COMPARISON OF BRAIN AND TYMPANIC TEMPERATURES DURING PASSIVE HEATING AND EXERCISE IN EWES

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INTRODUCTION

Tympanic temperature (T_{ty}) is considered a valid index of brain temperature (1). However, several researchers have questioned its validity as a measure of brain temperature because it may be significantly influenced by ambient temperature (2, 3). In spite of this controversy, use of a portable, noninvasive, infrared thermometer to assess tympanic temperature has become wide-spread. Although infrared thermometry has been validated against other indices of core temperature during hypothermic conditions in humans (4), comparison of infrared thermometry to direct assessment of brain temperature has not been made. Furthermore, whether infrared T_{ty} may provide a better index of elevated brain temperature when ambient temperature is held constant is unknown. Therefore, the purpose of the present investigation was to compare T_{ty} using infrared thermometry with brain temperature (T_{br}) during exercise and passive heating in ewes.

METHODS

Three adult Dorset ewes were chronically implanted with a multiple guide cannula assembly attached to the skull. Using roentgenograms, we determined the specific guide cannula for placement of a copper constantan thermocouple into the 3rd ventricle for assessment of T_{br}. Using this model we have been able to simultaneously measure brain temperature and neuropeptides during exercise (5). T_{ty} was determined using two brands of infrared thermometers ($T_{ty}1$ = Thermoscan®PRO-1; $T_{ty}2$ = FirstTemp®Genius™) set to the "core" temperature mode. Prior to experimentation, ewes were familiarized with the treadmill exercise. All experimental procedures were carried out during December.

On one day, ewes were instrumented with thermocouples and pre-exposure temperatures were recorded. Animals were placed in an environmental chamber (T_a = 37.6 ± 0.3 °C, rh = 54 ± 3 %) and remained standing in separate stalls for 60 min. Following the heat exposure, the chamber temperature was reduced and T_{br}, $T_{ty}1$ and $T_{ty}2$ were recorded over a 30 min recovery period (T_a = 27.4 ± 0.7 °C, rh = 32 ± 1 %). $T_{ty}1$ and $T_{ty}2$ were evaluated consecutively every 5 min by an experienced investigator. T_{br} was recorded every 5 min using a thermocouple datalogger (Omega Engineering). On a separate day ewes performed 30 min of treadmill running (65 ± 3 $m \cdot min^{-1}$) in a comfortable environment (T_a = 22.0 ± 0.1 °C, rh = 25 %). T_{br} was assessed every 5 min using the datalogger. $T_{ty}1$ and $T_{ty}2$ were evaluated every 10 min after the treadmill was briefly stopped. A 5 min post exercise temperature was recorded.

RESULTS

Data for all temperature measurements during passive heating and exercise are shown in Figure 1. During passive heating T_{br} did not change during heat exposure and increased during recovery. In contrast both measures of T_{ty} increased during heating and decreased during recovery. T_{br} was not correlated to $T_{ty}1$ (r = 0.20) or $T_{ty}2$ (r = 0.28) ($p > 0.05$). During exercise a rise in temperature was observed for all 3 sites, however correlation coefficients between T_{br} and $T_{ty}1$ (r = 0.28) and $T_{ty}2$ (r = 0.16) were not significant ($p > 0.05$). When comparing the two brands of infrared thermometers, $T_{ty}1$ was significantly correlated to $T_{ty}2$ during both passive heating (r = 0.86) and exercise (r = 0.82), although the values recorded from the Thermoscan®PRO-1 ($T_{ty}1$) were consistently lower than the values recorded by the FirstTemp®Genius™ ($T_{ty}2$).

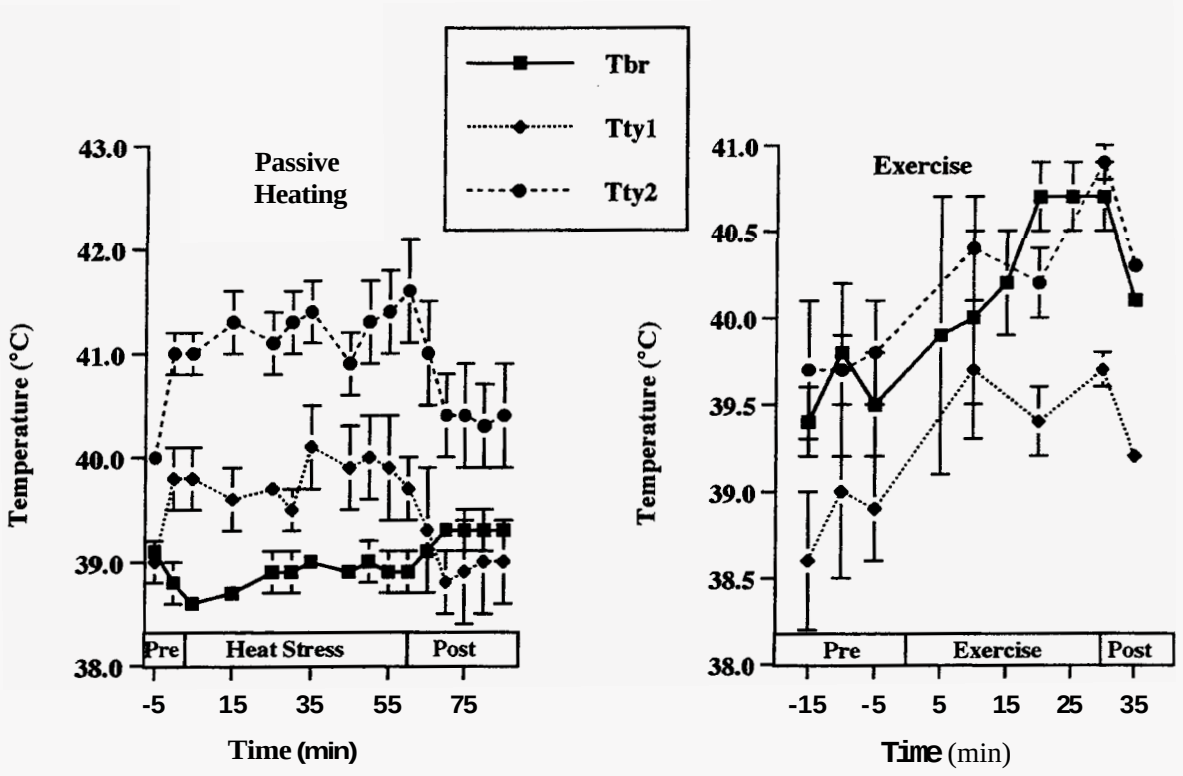

Figure 1: Time course of T_{br} (■), $T_{ty}1$ (◆), and $T_{ty}2$ (○) responses (mean ± SEM) prior to (pre), during, and following (post) passive heating (left) and treadmill exercise (right) in 3 ewes.

CONCLUSIONS

Using an *in vivo* animal model, tympanic temperature measured by infrared thermometry is poorly correlated to direct measurement of brain temperature (3rd ventricle) during both passive heating and exercise. Whether T_{ty} assessed by other techniques may more closely index T_{br} or whether T_{br} is related to other measures of core temperature (e.g., T_{es}, T_{re}) remain to be determined.

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