Plasma catecholamines and hyperglycaemia influence thermoregulation in man during prolonged exercise in the heat

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We manipulated plasma catecholamines (combined adrenaline and noradrenaline concentrations) to three levels during prolonged exercise to determine their effect on cutaneous and forearm vascular conductance (CVC and FVC), oesophageal temperature ($T_{oes}$) and cardiovascular responses.

On three occasions, seven endurance-trained men cycled at 65% VO$_{2\text{max}}$ in the heat (33·1 ± 0·7 °C) for 120-150 min. During the control trial (150 min duration), 0·45% saline was intravenously infused (SI) starting at 30 min, at a rate that replaced a third of the fluid losses. The infusion start time and rate were identical in all three trials. During SI plasma catecholamine levels increased progressively and were 18·2 ± 2·7 pmol ml$^{-1}$ at 150 min. in another trial (120 min duration), adrenaline was infused (AI) at 0·1 µg kg$^{-1}$ min$^{-1}$ and plasma catecholamine levels were elevated 6 pmol ml$^{-1}$ above SI during the 60-120 min period. In a third trial (150 min duration), an 18% glucose solution was infused (GI) at a rate that maintained plasma glucose levels above 11 mM and plasma catecholamine levels were 5·0 – 5·5 pmol ml$^{-1}$ lower (P < 0·05) than SI from 120-150 min.

Heat production and sweat rate were not different during the three trials and neither was the decline in stroke volume, cardiac output and mean arterial pressure.

Soon after beginning AI, CVC decreased 15%, $T_{oes}$ increased by 0·4 ± 0·1°C and heart rate increased by 6 ± 1 beats min$^{-1}$; these significant (P < 0·05) differences from SI were maintained throughout the bout. As a result of GI, FVC was 15% higher than SI and $T_{oes}$ and heart rate were attenuated by 0·3 ± 0·1°C and 7 ± 1 beats min$^{-1}$ at 150 min compared with SI (P < 0·05).

In conclusion, large increases in plasma catecholamine levels cause hyperthermia during exercise by vasoconstricting the skin. The mechanisms by which hyperglycaemia (i.e. 11 mM) attenuates hyperthermia are less clear and may be due to others factors besides attenuation of the plasma catecholamine response to exercise.