Anatomical-Surgical study on the Thyro-laryngeal region of Native dogs (*Canis lupus familiaris*)

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Abstract

The present study was carried out on 10 heads of adult apparently healthy native dogs of both sexes. The samples were attended for the anatomical study on the thyro-laryngeal region. Characteristic features of the latter were declared out, outer landmarks, superficial and deep anatomical structures as well as their relations. The anatomical work in this study tried to set the guidelines for surgeons during the critical interferencein regards to scanty literature. Thyro-laryngeal surgery is indicated for malignant and benign neoplasms or hyperplasia of the organs of this region. The ventral midline cervical approach is the most common approach. Caution should be taken to avoid the surrounding neurovascular structures and esophagus. Evaluation of thyroid gland, mandibular salivary glands, and related anatomical structures should be considered before proceeding with surgery. Complications of thyro-laryngeal surgeries include intraoperative hemorrhage and post-operative clinical signs associated with damage to the recurrent laryngeal nerve, parathyroid blood supply, or parathyroidectomy.

Keywords: Anatomy, surgery, thyroid, larynx, dog

Introduction

Nowadays, many cases of diseased dogs visited the veterinary clinics as well as department of surgery of the hospital of the Faculty of Veterinary Medicine, New Valley University. The affected animals suffered from an abnormal growth of the thyro-laryngeal region. The dogs were intended for physical and radiological examination. In case of thyroid tumors, radiographs of the neck may reveal a mass caudal to the pharynx, sometimes with presence of mineralization. The mass may cause deformed laryngeal lumen and compress or displace the trachea ventrally. Esophageal or tracheal displacement and focal dilatation of the esophagus may indicate esophageal tumors. However, neither survey nor contrast radiographs are consistently

reliable in diagnosing esophageal tumors (**Taeymans et al., 2007**).

Regional anatomy of the thyro-laryngeal region was significantly studied for surgical purposes in dogs. The available articles focused on the thyroid gland as the most important structure at the region. Radiological aids were applied for the study by **Taeymans et al. (2007**) and **Rajathi et al. (2019)**. Abnormal masses mainly were recognized to the thyroid gland (**Liptak, 2007**). The gland composed of right and left lobes of an ovoid to longitudinal shape. The former lobe was cranially situated than the left one **(Hollinger, 1979; Herrtage, 1999);** Köing & **Liebich 2004; and Taeymanset al. 2008).** The surgical examination of the thyroid region, however, is scarce in the available literature. The present study aimed to spot a light on the anatomical features of the thyro-laryngeal region, as a critical region for surgical purposes. As well as, for a comparative study to the foreign dog breeds.

Material and Methods

The current study was ethically approved from the animal use and welfare committee of the faculty of veterinary medicine, New Valley University with reference number 06/2021.

This study was applied on ten heads attached to their neck, of adult apparently healthy dogs of both sexes (seven males and three females) of Native (Balady) stray dogs weighing 27±2 kg. The dogs were prepared for the anatomical study, as the animals were euthanized by rapid intravenous administration of a large bolus of sodium thiopental 20% (20 ml, Thiopental, EIPICO, Egypt) (**Sinclair, 2004**). After confirmation of death, the carcasses were injected by 10% formalin solution via the common carotid artery, for preservation. The neck was sharply cut at the level of the last cervical vertebra. The common carotid artery was injected by 15 ml of red colored milky latex solution (Egylatex, ELCO, Egypt). Colorizing the blood vessels was significantly indicated for identifying the arterial distribution. The injected samples were left for 48 hours in room temperature (26±2ºC) for latex hardening.

Dissection started by applying a median longitudinal incision, extended from the mid inter-mandibular space to the level of the third cervical vertebra Fig. (1). After turning off the skin covering the thyro-laryngeal region, fine dissection was applied and the results were recorded.

Results

The **Thyro-laryngeal region** is a pyramidal shaped area, has a rectangular base and apex. The rostral two borders of the base, extends caudo-dorsal from the midpoint of the intermandibular space to the maxillary vein laterally. The caudal boundaries extend caudoventrally to the point of division of the two sternocephalic muscles.

(Figs. 1&3). While the larynx represents the apex of the pyramid.

Superficially, **Fascia coli** wraps around the ventral aspect of the thyro-laryngeal region. It is a thick fibrous coat with superficial and deep faces. The former, is related to the skin and facing ventrally while the deep one is related to the deep fascia coli and facing dorsally. The firmly attached thin muscle fibers of M. sphincter coli superficialis separate the fascia from the skin. The fibers traverse the neck and thyro-laryngeal region ventrally in a horizontal manner (Figs. 2a & b, 3,4 & 5). At the level of larynx, the deep face of the fascia receives the terminal insertion of the parotid-auricularis muscle. The deep fascia coli at the region, roll to separate between the terminal insertions of the cervical muscles and the vital structures.

Linguofacial vein represents the lateral boundaries of the laryngeal region. The vein opens into the external jugular one and crosses the terminal insertion of the sternocephalic muscle. It extends for about 2.2-2.5 cm in length and about 2-2.3 cm lateral to the sternohyoid muscle. Figs. (3,4&8). The linguofacial vein divides into lateral facial and medial lingual veins. The former, continues on the face, while the lingual one receives the hyoid venous arch and cranial laryngeal vein. The former, derives from a median impar lingual vein between both sternohyoid muscles.

The **Mandibular salivary gland** (Fig. 8). It represents the lateral angles of the thyro-laryngeal region. The gland occupies the triangular area between the mandibular angle rostrally, facial vein ventrally and the maxillary vein caudally. The gland enclosed in a fibrous capsule separate it with the sublingual salivary gland from the surrounding structures. It has a lateral convex and medial concave surface; the former, is related to the parotidoauricularis muscle and ramus coli nerve of facial, while the medial one is related to the terminal insertion of sternocephalic muscle. The gland is an ovoid to elliptical shaped mass measures 3.5-3.7cm in length, 2.1-2.3cm in width and 1.9-2.1cm in thickness. The dorsal border of the mandibular gland is related to the sublingual salivary gland while its ventral pole is related to the facial vein. The glandular vein emerges from its cranial border and opens in the facial vein. The mandibular duct arises from rostromedial and dorsal angle of the gland to the mandibular angle. The caudo-dorsal border of the gland receives fine nerve and arterial branch from the facial nerve and artery respectively.

At the ventromedial aspect of the mandibular angle, the **Mandibular lymph node** occupies the angle of division of the linguofacial vein. Figs. (3,4,5&8). Each node consists of two lobes: large medial and small lateral where the facial vein both lobes. The right medial lobe is an ovoid to an elliptical bean

shaped mass with lateral indentation. It has a medial greater curvature and lateral lesser one. The lateral lobe is triangular in shape having a base related to the facial vein and apex to the mandibular angle. Its caudal border is related to the fibrous capsule of the mandibular salivary gland. Its length from the apex to the base is about 1.3-1.4cm, and the base is ranging from 1.7-1.8cm while its thickness reaches 0.6-0.7cm.

The left medial lobe of the mandibular lymph node is broader than the right one. It measures about 2.6-2.7 cm in length from the rostral to the caudal poles and about 1.8-1.9 cm in width. The lateral lobe is c- shaped with greater and lesser curvatures. The former facing–rostrally while the lesser one facing the mandibular salivary gland. It measures about 1.7-1.8cm in length, 0.9-1cm in width and 0.6-0.7cm in thickness.

Sternohyoid and **Sternothyroid muscles** (Figs. 3,4,5,6,7&8) fill the ventrolateral aspect of the trachea. At the cranioventral aspect of the latter, there is a space of triangular area (Fig. 4) with a base cranially and apex caudally situated. The base is represented by the hyoid venous arch and basihyoid while the triangular limbs are the terminal parts of the sternohyoid and sternocephalic muscles. Cranial laryngeal nerve and Ansa cervicalis are hidden under a fatty tissue at this area. The sternohyoid muscle thickness reaches about 0.3-0.6 cm, its fibers run longitudinally covering the ventral aspect of larynx to the basihyoid.

The **Sternothyroid** muscle is an elongated tapered muscle runs on the dorsomedial aspect of sternohyoid. The muscle extends on the ventrolateral border of the trachea and terminates at the thyroid cartilage of larynx. The ventral branch of the 1stand 2nd cervical spinal nerve passes on the dorsal border of the muscle. They give branches for the sternohyoid muscle (Figs. 5,6&7). The terminal part of the sternothyroid muscle covers the ventrolateral aspect of the thyroid gland. The carotid sheath bounds the dorsomedial aspect of the latter in both right and left sides. The sheath traverses both dorsolateral aspect of the trachea. It encloses the common carotid artery, vago-sympathetic trunk, recurrent laryngeal nerve and tracheal lymph duct. The artery and the trunk are closely related and pass laterally while the recurrent nerve runs medially on the lateral border of the trachea Figs. (6&7). At the level of the terminal attachment of the sternothyroid muscle, the cranial thyroid artery detaches from the common carotid artery. It crosses cranially to the cranial pole of the thyroid gland, where a descending branch runs on the ventral border of the thyroid lobe.

The Thyroid gland (Figs. 6&7) represented by fibrous capsulated two separate lobes; right and left, the former is more cranially situated than the left

one. Each lobe lies on the dorsolateral aspects of the cranial part of the trachea. They are elongated elliptical masses with cranial and caudal poles, two surfaces; lateral and medial as well as two borders; dorsal and ventral. The lateral surface is related to the sternothyroid muscle while the medial one is related to the tracheal rings. The cranial pole is related to the cranial thyroid artery and vein while the caudal one receives the cranial thyroid vein from the internal jugular vein.

The right thyroid lobe measures about 2-2.2cm in length, 0.6-0.7cm in width and 0.3-0.5cm in thickness. It extends along the level of first five tracheal rings. The left thyroid lobe measures 2.5-2.6cm in length, 0.7-0.8cm in width and 0.2-0.3cm in thickness. It extends from the level of 2nd to 6th tracheal ring.

Discussion

Anatomical knowledge of the critical body regions was a point of significance for surgeons. On regarding the available literatures, most of the anatomists shaded light on studying the anatomical characteristics of the thyroid gland **Taeymans et al. (2007), Liptak (2007) and Rajathi et al. (2019)**. The recent study declared the characteristic features of the thyro-laryngeal region generally. It included the boundaries, layers, glands, lymph nodes, vascularization and innervations. Moreover, the study aimed to be a guide for surgeons.

The present results determined an imaginary anatomical-surgical boundary for the thyro-laryngeal region. As the latter was a pyramidal area with a rectangular base and an apex formed by the larynx. A result which was not notified in the available literatures.

Description of the superficial and deep layers of the fascia coli in the present work was neglected in the available literatures. As the former layer was a thick fibrous coat enroll the ventral aspect of the thyro-laryngeal region. Its superficial face was the terminal region for the sphincter coli superficialis and parotidoauricularis muscle. Regarding the muscular orientation of the recorded muscle, the study agreed with that recorded by **Evans & de Lahunta (2000), Done et al. (2005) and Budras et al. (2007).**

Concerning the findings of the mandibular salivary gland of this study; it revealed that the gland was enclosed in a common fibrous capsule with the sublingual salivary gland. That was nearly mentioned by **Evans and de Lahunta (2000) and Weidner et al. (2012)** in dog, **Amano et al. (2012)** in rodent and human and **Gaber et al. (2020)** in dog. Regarding the anatomical position of the gland, our results declared out that the gland occupied a triangular area caudally located to the mandibular angle and the facial and maxillary vein ventrally and caudally respectively. A finding which was similarly cited by **Evans and de Lahunta**

(2000) and Gaber et al. (2020). In this aspect, our opinion for the surgical interference of the mandibular gland should be carefully applied superficially (Extra capsular) and deeply (Intra capsular). The former, was determined by the facial and maxillary veins as well as the fibrous capsule of the gland. In the same region, the capsule was covered by the parotidoauricularis muscle and the fine ramus coli nerve of facial. An anatomical structure should be finely dissected during the interference. While during the intra capsular operations, vital structures that need to be handled with care; the glandular vein which arose at the cranial border of the gland, the sublingual gland on its dorsal border as well as the fine branches of the glandular nerve and artery from the facial nerve and artery respectively. An opinion which was in contrast with that mentioned by **Gaber et al. (2020)** as the authors stated that the surgical excision of the gland was safely to the maxillary vein.

A significant anatomical structure in the thyro-laryngeal region was the mandibular lymph node. The present article found that this gland consisted of small lateral and large medial lobes and they were separated by the facial vein. A result which was in an agreement with that of **Done et al. (2005) and Budras et al. (2007).** Regarding that, our findings described the anatomical structure of each lobe of the mandibular lymph node. Where the medial lobes were nearly similar in shape while the lateral ones were different. This result was not cited in the available literatures. It was significant to note that, the abnormal findings in the ventromedial aspect of the mandibular angel may be referred to the affection of the mandibular lymph nodes. Moreover, the surgical interference was superficially intended where the facial vein finely dissected.

Anatomical-surgical description of the thyroid gland was attended in the present work. The gland was represented as right and left lobes that were enclosed in a separate fibrous capsule, where the right lobe was cranially situated to the left one. A finding which was in agreement with **Hollinger (1979), Herrtage (1999), Bromel (2006), Liptak (2007) and Taeymans (2008). Liptak** (2007) have the opinion that the thyroid lobes were attached to a fascia along the ventrolateral surface of the proximal part of trachea. That was inconstant with our results, where the thyroid lobes were located on both dorsolateral aspects of the cranial part of trachea. Similar description was mentioned by **Taeymans et al. (2008)**. On the other hand, **Hollinger (1979), Frewein (1994), König and Liebich (2004) and Mayer and McDonald (2007)** found a thin isthmus traversed the trachea ventrally and connected both caudal thyroid lobes in large dog breeds.

Regarding the anatomical position of the thyroid lobes; our study revealed that the right lobe extended along the first five tracheal rings while the left one extended from the second to the sixth tracheal rings. While **Taeymans et al. (2008)** mentioned that the thyroid lobes occupied from the first to eighth tracheal ring. **Hollinger (1979), Herrtage (1999) and König and Liebich (2004)** mentioned that the thyroid lobes extended from the level of cricoids cartilage to the fifth to the eighth tracheal rings. Similar results were recorded by **Mayer and McDonald (2007)**.The authors stated that the right thyroid lobe extended caudally to the cricoids cartilage to the fifth tracheal ring while the left lobe extended from the third to the eighth tracheal rings.

The thyroid lobes shape of our findings revealed that each thyroid lobe was elongated elliptical in shape. A result which nearly agreed with that of **Bromelet al. (2005) and Rajathi et al. (2019).** On the other hand, the thyroid volume in the recent work declared out that the left thyroid lobe was slightly larger than that of the right one. That was in an agreement with the opinion of **Bromelet al. (2005) and Rajathi et al. (2019).**

It was a significantly to notify that, the anatomical point of view for the surgical interference to the thyroid gland in our work, depended on the description of the anatomical structures that surrounded the thyroid lobes. The latter were deeply hidden on the deep face of the terminal insertion of the sternothyroid muscle, and the radiographs did not offer a significant diagnosis for the lesion (fig. 9). Each lobe was guarded dorsolateral by the carotid sheath; the latter comprised the common carotid artery, vago-sympathetic trunk, recurrent laryngeal nerve, and tracheal lymph duct. Near arrangement was mentioned by **Hollinger (1979)** who observed that the thyroid lobes were bounded ventrally by the sternocephalic and sternohyoid muscles and the esophagus separated the left carotid sheath from the thyroid lobe. A result which was contrary to the present study.

Regarding the critical anatomical position of the thyroid lobes in the present findings, the surgical interference should be applied through the median approach, where turning off the sternohyoid muscle is laterally and reach the affected lobe medially. As the lateral interference between the sternohyoid and sternothyroid was risky because the ventral branches of the first and second cervical nerves pass. In addition, to saving the carotid sheath in both right and left sides.

Conclusion

Care should be taken during the intra capsular intervention, to avoid damage to vital structures.

Further clinical surgical study is needed regarding the anatomical description reported in the current study.

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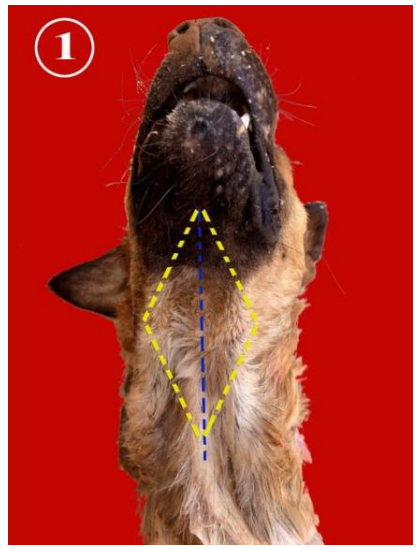

Fig. (1): A photograph showing the ventral aspect of the head and neck. The blue dotted line indicates the guide of incision the yellow dotted area indicates the outer boundaries of the thyro-laryngeal region.

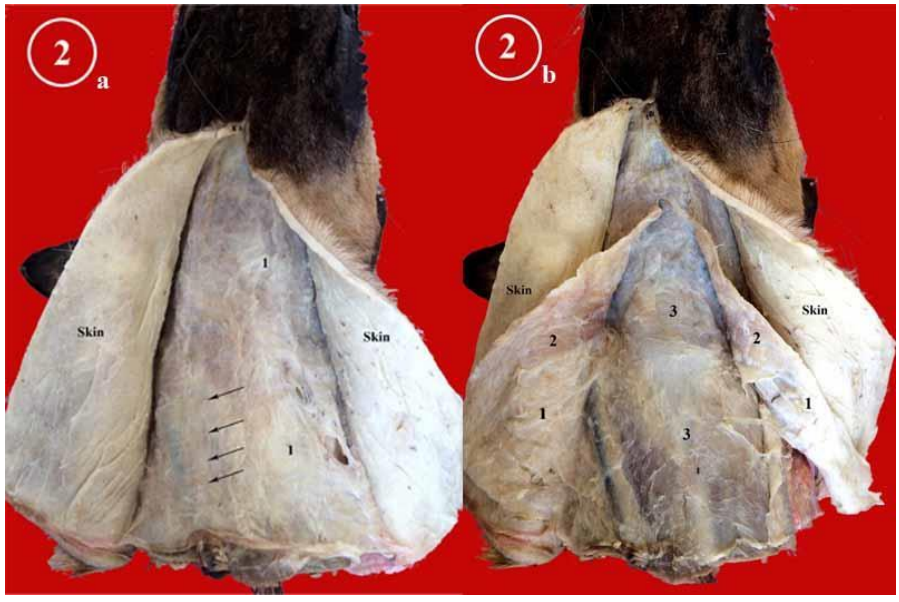

Fig. (2): A photograph showing the superficial dissection of the ventral aspect of neck (a) and deeper one (b). 1, Facia coli (superficial part), 2, Parotido-auricular muscle, 3, Facia coli (deep part), The arrows indicate the fibers of the sphincter coli superficialis muscle.

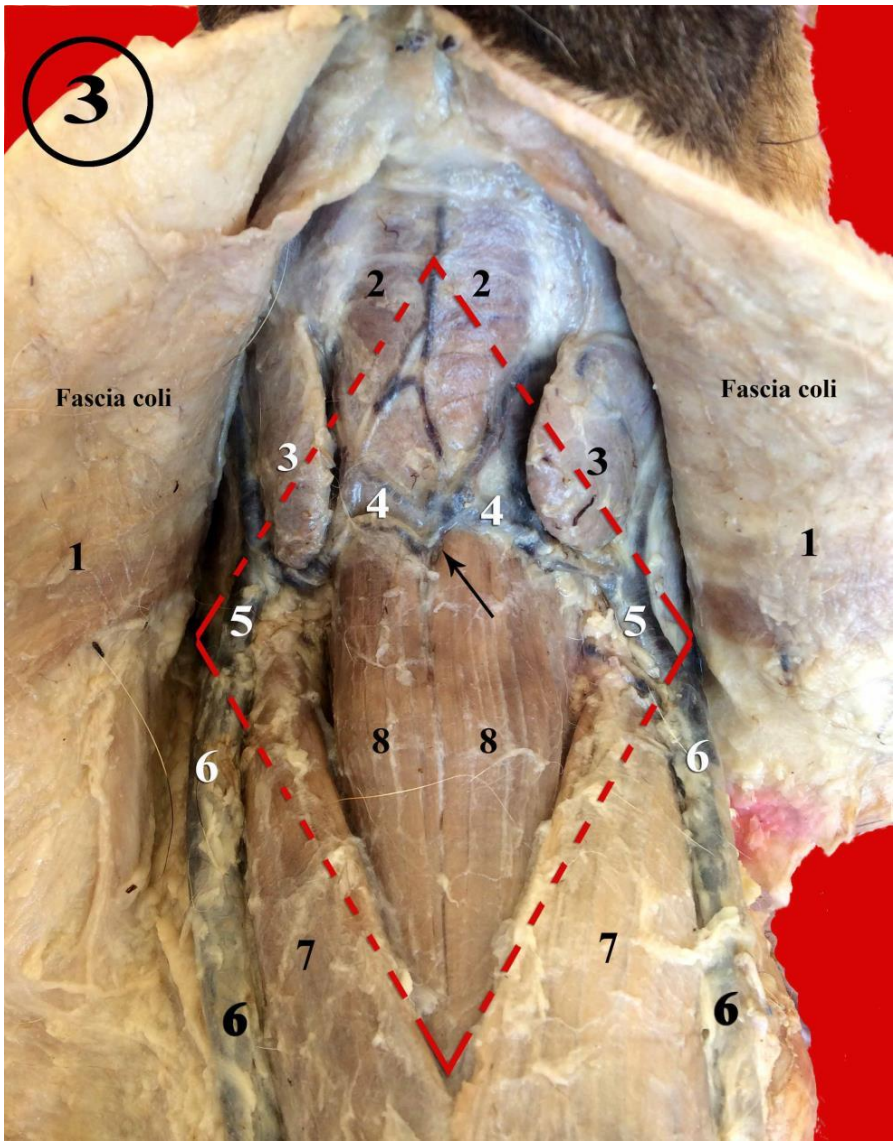

Fig. (3): A photograph showing deep dissection of the thyro-laryngeal region.

1, Parotido-auricular muscle, 2, Mylohyoid muscle, 3, Mandibular lymph node (medial part), 4, Hyoid venous arch, 5, Linguofacial vein, 6, External jugular vein, 7, Sternocephalic muscle, 8, Sternohyoid muscle. The black arrow, indicates the impar vein. The red dotted area indicates the boundaries of thyro-laryngeal region.

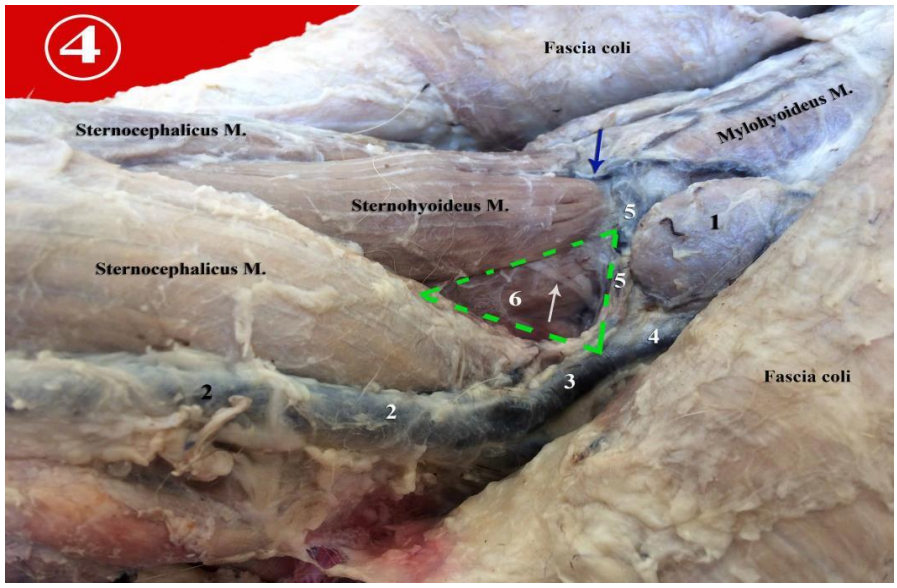

Fig. (4): A photograph showing deep dissection of the thyro-laryngeal region (lateral view). 1, Mandibular lymph node (medial part), 2, External jugular vein, 3, Linguofacial vein, 4, Facial vein, 5, Lingual vein, 6, Thyrohyoid muscle**, The blue arrow** indicates the impar lingual vein**, The white arrow** indicates the ansa cervicalis**, The green dotted area** indicates the area for ansa cervicalis.

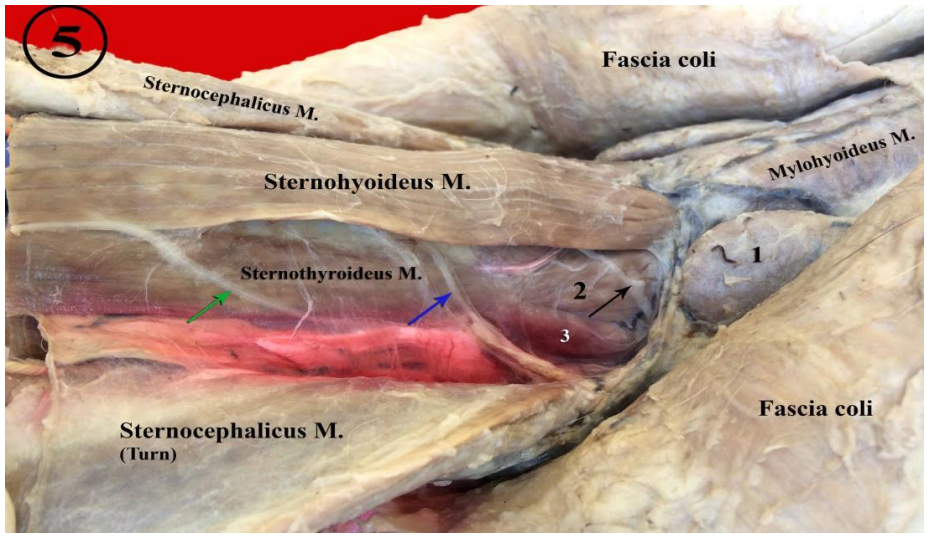

Fig. (5): A photograph showing deep dissection of the thyro-laryngeal region (lateral view). 1, Mandibular lymph node (medial part)**, 2,** Thyrohyoid muscle **, 3,** Cricopharyngeus muscle**, The black arrow** indicates ansa cervicalis**, The blue arrow** indicates the ventral branch of first cervical nerve**, The green arrow** indicates the ventral branch of the second cervical nerve.

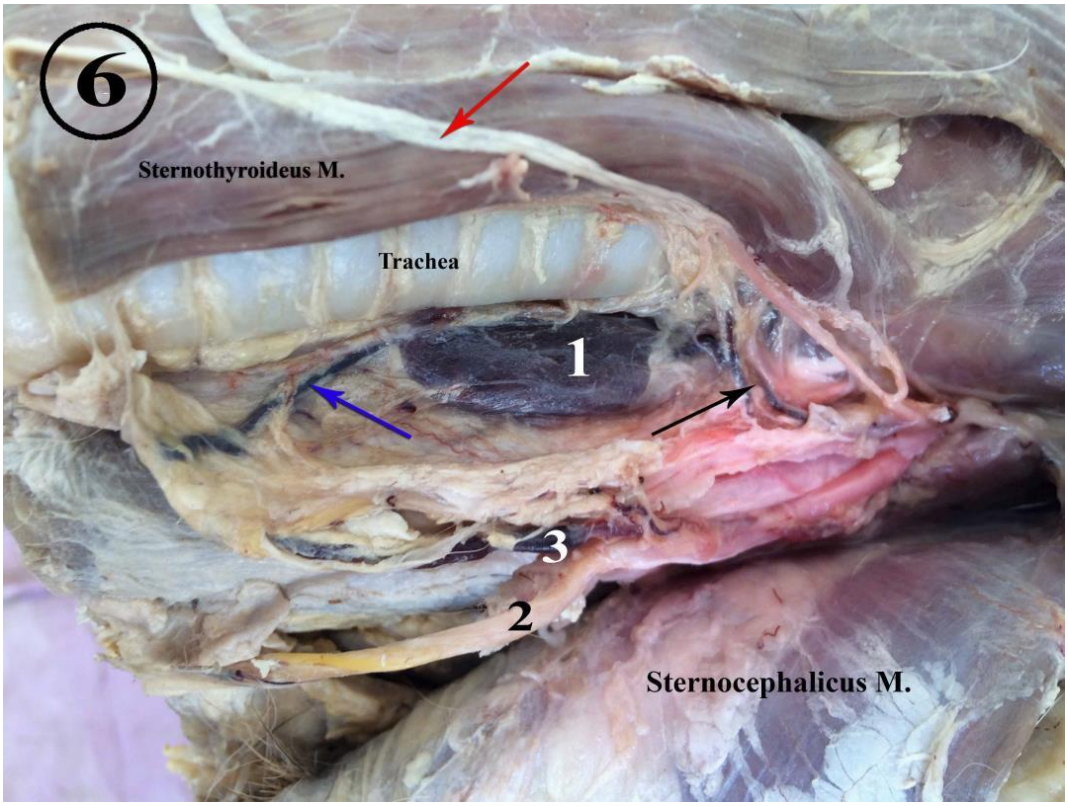

Fig. (6): A photograph showing deep dissection of the thyroid region (lateral view).

1, Thyroid gland (left lobe), 2, Vago- sympathetic trunk, 3, Internal jugular vein, The black arrow indicates the cranial artery and vein, The blue arrow indicates the caudal thyroid vein, The red arrow indicates the ventral branch of first cervical nerve

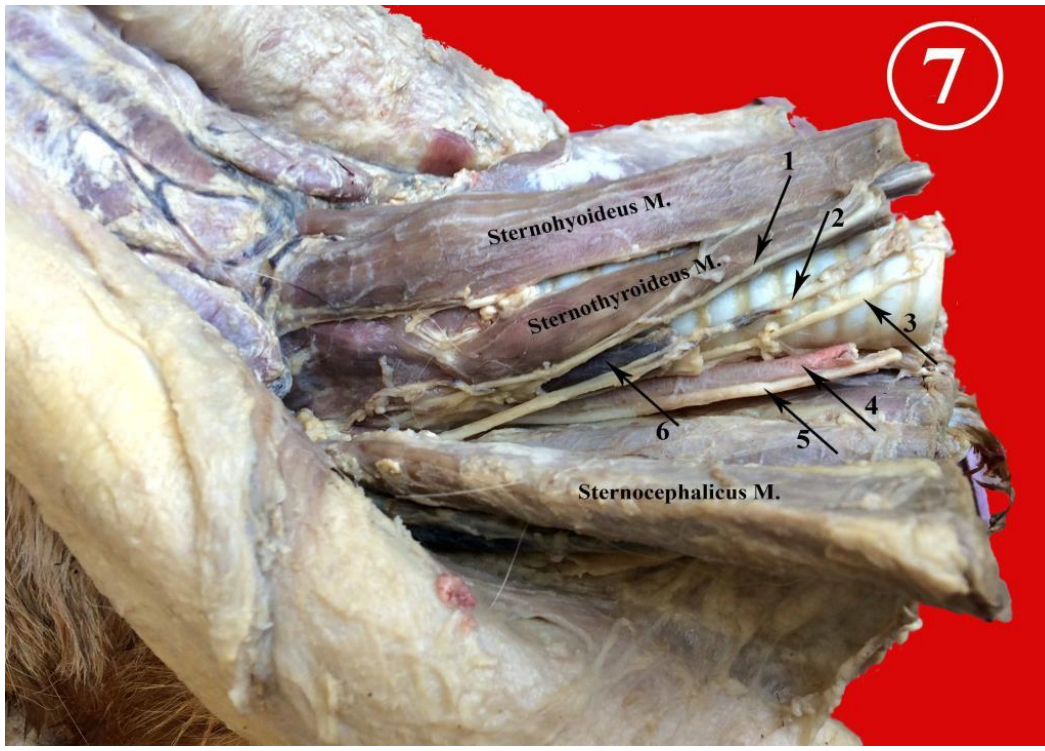

Fig. (7): A photograph showing deep dissection of the thyroid region (lateral view).

1, Ventral branch of second cervical nerve, 2-Tracheal lymph duct, 3-Recurrent laryngeal nerve, 4-Common carotid artery, 5-Vagosympathetic trunk, 6-Thyroid gland (right lobe).

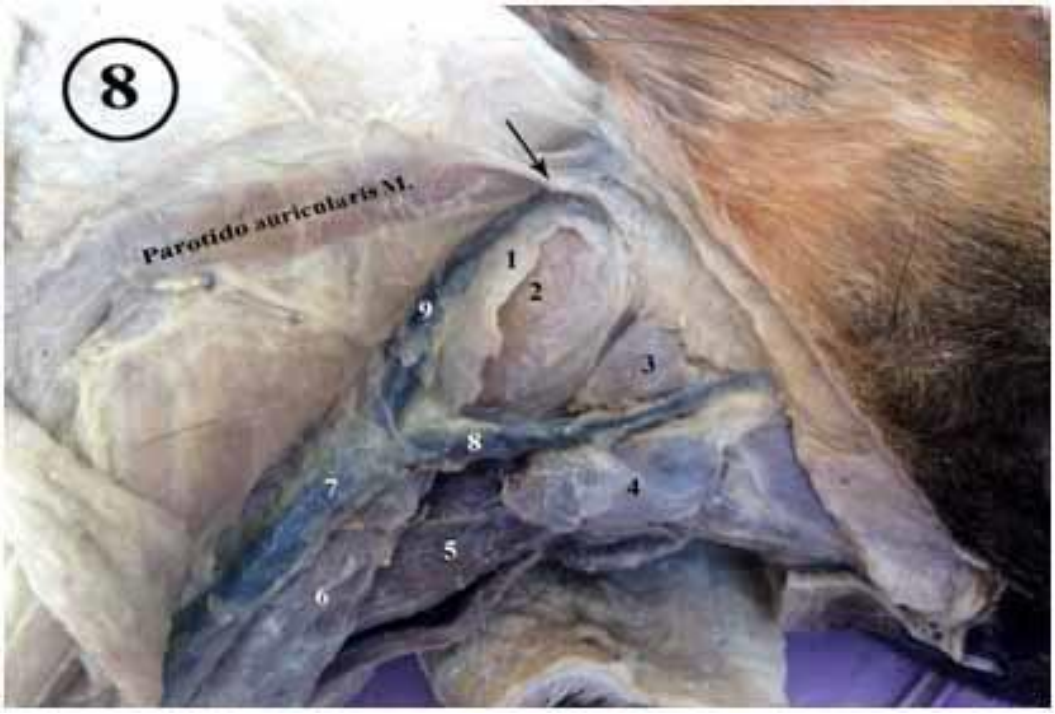

Fig. (8): A photograph showing superficial dissection of the thyro-laryngeal region (lateral view).

1, Fibrous capsule of the mandibular salivary gland, 2, Mandibular salivary gland, 3, Small lateral lobe of the mandibular lymph node, 4, Large medial lobe of the mandibular lymph node, 5, Sternohyoid muscle, 6, Sternocephalic muscle, 7, External jugular vein, 8, Linguofacial vein, 9, Maxillary vein.

Fig. (9): A photograph showing plain radiograph of the thyro-laryngeal region (left lateral view), showing nonspecific space occupying mass with vague organ relations and nature (red circle).