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Nanoparticle Induced Neurotoxicity Mediated by Mitochondria

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Abstract : Nanotechnology has emerged to play a vital role in developing all through the industrial world with an immense production of nanomaterials including nanoparticles (NPs). Many toxicological studies have confirmed that due to unique small size and physico-chemical properties of NPs (1-100nm), they can be potentially hazardous. Metallic NPs of small size have been shown to induce higher levels of cellular oxidative stress and can easily pass through the Blood Brain Barrier (BBB) and significantly accumulate in brain. With the wide applications of titanium dioxide nanoparticles (TNPs) in day-to-day life in form of cosmetics, paints, sterilisation and so on, there is growing concern regarding the deleterious effects of TNPs on central nervous system and mitochondria appear to be important cellular organelles targeted to the pro-oxidative effects of NPs and an important source that contribute significantly for the production of reactive oxygen species after some toxicity or an injury. The aim of our study was to elucidate the effect of TNPs in anatase form with different concentrations (5-50 µg/ml) following with various oxidative stress markers in isolated brain mitochondria as an in vitro model. Oxidative stress was determined by measuring the different oxidative stress markers like lipid peroxidation as well as the protein carbonyl content which was found to be significantly increased. Reduced glutathione content and major glutathione metabolizing enzymes were also modulated signifying the role of glutathione redox cycle in the pathophysiology of TNPs. The study also includes the mitochondrial enzymes (Complex 1, Complex II, complex IV, Complex V) and the enzymes showed toxicity in a relatively short time due to the effect of TNPs. The study provide a range of concentration that were toxic to the neuronal cells and data pointing to a general toxicity in brain mitochondria by TNPs, therefore, it is in need to consider the proper utilization of NPs in the environment.

Keywords : mitochondria, nanoparticles, brain, in vitro
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