

Morphometrical Evaluation of Parathyroid Aland in Native Chickens

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Abstract. The aim of the present investigation was morphometrical study of parathyroid gland in native chickens. Five adult male and five adult female native chickens were used in the experiment. Results showed a clear sexual dimorphism in several histomorphometric parameters at both light and electron microscopic levels. The parathyroid gland of male chicken composes of clusters or irregular cords between which are thin septa of connective tissue contained blood capillaries. In the female chicken, however, the parenchyma of the gland composes of a solid mass of cells with only small amounts of connective tissue. The parenchyma of the gland is composed of a single cell type, the chief cell. No oxyphil cells are seen. The chief cells of the female chicken are smaller than those of male chickens. The shape of the chief cells is columnar in male and cuboidal in female chickens. Chief cells of the male native chicken have an extensive Golgi apparatus and very well developed rough endoplasmic reticulum. In female chickens, however, they have less extensive rough endoplasmic reticulum and poorly developed Golgi complex and a small number of secretory granules. There were no significant differences among the sexes with regard to the smooth endoplasmic reticulum.

Keywords: parathyroid gland, chicken, morphometric, Electron microscop

1. Introduction

There are typically four parathyroid glands in birds. Cytologically, the parathyroid glands resemble those of mammals. The regulation of calcium and phosphate homeostasis is typically mammalian with only minor differences [1]. The parathyroid glands normally lie close to the division of the innominate artery into the subclavian and common carotid arteries, either just anteriorly or just posteriorly to it. The paired parathyroids on each side are closely apposed and form a single round to oval structure enclosed within a well-developed connective tissue capsule. The parenchyma has only a single cell type, the chief cell. No oxyphil cells, of the type found in some mammalian parathyroids and characterized by an acidophilic cytoplasm and abundant mitochondria, are seen [2]. While the ultrastructure of the avian chief cell is essentially similar to that in mammals, the low granular content of the avian cell is consistent with a low level of parathyroid hormone secretion [3]. Primary targets for parathyroid hormone in birds as in mammals are bone and kidney. The major physiological stimulus for parathyroid hormone secretion from the chief cells is a fall in plasma calcium concentration, while a rise in calcium suppresses it [4]. In the available literature on the subject, there is a lack of detailed histomorphometrical data characterizing the structure of the parathyroid gland in the native chickens. The aim of this study was to describe the structural organization of the parathyroid gland in these birds.

2. Materials and methods

Five adult male and five adult female native chickens were used in the experiment. After two weeks, the animals were deeply anesthetized with ketamin and fixed by intravascular perfusion via the left ventricle with buffered formalin. The parathyroid glands of all animals were dissected and were immersed

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immediately in 10% buffered formalin for light microscopy or 2.5% glutaraldehyde in 0.1 neutral buffers for electron microscopy. Paraffin-embedded sections were cut at 5 μm and stained with haematoxylin-eosin. For electron microscopic study, the glands were fixed by immersion in 2.5% glutaraldehyde in 0.1 M sodium cacodylate buffer for two hours, washed with buffer, postfixed in 1% osmium tetroxide in buffer, dehydrated with ethanol and embedded in resin. Ultrathin (70-90 nm thick) sections of the parathyroid glands were cut and mounted on 200 mesh copper grids and stained with uranyl acetate and lead citrate. Stereological measurements were performed using an image analyzer [5]. All stereological results were statistically evaluated by Student t-test.

3. Results

Results obtained from the histological and morphometric analysis of parathyroid gland in native chickens showed a clear sexual dimorphism in several histomorphometric parameters at both light and electron microscopic levels. Parathyroid glands (two pairs in number) in male and female native chickens lie just caudal to the division of the innominate artery into the subclavian and common carotid arteries. The parathyroid gland of male chicken composes of clusters or irregular anastomosing cords between which are thin septa of connective tissue contained blood capillaries. In the female chicken, however, the parenchyma of the gland composes of a solid mass of cells with only small amounts of connective tissue. In both sexes, occasional fat cells interrupt the parathyroid tissue organization. The parenchyma of the gland is composed of a single cell type, the chief cell. No oxyphil cells are seen. The chief cells of the female chicken are smaller than those of male chickens. The shape of the chief cells is columnar in male and cuboidal in female chickens. They measure 18- 22 μm (along their longitudinal axis) in males and 14-18 μm in females.

In both sexes, the cytoplasm of the chief cells is lightly basophilic. The parenchymal cells are separated from adjacent blood capillaries by a relatively thick basal lamina. It appears homogenous in light microscopic images and is about 6-8 μm thick. The nuclei are round or oval with a fine chromatin network. They are approximately 5 μm in diameter and contain one or two nucleoli. The mitochondria which are rod-shaped or filamentous are disposed throughout the cytoplasm. The cytoplasm contains clusters of free ribosomes plus ribosomes attached to the cisternae of rough endoplasmic reticulum. The Golgi complex lies either near the edge of the cell or close to the nucleus. Rough endoplasmic reticulum occurs in association with the nucleus and Golgi complex. The cisternae of the rough endoplasmic reticulum are arranged in parallel arrays or randomly distributed in the cytoplasm. Glycogen particles are interspersed between the mitochondria in both sexes.

Chief cells of the male native chicken have an extensive Golgi apparatus and very well developed rough endoplasmic reticulum. In female chickens, however, they have less extensive rough endoplasmic reticulum and poorly developed Golgi complex and a small number of secretory granules. Results obtained from morphometric findings also confirmed that in male chickens, the volume density occupied by Golgi complexes and cisternae of the rough endoplasmic reticulum was significantly greater as compared that of the female chickens. There were no significant differences among the sexes with regard to the smooth endoplasmic reticulum.

4. Discussion

The present investigation has highlighted some of the histomorphometric differences in parathyroid gland in male and female native chickens. To our knowledge, no sex differences in histomorphometric properties of the parathyroid gland have been reported in birds.

Results obtained from the present investigation showed that in male and female native chickens, the parathyroid glands (two pairs in number) lie just caudal to the division of the innominate artery into the subclavian and common carotid arteries. This finding is in agreement with reports of the other investigators in fowl [2]. It has been stated that the parathyroids may occasionally be placed more anteriorly, separated from the innominate bifurcation by a clear space [6]. In domestic animals, parathyroid glands consist of one or two pairs of beanlike organs located within or near the thyroid gland. In dogs, cats, and ruminants the caudal pair of glands are located just within the thyroid gland at the medial surface, and in the horse this pair of glands lie near the bifurcation of the carotid trunk. The cranial pair of glands lies anterior to the thyroid in

the ruminants and the horse, and they are found at the craniolateral pole of the thyroid gland in the dog and cat. The pig has a single pair of parathyroid glands lying just anterior to the thyroid [7]. Number of parathyroid glands varies between two and four in birds; in chicken there are two pairs slightly caudal to the thyroid and often fused together while one pair is found in Japanese quail [3, 8, 9].

Results obtained from the present study also showed that at light microscopic level the parenchyma of parathyroid gland show a clear sexual dimorphism. The parathyroid gland of male chicken composes of clusters or irregular anastomosing cords between which are thin septa of connective tissue contained blood capillaries. In the female chicken, however, the parenchyma of the gland composes of a solid mass of cells with only small amounts of connective tissue. Regarding the cellular arrangement of parathyroid parenchyma in female native chickens, our findings correspond to those of Hodges (1971) [10] who stated that the parenchyma of the parathyroid gland in actively laying hen is a compactly-arranged, solid mass of cells which is penetrated by blood capillaries and small amounts of connective tissue. Benoit (1950) [11] and Nevalainen (1969) [12] however stated that the parathyroid gland parenchyma is composed of irregular, anastomosing cords of cells.

Morphological and morphometrical data obtained from the present investigation also showed that despite the overall resemblance of chief cells in male and native chickens at electron microscopic level, the cells of the male chickens have an extensive Golgi apparatus and very well developed rough endoplasmic reticulum. In female chickens, however, they have less extensive rough endoplasmic reticulum and poorly developed Golgi complex and a small number of secretory granules. These findings reveal that the chief cells have probably more activity in hormone synthesis and secretion in male chickens in comparison to female ones. The importance of parathyroid hormone in maintaining avian calcium levels has been recognized for many years. Parathyroidectomy causes hypocalcemia, while parathyroid hormone injections into Japanese quail or chickens increase plasma calcium levels. The hypercalcemic effects of parathyroid hormone are greater in egg laying hens than in cockerels due to either calcium binding by yolk proteins in the plasma or additional parathyroid hormone receptors, which may be present in medullary bone and oviduct. Immature birds show a very rapid and sensitive reaction to an intravenous dose of parathyroid hormone, this response being widely used as a bioassay. Primary targets for parathyroid hormone in birds as in males are bone and kidney and the major physiological stimulus for parathyroid hormone secretion from the chief cells is a fall in plasma calcium concentration, while a rise in calcium suppresses it [13]. Nevalainen (1969) [12] stated that the Golgi apparatus of the parathyroid gland of the laying hen was well developed and consisted of dilated cisternae and vesicles.

5. Acknowledgments

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6. References

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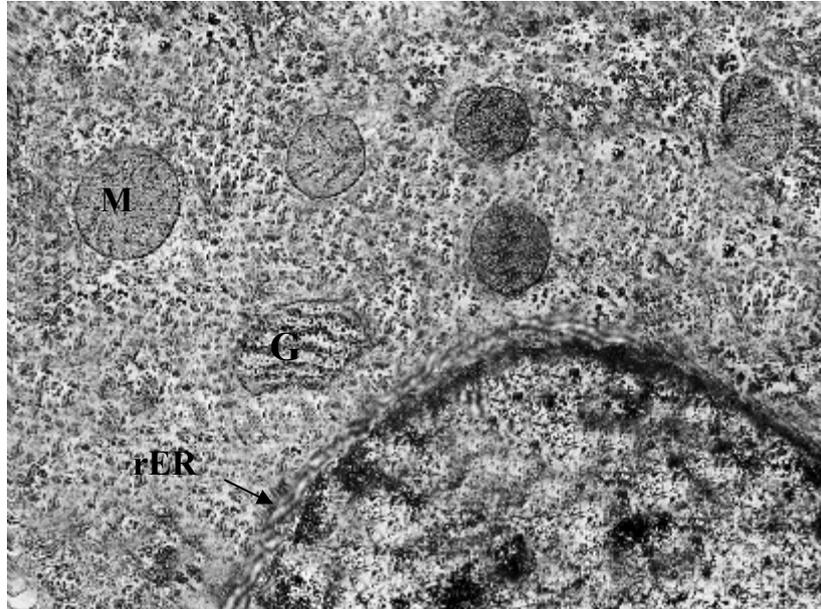


Fig. 1: Transmission electron micrograph of a paranchymal cell of the parathyroid gland in male chicken. Note the presence of numerous mitochondria (M), extensive Golgi complex (G) and rough endoplasmic reticulum (rER), ($\times 14800$).

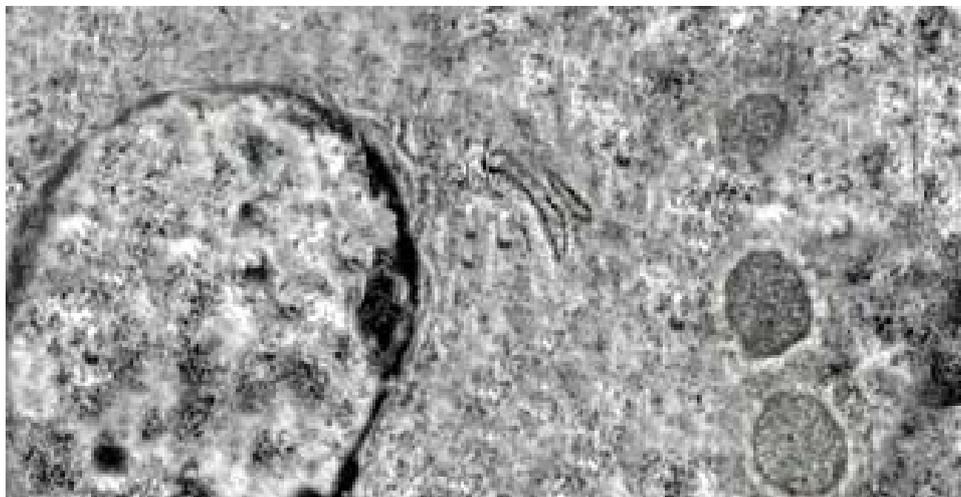


Fig. 2: Transmission electron micrograph of a paranchymal cell of the parathyroid gland in male chicken, ($\times 14800$).