Genotoxicity of nanoparticles

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Various nanoparticles have distinctive and remarkable material properties, different from bulk materials with the same chemical composition and potential technological applications, including those in biology and medicine. Many of them have recently emerged as a new option for cancer treatment, bioengineering and gene therapy, but inconsistent data on cytotoxicity and limited control over nanoparticles behavior currently restrict predictability of such applications. Most nanotubes, including single-walled carbon nanotubes (SWCNT), have a highly hydrophobic surface and a non-biodegradable nature that contributes to their reduced biocompatibility, limiting their biomedical applications, with growing concerns about their chronic toxicity. It is important to note that different variants of carbon nanotubes exhibit different toxicity both *in vitro* and *in vivo*. The toxicity of carbon nanotubes is attributed to their physicochemical properties, including structure and dose offered to cells or organisms and can elicit toxicity through numerous mechanisms. The SWCNT affects the expression of a number of genes associated with immune response, apoptosis, cell cycle control and cell proliferation in normal human astrocytes and glioma cells as well as genome stability. Similar results were obtained with many other nanoparticles (C_{60} fullerene, cerium dioxide, chromium disilicide, and titanium nitrite) both *in vitro* and *in vivo*. These nanoparticles activate the endoplasmic reticulum stress responsible genes with prooncogenic and cell surviving properties, strongly suppress immune response-related gene expressions as well as deregulate very important tumor suppressor genes. Furthermore, inhibition of IRE1-mediated endoplasmic reticulum stress signaling strongly reduces cell viability due to treatment with cerium dioxide nanotubes. Nanoparticles-mediated down-regulation of the expression of genes encoded the major histocompatibility complex proteins, which play a central role in the immune system, indicate the possibility of an immune response deregulation due to treatment with various nanoparticles. Therefore, most nanoparticles have a strong genotoxicity and more caution is needed in biomedical application of different nanoparticles

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