BODY TEMPERATURES DURING POSTURAL CHANGES

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INTRODUCTION

The effect of postural changes on body temperatures is occasionally neglected in studies of thermoregulation. Previous investigations (1,2) have shown a decrease in the rectal temperature (T_{re}) when posture changes from upright to supine, and vice-versa. However, the following questions remain unresolved: i) how long does it take to attain steady-state (ss) after a change in **posture,** ii) what **are** the subsequent changes in body temperatures, and iii) are these changes reversible? Given the implications that changes in body temperature, unaccounted for by postural changes, may have on the interpretation of thermal experiments, a study was designed to investigate these questions.

METHODS

Eleven male subjects particpated in 3 trials, all conducted in a thermoneutral resting condition (wearing shorts only at 28.4°C and 40% RH) in the morning. On the first trial (CN), the subject remained supine for 255 min to characterize their circadian rhythm. The second and third trials began with the subject in **an** upright position [either standing (ST) or sitting **(SI)]** until *ss* was attained, then tilting the subject to the supine position until *ss* was again attained. This was followed by a final tilt back to the original position. Steady-state was based on the following criteria. When T_{re} fluctuated and the maximum fluctuation within two consecutive 15 min periods did not exceed the natural fluctuation determined during the CN trial, the subject was declared to be at *ss* .

In addition to T_{re}, skin temperatures were measured continuously at 12 sites to obtain a mean-weighted value, $\overline{T}_{sk}$ (3). *All* tilts were performed on a customized tilt table, and sitting and standing postures were inclined by 7.5' to eliminate any effort in balancing. Mean body temperature ($\overline{T}_b$) in the supine position was determined by

$$\overline{T}_b = a \cdot T_{re} + (1 - a) \cdot \overline{T}_{sk} \qquad (1)$$

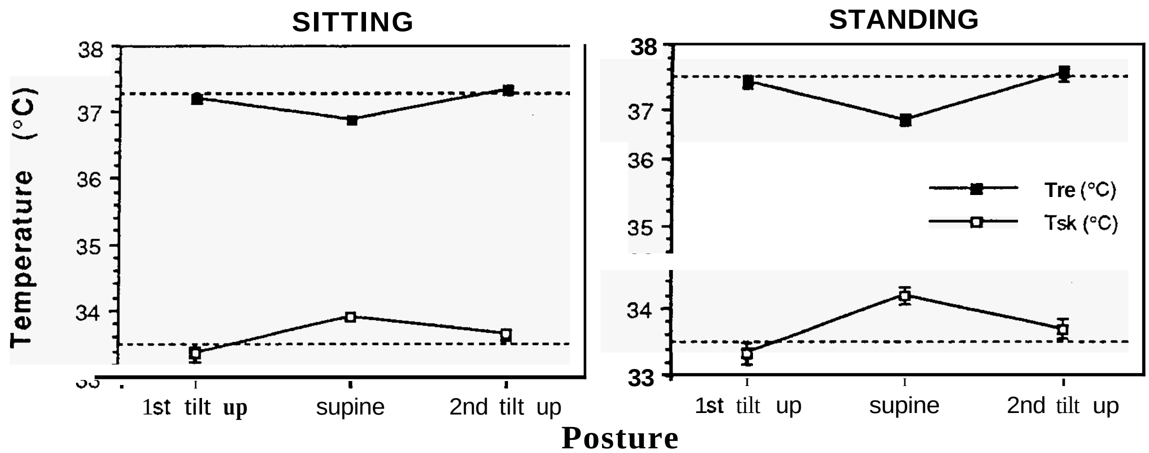
where the weighting factor *a* was assigned a value of 0.8 for the supine position. All results are presented as a mean (± **SE**, if given).

RESULTS

Control Trials. The increase in T_{re} during the CN trials (from 36.75 (0.08) to 36.86 (0.06)°C), although small, **is** significant. This increase ($0.046°C \cdot h^{-1}$) concurs with the expected rise due to the circadian rhythm (4). Concurrent with this increase is a small, but also significant, increase in $\overline{T}_{sk}$ (33.88 (0.09) to 34.03 (0.12)°C), resulting in a significant rise in $\overline{T}_b$ (36.18 (0.08) to 36.29 (0.07)"C).

Sifting ***and*** *Standing Trials*. Mean times to reach **ss** in the supine position following the 1st tilt from sitting and standing were 116.6 (5.1) and 92.6 (6.4) min, respectively. Mean times to *ss* following the 2nd tilt back to the upright positions were slightly longer, 124.1 (9.0) and 107.9 **(11.4)** min.

The figure below shows the *ss* T_{re} and $\overline{T}_{sk}$ in all postures. The values for the supine position (36.88 and 33.89°C for **SI,** and 36.86 and 34.19°C for ST) are not significantly different from **the** average values found during the CN trials. The **mean** of values for the 1st and 2nd upright postures (shown by the dashed lines) are 37.26 and 33.49°C for **SI,** and 37.48 and 33.50°C for ST.



DISCUSSION

The increases in T_{re} and $\bar{T}_{sk}$ between the 1st and 2nd upright postures at *ss* were 0.039 (0.016) and 0.089 (0.017)°C·h^{-1} for SI, and 0.028 (0.013) and 0.094 (0.017)°C·h^{-1} for ST, respectively. These increases are relatively low for T_{re} and high for $\bar{T}_{sk}$ when compared to the increases found during the CN trials (0.046 (0.017) and 0.060 (0.009)°C·h^{-1}, respectively). However, consider the values of $\bar{T}_b$ in the different postures. It can be expected that the weighting coefficient (a) that determines T_b (see **Eq.** 1) changes with posture due to vasomotor changes (5). Its value should decrease with increased vasoconstriction (6) during upright postures and can be derived as follows.

During the tilt trials, *ss* in the supine position occurred approximately mid-point in time between the two upright *ss* conditions. Therefore, a direct comparison of the average upright body temperatures at *ss* with the supine values inherently takes the circadian changes into account. The mean $\bar{T}_t$ during the *ss* supine condition in the SI trial was 36.28°C. Equating this value to $\bar{T}_b$ in Eq. 1 (assuming no change due to posture) leads to a = 0.74 in the sitting position. Similarily, the *ss* supine $\bar{T}_t$ in the ST trial was 36.33°C, therefore a = 0.71 in the standing position. These weighting factors concur with the expected decrease in the upright position and help explain the difference in the circadian changes in T_{re} and $\bar{T}_{sk}$ between supine and upright postures (i.e., in all postures, the circadian rate of change **of** mean body temperature $(a \cdot \dot{T}_{re} + (1-a) \cdot \dot{\bar{T}}_{sk})$ is approximately 0.05°C·h^{-1} using 0.80, 0.74, and 0.71 for a in the supine, sitting, and standing postures, respectively). We conclude that changes in body temperatures are reversible upon changes in posture.

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