Effects of Starvation on the Water-Clear Cell in the Golden Hamster
Parathyroid Gland

By

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Summary: Changes of the water-clear cells of the parathyroid glands in adult and senile golden hamsters 2 and 5 days after starvation were investigated. The ultrastructure of the water-clear cells of the parathyroid glands in the starved adult and senile animals almost resembled that of the control adult and senile animals. However, lipid droplets were very numerous in the water-clear cells in the adult and senile animals after starvation. It is considered that starvation affects functional activity in the water-clear cells of the parathyroid gland.

Albright et al. (1934) first reported the water-clear cell hyperplasia of the parathyroid glands in patients with primary hyperparathyroidism, and several authors have described the ultrastructure of the water-clear cell (Holzmann and Lange, 1963; Sheldon, 1964; Faccini, 1970; Roth, 1970; Thiele and Pichlmayr, 1974; Altenähr, 1981). It has been demonstrated that the water-clear cell was absent in normal human (Altenähr, 1981; Isono et al., 1990) or other vertebrate parathyroid glands (Isono et al., 1990). However, Emura et al. (1990, 1991) indicated that water-clear cells were observed in the parathyroid glands of golden hamster.

Physiological studies have shown that starvation had an effect on calcium metabolism (Kalu and Foster, 1976; Asch, 1978; Beck et al., 1979; Pak and Galosy, 1979; Shires et al., 1980; Asch and Asch, 1981). Recent morphological reports have suggested the changes of the parathyroid glands in starved mice (Isono et al., 1985) and starved golden hamsters (Emura et al., 1988).

This investigation was undertaken to study the effects of starvation on the water-clear cells in the parathyroid glands of golden hamsters.

Materials and Methods

Three-month-old (adult) and 18-month-old (senile) golden hamsters of both sexes were divided into 3 groups of 5 animals each, respectively. The control groups of adult and senile golden hamsters received solid chow (Clea Japan, CE-2) and water. The remaining groups (starved) of adult and senile animals were given water alone ad libitum for 2 and 5 days. The parathyroid glands of the control and starved golden hamsters were removed under sodium pentobarbital anesthesia, immersed in a mixture of 2.5% glutaraldehyde and 2% OsO₄ in Millonig's buffer at pH 7.4 for 1 hour, dehydrated through increasing concentrations of acetone, and embedded in Epon. Thin sections were cut on a Porter-Blum MT-1 ultramicrotome, stained with uranyl acetate and lead salts, and examined with a Hitachi H-700 H electron microscope.

Results

Our previous reports have demonstrated that the water-clear cell was occasionally observed in the parathyroid glands of golden hamsters of different ages (Emura et al., 1990, 1991). In the water-clear cell which was occasionally observed in the parathyroid glands of the control adult (Fig. 1) and senile golden hamsters (Fig. 2), the cytoplasm was filled, for the most part, with spherical membrane-limited vacuoles containing a finely particulate substance and thread-like material. A portion of the vacuole invaginated an adjacent vacuole (Fig. 1), and a few vacuoles showed fusion with adjacent vacuoles (Fig. 2). The cell was situated close to a basal lamina of the perivascular space which lay against the capillary vessel (Figs. 1 and 2) and attached by desmosomes.
to the chief cells (Fig. 2). In the cytoplasm, between the vacuoles were mitochondria, free ribosomes, lysosomes and glycogen particles (Figs. 1 and 2). Some secretory granules were observed in the peripheral cytoplasm (Fig. 2), and relatively well-developed Golgi complexes and cisternae of the granular endoplasmic reticulum were sometimes seen.

In the parathyroid glands of the adult (Fig. 3) and senile golden hamsters (Fig. 4) 2 and 5 days after starvation, the water-clear cells were occasionally observed. The ultrastructure of the water-clear cells of the parathyroid glands in the adult (Fig. 3) and senile animals (Fig. 4) 2 and 5 days after starvation almost resembled that of the control adult (Fig. 1) and senile animals (Fig. 2). However, lipid droplets were very numerous in the water-clear cells as well as in the chief cells of the parathyroid glands in the starved adult (Fig. 3) and senile animals (Fig. 4). A few secretory granules were present in the cytoplasm (Fig. 4).

Discussion

It has become apparent as a result of physiological studies that starvation had an effect on calcium metabolism (Kalu and Foster, 1976; Asch, 1978; Beck et al., 1979; Pak and Galosy, 1979; Shires et al., 1981; Asch and Asch, 1981). Recent morphological reports have suggested that in the chief cells of the parathyroid glands in the starved mice (Isono et al., 1985) and golden hamsters (Emura et al., 1988) the number of lipid droplets were increased as compared to those of the control animals.

In the present study, lipid droplets were very numerous in the water-clear cells as well as in the chief cells of the parathyroid glands in the starved golden hamsters. It has been described that the hypoactive chief cells showed an increase in lipid droplets (Isono et al., 1980, 1981, 1982, 1983; Hayashi et al., 1981; Shoumura et al., 1988). Furthermore, it has been demonstrated that the chief cells of the parathyroid gland in the starved mice showed a decrease in the Golgi complexes and cisternae of the granular endoplasmic reticulum (Isono et al., 1985). Therefore, result of our study suggests that starvation affects functional activity in the water-clear cells as well as in the chief cells of the parathyroid glands in the adult and senile golden hamsters.

References


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Explanation of Figures

Plate I

Fig. 1 Parathyroid water-clear cell in a control adult golden hamster. The cell is situated close to a basal lamina of the perivascular space which lies against the capillary vessel. The cytoplasm is filled with spherical membrane-limited vacuoles containing a finely particulate substance and thread-like material. CC = Chief cells; LY = lysosomes. ×13,000
Plate II

Fig. 2  Parathyroid water-clear cell in a control senile golden hamster. The cell is attached by desmosome (circle) to the chief cells (CC) and situated close to a basal lamina of the perivascular space which lies against the capillary vessel. The cytoplasm is filled with vacuoles and vacuole shows fusion with adjacent vacuole (arrow). Secretory granules (arrowheads) are present in the peripheral cytoplasm. LY = lysosomes. ×13,000
Plate III

Fig. 3 Parathyroid water-clear cell in an adult golden hamster 5 days after starvation. Lipid droplets (*) are very numerous in the water-clear cell and chief cells (CC). LY = lysosomes. ×13,000
Plate IV

Fig. 4  Parathyroid water-clear cell in a senile golden hamster 2 days after starvation. Lipid droplets (*) are very numerous in the water-clear cell and chief cells (CC). LY = lysosomes; arrowhead = secretory granule. ×17,000