

Identification and distribution of mercury species in rat tissues following administration of thimerosal or methylmercury

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Abstract Methylmercury (Met-Hg) is one the most toxic forms of Hg, with a considerable range of harmful effects on humans. Sodium ethyl mercury thiosalicylate, thimerosal (TM) is an ethylmercury (Et-Hg)-containing preservative that has been used in manufacturing vaccines in many countries. Whereas the behavior of Met-Hg in humans is relatively well known, that of ethylmercury (Et-Hg) is poorly understood. The present study describes the distribution of mercury as (-methyl, -ethyl and inorganic mercury) in rat tissues (brain, heart, kidney and liver) and blood following administration of TM or Met-Hg. Animals received one dose/day of Met-Hg or TM by gavage (0.5 mg Hg/kg). Blood samples were collected after 6, 12, 24, 48, 96 and 120 h of exposure. After 5 days, the animals were killed, and their tissues were collected. Total blood mercury (THg) levels were determined by ICP-MS, and methylmercury (Met-Hg), ethylmercury (Et-Hg) and inorganic mercury (Ino-Hg) levels were determined by speciation analysis with LC-ICP-MS. Mercury remains longer in the blood of rats treated with Met-Hg compared to that of TM-exposed rats. Moreover, after 48 h of the TM treatment, most of the Hg found in blood was inorganic. Of the total mercury found in the brain after TM exposure, 63% was in the form of Ino-Hg, with 13.5% as Et-Hg and 23.7% as Met-Hg. In general, mercury in tissues and blood following TM treatment was predominantly found as Ino-Hg, but a considerable amount of Et-Hg was also found in the liver and brain.

Taken together, our data demonstrated that the toxicokinetics of TM is completely different from that of Met-Hg. Thus, Met-Hg is not an appropriate reference for assessing the risk from exposure to TM-derived Hg. It also adds new data for further studies in the evaluation of TM toxicity.

Keywords Mercury · Distribution · Methylmercury · Ethylmercury · Inorganic mercury · Speciation analysis · Tissues · Toxicity · Thimerosal

Introduction

Methylmercury (Met-Hg) is one the most toxic forms of Hg and the most common form of mercury exposure. A considerable range of harmful effects on humans has been identified (Grotto et al. 2009a, b; Mori et al. 2007; Yamamoto and Shima 2009). On other hand, sodium ethyl mercury thiosalicylate (thimerosal) is an ethylmercury (Et-Hg)-containing preservative that has been used for over 60 years as an antimicrobial agent in vaccines to prevent contamination (Tan and Parkin 2000). In spite of the huge information about methylmercury metabolism, little is known about thimerosal (ethylmercury) disposition in mammals.

The use of thimerosal (TM) has probably prevented the death or illness of countless infants by reducing the risk of contamination from open multidose vials, for example. However, some experimental and epidemiological studies have shown associations between increased Hg exposure from TM-containing vaccines and toxic effects (Berman et al. 2008; Geier and Geier 2006; Westphal et al. 2003). For this reason, this compound has been removed from many childhood vaccines in several countries including United States. However, TM-preserved vaccines are still in use around the world in situations where the advantages of

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