EFFECT OF CHANGE IN INTRATHORACIC PRESSURE ON THERMOREGULATORY RESPONSES DURING -6° HEAD-DOWN BED REST

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ABSTRACT

We investigated the effect of change in intrathoracic pressure by total body negative pressure (TBNP) or positive pressure (TBPP) on thermoregulatory responses during -6° head-down bed rest (HDBR). Eight healthy male subjects participated to three of the following interventions in a randomised sequence: 1) HDBR, 2) HDBR with TBNP of -15 cmH_2O, 3) HDBR with TBPP of +15 cmH_2O. A rapid decrease of cutaneous blood flow occurred after the start of TBNP. In contrast, cutaneous blood flow increased slightly at TBPP. Sweat rate decreased immediately after the start of TBNP. Immediately after the TBPP was started, tympanic temperature greatly decreased. It is concluded that combination of HDBR and intrathoracic pressure changes thermoregulatory responses through the cardiopulmonary baroreceptor to reduce the wall stretch.

1. INTRODUCTION

In a microgravity environment like space, it seems that human thermoregulation is affected by postural redistribution of blood, the increase of blood return, and the decrease of skin pressure [1,2]. Therefore, it has been already observed that human thermoregulatory responses are impaired after prolonged -6° head-down bed rest (HDBR) as a ground-based simulation model of microgravity [3,4]. However, it is difficult to remove the influence of pressure to the skin of back by HDBR on the ground. Moreover, stretch of intrathoracic baroreceptors according to the shifted to the body fluid might affect the thermoregulatory responses [5], but it has not been fully understood.

The purpose of the present study was to investigate that a combination of HDBR and change in intrathoracic pressure by total body negative pressure (TBNP) or total body positive pressure (TBPP) using Thorax Pressure Manipulation System (TPMS) on thermoregulatory responses [6].

2. METHODS

Eight healthy male subjects (25.5 ± 4.7 yrs, 182.3 ± 4.4 cm, 79.2 ± 6.0 kg) participated in our study. The subjects were informed of potential risks involved and the purposes of the study, after which they provided written informed consent to participate. Each subject, after entering the chamber for 30 min, participate to three of the following interventions in a randomized sequence: sixty minute of either 1) HDBR, 2) HDBR with TBNP of -15 cmH_2O, 3) HDBR with TBPP of +15 cmH_2O. Ambient condition in the chamber were maintained constantly by all the experiments (34.5 ± 0.5°C). Tympanic temperature (Tty) measured continuously as core temperature using thermistor. The thermistor attached to the tympanic membrane accurately. The auditory canal was filled with absorbent cotton and fixed with adhesive tape. Local sweat rate was recorded continuously using a capacitance hygrometer technique. A sweat capsule covering an area of 8.cm^2 was mounted on the chest and the thigh area, and was ventilated with nitrogen. Cutaneous blood flow was measured with an LDF probe attached on the chest and the thigh using laser Doppler flowmetry (LDF). Each data was monitored continuously a multi-channel pen-recorder and stored on a personal computer. All data ware presented as mean values and standard errors.

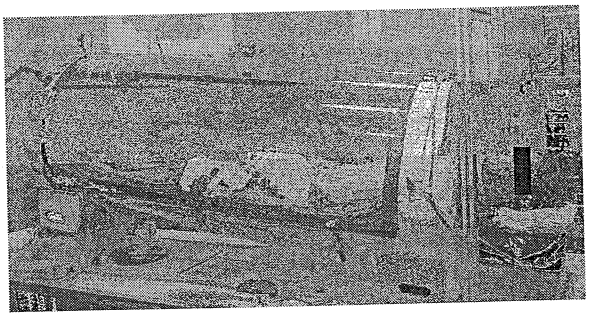

Fig. 1. Thorax Pressure Manipulation System (TPMS)

3. RESULTS AND DISCUSSION

It has been found by Takagi (1960) that regional sweating is affected markedly by skin pressure applied to a specified skin region [2]. During the rest period before pressure in this study, sweat rate on the thigh area continuously increased while sweat rate on the chest area was unchanged distinctly (Fig.1). Thus, skin pressure given to the dorsum of the trunk in the HDBR would be expected to cause depression of sweating on the chest area. Sweat rate and cutaneous blood flow on both the

chest and thigh decreased immediately after the start of TBNP. In contrast, it seemed to increased slightly at TBPP. The involvement of cardiopulmonary baroreceptor has been suggested as the primary afferent pathway of baroreflex in the regulation of cutaneous blood flow. TBNP enhanced vasoconstriction on skin and increased arterial pressure by the contract of cardiopulmonary baroreceptors. Consequently, TBNP decreases the sweat rate on the chest and thigh. Immediately after the TBPP was started, Tty greatly decreased by increase in heat dissipation on the face. Although we did not measure sweat rate on the face, the decrease of skin temperature on the forehead measured by thermograph during the TBPP suggests the increased on the face.

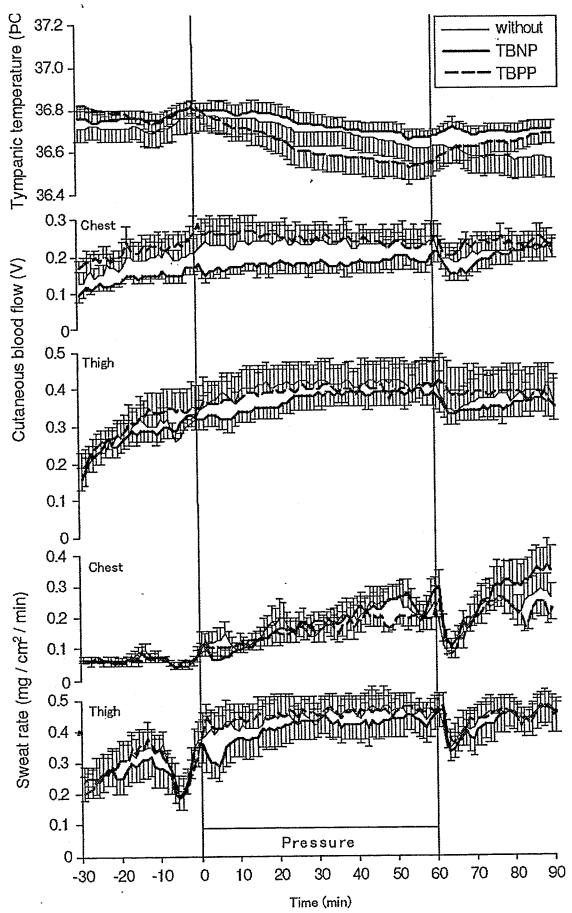

Fig.2. Effect of combination of –6° head-down bed rest and total body negative pressure (TBNP) or positive pressure (TBPP) on tympanic temperature, cutaneous blood flow and sweat rate.

4. CONCLUSION

These results suggest that thermoregulatory responses influences through the change in intrathoracic (cardiopulmonary) baroreceptor by the combination of HDBR and intrathoracic pressure changes.

5. ACKNOWLEGEMENT

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6. REFERENCES

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