ELECTRON MICROSCOPIC AUTORADIOGRAPHY ON THE IODINE METABOLISM OF THE THYROID GLAND IN PHYLOGENETIC ASPECT

HISAO FUJITA

Department of Anatomy, Hiroshima University School of Medicine, Hiroshima

The follicular epithelial cell synthesizes high molecular protein (thyroglobulin) and releases it into the follicular lumen. Then the thyroglobulin stored is reabsorbed into the cell to be hydrolyzed for liberating thyroxine ($T_4$) and triiodothyronine ($T_3$). In the thyroglobulin molecule, numerous molecules of iodinated tyrosine and thyronine are contained. The site of the iodination of these molecules is one of the important problems in thyroid morphology and biochemistry. Using the electron microscopic autoradiography of $^{125}$I, the present author has studied this problem in phylogenetic and evolutionary aspects.

In adult vertebrates whose thyroid follicular structure is well completed, the main site of the iodination of thyroglobulin is generally the follicular lumen and the apical plasma membrane region. However, the author does not deny the possibility that iodination could take place partly in the cytoplasm.

In the chick embryo (8–10 days of incubation) whose follicular lumen is very small, the silver grains for protein bound iodine are found over the apical vesicles, Golgi apparatus and rough endoplasmic reticulum in addition to the follicular lumen. Similar results were obtained in dissociated cultured rat thyroid cells.

Peroxidase reaction is positive in the cisterna of rough endoplasmic reticulum, Golgi apparatus, subapical vesicles and the peripheral part of the follicular lumen for the rat, and in Golgi apparatus, subapical vesicles and the peripheral part of the follicular lumen for the frog (*Rana nigromaculata*). In usual adult animals, thyroglobulin in the follicular lumen is far larger in quantity than that in the cell cytoplasm and numerous molecules of thyroglobulin in the follicular lumen might have not yet completely iodinated and therefore injected iodine is considered to be combined with luminal colloid preferentially. This seems to be the reason why the iodination takes place almost entirely in the follicular lumen and the apical plasma membrane region in adult animals having large follicular structures.

In larval lampreys (ammocoetes of *Lampetra japonica*) and ascidians (*Ciona intestinalis*), the endostyle which is homologous to the thyroid communicates with its pharynx by the ductus hypobranchialis. Type 2c and 3 cells of the endostyle of the larval lamprey and zone 7 and 8 cells of the ascidian synthesize thyroxine and triiodothyronine. The main site of iodination of protein in these animals is the apical plasma membrane region of these cells, and the possibility of iodination taking place in the endostylar lumen is not ruled out. Some of iodinated protein must be reabsorbed into these cells to be hydrolyzed like that in the higher vertebrate. From these data it is considered that the iodine metabolism of the thyroid or its homologous organ shows similar pattern throughout the vertebrates and protochordates.
Fig. 1. A part of the mouse thyroid 2 hr after the injection of 200 µCi of $^{125}$I. ×10,000
Fig. 2. and 3. Peroxidase reaction of the thyroid of a frog, Rana nigromaculata (2 cm). ×18,000. 31,000
Fig. 4. Type 3 cells of an endostyle of the larval lamprey, ammocoetes of Lampetra japonica, 2 hr after the injection of 200 µCi of $^{125}$I. ×12,000