THE DEPOSITION OF INHALED MANGANESE NANOPARTICLES IN MICE ORGANS

MACHALA Miroslav, KULICH Pavel, SERY Omar, DOCEKAL Bohumil, VECERA Zbynek, ZEMAN Tomas, MISEK Ivan

Veterinary Research Institute, Brno, Czech Republic, EU

Institute of Animal Physiology and Genetics; Institute of Analytical Chemistry of the AS CR, v.v.i.; University of Defence; Brno, Czech Republic, EU

Abstract

Biokinetics of manganese oxide (MnO.Mn2O3) nanoparticles (NPs) was studied in male ICR mice after 17-week exposure in inhalation chamber by transmission electron microscopy (TEM), scan electron microscopy (SEM) and electrothermal atomic absorption spectrometry (ET-AAS) analyses. The study focused on the distribution of Mn NPs in selected tissues (lung, erythrocytes, liver, spleen, brain). First, uniformity, shape and size of NPs, used for exposure inhalation experiments, were characterized by TEM. The NP size was on average 20 nm (9-35 nm), and they mostly polygonal shape. Using ET-AAS analysis, we evaluated concentrations of Mn within individual organs; with exception of the lungs at the beginning of the exposure, and a slight increase of Mn levels in brain, no significant accumulation of Mn was observed. Next, the ultrathin sections of different tissues (which were not contrasted) were prepared and then observed using TEM and SEM. Mn NPs were found in lung alveoli, lung capillaries and pneumocytes, as well as in erythrocytes and alveolar macrophages; in addition, Mn NPs were detected in hepatocytes, Kupffer cells, spleen reticulocytes, medulla oblongata and in frontal cortex neuronal cells. The results indicate that Mn NPs may pass into alveoli and then through the wall of lung capillaries, through pneumocytes and endothelila cells into erythrocytes, which may distribute them into distant organs. This is supported by observation that in blood, a major portion of Mn NPs was found in erythrocytes, but not in white blood cells or plasma. Deposited Mn NPs were found mostly in secondary lysosomes of target cells. Together, our findings support the hypothesis that Mn NPs deposition after inhalation exposure occurs via lung-blood-target organ axis and that erythrocytes are major carriers of NPs.

ACKNOWLEDGEMENTS

This study was supported by the Czech Science Foundation, project no. P503-12-G147.

Author did not supply full text of the paper.