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Letter to the Editor

Hydrogen as a novel hypothesized emerging treatment for oxidative stress in autism

Dear Editor,

Hydrogen H(2) is a "novel antioxidant" can be potentially used for many medical conditions[1]. Both human and animal studies indicated the protective effects of hydrogen inhalation[2,3]. H(2) decreases the hydroxyl radical while it does not react with other types of reactive oxygen species (ROS) including superoxide, hydrogen peroxide (H_2O_2) and nitric oxide (NO)[3]. This is very important because H_2O_2 and NO have some roles as second messengers during cell growth and differentiation[4].

Although H(2) can be explosive and inflammable, however, it will not flame in temperatures less than 527°C. It does not react with oxygen at room temperature[1]. It has been used in humans for diving[5]. A few advantages are reported for H(2) as an antioxidant[1]: (1) It passes through biomembranes and can enter the cytosol, while some other antioxidants do not; (2) H(2) is able to pass the blood brain barrier; and (3) Molecular hydrogen lacks any cytotoxicity effects, even at high concentration. Molecular hydrogen can be easily consumed through inhalation, drinking hydrogen water, injection, eye-dropping of hydrogen saline, and taking a hydrogen bath[1].

The continuous consumption of hydrogen water decreases oxidative stress in the mouse brain and prevents the stress-induced decline in learning and memory[6]. Moreover, molecular hydrogen in drinking water has preventive and therapeutic effects on the animal models of Parkinson disease[7,8]. Hydrogen, through effect on IL-6 and TNF-alpha, plays a therapeutic role in intestinal ischemia/reperfusion injury[9]. The inhalation of hydrogen gas decreases oxidative stress resulting in a reduction in hepatic injury due to ischemia/reperfusion[10]. Moreover, hydrogen water prevents atherosclerosis in animals[11].

Autism Spectrum Disorders (ASDs) consisted of several disorders including Autistic Disorder, Asperger's Disorder, and Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS). The clinical manifestations of ASD are impaired language and verbal communication, limited or impaired social relationships, restricted interests, and repetitive behaviors. These disorders usually start in early childhood. Autism a neuro-developmental disorder involves multiple organs. ASDs are associated with mitochondrial dysfunction[12-14].

There should be an equilibrium between oxidative stress and antioxidant defense capacity[15]. Oxidative stress plays a causative role for autism[16,17]. While oxidative stress is increased in autism, methylation capacity is impaired[18]. The deficit in antioxidant and methylation capacity in autism is a specific finding for autism[19]. Glutathione (GSH) is responsible for the reduction of oxidative stress. The major intracellular redox (reduction/oxidation) buffer is GSH. The enzymes of superoxide dismutase (SOD), catalase, and glutathione peroxidase (GSH-Px) are involved in elimination of reactive oxygen species (ROS). The level of SOD and GSH-Px are increased in autism[20]. This increase is explained in that the levels of oxidants are increased and these enzymes have already been triggered to counterbalance the level of oxidant and antioxidant levels[21]. The increased level of ROS may oxidize some biomolecules such as membrane lipids[22].

According to the mentioned above evidence, there is an increased level of oxidative stress, and a decreased antioxidant capacity in autism. In addition, there is a lack of evidenced-based research into treatments to address this issue. Considering the apparent usefulness of hydrogen as a non-toxic antioxidant that can readily cross the BBB and cellular membrane, it is worthwhile to conduct studies to examine the possible therapeutic role of molecular hydrogen for the treatment of autism.

Corresponding Author: Ahmad Ghanizadeh, MD; e-mail: ghanizad@sina.tums.ac.ir

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A. Ghanizadeh[1,2]

[1]Research Center for Psychiatry and Behavioral Sciences and

[2]Department of Psychiatry, School of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran