size of cell spheroids using Pearson` correlation coefficient, which for OLC is «- 0,84», UDD is «- 0,74», fullerenes is «+0,5» and NT is «+0,88».

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