https://dx.doi.org/10.22161/ijaers.6.3.29 ISSN: 2349-6495(P) | 2456-1908(O)

Topography, irrigation, and histology of the thyroid gland of New Zealand rabbits (*Oryctolagus cuniculus* Linnaeus, 1758)

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Abstract*—The objective of this study was to describe the topography, arterial irrigation, and microscopy of thyroid glands of thirty male specimens of New Zealand rabbits (Oryctolagus cuniculus). The aorta-thoracic system was analyzed by aorta thoracic cannulation and fixed in a 10% aqueous formaldehyde solution. Right and left lobes, and the isthmus of the thyroid gland were collected from only three rabbits for microscopic analyses. The procedure followed usual histological routine and histological sections were stained with Hematoxylin/Eosin. The thyroid gland consists of two flat, elongated lobes located ventrolateral to the trachea. Topographically, there is a close relationship between this gland and lateral surfaces of the first five tracheal rings, just below the cricoid cartilage and between the right and left common carotid arteries. The arterial supply to the thyroid gland in both antimers is performed by the thyroid artery, a branch of the common carotid artery. Following its origin at the level of the first tracheal ring, the thyroid artery continues in a caudocranial path. It reaches the cranial part of the thyroid gland and is divided into several branches that are distributed in this organ. The histological sections reveal that the cellular aspect of the isthmus region maintains the same organization and characteristics observed in the thyroid lobes. The thyroid gland in Oryctolagus cuniculus is small, consisting of two bilateral lobes united by an isthmus that presents glandular tissue.*

***Keywords*— *Irrigation, Thyroid artery, Histology*.**

I. INTRODUCTION

The endocrine system consists of several glands and tissues that secrete chemicals responsible for controlling most biological functions. These substances are hormones that act on target tissues binding to specific receptors **[1].**

The thyroid gland was the first described endocrine gland. It is present in all vertebrates, is bilateral, and is attached to the trachea through a loose connective tissue **[2].**

In dogs, the thyroid gland has two lobes that lie on the lateral surface of the first six tracheal rings **[3].** Miller (1979 **[4].** described the vertical and lateral location of the trachea on the cranial surface, ranging from the fifth to the eighth tracheal ring. A glandular isthmus connecting the caudal pole of each lobe may be present; this may be related to the consumption of iodine in the diet, or size of the dog **[3]**

Blood supply to the thyroid gland in dogs is from the cranial and caudal thyroid arteries **[3-5]**. Getty (1986) **[3]** reported that in bovine this gland is irrigated by the cranial and caudal thyroid arteries. The caudal thyroid artery is a small and inconstant vessel originated from the common carotid artery, caudally to the cranial thyroid artery.

Studies of topography and blood supply to the thyroid gland in domestic dogs Miller (1979 **[4],** Evans e la Hunta, (200) [5] and Rodrigues et al. (2016) and bovine are Getty (1986) **[3]** found in scientific literature. However, these studies have not been found for rabbits. Thus, the objective of the present study was to describe the topography, arterial irrigation, and histology of the thyroid gland of New Zealand rabbits (*Oryctolagus cuniculus*).

https://dx.doi.org/10.22161/ijaers.6.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

II. MATERIAL AND METHODS

Thirty male specimens of New Zealand rabbits (*Oryctolagus cuniculus* Linnaeus, 1758) were examined. These animals were property of the Animal Anatomy Laboratory of the Faculty of Veterinary Medicine of the Federal University of Uberlândia, Minas Gerais, Brazil.

The present study was approved by the Ethics Committee on the Use of Animals under the registration protocol CEUA/UFU 076/16).

The thoracic part of the aortic artery was isolated and filled with red latex through a small dorsoventral incision at the ninth intercostal space. The animals were then dosed with intramuscular, subcutaneous, and intravenous solutions of 10% formaldehyde and submerged in containers containing the concentration solution. A ventral midline incision, and two more transverse incisions were made for the dissections. The ventral midline incision was made radially across the mandibula and thyroid cartilage, extending to the cranial margin of the sternum bone. The transverse incisions were made at the levels of the cranial part of the thyroid cartilage and cranial margin of the sternum bone. The perioperative subcutaneous junctions were identified, allowing visualization of the topography and arteries that nourish the thyroid gland. An 8x magnifying glass was used to better visualize the structures when necessary. The nomenclature adopted for the descriptions of anatomical structures is in agreement with **[7]**.

The documentation was made by means of a digital camera (Nikon 18 mega pixels) and sketches depicting the origins and distribution of the vessels.

Histological processing was performed at the Laboratory of Cell Biology, Histology and Embryology of the Institute of Biomedical Sciences (DBHEM/ICBIM/UFU). The isthmus and lobes of the thyroid glands were collected from only three rabbits. The samples were fixed in a 10% formaldehyde solution for 72 hours, processed following usual histological routine and embedded in paraffin.–Histological sections (5µm) were stained in Hematoxylin/Eosin (H.E.) and analyzed by a histologist.

III. RESULTS

In New Zealand rabbits (*Oryctolagus cuniculus*), the thyroid gland is composed of two elongated flattened lobes located ventrolateral to the trachea. Topographically, there is a close relationship between the gland and the first five tracheal rings, immediately caudal to the cricoid cartilage and medially to the right and left of the common carotid arteries.

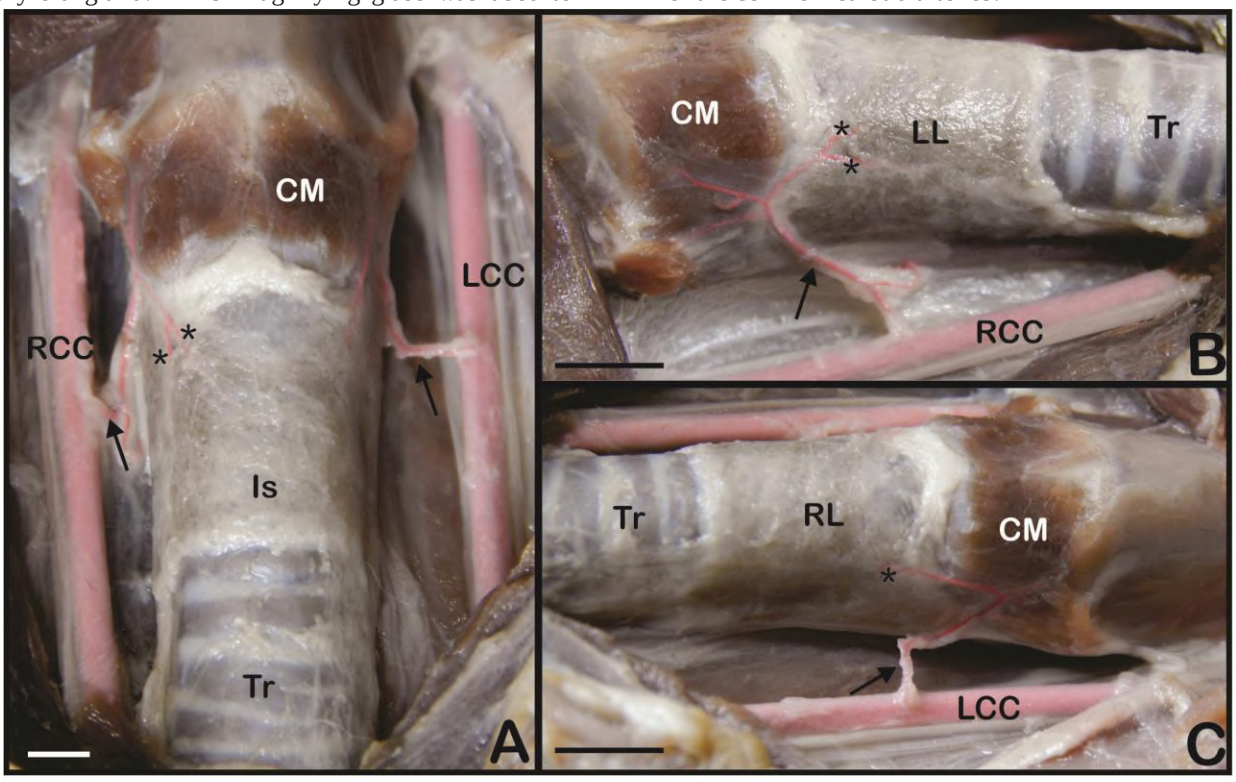

*Fig. 1: Ventral view of the thyroid gland (A), right antimer (B), and left antimer (C) of New Zealand rabbits (Oryctolagus cuniculus). RCC = right common carotid; LCC = left common carotid; CM = cricothyroid muscle; Is = isthmus; RL = right lobe; LL = left lobe; TR = trachea. → thyroid artery; * thyroid artery branches. Bar: (A-C) 1 cm.*

The arterial supply of the thyroid gland in both antimers is performed by the thyroid artery, a branch of the common carotid artery (Figure 01). Following its origin, at the level of the first tracheal ring (Figure 02A-

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F), the thyroid artery continues in a caudal cranial path and reaches the cranial part of the thyroid gland. Then, it divides into several terminal branches, ranging from three to ten. An irrigation pattern of the thyroid gland was found, however, in one of the specimens (3.33%), the thyroid artery first reached the cricothyroid muscle and then passed through two ventral and dorsal branches to nourish the gland (Figure 02 D-F). In another animal (3.33%), the origin of the thyroid artery occurred from the ninth tracheal ring level (Figure 02 G).

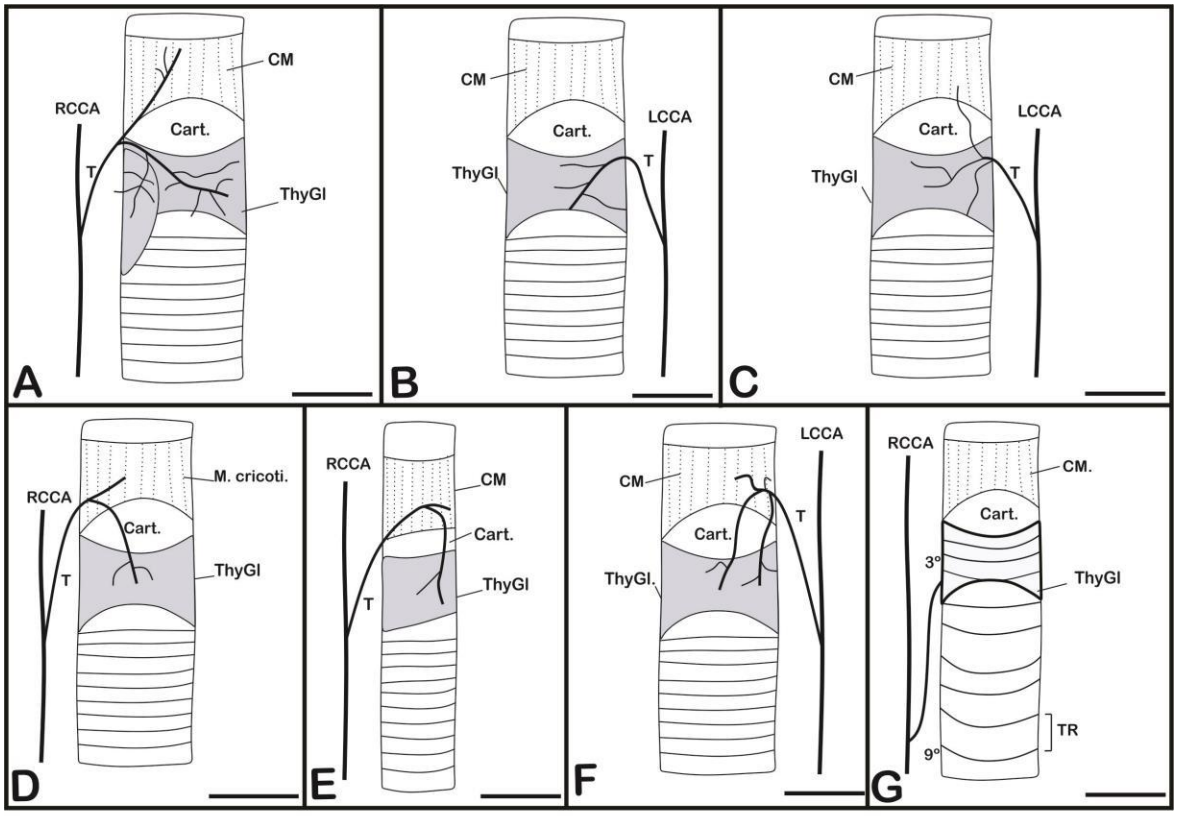

Fig. 2 Ventral view of the trachea (A, B, C, D, F, and G); Dorsal view of the trachea (E). RCCA = right common carotid artery; LCCA = left common carotid artery; Cart = cricoid cartilage; CM = Cricothyroid muscle; T = thyroid artery; ThyGl = thyroid gland; TR = tracheal ring. Bar: (A-G): 1cm.

The histological sections of the isthmus and lobes of thyroid glands presented glandular parenchyma consisting of thyroid follicles of varied sizes. Most of these follicles were filled with acidophilus amorphous secretion compatible with colloid. There were several groups of parafollicular cells and many unilocular adipocytes interspersed with the thyroid follicles. In the focal area, some multilocular adipocytes were found permeated by unilocular adipocytes.

The histological sections of the isthmus of the thyroid gland revealed the presence of thyroid follicles permeated by unilocular adipocytes, as well as groups of parafollicular cells. The histological aspect of the isthmus region maintained the same organization and the same characteristics found in the thyroid lobes.

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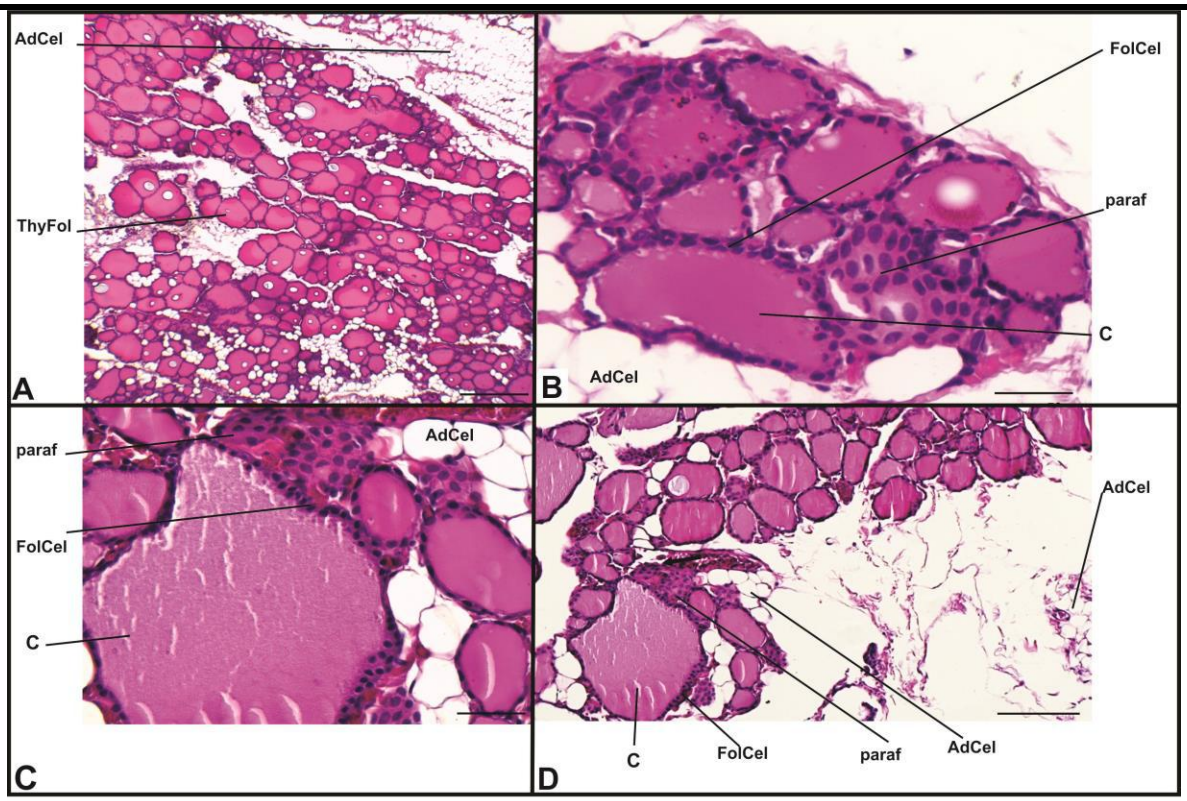

Fig. 3 Histological sections of the isthmus and lobes of the thyroid gland. Overview of one of the lobes (A); Lobe of the gland (B); Isthmus of the thyroid gland (C); Overview of the isthmus (D). C = colloid; AdCel = adipose cells; FolCel = follicular cells; paraf = prafollicular cells; ThyFol = thyroid follicle. Bar: (AD), 200µm; (BC), 50µm.

IV. DISCUSSION

The thyroid gland of New Zealand rabbits (*Oryctolagus cuniculus*) is smaller when compared to Santa Inês sheep and Saanen goats **[8, 9]**. Getty (1986) **[3]** reported that the reduced size of this gland in bovine might be related to the size and the diet of the animal.

The rabbit thyroid gland is located ventrolateral to the trachea, similar to dogs **[4]**, domestic cats **[10],** and *Herpailurus yagouaroundi* **[11]**, and dorsolateral to trachea in ruminants **[12, 13]**. It is constituted of two caudal lobes in goats **[8, 9]**, and bovines **[3]**.

In *O. cuniculus*, the irrigation of the thyroid gland occurs through only one artery called the thyroid artery. However, the thyroid gland of some species is supplied by cranial and caudal thyroid arteries, as observed in dogs **[4,5,6],** *Herpailurus yagouaroundi* **[11]**, ruminants **[12]**. These studies reported that the cranial thyroid artery originates from a branch of the common carotid artery.

The caudal thyroid artery in dogs is derived from the brachiocephalic artery **[4,5]**. However, the caudal thyroid artery in bovines **[3]** and *Herpailurus yagouaroundi* **[11]** originates from the common carotid artery. Godino et al. (1987) **[12]** also found this result for bovine, and variable results for goats and sheep. Getty (1986) **[3]** reported that the caudal thyroid artery is a small and inconstant vessel in bovine. In *O. cuniculus* there was no evidence of the caudal thyroid artery.

According to Carvalho et al. (2003) **[11]**, the thyroid gland of *Herpailurus yagouaroundi* receives branches from the cranial thyroid and caudal thyroid arteries. According to Dyce et al. (2010) **[13]**, this gland is supplied mainly by the cranial thyroid artery in ruminants. Bruni and Zimmerl (1947) **[14]** reported that the path of the cranial thyroid artery of pigs is towards the cranial pole, whereas the path of the caudal thyroid artery is towards the caudal pole of the gland, both are direct branches of the common carotid artery.

The caudal thyroid artery is inconstant in bovine **[3]** and in other ruminants **[13].** in *O. cuniculus*, it is not present. Regarding the vessels that supply individually the lobes of the thyroid gland Dicy et al. (2010) **[13]**Bruni and Zimmerl (1947) **[14],** Sisson and Grossman (1947) **[15]** and Schwarze and Schroder **[16]**, were not specific, but they reported that these lobes receive branches from the common carotid artery.

Histological analysis confirmed that the isthmus of the thyroid gland in New Zealand rabbits has the same organization and characteristics of the thyroid lobes. Thus, isthmus and thyroid lobes constitute a glandular tissue, according to **[2]**.

Ellenberger and Baum, (1977) **[17]** reported that the isthmus has a parenchymal constitution in domestic

https://dx.doi.org/10.22161/ijaers.6.3.29 *ISSN: 2349-6495(P) | 2456-1908(O)*

animals, confirming the results found for *O. cuniculus*. According to **[9]**, the thyroid isthmus of goats has a fibrous constitution that joins the middle third of the right and left lobes of the thyroid gland. Contrastingly, the thyroid isthmus in bovine is glandular **[3]**.

Dyce et al. (2010) **[13]** reported that the isthmus is not present in all individuals of small ruminants, but when present it is characterized as a simple connective tissue. Dukes (1999) **[18]** stated that the thyroid gland of most mammals has two lateral lobes that may or may not be connected by an isthmus. In *O. cuniculus*, the isthmus was found in all analyzed animals and it makes a connection between the cranial and caudal poles of the thyroid gland.

V. CONCLUSIONS

The thyroid gland of New Zealand rabbits (*Oryctolagus cuniculus*) is small, located ventrolateral to the trachea and is constituted of two bilateral lobes united by an isthmus that presents glandular tissue. Blood is supplied by the thyroid artery that originates from the common carotid arteries in both antimers and emits three to ten terminals branches.

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