Multi-Compartment Cooling/Warming Garment for Human Thermal Dynamic Research and Medical Applications

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Human thermoregulatory research is fraught with multifaceted physiological issues. A notable quandary is the fact that the human body has several different types of tissues, each with unique heat transfer/conductive properties. The primary goal of our research is to determine how to effectively and appropriately regulate human thermal physiology in the context of medical, occupational, and sporting fields. Of paramount importance is quantifying heat extraction/insertion from various body regions under different heat surplus/deficit situations imposed by environmental conditions and/or metabolic fluctuations, and understanding the associated mechanisms and their relationships. Our laboratory has conducted research involving the simulation of contradictory thermal regimes on the body surface to observe the dynamic process of simultaneous heat insertion and extraction. To achieve this, we have designed a tubing cooling/warming garment through which water circulates and controller (patent #7,089,995) that can provide the desired thermal stimuli in uniform/non-uniform and symmetrical/non- symmetrical patterns. We believe this methodology of divided surfaces for the application of concurrent cooling/warming regimes affords the greatest opportunity to quantify the maximum zonal capabilities for heat transfer. This paradigm allows for the regulation of heat flow in dynamic non-uniform conditions and is particularly suited for the comfort/support of a range of clinical populations (e.g., surgical, multiple sclerosis, burns/trauma, hyper/hypothermia). It is also applicable for the design of protective clothing for personnel in occupational settings (e.g., military, firefighting, space flyers), and for sporting apparel (i.e., a cooling garment/hood/blanket). Our laboratory has used the physiologically designed cooling/warming garment to evaluate individual thermoregulatory profiles elicited by conditions representative of extreme terrestrial and space thermal environments.