Anti-inflammatory properties of molecular hydrogen: investigation on parasite-induced liver inflammation

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Abstract – Molecular hydrogen reacts with the hydroxyl radical, a highly cytotoxic species produced in inflamed tissues. It has been suggested therefore to use gaseous hydrogen in a new anti-inflammatory strategy. We tested this idea, with the aid of the equipment and skills of COMEX SA in Marseille, a group who experiments with oxygen–hydrogen breathing mixtures for professional deep-sea diving. The model used was schistosomiasis-associated chronic liver inflammation. Infected animals stayed 2 weeks in an hyperbaric chamber in a normal atmosphere supplemented with 0.7 MPa hydrogen. The treatment had significant protective effects towards liver injury, namely decreased fibrosis, improvement of hemodynamics, increased NOSII activity, increased antioxidant enzyme activity, decreased lipid peroxide levels and decreased circulating TNF-α levels. Under the same conditions, helium exerted also some protective effects, indicating that hydroxyl radical scavenging is not the only protective mechanism. These findings indicate that the proposed anti-inflammatory strategy deserves further attention.

Hydrogen from intestinal bacteria is protective for Concanavalin A-induced hepatitis

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ABSTRACT

It is well known that some intestinal bacteria, such as *Escherichia coli*, can produce a remarkable amount of molecular hydrogen (H_2). Although the antioxidant effects of H_2 are well documented, the present study examined whether H_2 released from intestinally colonized bacteria could affect Concanavalin A (ConA)-induced mouse hepatitis. Systemic antibiotics significantly decreased the level of H_2 in both liver and intestines along with suppression of intestinal bacteria. As determined by the levels of AST, ALT, TNF-α and IFN-γ in serum, suppression of intestinal bacterial flora by antibiotics increased the severity of ConA-induced hepatitis, while reconstitution of intestinal flora with H_2-producing *E. coli*, but not H_2-deficient mutant *E. coli*, down-regulated the ConA-induced liver inflammation. Furthermore, *in vitro* production of both TNF-α and IFN-γ by ConA-stimulated spleen lymphocytes was significantly inhibited by the introduction of H_2. These results indicate that H_2 released from intestinal bacteria can suppress inflammation induced in liver by ConA.

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Hydrogen-rich saline ameliorates the severity of L-arginine-induced acute pancreatitis in rats

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ABSTRACT

Molecular hydrogen, which reacts with the hydroxyl radical, has been considered as a novel antioxidant. Here, we evaluated the protective effects of hydrogen-rich saline on the L-arginine (L-Arg)-induced acute pancreatitis (AP). AP was induced in Sprague–Dawley rats by giving two intraperitoneal injections of L-Arg, each at concentrations of 250 mg/100 g body weight, with an interval of 1 h. Hydrogen-rich saline (>0.6 mM, 6 ml/kg) or saline (6 ml/kg) was administered, respectively, via tail vein 15 min after each L-Arg administration. Severity of AP was assessed by analysis of serum amylase activity, pancreatic water content and histology. Samples of pancreas were taken for measuring malondialdehyde and myeloperoxidase. Apoptosis in pancreatic acinar cell was determined with terminal deoxynucleotidyl transferase-mediated deoxyuridine triphosphate nick-end labeling technique (TUNEL). Expression of proliferating cell nuclear antigen (PCNA) and nuclear factor kappa B (NF-κB) were detected with immunohistochemistry. Hydrogen-rich saline treatment significantly attenuated the severity of L-Arg-induced AP by ameliorating the increased serum amylase activity, inhibiting neutrophil infiltration, lipid oxidation and pancreatic tissue edema. Moreover, hydrogen-rich saline treatment could promote acinar cell proliferation, inhibit apoptosis and NF-κB activation. These results indicate that hydrogen treatment has a protective effect against AP, and the effect is possibly due to its ability to inhibit oxidative stress, apoptosis, NF-κB activation and to promote acinar cell proliferation.