

**Evaluation of hot spring bath on the cardiovascular functions:
Combined effects of high concentration of CO₂ and salt**

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Summary

The present study was performed to investigate the influence of salt concentration on cardiovascular responses of the anesthetized rat bathing in artificial CO₂ hot spring water. We have observed that heart rate of the anesthetized animals was significantly decreased in bath water containing high concentration of CO₂ (1000 ppm) in comparison with tap water bath at the neutral temperature (35°C). Though a similar observations are reported in human subjects in natural CO₂ hot spring bath, whether the bradycardia in natural CO₂ spring is caused by sole influence of CO₂ ingredient is not known, because natural hot spring water generally contains many kinds of salt. Male Wistar rats were used in the experiments. Animals were anesthetized with urethane, shaved fur around the chest, abdomen and legs, and equipped with arterial catheter for blood pressure and heart rate measurements. Tissue blood flow and temperatures of the immersed skin and rectum were measured with laser Doppler flowmetry and thermometry using thermocouples, respectively. All animals were immersed into bath water (35 °C) to the axillary level after base lines of all recording parameters became almost constant under the room temperature (25 ± 2 °C). CO₂ water (1000 ppm) was produced by MRE-SPA (Mitsubishi Rayon Engineering Co.). NaCl a common salt of natural hot spring water, was dissolved in tap water or CO₂ water at the concentration of 0.4, 1.5 or 4.0 %. Heart rate of the anesthetized rats immersed in CO₂ water was significantly lower than that in tap water irrespective of the salt concentration. Result suggests that NaCl in natural spring water is not a factor for bradycardia in CO₂ hot spring bath. The coefficient of variation (CV) of heart rate fluctuation was significantly smaller in CO₂ water than in tap water with salt(1.5%, 4.0%). The similar tendency was also observed in CV of the blood pressure. These effects on CV were not observed in rats immersed into CO₂ water bath without salt. The results suggest that the observed stabilization on haemodynamic parameters might be caused by some combination effect of CO₂ with NaCl.