Effects of Motion Sickness on Human Thermoregulatory Mechanisms

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Abstract

The presented studies were performed to investigate the effects of motion sickness (MS) on human autonomic and behavioural thermoregulatory mechanisms during cold stress and in a thermoneutral environment. The roles of histaminergic and cholinergic neuron systems in autonomic thermoregulation and MS-dependent dysfunction of autonomic thermoregulation were studied using a histamine-receptor blocker, dimenhydrinate (DMH), and a muscarine-receptor blocker, scopolamine (Scop). In addition, the effects of these substances on MS-induced nausea and perceptual thermoregulatory responses were studied. MS was found to lower core temperature, during cold stress by attenuation of cold-induced vasoconstriction and decreased shivering thermogenesis, and in a thermoneutral environment by inducing sweating and vasodilatation. The increased core cooling during cold stress was counteracted by DMH but not by Scop. In a thermoneutral environment, the temperature was perceived as uncomfortably warm during and after the MS provocation despite decreases in both core and skin temperature. No such effect was seen during cold-water immersion. Both pharmacologic substances had per se different effects on autonomic thermoregulatory responses during cold stress. Scop decreased heat preservation, but did not affect core cooling, while DMH reduced the rate of core cooling through increased shivering thermogenesis. Both DMH and Scop per se decreased thermal discomfort during cold-water immersion. Findings support the notion of modulating roles of histamine (H) and acetylcholine (Ach) in autonomic thermoregulation and during MS. MS activates cholinergic and histaminergic pathways, thereby increasing the levels of H and Ach in several neuro-anatomical structures. As a secondary effect, MS also elevates blood levels of several neuropeptides, which in turn would influence central and/or peripheral thermoregulatory responses. In conclusion, MS may predispose to hypothermia, by impairment of autonomic thermoregulation in both cold and thermoneutral environments and by modulation of behavioural thermoregulatory input signals. This might have significant implications for survival in maritime accidents.

Key Words
Motion Sickness, autonomic thermoregulation, behavioural thermoregulation, hypothermia, acetylcholine, histamine