A MORPHOLOGICAL STUDY OF THE THYROID GLAND IN RISSO'S DOLPHIN, *Grampus griseus*

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Introduction

Risso's dolphin, *Grampus griseus*, belongs to suborder odontoceti, family delphinidae, and inhabits from deep ocean to continental slope ranging from the tropics to the temperete regions of both hemispheres[16]. Cetaceans have been suggested to have high metabolic rate [4,17]. Although various aspects of feeding habit have been investigated, little information is available about the metabolic systems [1,5-6,8-10,12,15]. To accumulate histological information of cetaceans and obtain basic understanding about metabolic systems of marine mammals, the thyroid gland of Risso's dolphins was examined by gross anatomical and light and electron microscopic observation.

Methods and Materials

Seven male Risso's dolphins (2.42~2.79 m in body length), which were caught at the seacoast of Wakayama Prefecture, Japan by Fisheries Agency of Japan from December, 1995 to February, 1996, were used in this study. After gross anatomical observation, tissue samples were excised and fixed in 10 % phosphate-buffered formalin. Subsequently, specimens were dehydrated in a graded series of ethanol, infiltrated in xylene, and embedded in paraffin wax. Sections of 5 μm thickness were prepared and stained with hematoxylin and eosin. Follicular diameters of the thyroid gland were measured in four dolphins and calculated their mean values. For ultrastructural investigation, samples were fixed in 4 % glutaraldehyde/0.1 M sodium cacodylate buffer (ph 7.4), post-fixed in 1 % osmium tetroxide/the same buffer. Ultrathin sections were stained by uranyl acetete and lead citrate, and observed by a transmission electron microscope (HITACHI, H-700L).

Results and Discussion

Gross anatomy

The thyroid gland was located at the lateral ventral side of the thyroid cartilage. The glands showed various shapes, the crown-tail length was ranging from 5.0 to 15.0 cm, and the thickness was from 1.5 to 2.0 cm. Two lobes were not clearly discriminated, and both ends of single lobe were joined by narrow parenchyma at the dorsal side of the trachea. No isthmus was observed.

Light microscopy

Irregular or oval follicular lumens were seen, and surrounded by follicular epithelial cells. Parafollicular cells were recognized among the follicular cells and in the interstitial regions. These cells never protrude into the follicular lumen. Clusters of follicular epithelial cells were often invaginated into the follicular lumen. The size of follicular lumen in the central regions of the lobe was larger than in the peripheral regions. Diameters of follicular lumen ranged from 98.1 to 120.3 μm.

Electron microscopy

Various forms of follicular epithelial cells were identified, i.e., cuboidal and squamous. Their nuclei were squamous-, cuboidal- and oval-shaped. The rough endoplasmic reticulum (rER) was seen at the basal and lateral regions of the cell, and adjacently to mitochondria. rERs at the basal side of follicular epithelial cells sometimes contained a material with the same electron density as the follicular lumen component. The mitochondria were widely diffused in the cytoplasm and their forms were circle, oval and/or bifurcate (Fig.1). The follicular epithelial cells contained granules that had various electron density. Primary lysosomes had high electron density, and secondary lysosomes were formed after granules and primary lysosomes were fused. These numerous granules were not present at the same proportion in each cell. Microvilli were poorly developed at the apical surface of the follicular epithelial cells. In the apical regions of the follicular epithelial cells, there are granules with various size and electron density, typical Golgi complex, multivesicles, and secretory granules.

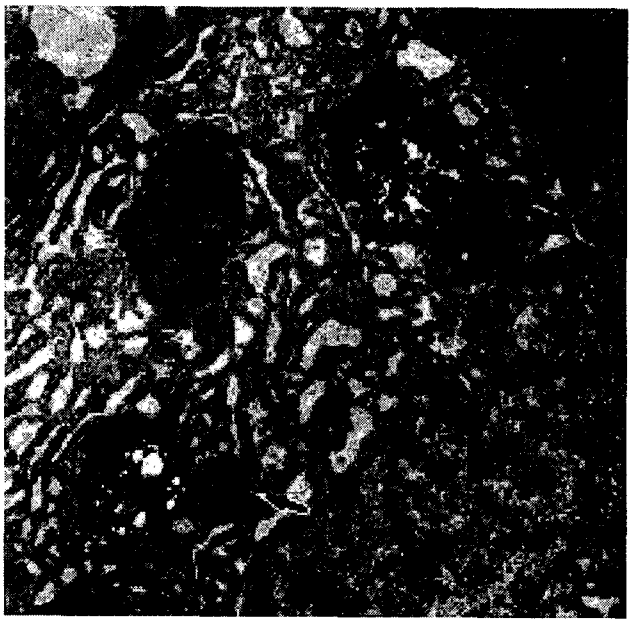

Fig.1. Transmission electron micrograph showing a parafollicular cell. M: multivesicle. Arrowhead : phagovacuole. Arrow: secondary lysosome. × 7600.

The parafollicular cells are present singly and/or formed clusters among the follicular epithelial cells (Fig.1). These cells were obviously discriminated from epitherial cells by irregularly shaped nucleus and higher electron density of the cytoplasm. They often located adjacent to capillaries (Figs.1 and 2). rERs were well-developed. Primary lysosomes, secondary lysosomes, multivesicles, and phagovacuoles were recognized.

Fig. 2. A parafollicular cell with a large Golgi zone (G), containing with higher electron density of abundant granules (arrow). Arrowhead : rER. F : follicular epithelial cell × 7280.

The thyroid gland of the ruminants have two lobes and joined by glandular isthmus. The thyroid gland of pig has two lobes [17], but isthmus is well-developed and shows pyramidal-shape [2]. The thyroid gland of Risso's dolphin was similar to the pig rather than ruminants. Lobules of Risso's dolphin were clearly identified at gross anatomical level because of the development of interlobular connective tissues, on the other hand, those of ruminants and pig is not the case. Also, it is reported that interlobular connective tissues of small mammals are poorly developed [14]. Thus, well-developed lobules in the thyroid gland are characteristic to Risso's dolphin.

Clusters of the follicular epithelial cells were invaginated into the follicular lumen, suggesting that the colloid in the follicles was consumed and resulted in shrinkage of follicles. The size of follicular lumen of the Risso's dolphins was ranging from 98.1 to 120.3 μm (mouse; 41.8~52.6, cat; 56.0~66.4, goat; 89.7~102.8, cattle; 169.1~182.0, camel; 155.3~240.7 μm) [3]. Although the follicular lumen of Risso's dolphin was shrunken in size, it was larger than that of goat. Therefore, the size of active follicles of Risso's dolphin may be the same extent as and/or larger than large ruminants. Abundant granules, lysosomes, and secretory granules at electron microscopic level indiate that function of the thyroid gland of Risso's dolphin in was active. Inconsistent discussion on the activity of the thyroid gland, resulting from the light and electron microscopy, could be explained by the rapid

consumption of follicular colloids. Microvilli of Risso's dolphin were poorly developed , even if the follicular epithelial cells were active. In rats, microvilli are well-developed [11,13], but not in goats and common dolphins [13]. Difference among species should be determined. Mal-formation of microvilli of follicular epithelial cells might be the common feature of odontoceti [7,18]. The ultrastructure of parafollicular cells of Risso's dolphin was closely similar to that of goats. This study revealed the profiles of basic structures of the thyroid gland of Risso's dolphins. Further investigation on this gland should be required in the point of seasonal changes, because the system of metabolism is supposed to be drastically changed according to seasonal behavior including feeding habits in marine mammals.

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