Cytotoxicity and DNA damage in mouse macrophages exposed to silica nanoparticles

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ABSTRACT. Silica (SiO_2) nanoparticles are being progressively applied in various applications, including cosmetics, food technology, and medical diagnostics. Although crystalline SiO_2 is a known carcinogen, the carcinogenicity of SiO_2 nanoparticles remains unclear. Here, we assessed the cytotoxic effects and DNA injury induced by exposure to various dosages of SiO_2 nanoparticles at 0-2400 μg/mL (0-3200 μg/mL microscale SiO_2 as positive control) for 24 h using RAW264.7 cells, followed by methyl tetrazolium (MTT) assay. Cells were also treated by 31.25, 125, and 500 μg/mL SiO_2 nanoparticles (500 μg/mL microscale SiO_2 as positive control) for 24 h and examined by single cell gel electrophoresis assay (SCEG) and flow cytometry. Outstanding dose-related decline in cell viability was observed with enhancing dosages of SiO_2 nanoparticles by MTT assay. The inhibitory concentration 50% of SiO_2 nanoparticles and microscale SiO_2 was

16690 and 5080 μg/mL, respectively. The comet rate (comet%), length of tail, the percentage in DNA tail (TDNA%) and olive tail moment (OTM) induced by SiO_2 nanoparticles were significantly increased in comparison with control and microscale SiO_2 at 500 μg/mL. 500 μg/mL SiO_2 nanoparticles and microscale SiO_2 caused a significant increase in apoptosis rate, decreased proliferation index and increased cell proportions in G_0/G_1 phases by contrast to the negative control ($P < 0.05$). This indicates that SiO_2 nanoparticles are more cytotoxic than microscale SiO_2 particles; they induce DNA injury, increase apoptosis, and decrease the proliferation index in RAW264.7 cells. DNA injury and apoptosis may be involved in reducing cell proliferation.

Key words: SiO_2 nanoparticles; RAW 264.7 cells; DNA damage; Cytotoxicity; Apoptosis; Cell cycle