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Response of Serum Prolactin to Thermal Stress During Water Immersion

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Abstract: Physiological action of prolactin is not well-known in human except those concerning pregnancy and lactation. Elevated serum prolactin level due to various stresses such as heat load, physical exercise, surgery, gastroscopy has been reported. In order to elucidate the response of serum prolactin to thermal stress, preliminary experiments were done in a male subject. Three different thermal stimuli were applied by head-out water immersion (water temperature: 28.5, 34 and 40℃, respectively) for 30 or 60 min. Decrease of 1.5℃ in oral temperature and 48% decrease of serum prolactin concentration compared to basel level were induced by 28.5℃ water immersion. Decrease of 0.6℃ in oral temperature and almost stable prolactin level were observed during 34℃ water immersion. By 40℃ water immersion, 2.1℃ increase in oral temperature and 578% increase of prolactin level were induced. And in every experiment, prolactin level returned to control level (5−13 ng/ml) 24 hours after cessation of thermal stimuli. Highly significant correlation of mean body temperature with serum prolactin level was observed at the different thermal stimuli. The present results indicate the thermo-dependent regulatory mechanism of prolactin release in human.
Key words: Prolactin, Thermal stress, Oral temperature, Mean body temperature, Human

Although the role of prolactin is considered to be important for women concerning pregnancy and lactation, physiological action of prolactin in human is still unclear in male. Breast stimulation, sleep, physical exercise and various stress were reported as physiological stimuli of prolactin release (Noel *et al.,* 1972; Gawel *et. al.,* 1979; Brisson *et. al.,* 1980; Shangold *et. al.,* 1981; Baker *et. al.,* 1982; Hale *et. al.,* 1983; Meirleir *et. al.,* 1985; Hashimoto *et. al.,* 1986). The factors that trigger prolactin release in exercise are complex, and may vary with the type, intensity and length of exercise (Gawel *et. al.,* 1979).

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And elevation of body temperature is associated with exercise under neutral and warm environments, however, very little attention to thermal factor was paid except a few reports, in which elevated serum prolactin level due to heat stress with or without exercise were demonstrated in man (Mills and David, 1981; Brisson *et al.,* 1986 a, b), in rats (Mueller *et. al.,* 1974). In the present study, responses of serum prolactin level to thermal stress during head-out water immersion were preliminarily investigated in a man.

Thirty-years-old healthy man was chosen for a subject in this study. Head-out water immersion to 28.5℃, 34℃ water for 60 min and 40℃ water for 30 min were performed with swimming trunks at neutral ambient temperature (24−27℃). The present experiments were performed at 2 p.m. −5 p.m. to avoid the influence of circadian variation of prolactin secretion. Changes in oral temperature as well as in serum prolactin level were shown in Figs. 1 and 2, respectively. Initial values of oral temperature and serum prolactin were 37.00−37.47℃ and 5.4−10.9 ng/ml, respectively. During 28.5℃ water immersion, oral temperature rapidly decreased 1.55℃ and remained low even 60 min after cessation of immersion. Serum prolactin decreased 3.3 ng/ml by 60 min immersion and further decreased 5. 4 ng/ml (48%) after 60 min (Figs. 1 and 2). It is considered that water temperature of 28.5℃ is serious cold stress for this subject, in fact, large decrease in oral temperature and considerable shivering were observed, and serum prolactin level was suppressed by cold stress. During 34℃ water immersion, though the temperature 34℃ was generally considered as to be thermo-neutral for human, oral temperature slightly decreased and returned to control level within 60 min. Serum prolactin level did not change during water immersion but slightly increased at the recovery period. In contrast, marked and steep prolactin increase associated with considerable steep rise in oral temperature was observed during 40℃ water immersion for 30 min. Peak value of serum prolactin level was 36.6 ng/ml (578% increase), which was excess normal range, and oral temperature reached 39.14℃. Profuse sweating was observed on the face above water level. And it is known that considerable amonut of sweat breakes out on the immersed human skin in hot bath (Fujishima and Kosaka, 1971). Highly significant correlation between serum prolactin level and mean body temperature (0.8× oral temperature + 0.2× mean skin temperature), $Y=6.57X-223.3$, $r=0.975$, $p<0.01$, was observed during water immersion.

Although water immersion stimuli include multiple factors not only thermal load but also pressure load, floating power effect and so on, increase and decrease of different directional responses in serum prolactin level were induced by the just only alteration of water temperature to hot and cold. Increased polactin level at high ambient temperature and decreased that at low ambient temperature in human (Mills and David, 1981) and in rats (Mueller *et. al.,* 1974) support that prolactin release is modulated by thermal factor. In conclusion, the results of the preliminary study demonstrate that circulating prolactin concentration is elevated by heat load and decreased by cold load during head-out water immersion. These findings suggest that there exists temperature-dependent regulatory mechanism of prolactin release in human.

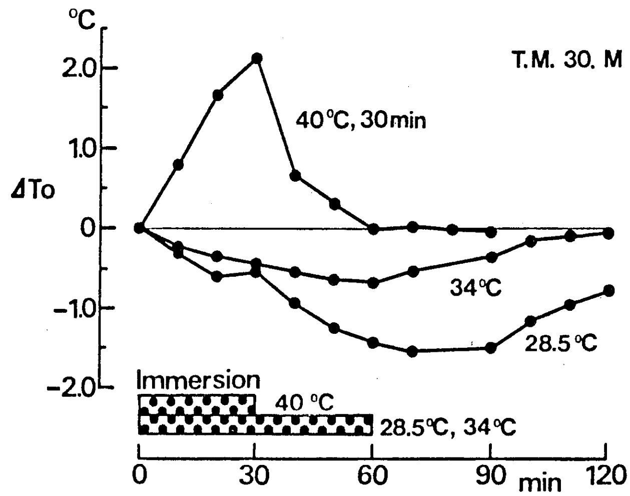

Fig. 1. Changes in oral temperature (△To) due to head-out water immersion (28.5, 34 and 40℃). Oral temperature decreased 1.5℃ during 28.5℃ water immersion and remained low for following 60 min. In 34℃ slight decrease in oral temperature was observed. During 40℃ water immersion steep rise of 2.1℃ in oral temperature observed at 30 min.

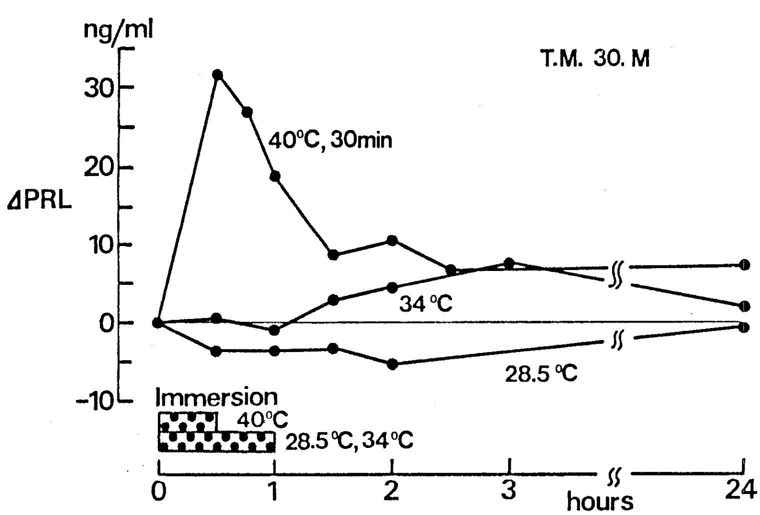

Fig. 2. Changes in serum prolactin (△PRL) level due to head-out water immersion (28.5, 34 and 40℃). Serum prolactin decreased 48% during 28.5℃ water immersion. In 34℃ serum prolactin level kept constant and slightly increased after cessation of water immersion. Marked increase (578%) in serum prolactin was observed during 40℃ water immersion. In every experiment serum prolactin level returned to control level after 24 hours.

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