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Molecular hydrogen in drinking water protects against neurodegenerative changes induced by traumatic brain injury

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Abstract

Traumatic brain injury (TBI) in its various forms has emerged as a major problem for modern society. Acute TBI can transform into a chronic condition and be a risk factor for neurodegenerative diseases such as Alzheimer's and Parkinson's diseases, probably through induction of oxidative stress and neuroinflammation. Here, we examined the ability of the antioxidant molecular hydrogen given in drinking water (molecular hydrogen water; mHW) to alter the acute changes induced by controlled cortical impact (CCI), a commonly used experimental model of TBI. We found that mHW reversed CCI-induced edema by about half, completely blocked pathological tau expression, accentuated an early increase seen in several cytokines but attenuated that increase by day 7, reversed changes seen in the protein levels of aquaporin-4, HIF-1, MMP-2, and MMP-9, but not for amyloid beta peptide 1-40 or 1-42. Treatment with mHW also reversed the increase seen 4 h after CCI in gene expression related to oxidation/carbohydrate metabolism, cytokine release, leukocyte or cell migration, cytokine transport, ATP and nucleotide binding. Finally, we found that mHW preserved or increased ATP levels and propose a new mechanism for mHW, that of ATP production through the Jagendorf reaction. These results show that molecular hydrogen given in drinking water reverses many of the sequelae of CCI and suggests that it could be an easily administered, highly effective treatment for TBI.

Figures

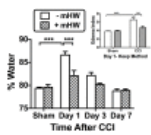


Figure 1. Effects of CCI and mHW...

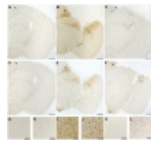


Figure 2. Reduction of CCI-induced pathological tau...

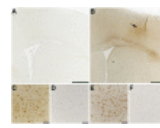


Figure 3. Reduction of CCI-induced pathological tau...

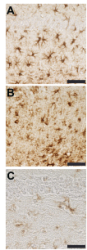


Figure 4. GFAP immunoreactivity is decreased in...

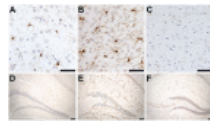


Figure 5. The CCI induced increase in...

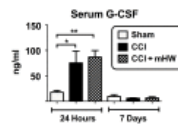


Figure 6. Effects of CCI and mHW...

All figures (11)

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