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Hydrogen-rich saline improves survival and neurological outcome after cardiac arrest and cardiopulmonary resuscitation in rats

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Abstract

Background: Sudden cardiac arrest is a leading cause of death worldwide. Three-fourths of cardiac arrest patients die before hospital discharge or experience significant neurological damage. Hydrogen-rich saline, a portable, easily administered, and safe means of delivering hydrogen gas, can exert organ-protective effects through regulating oxidative stress, inflammation, and apoptosis. We designed this study to investigate whether hydrogen-rich saline treatment could improve survival and neurological outcome after cardiac arrest and cardiopulmonary resuscitation, and the mechanism responsible for this effect.

Methods: Sprague-Dawley rats were subjected to 8 minutes of cardiac arrest by asphyxia. Different doses of hydrogen-rich saline or normal saline were administered IV at 1 minute before cardiopulmonary resuscitation, followed by injections at 6 and 12 hours after restoration of spontaneous circulation, respectively. We assessed survival, neurological outcome, oxidative stress, inflammation biomarkers, and apoptosis.

Results: Hydrogen-rich saline treatment dose dependently improved survival and neurological function after cardiac arrest/resuscitation. Moreover, hydrogen-rich saline treatment dose dependently ameliorated brain injury after cardiac arrest/resuscitation, which was characterized by the increase of survival neurons in hippocampus CA1, reduction of brain edema in cortex and hippocampus, preservation of blood-brain barrier integrity, as well as the decrease of serum S100β and neuron-specific enolase. Furthermore, we found that the beneficial effects of hydrogen-rich saline treatment were associated with decreased levels of oxidative products (8-iso-prostaglandin F2α and malondialdehyde) and inflammatory cytokines (tumor necrosis factor-α, interleukin-1β, and high-mobility group box protein 1), as well as the increased activity of antioxidant enzymes (superoxide dismutase and catalase) in serum and brain tissues. In addition, hydrogen-rich saline treatment reduced caspase-3 activity in cortex and hippocampus after cardiac arrest/resuscitation.

Conclusions: Hydrogen-rich saline treatment improved survival and neurological outcome after cardiac arrest/resuscitation in rats, which was partially mediated by reducing oxidative stress, inflammation, and apoptosis.

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