SHORT COMMUNICATION:

The effect of blocking the angularis oculi and the facial veins on metabolism of Tswana goats

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ABSTRACT
The aim of this study was to compare changes in resting metabolism of Tswana goats as a result of diverting venous blood to and away from the cavernous sinus. Eighteen male yearlings were equally and randomly assigned to three groups: A non-operated control group (NOC), a facial veins blocked (BFV) group and an angularis oculi veins blocked group (BAOV). Resting metabolism was measured by an open circuit calorimetry system using a face mask. At the ambient temperatures (T_a) of 16 ° C resting metabolic rate of the NOC group was significantly higher (p=0.014) than for the BOAV group but not significantly higher (p=0.303) than for the BFV group. At the T_a of 25 ° C resting metabolic rate of the NOC group was significantly higher (p=0.006) than for the BAOV group but not significantly higher (p=0.62) than for the BFV group. It appears that heat exchange at the carotid rete-cavernous sinus complex contributed significantly to the control of metabolic rate in the Tswana goats under non heat stressful conditions. Diverting blood from the facial veins into the jugular vein had no significant effect on resting metabolic rate under the same test conditions.
Key words: selective brain cooling, carotid rete, metabolic rate, Tswana goats, angularis oculi vein, facial vein.

INTRODUCTION

Brain temperature (T_{brain}) is a balance between heat generated by metabolism and electrical activities of the neurons and the glia as well as the heat dissipation by local cerebral blood flow which responds partly to somatosensory stimulation, (Gorbach, 2004). The definition of selective brain cooling (SBC) and its role in thermoregulation is an active area of debate by thermal physiologists. There is still lack of a clear reference point for measurement of SBC, while its scope and effector mechanisms are still not well understood (Caputa, 2004, Kamau and Nsoso, 2004).

There is a need to study the structures and physiological responses associated with selective brain cooling rather than temperature deviations from non specific reference points. Only a few such studies have been carried out (Laburn *et al.*, 1988, Maloney and Mitchell, 1997). Such studies give useful information in support of temperature differences observed between the brain and specific body locations. Change in brain temperature relative to the body "core" should not be seen as the only indicator of SBC as there are other non-thermal variables such as emotional changes that could indirectly alter blood flow patterns which may influence both " core" and brain temperatures (Caputa, 2004), .

In view of the scarcity of indirect investigations on the thermoregulatory responses associated with brain cooling, this study compared the effect of blocking permanently the angularis oculi (AOV) or the facial veins on the resting metabolism of Tswana goats within ambient temperature ranges they normally encounter in their environment during winter.

The Tswana goats are a multicoloured medium size breed of goats characterized by long lopping ears and short coarse hair. They are predominantly bearded and horned and do well in the semiarid region of Botswana (Katongole *et al.*, 1996)

showed that metabolism of the BOAV group was significantly lower than that of the NOC group (p=0.003) and the BFV group (p=0.033).

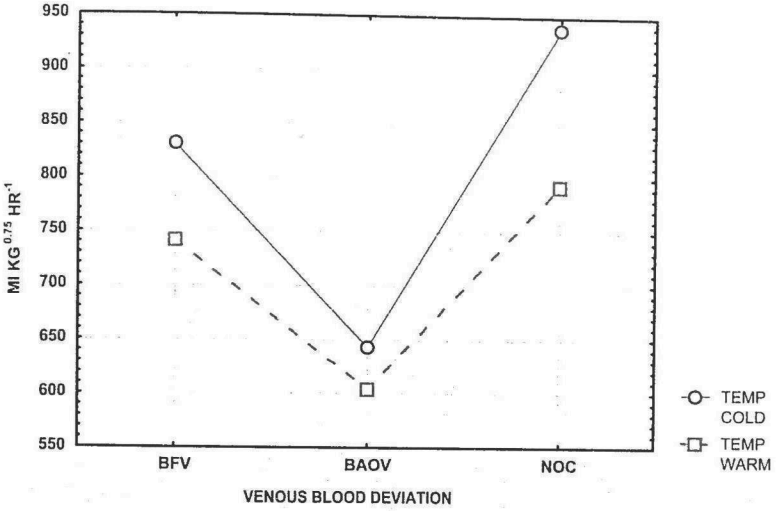

Fig.1. A plot of means for 2-way interaction between metabolism and venous blood deviation in the cold (16 ° C) and warm (25 ° C) environments.

The blocking of the blood vessels in this study imitated, what may be the maximum effect of sympathetic activity to the sphincters smooth muscles of the AOV (Johnsen *et al.*, 1985, Johnsen and Folkow, 1988). The sphincters in the AOV were reported to contain excitatory alpha-adrenergic receptors while those in the facial veins contain inhibitory beta-adrenergic receptors (Winquist and Bevan 1980; Johnsen *et al.*, 1985 and Johnsen and Folkow, 1988). According to the above researchers, an increase in general sympathetic activity constricts the angularis oculi veins while simultaneously dilating the facial vein. During heat stress the opposite effects is supposed to take place.

In this study, blocking the AOV may have reduced the volume of cool blood reaching the cavernous sinus from the heat exchanging nasal passages. This allowed the arterial blood to reach the brain at higher temperature. The brain interpreted this as a rise in core temperature and sent out the appropriate thermoregulatory signals to reduce heat production and save energy. Blocking the facial vein did not yield the expected result - an increase in cool blood flowing to the cavernous sinus from the nasal passages and increase in metabolism. The reasons for this are not clear at this stage. There could be a blood flow regulatory mechanism in the AOV after its junction with the facial vein that reduced the volume and the rate of blood flow to the cavernous.

In conclusion, the presence of the AOV-rete-cavernous sinus - complex is important for the control of metabolic rate of the Tswana goats at average ambient temperatures during winter. The capacity to reduce metabolic rate by blocking the angularis oculi vein ranged from 32 % at the T_a of 25 ° C to 46 % at the T_a

of 16 " C. Contrary to intuition, blocking the facial vein had no effect on metabolism.

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