The Uptake of Manganese in Brain Endothelial Cultures

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ABSTRACT

Recent emission characterizations of methylcyclopentadienyl manganese tricarbonyl (MMT) indicate that a mixture of manganese phosphate and manganese sulfate best fit the emissions characteristics of manganese (Mn) from the tail pipe of vehicles (Ethyl Corporation, personal communication; Pellizzari et al., 1998). Accordingly, we focused on CNS transport kinetics of manganese phosphate and manganese sulfate, and the findings were correlated with the transport kinetics of manganese chloride ($MnCl_2$), a model Mn compound that has been previously studied. A series of studies was performed to address the transport of Mn salts in confluent cultured endothelial cells. The initial rate of uptake (5 min) of Mn salts (chloride, sulfate, and phosphate) in rat brain endothelial (RBE4) cell cultures is salt-dependent, with the highest rates of uptake for Mn chloride and Mn sulfate (as reflected by the greatest displacement of ^{54}Mn compared with control), and >Mn phosphate. Notably, both with 50 and 100 μM Mn salts, the rate (% uptake versus control), and the rank order of transport of Mn salts are identical to those in astrocytes, with the highest transport for Mn chloride and Mn sulfate, and >Mn phosphate. Analogous studies on Mn uptake were completed in bovine brain endothelial cells with both 100 and 50 μM of Mn chloride, Mn sulfate, or Mn phosphate. The results of these studies are identical to those obtained in RBE4 cells, and astrocytes. Notably, there are no qualitative differences in the absolute uptake and rank order of the various Mn salts between the different cell types (endothelium vs. astrocytes). These data corroborate observations by Dorman (personal communication) that brain concentrations of Mn in rats repeatedly (14 days) exposed to Mn phosphate or Mn sulfate (0-3 mg Mn/m^3) are significantly higher upon exposure to Mn sulfate (no studies were conducted with inhaled Mn chloride).