A Case of Intracytoplasmic Edema of Follicular Epithelial Cells in Rat Thyroid

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ABSTRACT. Hydropic change of follicular epithelial cells in the thyroid was observed in a female Fischer 344 rat. Microscopically, follicular epithelial cells were characterized by edematous swelling with weakly eosinophilic and homogeneous cytoplasm. The cytoplasm was negative for periodic acid-Schiff reaction, and thyroxine- and thyroglobulin-immunohistochemical reactions. Electron-microscopically, a small amount of amorphous substance was noted in remarkably dilated rough-surfaced endoplasmic reticulum (r-ER), and slight regressive changes of cytoplasmic organella were also observed. These morphological changes may indicate that focal intracytoplasmic edema was occurred in r-ER, and that the change belonged to hydropic degeneration of the thyroid follicular cells in the thyroid. —KEY WORDS: follicular epithelial cell, hydropic degeneration, rat thyroid.


Accumulation of substance in dilated rough-surfaced endoplasmic reticulum (r-ER) has been reported in pituitary thyrotrrophs in rats after administration of anti-thyroid compounds [3], and in the biliary epithelium in mice injected with swine serum [4]. In the present study, we report a spontaneous case with remarkably dilated r-ER in thyroid follicular cells of a female Fischer 344 (F344) rat.

The F344 strain of rat was obtained from the Charles River U.S.A. in 1968 and maintained by full sib-mating in our laboratories. The lesion bearing rat was 19 weeks of age which was one of a non-treated control group in a subacute toxicity study, and was given a standard laboratory diet and tap water ad libitum in a barrier-sustained animal room. Blood samples were collected from the abdominal aorta under ether anesthesia and then the animal was killed by exsanguination.

No abnormalities were recorded in clinical signs, macroscopic pathology, hematology, and serum chemistry. But body, thyroid, and pituitary weights of this rat were slightly higher than those in animals of the same age.

Thyroid and pituitary glands were fixed in 10% neutral buffered formalin. Paraffin sections of these samples were stained with hematoxylin and eosin (H&E). Selected sections from the thyroid were subjected to periodic acid-Schiff reaction (PAS), Mallory's azan (Azan), and immunohistochemical staining for thyroxine and thyroglobulin (Dako), which was performed using the peroxidase-antiperoxidase (PAP) method on paraffin sections. Immunohistochemical staining for thyroid-stimulating hormone (TSH: Dako) by PAP method was also performed on pituitary gland sections.

For electron microscopy, small formalin-fixed tissue samples of the thyroid were washed in running tap water and refixed using 2% glutaraldehyde and 1% osmium tetroxide. Ultrathin sections were prepared routinely and examined with a transmission electron microscope.

Microscopically, all of the follicular epithelial cells were swollen and characterized by weakly eosinophilic and homogeneous cytoplasm (Fig. 1a). The epithelial nuclei were pushed up and some of these nuclei showed pyknotic appearance. In Azan staining, the cytoplasm was pale-blue in color (Fig. 1b). However, this cytoplasmic change was negative for PAS reaction (Fig. 1c) and thyroxine- (Fig. 1d) or thyroglobulin-immunohistochemical reactions. No abnormalities were observed in the colloid contents.

Electron-microscopically, a small amount of amorphous substance was observed in remarkably dilated r-ER. The electron-density of this substance was lower than that of colloid in the follicular lumen (Fig. 2). Small Golgi complex was observed in apical cytoplasm, but there was no noticeable change in the number and size of ribosomes, transporting vesicles, secretory granules, and colloid droplets (Fig. 3). No histopathologic abnormalities were observed in TSH-positive cells of the pituitary gland.

To our knowledge, these changes of the thyroid follicular epithelial cells have not been reported. But the lesion characterized by dilated r-ER was reported on the pituitary thyrotrrophs treated with antithyroid drug [3]. It is generally considered that the accumulation of amorphous substance in dilated r-ER suggests excess protein synthesis, and suppressed or impaired protein secretion in cells [4]. The dilatation of r-ER of thyroidectomy cell was reported to indicate excess protein synthesis by the increase in secretory vesicles from well-developed Golgi complex [3]. The changes of the follicular epithelium presented in this study were different from those of thyroidectomy cells with the secretory activity of functional vesicles.

The proteinous part of thyroglobulin is synthesized on the attached ribosomes of r-ER and then stored in its cisternae, and sugar components are bound to exportable protein in Golgi complex after the synthesized protein is transported to the Golgi complex by a mechanism of budding from the r-ER [2]. Based on these processes of thyroglobulin synthesis and the present results of immunostaining of thyroid, a small amount of substance in the dilated r-ER is thought to be the precursory proteins of thyroglobulin, not the reabsorption of colloid. In addition, there were no remarkable changes in the number and size of ribosomes and transporting vesicles from r-ER. These results suggest that the dilatation of r-ER is not due to impaired thyroid hormone synthesis but a focal abnormality of the r-ER. On the other hand, the secondary changes followed by the dilatation of r-ER,
such as pyknotic nuclei and atrophic Golgi complex, were observed in some follicular cells. This fact suggests that the dilatation of r-ER may provoke secondary degenerative changes.

In this animal, no abnormality was observed in TSH-positive cells of pituitary, and the number and size of secretory granules and colloid droplets of follicular epithelium were also unchanged. These morphological findings suggest that the thyroid function in this animal is not impaired.

In general, hydropic degeneration is defined as a degenerative lesion characterized by diffuse cytoplasmic edema and vacuolation due to failed regulation of the intra-cellular control of fluid content, and some degeneration arise from dilatation of the r-ER [1]. In addition, the dilatation of r-ER is caused by mild injuries with changes in ion and water movement [5]. Therefore, the dilated r-ER in the thyroid follicular cells may show the focal cytoplasmic edema, and it may be possible that the lesion presented here belongs to the category of hydropic degeneration.

Fig. 1. Microscopic photographs of hydropic change of the thyroid gland. Cytoplasmic change of the thyroid follicular epithelial cells (arrows). (a, H&E; b, Azan; C, PAS; d, Thyroxine; × 330)
Fig. 2. Electron micrograph of the thyroid gland. Remarkably dilated rough-surfaced endoplasmic reticulum (E) with a small amount of amorphous substance. Bar = 5 μm

Fig. 3. Electron micrograph of the thyroid gland. Atrophic Golgi complex (G), normal secretory granules (S) and colloid droplets (C). (N, nucleus; E, r-ER). Bar = 1 μm

REFERENCES


