

Autonomic defense responses to extremely strong heat stress

メタデータ	言語: jpn 出版者: 公開日: 2022-11-04 キーワード (Ja): キーワード (En): 作成者: Nagasaka, Tetsuo メールアドレス: 所属:
URL	https://doi.org/10.24517/00067615

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1989 Fiscal Year Final Research Report Summary

Autonomic defense responses to extremely strong heat stress

Research Project

Project/Area Number

61440027

Research Category

Grant-in-Aid for General Scientific Research (A)

Allocation Type

Single-year Grants

Research Field

環境生理学(含体力医学・栄養生理学)

Research Institution

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Project Period (FY)

1986 - 1989

Keywords

Heat-induced Vasoconstriction / Arteriovenous Anastomoses / Skin Sympathetic Nerve Activity / Hyperthermia / Selective Brain Cooling / Emissary Veins

Research Abstract

We studied thermoregulatory defense responses to extreme heat stress in human subjects. 1. Heat-induced skin vasoconstriction (HIVC). Finger vessels constricted and finger volume decreased when the hand was heated locally to temperature above body core temperature. This vasoconstriction was consistent when the subject was hyperthermic, and was not observed in the forearm skin where arteriovenous anastomoses (AVA) do not exist. HIVC was marked when the subject reported a sharp rise of local thermal sensation. During this period, skin sympathetic nerve activity to the hand increased. Partitional measurements of blood flow through superficial capillaries and deeply located AVA's confirmed that the vascular compartments responsible for

HIVC were mainly AVA'S. From these results, we propose that HIVC is a response to retard heat transfer from hot contact objects to the body in already hyperthermic subjects. 2. Selective brain cooling enhanced by inward venous flowing through emissary veins. We confirmed that selective brain cooling via emissary veins such as angular oculi veins (AOV) was an important process enabling brain temperature (indicated by tympanic membrane temperature (T_{tm})), to become lower than body core temperature in hyperthermic subjects. Mechanical obstruction of flow through AOV resulted an increase in the rise of T_{tm} during whole body warming. Mechanical obstruction of facial veins increased inward flowing of AOV-flow and suppressed the rate of rise in T_{tm} . These results strongly support the idea that emissary veins supply venous blood into the cavernous sinuses which act as a heat sink to cool the brain during hyperthermia in humans.

Research Products (8 results)

All Other

All Publications (8 results)

- [Publications] 永坂鉄夫: "Partitional measurements of circulation can be made between capillaries and arteriovenous anastomoses in the human finger." Japanese Journal of Physiology. 38. 65-75 (1988) ▼

- [Publications] 平田耕造: "Partitional measurement of capillary and arteriovenous anastomotic blood flow in the human finger by laser-Doppler flowmetry." European Journal of Applied Physiology. 57. 616-621 (1988) ▼

- [Publications] 平田耕造: "Local thermal sensation and finger vasoconstriction in the locally heated hand." European Journal of Applied Physiology. 58. 92-96 (1988) ▼

- [Publications] 永坂鉄夫: "Decrease in foot blood flow induced by local warming." Japanese Journal of Biometeorology. 26. 91-96 (1989) ▼

- [Publications] 永坂鉄夫: "Heat-induced finger vasoconstriction controlled by skin sympathetic nerve activity." Journal of Applied Physiology. 68. 71-75 (1990) ▼

- [Publications] 永坂鉄夫: "温熱皮膚血管収縮反応—暑熱時の生体自律防御反射" 病態生理. 8. 169-171 (1989) ▼

- [Publications] 永坂鉄夫(分担): "Thermal Physiology 1989(ed.Mercer,J.B.)" Excerpta Medica,Amsterdam, 205-210 (1989) ▼

- [Publications] 永坂鉄夫(分担): "Hyperthermic Oncology 1988,Vol.2(eds.Sugahara,T.et al.)" Taylor & Francis,London, 322-325 (1989) ▼

URL: https://kaken.nii.ac.jp/report/KAKENHI-PROJECT-61440027/614400271989kenkyu_seika_hokoku_

Published: 1993-03-25