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Histopathological Study on Thyroid Gland of Goat in East Azerbaijan Province of Iran

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Abstract: The thyroid gland in most animal species has two lobes, one on each lateral surface of the trachea. In pigs, the main lobe of the thyroid gland is on the midline in the ventral cervical region with dorsolateral projections from each side. The thyroid structural changes in gouts were investigated. About 386 pairs of thyroid glands collected from gout at the local municipal abattoir in Tabriz city of East Azerbaijan province. A total of 386 thyroid specimens examined, 8 cases were follicular atrophy, 4 cases were thyroid fibrosis, 71 cases were diffuse hyperplasia of thyroid follicular cells, 5 cases were colloid goiter, 10 cases were parenchymal cysts, 3 cases were nodular hyperplasia, 1 case was C-cell adenoma and 1 case was C-cell carcinoma.

Key words: Histopathology, thyroid gland, gout, slaughterhouse, Tabriz, Iran

INTRODUCTION

The thyroid gland in most animal species has two lobes, one on each lateral surface of the trachea. In pigs, the main lobe of the thyroid gland is on the midline in the ventral cervical region with dorsolateral projections from each side. In dogs, the right lobe of the thyroid gland is situated slightly cranial to the left lobe and almost touches the caudal aspect of the larynx. The thyroid gland is the largest of the endocrine organs that function exclusively as endocrine glands. The basic histologic structure of the thyroid gland is unique among endocrine glands and consists of follicles of varying size (20-250 pan) which contain colloid produced by the follicular cells.

The follicular cells are cuboidal to columnar and are orientated so that their secretory pole is directed toward the lumen of the follicle. An extensive network of interfollicular and intrafollicular capillaries provides the follicular cells with an abundant blood supply. Follicular cells have extensive profiles of rough endoplasmic reticulum for synthesis and a large Golgi apparatus for packaging of substantial amounts of protein which are then transported into the follicular lumen. The luminal side of follicular cells in contact with the colloid has numerous microvilli (Barb *et al*., 1991; Brown and Aughenbaugh, 1991; Gooding, 1993). The synthesis of thyroid hormones is unique among those of the endocrine glands because the final assembly of hormone occurs extracellularly within the follicular lumen. Follicular cells trap essential raw materials such as iodide from the blood by a sodium-iodide sym porter in the basolateral plasma membrane and then transport them rapidly against a concentration gradient to the lumen where the iodide is oxidized by thyroper-oxidase in the microvilli to iodine Sutherland *et al*., 1974). The assembly of thyroid hormones within the follicular lumen is made possible by a unique protein, thyroglobulin. Thyroglobulin is a high molecular weight (600,000-750,000 Da) glycoprotein synthesized in successive subunits on the ribosomes of the endoplasmic reticulum in follicular cells. The constituent amino acids (tyrosine and others) and carbohydrates (e.g., mannose, fructose, galactose) are derived from the circulation. Recently synthesized thyroglobulin (17S) leaves the Golgi apparatus and is packaged into apical vesicles that are extruded into the follicular lumen.

The amino acid tyrosine, an essential component of thyroid hormones is incorporated within the molecular structure of thyroglobulin. Iodine is bound to tyrosyl residues in thyroglobulin at the apical surface of follicular cells to form Monoiodotyrosine (MIT) and Diiodotyrosine (DIT).

The resulting MIT and DIT combine to form the two biologically active iodothyronines, T4 and T3, secreted by the thyroid gland (Auffermann *et al*., 1988; Hatabu *et al*., 1990; Kahl *et al*., 1977). The secretion of thyroid hormones into the blood stream from colloid is initiated by elongation of microvilli and formation of pseudopodia on the luminal surface of follicular cells. In response to TSH, these extend into the follicular lumen and indiscriminately phagocytose the adjacent colloid. Colloid droplets within follicular cells fuse with numerous lysosomes. T3 and T4 are released from the thyroglobulin molecule, diffuse across the follicular cell basement membrane and enter into adjacent capillaries. Negative feedback control of

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thyroid hormone secretion is accomplished by the coordinated response of the adenohypophysis and certain hypothalamic nuclei to concentrations of T4 and T3 in the blood (Compagno and Oertel, 1980; Noyek and Friedberg, 1981; Sandler *et al*., 1990). TSH is delivered to thyroid follicular cells where it binds to the basilar aspect of the cell, activates adenyl cyclase and increases the rate of all biochemical reactions concerned with the biosynthesis and secretion of thyroidal hormones.

If the secretion of TSH is sustained (hours or days), thyroid follicular cells become more columnar and follicular lumina become smaller as a result of increased uptake of colloid by endocytosis (Hefco *et al*., 1975). Calcitonin is secreted by a second endocrine cell population, C or parafollicular cells in the mammalian thyroid gland. These cells are situated either in the follicular wall within the basement membrane between follicular cells or in small groups adjacent to interfollicular capillaries between follicles. C cells do not border the follicular colloid directly and their secretory pole is oriented toward the interfollicular capillaries. The distinctive feature of C cells is the presence of numerous small, membrane-limited secretory granules in their cytoplasm. Immunohistochemical techniques have demonstrated calcitonin activity in these secretory granules. Calcitonin is a polypeptide hormone and the calcium ion concentration in plasma and extracellular fluids is the principal physiologic stimulus for the secretion of calcitonin by C cells (Shamma and Abrahams, 1992; Takashima *et al*., 1988). The rate of secretion of calcitonin is increased greatly in response to increased blood calcium concentrations. C cells store substantial amounts of calcitonin in their cytoplasm and the hormone is discharged rapidly into interfollicular capillaries in response to hypercalcemia. C cells respond to long-term hypercalcemia by hyperplasia. When the blood calcium concentration is reduced, the stimulus for calcitonin secretion is diminished and numerous secretory granules accumulate in the cytoplasm of C cells. Calcitonin exerts its function by interacting with target cells located primarily in bone and kidneys. The actions of Parathyroid Hormone (PTH) and calcitonin are antagonistic on bone resorption but synergistic in decreasing the renal tubular re-absorption of phosphorus (Barb *et al*., 1991; Sutherland and Irvine, 1974; Uden *et al*., 1990). The aim of this study was to histopathological study on thyroid gland of goat in Azerbaijan province of Iran.

MATERIALS AND METHODS

For this study, 386 pairs of the thyroid gland of slaughtered goats were randomly picked up in Tabriz abattoir at a 3 months period. Sex and age of goats was determined on the condition of teeth. After slaughter and emptying of carcass completely, thyroid gland was removed. Immediately after removing of glands, they were examined carefully in terms of macroscopic lesions. Samples of approximately 5 mm thickness were obtained by forceps and scalpel from pathologic parts of glands and fixed in 10% buffered formalin solution and sent to the Veterinary Pathology Laboratory. In lab during routine methods, slides were prepared and stained by Hematoxylin-Eosin Method. Prepared tissue sections were studied under the light microscope Nikon (Eclipse E200, made in Japan) with magnification 4x, 10x and 40x.

RESULTS AND DISCUSSION

Of 386 thyroid specimens examined, 103 cases were pathologic lesions as follows:

Idiopathic follicular atrophy (Collapse): In follicular atrophy, the loss of follicular epithelium and disruption of follicles is progressive and the gland is replaced by adipose connective tissue with only a minimal inflammatory response.

The gland usually is smaller and lighter in color than normal. The affected part is composed of small follicles that contain little colloid and are lined by tall columnar follicular cells. A more advanced form of follicular atrophy is present in dogs with clinical hypothyroidism and low blood concentrations of thyroidal hormones. These thyroid glands are notably reduced in size and are composed predominantly of adipose connective tissue with only a few clusters of small follicles containing vacuolated colloid. A total of 386 thyroid specimens examined, 8 cases were follicular atrophy (Fig. 1).

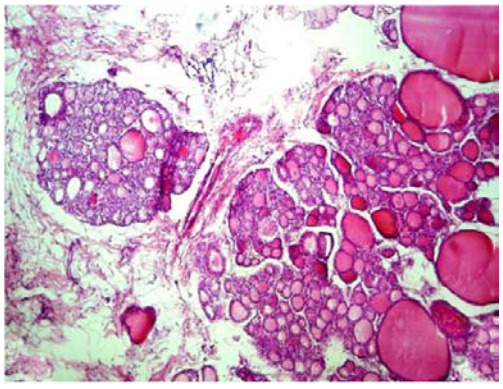

Fig. 1: Microscopic view from affected thyroid to idiopathic follicular atrophy. H and E; 40x

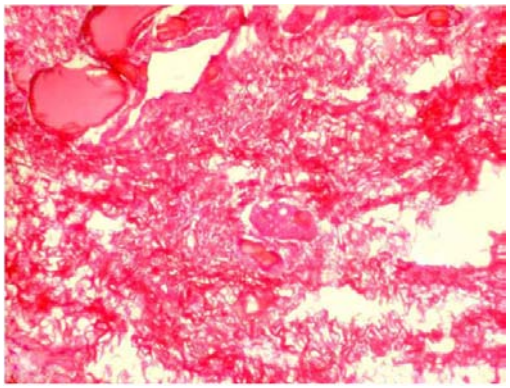

Fig. 2: Microscopic view from affected thyroid to thyroid fibrosis. H and E; 40x

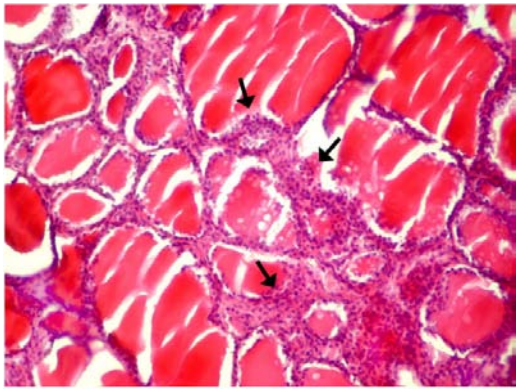

Fig. 3: Microscopic view from affected thyroid to diffuse hyperplasia of thyroid follicular cells. H and E; 40x

Thyroid fibrosis: A total of 386 thyroid specimens examined, 4 cases were Thyroid fibrosis. In microscopic observations, increased interstitial collagen fibers were leaded to the follicles surrounded. In some areas, follicular cells degenerated and disappeared and base membrane surrounding the follicle was thickened (Fig. 2).

Diffuse hyperplasia of thyroid follicular cells (Goiter): Goiter is a clinical term used to describe a non-neoplastic and non-inflammatory enlargement of the thyroid gland. It develops in all domestic mammals, birds and other submammalian vertebrates as a result of hyperplasia of follicular cells. Certain forms of thyroid hyperplasia, especially nodular are difficult to differentiate from adenomas.

The major pathogenetic mechanisms for the development of thyroid hyperplasia include iodine-deficient diets, goitrogenic compounds that interfere with thyroxinogenesis, excess dietary iodide and genetically determined defects in the enzymes or thyroglobulin that

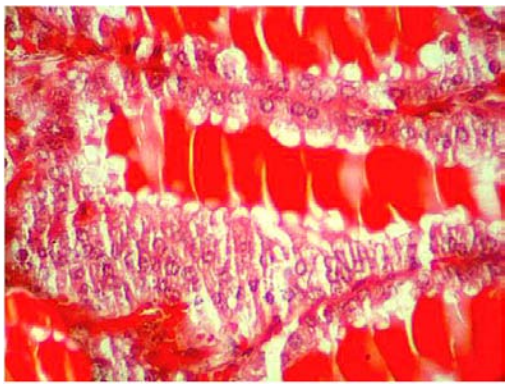

Fig. 4: Microscopic view from affected thyroid to diffuse hyperplasia of thyroid follicular cells. H and E; 400x

are essential for the biosynthesis of thyroidal hormones. All these result in inadequate thyroxine synthesis and decreased blood concentrations of T4 and T3 which are detected by the hypothalamus. This in turn, stimulates the pituitary gland to increase the secretion of TSH resulting in hypertrophy and hyperplasia of follicular cells.

The enlargements when extensive, result in palpable or visible swellings in the cranial ventral cervical area. The affected lobes are firm and dark red because an extensive interfollicular capillary network develops under the influence of long-term TSH stimulation. A total of 386 thyroid specimens examined, 71 cases were diffuse hyperplasia of thyroid follicular cells (Fig. 3 and 4).

Colloid goiter: Colloid goiter represents the evolutionary phase of diffuse hyperplastic goiter in both young and adult animals. It develops either after sufficient amounts of iodide have been added to the diet or after the requirements for thyroid hormones have diminished as the animal ages. The notably hyperplastic follicular cells continue to produce colloid but endocytosis of colloid from the lumen is decreased. This is a consequence of the diminished TSH concentrations produced in response to the return of blood T4 and T3 concentrations to normal. Both thyroid lobes are diffusely enlarged but are more translucent and lighter in color than in hyperplastic goiter. These differences in macroscopic appearances are the result of less vascularity in colloid goiter and development of macrofollicles distended with colloid. Follicles are progressively distended with densely eosinophilic colloid because of diminished TSH-induced endocytosis. As a result, follicular cells lining the macrofollicles are flattened and atrophic.

The interface between the colloid and luminal surface of the follicular cells is smooth and the cells lack the endocytic vacuoles characteristic of actively secreting

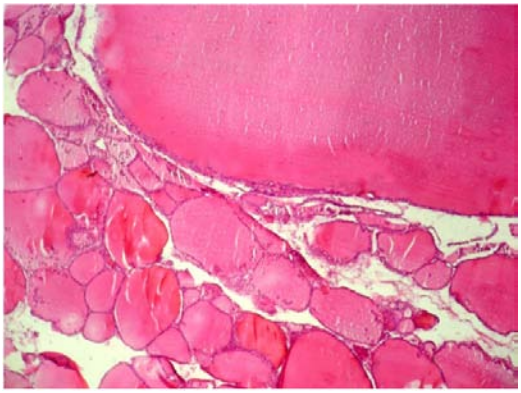

Fig. 5: Microscopic view from affected thyroid to colloid goiter. H and E; 40x

Fig. 6: Gross view from affected thyroid to parenchymal cysts

thyroid follicular cells. Some involuted follicles in colloid goiter have remnants of the papillary projections on follicular cells extending into their lumens. A total of 386 thyroid specimens examined, 5 cases were colloid goiter (Fig. 5).

Parenchymal cysts: A total of 386 thyroid specimens examined, 10 cases were Parenchymal cysts (Fig. 6).

Nodular hyperplasia: The microscopic appearance of nodular hyperplasia often varies. Some hyperplastic follicular cells form small follicles with little or no colloid. Other nodules are composed of larger, irregularly shaped follicles lined by one or more layers of columnar cells that form papillary projections into the lumen. Some of the follicles have undergone colloid involution and are filled with densely eosinophilic colloid. These changes appear to be the result of alternating periods of hyperplasia and colloid involution in the thyroid glands of aged animals. A total of 386 thyroid specimens examined, 3 cases were nodular hyperplasia (Fig. 7a, b and 8).

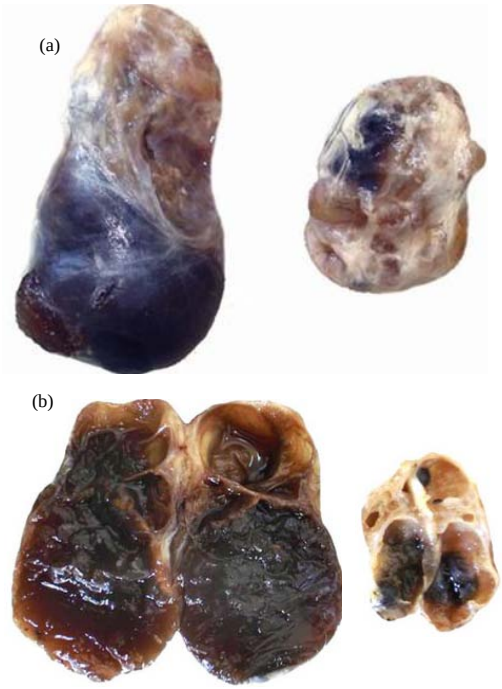

Fig. 7: a, b) Gross view from affected thyroid to nodular hyperplasia

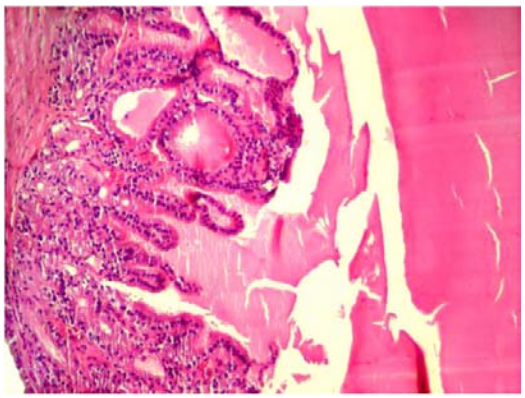

Fig. 8: Microscopic view from affected thyroid to nodular hyperplasia. H and E; 40x

C-cell (Ultimobranchial) adenomas: C-cell adenomas occur as discrete, single or multiple gray to tan nodules in one or both thyroid lobes. Adenomas are smaller (approximately 1-3 cm in diameter) than carcinomas and are separated from the adjacent thyroid gland parenchyma which is compressed by a thin, fibrous connective tissue capsule.

Larger C-cell adenomas replace most of the thyroid lobe but a rim of dark, brown-red thyroid gland often is present on one side. Histologically, thyroid C-cell

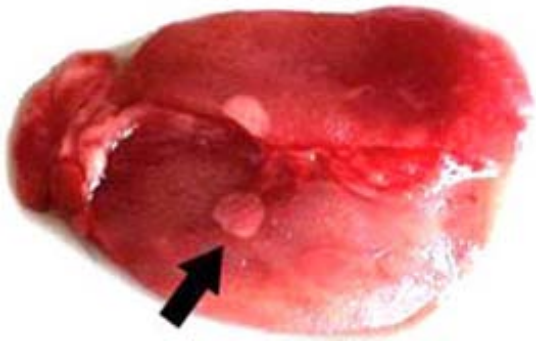

Fig. 9: Gross view from affected thyroid to C-cell adenomas

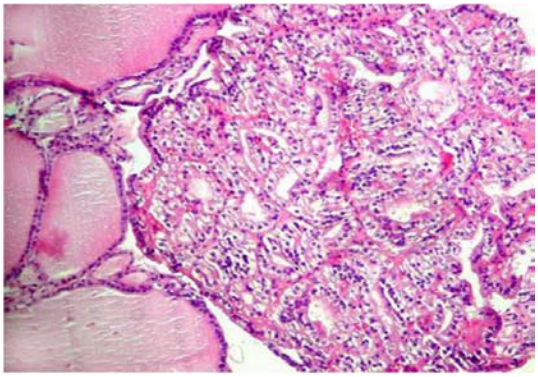

Fig. 10: Microscopic view from affected thyroid to C-cell adenomas. H and E; 40x

adenomas are discrete, expansive masses composed of cells larger than a colloid-distended follicle. The adenoma is well circumscribed or partially encapsulated and adjacent follicles are compressed to varying degrees. The neoplastic C-cells are well differentiated and have abundant to clear, pale eosinophilic cytoplasm. A total of 386 thyroid specimens examined, 1 case was C-cell adenoma (Fig. 9 and 10).

Carcinomas: Thyroid C-cell carcinomas result in extensive multi-nodular enlargements of one or both thyroid lobes and can replace an entire thyroid gland. Thyroid C-cell neoplasms in bulls, other animal species and human beings are firm and in some areas the stroma consists of dense bands of fibrous connective tissue. Multiple metastases occur in the cranial cervical lymph nodes. These nodes are usually large and have areas of necrosis and hemorrhage.

Pulmonary metastases appear as discrete tan nodules and occur infrequently. C-cell carcinomas are composed of neoplastic cells that are more pleomorphic than cells of adenomas. The carcinomatous cells re poorly

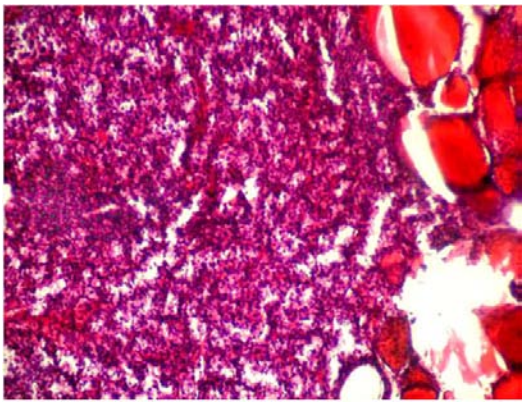

Fig. 11: Microscopic view from affected thyroid to C-cell carcinomas. H and E; 40x

differentiated, polyhedral to spindle-shaped and have pale eosinophilic, finely granular, indistinct cytoplasm. A total of 386 thyroid specimens examined, 1 case was C-cell carcinoma (Fig. 11).

There are several reports in relation to pathological changes in the thyroid glands of various animals, including ruminants and dogs (Hefco *et al*., 1975; Sandler *et al*., 1990). The major pathological cases of thyroid disease is goiter (Hefco *et al*., 1975; Sandler *et al*., 1990; Sutherland and Irvine, 1974). Previously studies have shown that colloid goiter (5.18%) was most and thyroid lymphocytic inflammation (8.0%) was lowest cases of pathological lesions in buffalo of East Azarbaijan (Gooding, 1993).

However, the hyperplastic goiter (27%) was the most and lymphocytic thyroiditis was lowest thyroid pathology in carcasses of slaughtered sheep in East Azarbaijan (Barb *et al*., 1991). Studies have shown that diffuse hyperplastic goiter in cattle in East Azarbaijan has most (56.7%) and multi-nodular goiter has lowest (54.0%) pathological cases.

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