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Human thermal response with improved modeling of cold-induced vasodilation

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Abstract

The Cold-induced vasodilation (*CIVD*) which is activated in the fingers during local exposure to cold is linked to thermoregulatory arterio-venous anastomoses (*AVA*). In this phenomenon, AVA periodically constricts and dilates causing the temperature in the extremities to follow suit believed to reduce the risk of cold injury. This work aims to improve a segmental bioheat model of the human body composed of 25 segments to accurately predict the *CIVD* response in fingers after local exposure to cold conditions. Blood flow to the hand is determined by the segmental bioheat model of the human body which uses a modified Avolio multi-branched circulatory system. The *CIVD* response is modeled by constricting and dilating the blood flow through the *AVA* in the fingers periodically. The formulation of *AVA* response is developed and two similar *AVA* mechanisms are included in the model differing in the response rate. The first is activated during drops in local skin temperature (<32°C) which cause the constriction of *AVA* flow to the fingers. A second *AVA* mechanism is used once the *CIVD* is activated. The *CIVD* is triggered in the model when the body is subject to warm conditions (Tcore > 36.8°C) and the fingers to cold conditions. The *AVA* flow is dilated below a finger skin temperature Tmin and constricted again once above a temperature Tmax. Comparisons with several reported experimental data of controlled experiments on figure skin temperature and body core showed good agreement with prediction of our model detecting the observed periodic *CIVD* finger skin temperature

Biography

Nesreen Ghaddar is associate provost, Qatar Chair of Energy Studies, and professor of mechanical engineering at the American University of Beirut. She obtained her Master's (1982) and PhD (1985) in Mechanical Engineering from the Massachusetts Institute of Technology. Her primary research focus is in the area of computational and experimental heat transfer enhancement for efficient cooling, solar energy applications, energy conversion, modeling of moisture and heat transport processes for walking clothed humans and thermal comfort. She has published more than 90 peer-reviewed papers in journals and serving as an editorial board member of several reputable journals..