“Nanobiotechnology and Chemistry”

Investigation of the effectiveness of carbon nanotubes for targeted delivery of antitumor drugs

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The aim of the study was to investigate the possibilities of targeted delivery of antitumor drugs and the cytotoxic effect of CNTs on tumor cells in vitro. The nanocomposite material was based on carbon nanotubes (CNTs) modified with doxorubicin (DOX) and a fluorescent label (FITC). For targeted delivery DOX to EGFR over-expressed tumor cells anti-EGFR antibodies were deposited on CNTs. Breast adenocarcinoma cells (line MCF-7) and hepatocellular carcinoma (line HT29) in monolayer and spheroid cultures were used as cell models.

The cytotoxic effect of CNTs was determined by MTT test. The penetration of CNT-FITCs through the cell membrane, fluorescent microscopy was used. The receptor profile of tumor cells was determined by immunohistochemistry. The clonogenic potential of CNTs was analyzed on 3-D culture.

As a result of the studies it was determined low cytotoxicity of CNTs at concentrations ranging from 12.5 to 50 μg / ml. CNTs cytotoxicity increased from 100 to 200 μg / ml and from CNTox to CNT-FITC and CNT-DOX. Clonogenesis of CNTs depends on concentration. Thus, at 12.5 μg/ml, the median volume of the spheroids (HT29) was 2.7×10^{-6} mm^3, and at 200 μg/ml already 67×10^{-6} mm^3. MCF-7 generated large number of MTS up to $1 \cdot 10^{-3}$ mm^3 volume at concentration SWCNTs from 12.5 to 50 μg/ml. When the concentration of SWCNTs increased to 100-200 μg/ml the number of MTS decreased. However the size of the tumor aggregates growth to $7 \cdot 10^{-3}$ mm^3. CNTs did not significantly affect the expression of tumor markers (p53, EGFR , Vim, EpCam). At the same time, it was found that increasing the concentration of trypsin leaded to release of DOX from CNT surface and correlated with decreasing of tumor cell survival. And breast adenocarcinoma cells, MCF-7, were more sensitive to the action of the CNTs-DOX than HT29.