Interaction of glial cells with Zinc oxide nanoparticles

Zinc oxide nanoparticles have wide applications in electronics, goods packaging, cosmetics, daily care products as well as biomedical sector. The exposure risk of ZnO NPs has been evaluated in different organisms and cell lines. It is reported that the ZnO NPs reach brain via olfactory neuronal pathways and increase zinc content in brain up on intraperitonial injection. Disruption of zinc homeostasis has been linked to neurodegenerative conditions like Alzheimer's disease. Astrocytes are the principle cells of brain involved in zinc homeostasis. It helps to sequester the micronutrient zinc in metallothioneins and ferritin.

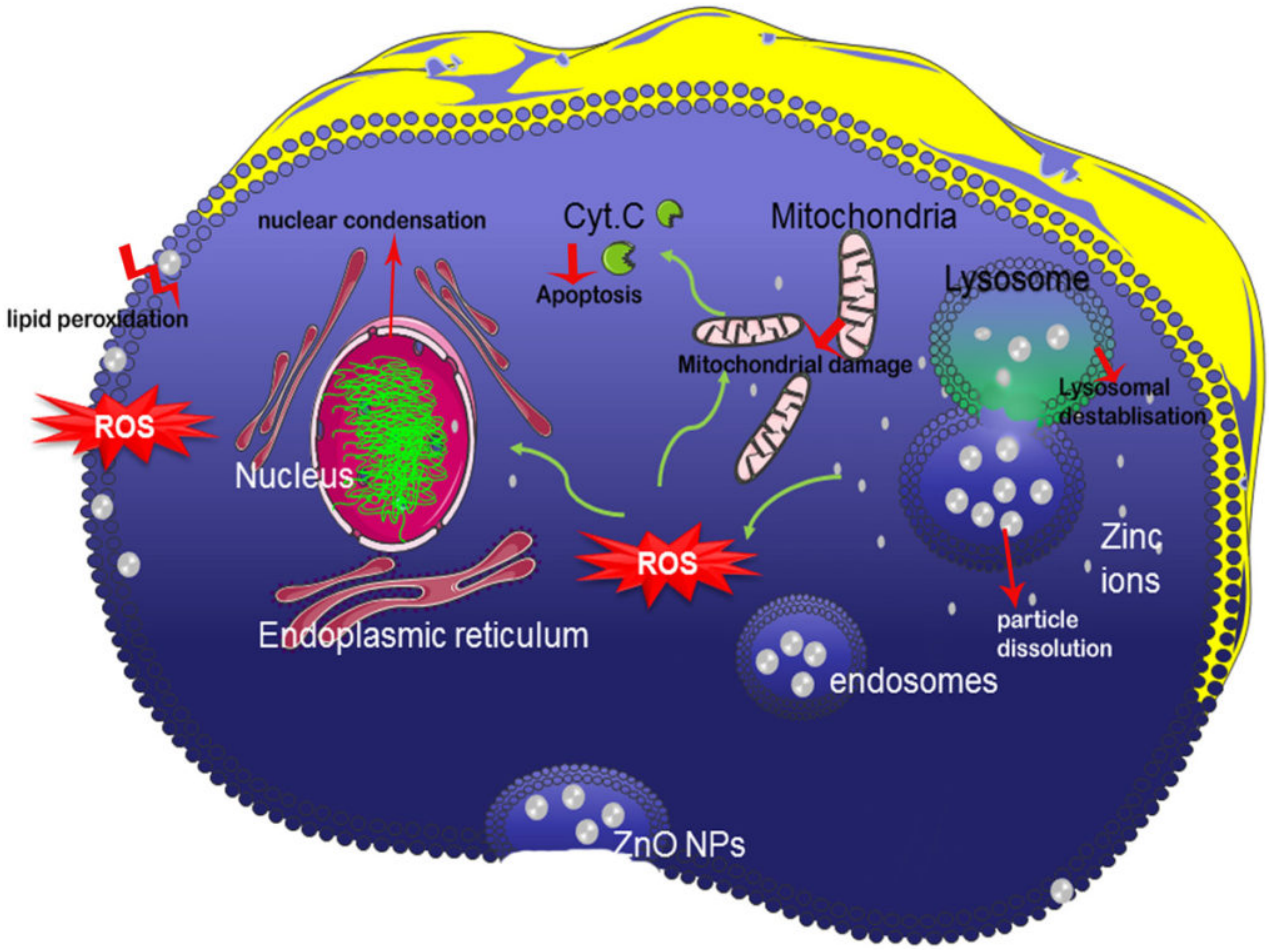

Fig. 1.

The astrocytes dysfunction and activation are hallmarks of many brain pathological conditions. Most of the studies on the neurotoxic potential of ZnO NPs are centred on neurons. Bio-interaction studies using astrocytes are of extreme importance in understanding neurotoxicity of ZnO NPs

because of the housekeeping role it plays in brain. Study on glioma cells reveals that the ZnO NPs are taken up by the astrocytes when exposed in vitro. The particles induce toxicity in astrocytes, in a dose and time dependent manner. Mitochondrial and lysosomal activities of the cells are reduced, when cells are exposed to ZnO NPs. Morphology of the cells is altered in presence of nanoparticle even at 6h of incubation, suggesting high toxicity of nanoparticle. Density of adherent cells is affected at high concentration of particle treatment. The nanoparticle induces ROS in astrocytes in a time dependent manner with 3 and 6h showing maximum ROS. There was no ROS increase at 24h probably because of the cellular degradation in presence of ZnO NPs or due to the high catalase activity exhibited by astrocytes. The nanoparticle induce apoptosis in astrocytes as revealed by nuclear condensation and annexin IV staining. This study demonstrates that the ZnO NPS interactions can be detrimental to astrocytes by interfering with its normal functioning. The study suggests that the persistence of ZnO NPs can continue to have damaging effect on the cells. Hence the nanoparticles exposure time and clearance by the cells has to be carefully evaluated to predict the exact toxicological interaction of ZnO NPs with astrocytes.

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