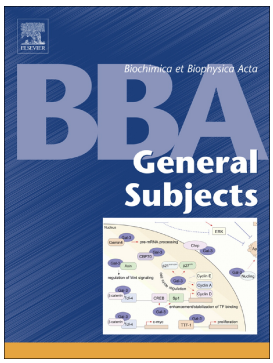

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3D cellular spheroids as tools for understanding carboxylated quantum dot behavior in tumors

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Abstract

Background

Monolayer cell cultures have been considered the most suitable technique for *in vivo* cellular experiments. However, a lot of cellular functions and responses that are present in natural tissues are lost in two-dimensional cell cultures. In this context, nanoparticle accumulation data presented in literature are often not accurate enough to predict behavior of nanoparticles *in vivo*. Cellular spheroids show a higher degree of morphological and functional similarity to the tissues.

Methods

Accumulation and distribution of carboxylated CdSe/ZnS quantum dots (QDs), chosen as model nanoparticles, was investigated in cellular spheroids composed of different phenotype mammalian cells. The findings were compared with the results obtained in *in vivo* experiments with human tumor xenografts in immunodeficient mice. The diffusive transport model was used for theoretical nanoparticles distribution estimation.

Results

QDs were accumulated only in cells, which were localized in the periphery of cellular spheroids. CdSe/ZnS QDs were shown to be stable and inert; they did not have any side-effects for cellular spheroids formation. Penetration of QDs in both cellular spheroids and *in vivo* tumor model was limited. The mathematical model confirmed the experimental results: nanoparticles penetrated only 25 μm into cellular spheroids after 24 h of incubation.

Conclusions

Penetration of negatively charged nanoparticles is limited not only in tumor tissue, but also in cellular spheroids.

General Significance