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The preventive and therapeutic effects of molecular hydrogen in ocular diseases and injuries where oxidative stress is involved

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Abstract

Oxidative stress initiates, accompanies and contributes to the development of several human diseases and injuries, including ocular diseases. Reactive oxygen species (ROS) can generate oxidative stress via excessive ROS production and/or decreased physiologically occurring antioxidants. To replace these weakened antioxidants, substances with effective antioxidant properties are needed in order to suppress oxidative stress and enable healing. Molecular hydrogen (H₂) is very suitable for this purpose due to its unique properties. H₂ is the only antioxidant that crosses the blood-brain and blood-ocular barriers. It quickly penetrates through tissue due to its small molecular size and effectively removes ROS, mainly hydroxyl radicals and peroxynitrite. Apart from its antioxidant effects, H₂ also displays anti-inflammatory, antiapoptotic, cytoprotective and mitohormetic properties. A significant advantage of H₂ is its nontoxicity, even when applied at high concentrations. In this review, we present the results of studies utilising H₂ in the treatment of ocular diseases involving oxidative stress. These results, obtained in experimental animals as well as in human clinical studies, show that the suppression of oxidative stress by H₂ treatment leads to the prevention or improvement of ocular diseases. In severe degenerative diseases, H₂ slows disease progression.

Keywords: Molecular hydrogen; ocular diseases and injuries; reactive oxygen species.

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