https://iopscience.iop.org/article/10.1088/1361-6528/ac28da/meta

Nanotechnology

PAPER

Rapid and delayed effects of single-walled carbon nanotubes in glioma cells

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Published 6 October 2021 • © 2021 IOP Publishing Ltd
Nanotechnology, Volume 32, Number 50

Citation Lena Golubewa *et al* 2021 *Nanotechnology* **32** 505103

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Abstract

Single-walled carbon nanotubes (SWCNTs) demonstrate a strong potential as an optically activated theranostic nano-agent. However, using SWCNTs in theranostics still requires revealing mechanisms of the SWCNT-mediated effects on cellular functions. Even though rapid and delayed cellular responses can differ significantly and may lead to undesirable consequences, understanding of these mechanisms is still incomplete. We demonstrate that introducing short (150–250 nm) SWCNTs into C6 rat glioma cells leads to SWCNT-driven effects that show pronounced time dependence. Accumulation of SWCNTs is carried out due to endocytosis with modification of the actin cytoskeleton but not accompanied with autophagy. Its initial stage launches a rapid cellular response via significantly heightened mitochondrial membrane potential and superoxide anion

radical production, satisfying the cell demand of energy for SWCNT transfer inside the cytoplasm. In the long term, SWCNTs agglomerate to micron-sized structures surrounded by highly active mitochondria having parameters return to control values. SWCNTs postponed effects are also manifested themselves in the suppression of the cell proliferative activity with further restoration after five passages. These results demonstrate relative cellular inertness and safety of SWCNTs eliminating possible side effects caused by optically activated theranostic applications.