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H(2) gas improves functional outcome after cardiac arrest to an extent comparable to therapeutic hypothermia in a rat model

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Abstract

Background: All clinical and biological manifestations related to postcardiac arrest (CA) syndrome are attributed to ischemia-reperfusion injury in various organs including brain and heart. Molecular hydrogen (H(2)) has potential as a novel antioxidant. This study tested the hypothesis that inhalation of H(2) gas starting at the beginning of cardiopulmonary resuscitation (CPR) could improve the outcome of CA.

Methods and results: Ventricular fibrillation was induced by transcutaneous electrical epicardial stimulation in rats. After 5 minutes of the subsequent CA, rats were randomly assigned to 1 of 4 experimental groups at the beginning of CPR: mechanical ventilation (MV) with 2% N(2) and 98% O(2) under normothermia (37°C), the control group; MV with 2% H(2) and 98% O(2) under normothermia; MV with 2% N(2) and 98% O(2) under therapeutic hypothermia (TH), 33°C; and MV with 2% H(2) and 98% O(2) under TH. Mixed gas inhalation and TH continued until 2 hours after the return of spontaneous circulation (ROSC). H(2) gas inhalation yielded better improvement in survival and neurological deficit score (NDS) after ROSC to an extent comparable to TH. H(2) gas inhalation, but not TH, prevented a rise in left ventricular end-diastolic pressure and increase in serum IL-6 level after ROSC. The salutary impact of H(2) gas was at least partially attributed to the radical-scavenging effects of H(2) gas, because both 8-OHdG- and 4-HNE-positive cardiomyocytes were markedly suppressed by H(2) gas inhalation after ROSC.

Conclusions: Inhalation of H(2) gas is a favorable strategy to mitigate mortality and functional outcome of post-CA syndrome in a rat model, either alone or in combination with TH.

Keywords: cardiac arrest; cardiopulmonary resuscitation; hydrogen gas; therapeutic hypothermia; ventricular fibrillation.

Figures

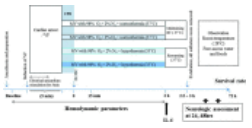

Figure 1. Experimental protocol of CPR and...

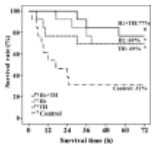

Figure 2. Kaplan–Meier analyses of cumulative survival...

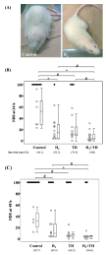

Figure 3. A, Representative photographs of rat...

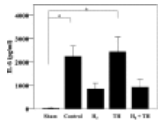

Figure 4. Serum IL-6 concentrations 2 hours...

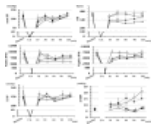

Figure 5. Changes in mean blood pressure...

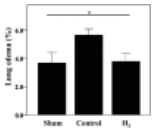

Figure 6. Effects of hydrogen on lung...

All figures (9)

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