Oxidative stress-mediated neural cell death induced by nanoparticles

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Nanomaterials have a variety of unique physical and chemical properties, and are being studied for biotechnological, pharmacological, and medical applications. Silica nanoparticles (SiNPs) are produced on an industrial scale and used in various fields. Despite these benefits, there is concern that exposure to nanoparticles may lead to adverse effects on certain types of cells or tissues. Because SiNPs can cross the blood–brain barrier and the blood–placental barrier, they may cause toxic effects such as hemolysis, immune responses, and developmental abnormalities in the brain and developing embryos. Although investigations of the toxicity of SiNP to neurons are essential for medicinal use, few studies have assessed the direct effects of SiNPs on cells derived from the central nervous system. In this study, we showed that treatment with SiNPs caused oxidative stress, morphological damage, and neural cell death. Furthermore, we found that these cytotoxicities was reduced by SiNP surface functionalization or protein coating, and pretreating cells with an antioxidant, suggesting that contact-induced oxidative stress may be responsible for SiNP-induced cell death. These data will be valuable for utilizing SiNPs in biomedical applications.