PERIPHERAL THERMAL INPUT AND RESPIRATORY REGULATION IN MEN

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INTRODUCTION

Thermoregulatory reactions can be initiated by different localized thermoreceptors. One of the principal questions in thermoregulation is - what are the contributions of these different thermoreceptors in the effector reactions. The magnitude of the input signal from skin cold receptors depends on the impulse frequency and the number of active receptors. The latter could be estimated in men by the number of sensitive cold spots. The respiratory system is involved in the thermoregulation (1,2). We wanted to determine the relationship between the number of cold spots and respiratory responses in resting men.

METHOD

In men the number of cold spots was calculated on 25 cm^2 sections of forearm, hand, face, thigh and foot at the ambient temperature of 26 C. For these tests a special thermode was used with the tip diameter 1 mm and tip temperature +3-4° C. Minute volume, respiratory rate, tidal volume, oxygen uptake, true oxygen (ml 02 extracted 100 ml expired air volume) and C02 production were recorded before, during and after the acute cooling of each region firstly tested for cold spots. In every experiment only one of mentioned areas was cooled by 10-12° C with the rate 0.02-0.03° C/s. The respiratory parameters were recorded with a Beckman metabolic cart.

RESULTS

A great number of forearm or foot cold spots was accompanied with the high minute volume and respiratory rate but the low true oxygen. No relationship between the examined respiratory parameters and the number of cold spots in the hand, thigh and face was observed. It may indicate a various contribution of skin thermoreceptors with different localisation to the respiratory modulation.

After the adaptation to cold the men (out-of-doors Siberian builders) had a lower number of forearm cold spots, a lower minute volume and a higher true oxygen in comparison with nonadapted ones (3). Thus we can suggest that the adaptive changes of the peripheral temperature input take part in the respiratory adaptive modifications. The low ventilation may result in the diminishing of the respiratory heat loss, and the nigh true oxygen may signify an increase in heat production.

The local acute cooling of each area (except the thigh) caused the short-time changes in respiration, but the patterns of responses were different. While cooling the hand, forearm and face the increase of oxygen uptake (about 20%) was observed in all cases: in the case of forearm cooling it was due to respiratory rate increasing by 30% but with hand and face cooling it was mostly the result of tidal volume (10%) and true oxygen increase (10%). This also confirms the functional inequality of thermoreceptors of different skin regions.

During cooling of the forearm and hand the skin temperature at the peak oxygen uptake response to the cooling depended on the number of cold spots in these areas. In cases of greater number of cold spots, the skin temperature at the peak of the oxygen uptake response also higher. That is the greater number of cold spots, less cooling is required to attain a given oxygen uptake response to the cooling.

In a separate series we found out that the responses to foot cooling in men with high respiratory rates differed from those with low initial respiratory rates. In the group of tachypnoic men (15.9±0.9 /min), foot cooling decreased the minute volume by 22%, tidal **volume** by 28% and oxygen uptake by 20%. On the contrary, in bradypnoic men (8.1±1.1 /min) foot cooling increased the minute volume by 34%, tidal volume by 60% and osygen uptake **by 31%.** Thus the respiratory response to the local cooling of the same region depends on the initial respiratory pattern.

CONCLUSION

The number of cold spots in the hand, face and thigh does not correlate with the respiratory values in rest. The correlation of respiratory parameters with the number of cold spots on forearm and foot in thermoneutral conditions could indicate the importance of static activity of some skin thermoreceptors in the respiratory modulation. Reduction of the number of forearm cold-sensitive receptors in cold adapted men is accompanied by ventilation decrease and true oxygen increase.

The dynamic response of cold-sensitive receptors determines the skin temperature at which **the** maximal metabolic response to local acute cooling is observed. The pattern of respiratory response depends on the skin region where acute cooling is performed. The latter may indicate the different importance of various localized skin thermoreceptors for respiration.

Cold sensation **of** the foot in tachypnoic men is increased in comparison with bradypnoic ones. The local cooling of the foot causes the opposite respiratory response in tachy - and bradypnoic persons. This suggests that the initial respiratory pattern could determine the respiratory reaction to external temperature stimulation.

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