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Morphological and Histological Study of Thyroid Gland in *Felis Catus* (Linnaeus,1758)

Noor Mohammed Jaafer Hammodi*
Department of Biology, College of Education for Pure Science Ibn Al-Haitham, University of Baghdad, Baghdad, Iraq.

Rana Alaa Al Aamery
Department of Biology, College of Education for Pure Science Ibn Al-Haitham, University of Baghdad, Baghdad, Iraq.

***Corresponding Author:** Noor.m@ihcoedu.uobaghdad.edu.iq

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Abstract

The results of the current study showed that the thyroid gland in an adult domestic cat (*Felis catus*) is located in the neck area on both sides of the trachea at rings 1–5. The gland consists of two lobes (right and left), and it is surrounded by a capsule of connective tissue consisting of two outer and inner layers, and a layer of fatty tissue overlaps with the outer layer of the capsule. In addition, the results of this study found that the histological structure of the thyroid gland is composed of several follicles that appear in different sizes and shapes. The follicles are lined with simple cuboidal epithelial tissue and sometimes appear lined with high and low simple cuboidal epithelial tissue. The gland is histologically composed of two types of cells: epithelial cells and parafollicular cells, or calcitonin cells (C-cells), the latter being few in number compared to the epithelial cells and appearing as single cells or forming clusters in two locations: the first is between the follicular and the second is intrafollicular.

Keywords: Thyroid gland, *Felis catus*, Anatomical study, Histological study.

1. Introduction

The thyroid gland is one of the largest endocrine glands that has a relationship with evolution or quantitative formation in different vertebrates, and it is unique from other endocrine glands in the method of secretion and storing of hormones [1, 2]. The thyroid gland is composed of two lobes, right and left, which are connected at the ventral surface of the trachea by a narrow isthmus [3]. Histologically, the thyroid gland consists of follicles of different shapes and sizes that represent the structural and functional unit of the thyroid gland [4,5]. The follicles of the thyroid gland consist of three main components: the follicular cell lining, basal parafollicular cells, and a colloid-filled cavity. The follicular cells produce thyroid hormones (Thyroxin T4 and Triiodothyronin T3)

that play a role in cell proliferation, differentiation, and migration, as well as the general growth and metabolism of the fetus [6]. On the other hand, the parafollicular cells, sometimes called C-cells, secrete the calcitonin hormone, which regulates the level of calcium in the blood along with the parathyroid hormone (PTH) [5,7]. Several previous reviews observed the scarcity or insufficiency of research that deals with the phenotypic description and histological structure of the thyroid gland in Iraqi mammals, especially the wild type, with the exception that there are few studies in this field. Thus, this study aimed to study the anatomical and histological characteristics of the thyroid gland in a domestic cat (*Felis catus*), which may be the first study related to the thyroid gland of a cat from an Iraqi environment, with the hope of enriching knowledge in this field.

2. Material and Methods

In the present study, six adult cats were used. Samples were obtained from local markets in Baghdad governorate and classified according to the taxonomic key provided by the Natural History Museum Research Center in Baghdad. The animals were anesthetized and dissected by longitudinal incisions, and then the thyroid gland was removed. Samples were fixed in formalin (10%) in order to prepare these specimens for the histological study.

For the histological study, the samples were passed through an ascending series of alcohols (70%, 80%, 90%, 100%); then all the samples were cleared using xylene and embedded in paraffin wax blocks. The paraffin wax blocks were cut by using a microtome to prepare sections with 6 m in thickness; the sections were stained using Haris Haematoxylin and Eosin stain and Periodic acid-Schiff (PAS) stain [8, 9]. The slides were then examined under a photomicroscope that was connected to a digital camera, which was used to take pictures of the selected sections of the thyroid gland.

3. Results

The Morphological Description of the Gland

The anatomical examination of the thyroid gland in the adult male domestic cat (*Felis catus*) showed that the gland is double-lobed and is located in the neck below the larynx, and the two lobes of the gland are located on both sides of the trachea at the rings (1–5) (**Figure 1**). Moreover, the isthmus, which connects the two lobes, was not observed, as in many other labyrinths; the lobes of the gland also appear oval to elliptical with a reddish brown color.

The histological composition of the thyroid glands

The results of the current study found that the thyroid gland in the domestic cat (*Felis catus*) is surrounded by a capsule of connective tissue consisting of two layers represented by an outer and inner layer, and a layer of adipose tissue interferes with the outer layer. The outer layer consists of collagenous fibers, elastic fibers, and a few reticular fibers interspersed with nuclei of fibroblasts, while the inner layer consists of collagenous fibers interspersed with the nuclei of smooth muscle fibers, blood vessels, and nerves (**Figure 2**). Thin septa extend from the capsule into the gland tissue, dividing the gland into lobules. The thyroid tissue consists mainly of follicles and parafollicular cells. The follicles are composed of three main components: cells lining the follicles, basal parafollicular cells, and the colloid-containing cavity. The follicles appear in various shapes,

including oval, circular, and sometimes irregular. Furthermore, these follicles are also of different sizes, including small, medium, and large ones (**Figure 3**).

The microscopic examination showed that the tissue lining the follicles is simple cuboidal epithelial tissue, and sometimes high and low simple cuboidal epithelial tissue appear depending on the activity of the gland (**Figure 4**). The lumen of the follicles contains colloid material; some of the follicles are filled with colloid, others contain a lesser amount of it, and a few of them appear completely free of colloid. In addition, colloids are purple in color and appear more receptive to PAS stain than hematoxylin-eosin (H&E), as they appear in a light pink color. The blood vessels are spread between the follicles; in addition to the follicular epithelial cells, there are parafollicular cells called C-cells, and these cells appear spherical to polygonal in shape or multifaceted, and their nuclei are spherical in shape and large in size, and the cytoplasm is transparent. C-cells are located in two sites: the first is within the follicle (interfollicular) and located between the basement membrane of the follicle and the follicular cells, while the second site is between the follicles (intrafollicular) and is between the follicles in the gland tissue. Moreover, these cells are found as single cells or in clusters and in small percentages in the thyroid gland (**Figure 5**).

4. Discussion

The anatomical examination of the thyroid gland in the adult domestic cat (*Felis catus*) showed that the gland is bi-lobed and is located on the anterior side of the neck on both sides of the trachea at the rings (1–5), and the isthmus did not appear. This result is in agreement with previous studies that studied the thyroid gland morphologically and histologically in different mammals, including the wild African grusscutter [10], the mice, *Swiss albicans* [11], the weasel, *Herpestes javanicus* [12], the hedgohoge, *Hemiechinus auritus* [13], the guinea pigs, and albino rats [14]. While other studies in different vertebrates, including the study of the thyroid gland in local donkey females [15], local Iraqi sheep [16], and one-humped camels [17], indicated the presence of the isthmus that connects the two lobes of the thyroid gland, this is not consistent with the current study result, and this may be due to the size of the gland related to the size of the animal or the nature of the functional activity of the gland in the studied animal.

Several previous studies indicate that there are some differences in the capsule structure that surrounds the thyroid gland, as the study of the thyroid gland goat [18], the local Iraqi sheep [16], and the African giant mouse [19] indicates that the capsule consists of a thin layer of connective tissue. While the studies of the thyroid gland in Indian buffalo [20], the black Bengal goat [21] and rabbit [22] observed that the thyroid gland consists of three layers: outer, middle, and inner layers, whereas this study showed that the capsule consists of two layers, an outer and inner layer, and a layer of fatty tissue interferes with the outer layer. This is consistent with the findings of the guinea pig [14], Hussin and Al-Taay's [23] study on Iraqi buffalo, domestic rabbits [24], and other studies.

This study on the domestic cat did not show a clear difference in histological structure of the gland with previous studies in terms of the extension of sacs from the capsule to the inside of the gland, and divided it into lobules, as well as the gland containing capillary blood vessels that spread clearly between the follicles. This is in agreement with previous studies that revealed the gland contains large numbers of follicles, which are of different shapes and sizes, including the studies on the wild African grusscutter [10],Weasel (*Herpestes javanicus*) [12], Hedgehoge (*Hemiechinus auritus*) [13], the giant African mouse [19], Indian buffalo [20] and other studies.

The current study observed that the tissue lining the follicles is simple cuboidal epithelial tissue, which is composed of cuboidal cells with a central spherical nucleus, and high and low simple cuboidal epithelial tissue. This is consistent with the study of the gland in wild African grusscutter [10], local female donkeys [15], local Iraqi sheep [16], white hybrid pigs [25], and other studies. When the follicle consists of high simple cuboidal epithelial tissue, the gland is hyperactive, but in the case of low cubic epithelial tissue, the gland is underactive, as the type of tissue is an indicator of the gland's activity and its functional state. It is an indicator of functional activity that is not limited to glands but extends to the lining of hollow organs in the animal's body, such as the digestive canal, urinary and reproductive ducts, and others [5].

The follicles contain a colloid material in the follicular cavity, and some follicles are filled with colloid, while others contain a small amount, while other follicles lack this substance; this is in agreement with previous studies, including the study in wild African grusscutter [10], Weasel (*Herpestes javanicus*) [12], guinea pigs and albino rats [14], and Iraqi buffaloes [23]. These studies are consistent with the current study in the domestic cat, and they certainly come with a plan for histological structure and physiological composition.

The microscopic examination of the histological structure of the thyroid gland found that it contains parafollicular cells, or C-cells, and these cells appear as single cells or in clusters. These cells secrete the calcitonin hormone [5, 10, 15]. The results of this study showed that C-cells are spherical to oval in shape, large in size, with dark circular nuclei, and light-colored cytoplasm, and they appeared clearly with hematoxylin-eosin (H&E) and PAS staining. This is consistent with previous studies, including the study of [11, 12, 14, 16, 21, 23]. However, another study revealed the inconsistency with other studies in regards to distinguishing C-cells using routine stains, so their detection is limited by using histological and immunological techniques [7]. The present study also showed that the follicular cells are few in number and occupy two different places in the thyroid gland: the first is within the follicular (interfollicular) between the basement membrane of the follicle and the follicular cells, while the second is intafollicular, which is between the follicles within the gland tissue. These results are in agreement with the studies mentioned previously.

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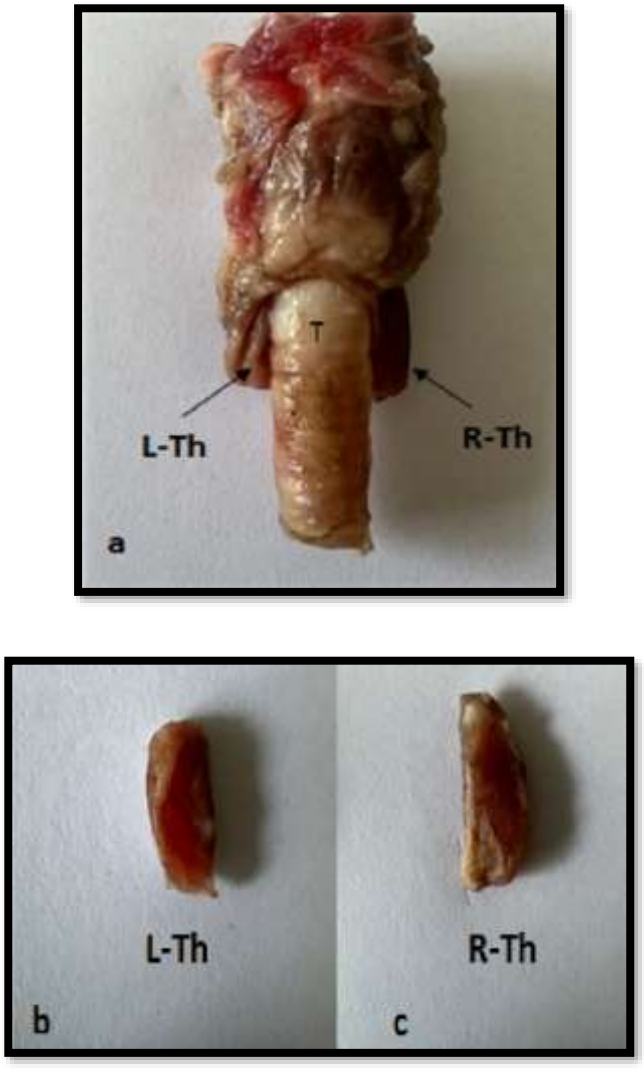

Figure 1.a. Positon of Thyroid Gland in *Felis catus* ,Trachea (T), b. Left Thyroid lobe (L.Th) , c. Right Thyroid lobe (R.Th)

Figure 2. Cross section in Thyroid Gland showing Capsule (C) , External layer of capsule (Ext), Internal layer of capsule (Int) , Adipose tissue (Adp) , Blood vessel (Bv), Trabecule (Tb) , Follicle (F) (H&E stain, 10X)

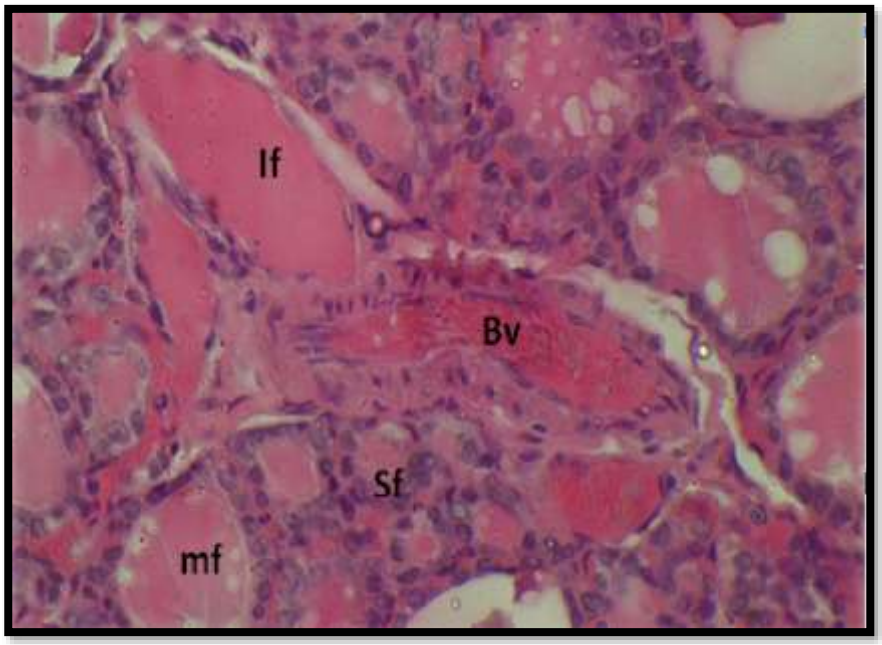

Figure 3. Cross section in Thyroid Gland showing Blood vessel (Bv), Large follicle (If), Medium follicle (mf) . Small follicle (Sf) (PAS stain, 40X)

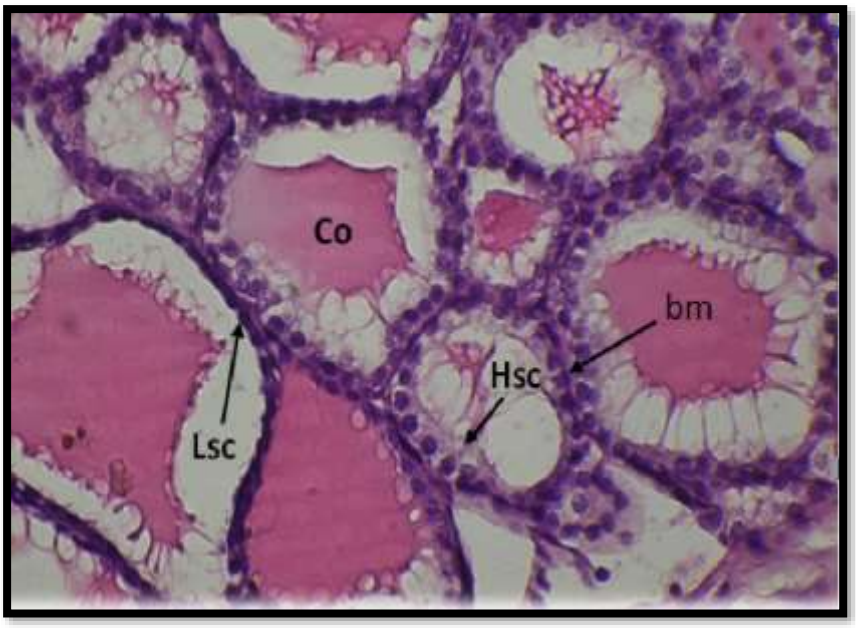

Figure 4. Cross section of Thyroid Gland showing High simple cuboidal epithelial tissue (Hsc) , Low simple cuboidal epithelial tissue (Lsc), Basement membrane (bm), colloid (Co) (H&E stain, 40X)

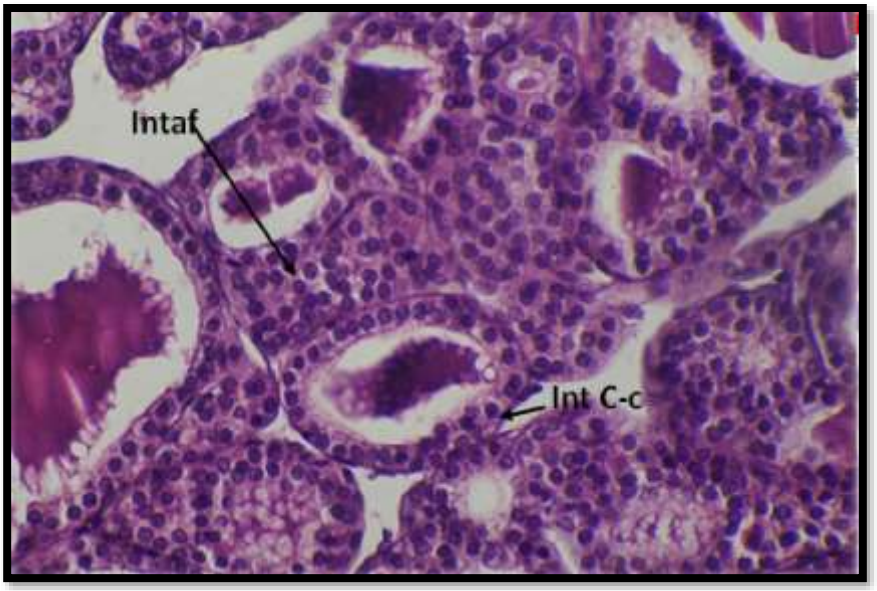

Figure 5. Cross section of Thyroid Gland showing Intra follicles parafollicular cell (Intaf), Inter follicles parafollicular cell (Int C-c) (H&E stain, 40X)

5. Conclusion

The current study showed that the thyroid gland in an adult domestic cat (*Felis catus*) consists of two lobes (right and left) and is surrounded by a capsule of two outer and inner layers. The histological structure of the thyroid gland is composed of several follicles and two types of cells: epithelial cells and C-cells. Some follicles are filled with colloid, and others contain a lesser amount of it.

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