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Laboratory of Anatomy

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Teaching staff is composed of a professor, an associate professor and an instructor. In addition, three postgraduate and six undergraduate students study on the basis of their own theme. We teach gross anatomy and histology to students at the second and third grades, and are in charge of practical exercises using animals such as the dog, cow, horse and chicken. Out of the Veterinary School, we also teach anatomy of domestic animals to students at Department of Animal Science, Faculty of Agriculture.

In research field, our laboratory is engaged in histochemical and ultrastructural analysis of cells and tissues. Techniques frequently used in our investigation is the immunohistochemistry and ultrastructural observation by use of transmission and scanning electron microscopes. Main topics of our research are classified into the following three fields:

1. Histochemical detection of hormones and their receptors, 2. Functional morphology of macrophages and lymphocytes. 3. Mechanism of apoptosis.

1. We have investigated the distribution and ultrastructure of cells containing bioactive substances such as hormones and neurotransmitters. For this purpose the immunohistochemistry using specific antibodies is the most reliable and convenient method. These substances are usually shared by neurons and endocrine cells which are represented by gut endocrine cells. Thus, they are often called brain-gut peptides. In series of studies, we have focused in gut endocrine cells dispersed in the stomach and intestine. They are situated keeping contact with the lumen and stimulated by luminal substances derived from foods. The stimulated endocrine cells secrete basally content of secretory granules, which act smooth muscle, secretory cells and neurons. Gut endocrine cells, recepto-secretory cells in nature, can taste foods and, in response to them, regulate the digestion and absorption. Thus, we regard the gut endocrine cells as a prototype of sensory cells and endocrine cells.

In order to understand the function of hormones and transmitters, an analysis on receptors is necessary. *In situ* hybridization is a powerful technique for visualization of receptor molecules on sections. One of recent advances in this field is an analysis of ATP receptor subtypes. ATP functions as a signal released from neurons and endocrine cells, as well as a energy source within cells. We demonstrated the cellular distribution of ATP receptor mRNA in the brain and peripheral organs, suggesting the important role of the purinergic transmission system (Fig. 1)[1].

2. A series of studies on lymphoid organs is a theme which our laboratory has long dealt with. Immune system is quite different in functional significance among animals. To understand the immune system, we have investigated the distribution of lymphocyte subpopulation using monoclonal antibodies against surface antigens and immunoglobulins. Recent advances in this field was brought by two postgraduate students.

Fig. 1. *In situ* hybridization of ATP receptor mRNA in the rat brain

Dr. Ismail demonstrated the distribution of lymphocytes and plasma cells in the mammary glands of the goat. Especially, the dynamic changes of the cells during different stages of reproductive cycle was shown[2]. On the other hand, Dr. Kahn investigated developmental changes of lymphocytes and plasma cells in the chicken oviduct[3]. The chicken oviduct is a useful model to analyse the hormonal changes of the immune cells. Thus, he demonstrated that the estrogen could dramatically induce the lymphocyte infiltration in the chicken oviduct.

3. Apoptosis of intestinal epithelial cells and involvement of macrophages and lymphocytes : Epithelial cells of the gut are characterized by rapid, constant cell renewal. The epithelial cells proliferate in the crypts, move towards the villi, and die at the tips of villi. The death of epithelial cells at the villus tips occurs so regularly that it must be regarded as a well-controled cell death, designated as apoptosis. However, only limited information has been available on the mechanism of this phenomenon, including the disposal of the effete cells.

Our studies on the apoptosis of enterocytes started with our noting peculiar aggregations of lamina propria macrophages at the villus tips (Fig 2). Histochemical and ultrastructural studies revealed that these macrophages are vigorously engaged in the phagocytosis of effete epithelial cells in the small intestine of the guinea pig and monkey[4]. Intraepithelial lymphocytes possessing cytoplasmic granules, possibly intense in cytotoxicity, are topographically associated with the dying enterocytes, suggesting lymphocyte-mediated killing. After the engulfing of apoptotic enterocytes by macrophages, a thin apical portion of the enterocytes is left within the epithelium, maintaining the epithelial barrier until it is pinched off by pushing of surrounding enterocytes.

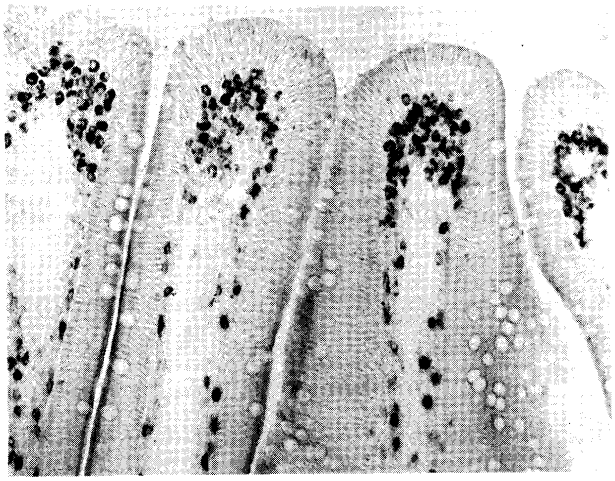

Fig. 2. Aggregation of macrophages in the villus tips of the monkey duodenum

In the rat and mouse, on the other hand, effete enterocytes are exfoliated as a whole from the villus tips into the gut lumen. Macrophages, also numerous at the villus tips in these species, are less intense in phagocytotic activity. The species difference in the mechanism of the apoptosis of enterocytes provides clues for understanding apoptosis.

References

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