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Hydrogen inhalation during normoxic resuscitation improves neurological outcome in a rat model of cardiac arrest independently of targeted temperature management

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Abstract

Background: We have previously shown that hydrogen (H2) inhalation, begun at the start of hyperoxic cardiopulmonary resuscitation, significantly improves brain and cardiac function in a rat model of cardiac arrest. Here, we examine the effectiveness of this therapeutic approach when H2 inhalation is begun on the return of spontaneous circulation (ROSC) under normoxic conditions, either alone or in combination with targeted temperature management (TTM).

Methods and results: Rats were subjected to 6 minutes of ventricular fibrillation cardiac arrest followed by cardiopulmonary resuscitation. Five minutes after achieving ROSC, post-cardiac arrest rats were randomized into 4 groups: mechanically ventilated with 26% O2 and normothermia (control); mechanically ventilated with 26% O2, 1.3% H2, and normothermia (H2); mechanically ventilated with 26% O2 and TTM (TTM); and mechanically ventilated with 26% O2, 1.3% H2, and TTM (TTM+H2). Animal survival rate at 7 days after ROSC was 38.4% in the control group, 71.4% in the H2 and TTM groups, and 85.7% in the TTM+H2 group. Combined therapy of TTM and H2 inhalation was superior to TTM alone in terms of neurological deficit scores at 24, 48, and 72 hours after ROSC, and motor activity at 7 days after ROSC. Neuronal degeneration and microglial activation in a vulnerable brain region was suppressed by both TTM alone and H2 inhalation alone, with the combined therapy of TTM and H2 inhalation being most effective.

Conclusions: H2 inhalation was beneficial when begun after ROSC, even when delivered in the absence of hyperoxia. Combined TTM and H2 inhalation was more effective than TTM alone.

Keywords: antioxidants; cardiopulmonary resuscitation; heart arrest; ischemia; reperfusion injury.

Comment in

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