Attenuating brain edema, hippocampal oxidative stress, and cognitive dysfunction in rats using hyperbaric oxygen preconditioning during simulated high-altitude exposure.

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Source

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Abstract

BACKGROUND:

We assessed whether hyperbaric oxygen preconditioning (HBO2P) in rats induced heat shock protein (HSP)-70 and whether HSP-70 antibody (Ab) preconditioning attenuates high altitude exposure (HAE)-induced brain edema, hippocampal oxidative stress, and cognitive dysfunction.

METHODS:

Rats were randomly divided into five groups: the non-HBO2P + non-HAE group, the HBO2P + non-HAE group, the non-HBO2P + HAE group, the HBO2P + HAE group, and the HBO2P + HSP-70 Abs + HAE group. The HBO2P groups were given 100% O2 at 2.0 absolute atmospheres for 1 hour per day for 5 consecutive days. The HAE groups were exposed to simulated HAE (9.7% O2 at 0.47 absolute atmospheres of 6,000 m) in a hypobaric chamber for 3 days. Polyclonal rabbit anti-mouse HSP-70-neutralizing Abs were intravenously injected 24 hours before the HAE experiments. Immediately after returning to normal atmosphere, the rats were given cognitive performance tests, overdosed with a general anesthetic, and then their brains were excised en bloc for water content measurements and biochemical evaluation and analysis.

RESULTS:
Non-HBO2P group rats displayed cognitive deficits, brain edema, and hippocampal oxidative stress (evidenced by increased toxic oxidizing radicals [e.g., nitric oxide metabolites and hydroxyl radicals], increased pro-oxidant enzymes [e.g., malondialdehyde and oxidized glutathione] but decreased antioxidant enzymes [e.g., reduced glutathione, glutathione peroxide, glutathione reductase, and superoxide dismutase]) in HAE. HBO2P induced HSP-70 overexpression in the hippocampus and significantly attenuated HAE-induced brain edema, cognitive deficits, and hippocampal oxidative stress. The beneficial effects of HBO2P were significantly reduced by HSP-70 Ab preconditioning.

**CONCLUSION:**

Our results suggest that high-altitude cerebral edema, cognitive deficit, and hippocampal oxidative stress can be prevented by HSP-70-mediated HBO2P in rats.