Electron Microscopic Study of the Parathyroid Gland of Rattus rattus

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Summary: The ultrastructure of the parathyroid glands of Rattus rattus was investigated. In the chief cells, the nucleus showed deep indentations, and lysosomal inclusions and rod-shaped crystalloids were present. Their ultrastructure is described, and the role of the lysosomal inclusions is discussed.

A large number of ultrastructural studies of the normal parathyroid glands have been reported in mammals. More ultrastructural studies have been done on the parathyroid glands of the rat (Rattus norvegicus) than on those of any other species. The first ultrastructural studies on the parathyroid glands were reported by Lever (1957, 1958). Davis and Enders (1961) and Roth and Raisz (1964, 1966) reported a general description of the rat parathyroid gland and noted rare large secretory granules. Zawistowski (1966), Mazzocchi et al. (1967), Hara and Nagatsu (1968), Stoeckel and Porte (1969, 1973), Altenahr (1970), Altenahr and Lietz (1970), Murakami (1970), and Takai (1976) postulated a secretory cycle and demonstrated rare secretory granules in the chief cells of the rat parathyroid glands.

However, there is no study on the ultrastructure of the parathyroid glands of Rattus rattus. The present study is concerned with morphological features of the parathyroid glands of Rattus rattus.

Materials and Methods

Ten Rattus rattus weighing 70–150 g were used in this study. The parathyroid glands of Rattus rattus were removed under diethylether anesthesia. The glands were immersed in a mixture of 2.5% glutaraldehyde and 2% OsO₄ in Millonig's buffer at pH 7.4 for 1 h, dehydrated through increasing concentrations of aceton and embedded in Epon 812. Thin sections were cut on a Porter-Blum MT-1 ultramicrotome, stained with uranyl acetate and lead salts, and examined with a Hitachi H-700H electron microscope.

Results

In the parathyroid glands of Rattus rattus, the chief cells were oval or polygonal in shape. The intercellular spaces were generally narrow, and occasional enlargements contained floccular material (Fig. 1). Plasma membranes of adjacent chief cells pursued a tortuous course with complex interdigitations (Fig. 1). The nucleus was irregular in shape and often showed deep indentations (Fig. 1). Mitochondria, lysosomes, cisternae of granular endoplasmic reticulum and free ribosomes were scattered throughout the cytoplasm (Fig. 1). The Golgi complexes were widely dispersed in the cytoplasm (Fig. 1). The chief cells contained a few large secretory granules (Fig. 1) and some secretory granules. No oxyphil cells were observed within the parathyroid gland of Rattus rattus.

Lysosomal inclusions of various size were sometimes found in the cytoplasm (Figs. 2, 3, 4, 6). The inclusions contained numerous heterogeneously dense bodies and/or rod-shaped crystalloids (Figs. 2, 3, 4, 5, 6). The inclusion rarely showed fusion with large secretory granule (Fig. 3).
Rod-shaped crystalloids consisting of parallel arrays of filament were seen inside and/or outside the inclusions (Figs. 3, 4, 5, 6).

Discussion

Many authors have reported to the ultrastructure of the parathyroid glands in laboratory rat (Rattus norvegicus) (Setoguti et al., 1981; Wild et al., 1982; setoguti et al., 1984, 1985a, b; wild et al., 1993; Hashizume et al., 1993). The parathyroid gland of Rattus norvegicus contained two types of secretory granules: storage and secretory granules (Setoguti et al., 1984). The storage granules were membrane-limited, round or ovoid bodies, and had a clear space between the limiting membrane and the finely particulate, homogeneous content, a core (Setoguti et al., 1984).

In the present study, large secretory granules in the parathyroid glands of Rattus rattus were similar to those of Rattus norvegicus. We think that the large secretory granules are storage granules, as reported earlier (Isono and Shoumura, 1980; Isono et al., 1980, 1981, 1982, 1985, 1990; Setoguti et al., 1981; Shoumura et al., 1988a—d, 1989a, b, 1990).

In the ultrastructural studies of the parathyroid glands of urodela, the newt Triturus pyrrhogaster, the parenchymal cells of the parathyroid gland are divided into two main types: basal and suprabasal cells (Isono et al., 1990). In the basal cells, the nucleus shows deep indentations (Isono et al., 1990). In addition, the nucleus of the chief cells of the toad Bufo vulgaris japonicus indents (Isono et al., 1990). However, the nucleus of the rodent is generally oval or polygonal in shape (Isono et al. 1990). In the present study, the nucleus of the chief cells of Rattus rattus was irregular in shape and often shows deep indentations. Accordingly, there is morphologically difference between Rattus rattus and Rattus norvegicus with regard to the nucleus of the parathyroid glands.

In the present study, the lysosomal inclusions contained numerous heterogeneously dense bodies and/or rod shaped crystalloids were observed in the cytoplasm of the parathyroid glands of Rattus rattus. These inclusions in the parathyroid glands have never been reported. The heterogeneously dense bodies observed into the inclusion showed lysosome-like structure and the inclusion showed fusion with large secretory granules. The large secretory granules, storage granules, were not released until the serum calcium concentration was reduced to a certain level, and they were stored for parathormone supply emergencies (Setoguti et al., 1984). We believe that the large secretory granules remain undischarged in the cells. Therefore, it is suggested that the lysosomal inclusions are components of intracellular digestive system for the cell. Further work is required to clarify the role of the lysosomal inclusion on the parathyroid gland.

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References


Explanation of Figures
Plate I

Fig. 1. Irregularly shaped nucleus in the chief cells. L: Large secretory granules. 13,000
Plate I
Plate II

Fig. 2. Lysosomal inclusion in the chief cell. D: Heterogeneously dense bodies. 21,000

Fig. 3. Lysosomal inclusion in the chief cell. Note fusion with large secretory granule (L) and rod-shaped crystalloids (arrows) inside the inclusion. D: Heterogeneously dense bodies. 35,000
Plate III

Fig. 4. The chief cell showing many rod-shaped crystalloids (arrows) inside and outside the inclusions. 18,000

Fig. 5. The rode-shaped crystalloid (arrow) showing enlargement from vacuole. 35,000
Plate IV

Fig. 6. The rod-shaped crystalloids (arrows) showing inside the inclusion and enlargement from the inclusion. 35,000