Eunjoo Kim, J Clin Toxicol 2014, 4:4
http://dx.doi.org/10.4172/2161-0495.S1.012

OMICS Group Conferences
Accelerating Scientific Discovery

3rd International Summit on
Toxicology & Applied Pharmacology
October 20-22, 2014 DoubleTree by Hilton Hotel Chicago-North Shore, USA

Toxicity analysis of PbS nanoparticles using nano-sized vesicles (exosome) excreted from HEK293 cells

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Tremendous research efforts have been devoted to fabricating high quality quantum dots (QDs) for applications in biology and medicine. However, a great deal of concern has been demonstrated about the potential hazards of QDs due to their heavy-metal content. In this work, we present the results of the cytotoxic study with PbS QDs modified with 3-mercaptopropionic acid (QD-MPA, ~10 nm). Small nucleotides known to participate in regulation of mRNA expression, miRNAs, were excreted into culture media following encapsulation by nano-sezed vesicles (~50 nm) called "exosome". To investigate the pathological toxicity caused by QD-MPA, exosomes excreted from HEK293 cells were analyzed to see the genomic and proteomic biomarker changes. Exosome also contains proteins as a consequence of toxicological changes by environmental stressors. In this study, the change of exosome miRNA profiles was analyzed followed by an exposure of QD-MPA to HEK293 cells. As a result, 15 differentially expressed genes (DEG) were determined. A pathway analysis by IPA (Ingenuity Pathway Analysis) database showed that the DEGs caused by QD-MPA were primarily involved in cancer and organismal injury and abnormalities. A proteomic analysis in exoxomes also supported that the cancerous change was occurred by QD-MPA exposure. IRR23b and keratin 5 were identified as biomarkers for QD-MPA exposure identified in exosome proteomes. These proteins are also known as cancer biomarkers. When comet assay was performed whether DNA alteration was occurred, the results clearly showed that DNA fragmentation was occurred following the QD-MPA exposure. In conclusion, QD-MPA nanoparticles shows carcinogenic activities and these pathological changes could be identified by genomic and proteomic analysis for secreted exosomes, which could provide an effective protocol to identify a possible pathological toxicity.

Biography

Eunjoo Kim finished her PhD in Environmental Toxicology in 2000 from Seoul National University. She worked as Principle Research Scientist at Daegu Gyeongbuk Institute of Science and Technology (DGIST) from 2005. Her major research field is toxicological pathology based on identification and analysis of biomarkers, and has been developed for biosensors to detect important biomarkers effectively. Recently, she has started to focus on exosome studies for identification of serum biomarkers for disease and toxicology.

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