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Hydrogen-rich saline prevents early neurovascular dysfunction resulting from inhibition of oxidative stress in STZ-diabetic rats

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Abstract

Purpose: Diabetic retinopathy (DR) is characterized by increased oxidative and nitrosative stress, both of which lead to neurotoxicity and vascular permeability. Previous studies on a variety of organs indicate that hydrogen-rich saline not only has considerable antioxidant and anti-inflammatory properties, but also suppresses oxidative stress-induced injury. In the present study, we assessed the effects of hydrogen-rich saline on neurovascular dysfunction and oxidative stress in an animal model (rat) of DR.

Materials and methods: Male Sprague-Dawley rats with streptozotocin (STZ)-induced diabetes mellitus (DM) were injected intraperitoneally with 5 ml/kg hydrogen-saturated (experimental) or plain (control) saline daily for one month. Visual function and blood-retinal barrier (BRB) integrity were evaluated by electroretinography (ERG) and bovine serum albumin (BSA)-fluorescence, respectively. Histological changes in the inner retina were assessed by light microscopy. Biomarkers of oxidative stress, including 4-hydroxynonenal (4-HNE) and 8-hydroxy-2-deoxyguanosine (8-OH-dG), and antioxidant enzymes, including superoxide dismutase, glutathione peroxidase, glutathione reductase and glutathione transferase, were evaluated by ELISA. Synaptophysin and brain-derived neurotrophic factor (BDNF) levels were measured by immunoblotting.

Results: STZ-diabetic rats were marked by clearly reduced b-wave amplitudes and oscillatory potentials, DM-related BRB breakdown and histological changes in the inner retina, all of which were suppressed following treatment with hydrogen-rich saline. Furthermore, hydrogen-rich saline reduced oxidative stress, increased antioxidant enzyme activities and preserved synaptophysin and BDNF levels in the diabetic rat retina.

Conclusions: Based on its inhibition of oxidative stress and up-regulation of anti-oxidative enzymes, we conclude that hydrogen-rich saline is a potentially valuable therapeutic modality for the treatment of DR.

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