

Department of Physiology (II)

Division of Aerospace Medicine

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General Summary

Our main interests are research on gravitational physiology, aerospace medicine, and stress reactions.

Research Activities

Body fluid distribution during parabolic flight

Changes in body fluid distribution in response to the levels or the direction or both of gravity created by the parabolic flight of a jet airplane (Gulfstream II; Diamond Air Service, Aichi, Japan), were investigated in 5 healthy male subjects (22-52 years old). Distribution of body fluid was estimated with impedance plethysmography. Electrodes were placed around the chest, abdominal, thigh, and calf regions. A total of 5 experiments were performed. The period of each experiment in each subject was 1 hour per day. The gravity levels were altered from 1 g to 1.8 g during the ascending phase and then microgravity was created for 23 seconds. The levels were recovered to 1.5 g and then to 1 g during the descending phase. Such parabolic flights were repeated 12 to 15 times during a 1-hour period. The recordings were made with each subject in the sitting, upright standing with both feet, and horizontal positions. For the sitting position, the subject's knees were either bent at 120° on a seat or fully extended on a bed. Recordings were also made with the subjects in the supine and prone positions on a bed with their head pointed toward either the nose or the tail of the airplane. The greatest shift in fluid toward the lower limbs was noted when the standing subjects were exposed to 1.8 g, and the shift was reversed toward the upper body at microgravity. Similar shifts were observed in the sitting position on a seat, even though the magnitude was minor. A profound shift was not induced when the subjects were sitting on a bed. Furthermore, a slight but significant shift from the upper body toward the lower extremities was seen in a microgravity environment when the subjects were in a horizontal position with their head toward the nose of the airplane, or vice versa. These results suggest that body fluid clearly shifts toward the upper body when the Gz gravity becomes zero. The results also indicate that a slight but significant Gx-gravity-dependent shift occurs in a microgravity environment, even though such a shift is not detectable in a hypergravity environment because of the greater Gz gravity.

Stress

1. The processing of stress in the human brain and stress-related disorders

We performed near-infrared optical topography and recorded P300 event-related poten-

tials, when subjects were stressed. We then investigated information processing in the human brain.

2. Brain imaging in *karuta* players by means of near-infrared optical topography and recording of event-related potentials

We recorded event-related P300 potentials and performed near-infrared optical topography in players of *karuta* (a traditional Japanese card game) during an auditory oddball task that is similar to *karuta*, and we investigated the information processing in the brains of *karuta* players.

3. Stress facilitates spontaneous platelet aggregation in healthy young persons

After arithmetic stress loading, the concentration of norepinephrine was significantly increased. Spontaneous platelet aggregation was also accelerated by arithmetic stress, which was correlated with the increase in norepinephrine concentration. Stress releases norepinephrine from sympathetic nerve terminals, and the binding of norepinephrine to α 2A-adrenoreceptors of platelets triggers platelet aggregation.

Publications

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