

# **Progressive exercise preconditioning protects against circulatory shock during experimental heatstroke**

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摘要

## **Abstract**

Heat shock protein (HSP) 72 expression protects against arterial hypotension in rat heatstroke. HSP72 can also be induced in multiple organs, including hearts from rats with endurance exercise. We validated the hypothesis that progressive exercise preconditioning may confer cardiovascular protection during heatstroke by inducing the overexpression of HSP72 in multiple organs. To deal with the matter, we assessed the effects of heatstroke on mean arterial pressure, heart rate, cardiac output, stroke volume, total peripheral vascular resistance, colonic temperature, blood gases, and serum or tissue levels of tumor necrosis factor-alpha (TNF-alpha) in urethane-anesthetized rats pretreated without or with progressive exercise training for 1, 2, or 3 weeks. In addition, HSP72 expression in multiple organs was determined in different groups of animals. Heatstroke was induced by exposing the rats to a high blanket temperature (43 degrees C); the moment at which mean arterial pressure decreased from the peak value was taken as the time of heatstroke onset. Previous exercise training for 3 weeks, but not 1 or 2 weeks, conferred significant protection against hyperthermia, arterial hypotension, decreased cardiac output, decreased stroke volume, decreased peripheral vascular resistance, and increased levels of serum or tissue TNF-alpha during heatstroke and correlated with overexpression of HSP72 in multiple organs, including heart, liver, and adrenal gland. However, 10 days after 3 weeks of progressive exercise training, when HSP72 expression in multiple organs returned to basal values, the beneficial effects exerted by 3 weeks of exercise training were no longer observed. These results strongly suggest that HSP72 preconditioning with progressive exercise training protects against hyperthermia, circulatory shock, and TNF-alpha overproduction during heatstroke.