1. Title

2. Research Term
2001-2002

3. Research Fields
Space Science

4. Research Categories
ISAS Grant for Basic Study Oriented to Utilization of Space Station

5. Research Theme
Development of active Na transport across amphibian skin during metamorphosis

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8. Summary of Research
During metamorphosis, amphibians, especially anurans, change their habitat from terrestrial to aquatic and from lower-gravity to 1G conditions. Similar events occur during metamorphosis in amphibians as occur during birth in mammals. Our interest is in the development of epithelial Na transport and the epithelial Na channel (ENaC). In mammals, ENaC develops in the lung and cochlea just after birth. In anurans, Na transport/ENaC develops in the skin during metamorphosis. The development of ENaC may a factor in the development of antigravity mechanisms in vertebrates. We have studied how hormones control the development of epithelial Na transport/ENaC in amphibian skin to help us understand the development of antigravity mechanisms in vertebrates.

Samples of larval amphibian skin were cultured in the presence of several kinds of hormones, and the development of epithelial Na transport/ENaC was investigated. We also investigated the short-term effects of hormones on adult skin (in which ENaC has already developed), and we tried to raise an antibody against Rana ENaC to facilitate investigations of the development of ENaC in other organs, such as the amphibian lung.

We found that ENaC develops in larval skin cultured with aldosterone. However, prolactin (PRL) and growth hormone (GH) inhibit the action of aldosterone, causing skin to develop larval-type features (Fig. 1). Thus, aldosterone may be involved in the development of antigravity mechanisms, and both PRL and GH may inhibit their aldosterone-induced development. In contrast to the long-term effect of PRL on cultured larval skin, its short-term effect on adult amphibian skin is to stimulate ENaC by increasing the channel density (Fig. 2). The explanation for this difference in the action of PRL before versus after the development of antigravity mechanisms by aldosterone is a matter for future consideration. We also raised antibodies against Rana ENaC. Although we have to yet to determine whether an antibody against the N-terminal peptide (N-T) is adequate for ENaC, the expected molecular weight of which is over 75 kDa, an antibody against the C-terminal peptide (C-T) should really act as an antibody against Rana ENaC, since whereas the former antibody reacts to 55 kDa molecules, the latter one reacts to 86 kDa molecules (Fig. 3).

9. Publication List
Original Reports

Book

Congress
1) Takada, M. and Kasai, M.: Prolactin Increases Open-Channel Density of Epithelial Na\(^+\) Channel in Frog Skin, 14th International Congress of Comparative Endocrinology (Sorrento, Italy), 2001.

Fig. 1: Effect of hormones on the development of epithelial Na transport/ENaC.

Fig. 3: W-blotting of adult frog skin with anti-ENaC.

Fig. 2: Short-term effect of PRL on adult frog skin.