REGULATORY EFFECT OF SKIN BLOOD FLOW RESPONSE TO MILD COLD

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The basis of regulatory effect of skin blood flow is the decrease of circulating blood in the surface of human body. In severe cold environment it is occurred simultaneously with shivering that is why it is difficult to separate the role of skin blood flow response. In mild cold environment vascular skin response is the only way to cope disturbance. The aim of this study is to evaluate thermoregulatory efficiency of skin blood flow response to mild cold exposure. It is developed mathematical model of human thermoregulation, which comprises active and passive processes of heat production, heat transfer via blood and conduction between organs, heat-exchange with environment. Skin blood flow is performed by additive proportional control following brain and skin temperatures changes. Mathematical model is the system of usual differential equations which allows to calculate organs and tissues temperatures in transient and steady-state. Modeling researches were performed in air temperature varying from neutral 29°C to 15°C for clothing 0.3 clo. To evaluate effect of skin blood flow response of organism in mild cold it was considered the coefficient of regulatory efficiency K_e. It is the ratio of temperature deviation in any organ from initial value in theoretical case of absence of skin vasoconstriction to temperature deviation from initial value in presence of this response.

$$K_e = \left| \frac{T_i^* - T_i}{T_i^* - T_i^R} \right|$$

where T^*_i - initial organ temperature in neutral environment, T_i - temperature of this organ at cold exposure without skin blood decrease (i.e. without regulatory response), T^R_i - organ temperature for skin blood flow decrease (presence of regulatory response). Coefficients K_e were calculated for all organs and parts of the body at different mild cold exposures and were the subject of the analysis. Results of modeling as follows. The coefficient K_e differs greatly for core and shell of body. K_e shows regulatory influence of skin blood flow changes on the parameters of temperature homeostasis. For brain, blood and internal organs temperatures K_e increased as far as skin blood flow decreases (20%, 30%) and got maximum at 40% decrease from initial value. K_e increased in 2 times for brain temperature and in 4 times for blood and internal organs temperatures. Modeling results shows that vascular skin response to mild cold exposure is considerably effective for core temperatures. These temperatures are sensitive to skin blood flow and as a result insignificant decrease of skin blood flow allows to maintain core temperatures close to initial values. Influence of skin blood flow response on skin temperatures is less than to core temperature. Results of modeling show that ambient temperature prevails in influence on skin temperatures. For 40% decrease of skin blood flow (from 9 *l*/h to 5,7 *l*/h) K_e practically does not differ. It may concludes. This modeling result has important physiological importance: the main significance of skin blood flow response to mild cold is the decrease of heat transfer by blood but not heat conduction in skin.

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