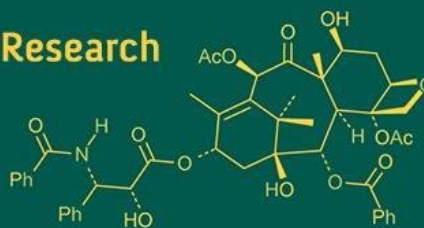


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Malvika Maru
Department of Veterinary
Anatomy, College of
Veterinary and Animal
Science, RAJUVAS, Bikaner,
Rajasthan, India

Pankaj Kumar Thanvi
Department of Veterinary
Anatomy, College of
Veterinary and Animal
Science, RAJUVAS, Bikaner,
Rajasthan, India

Ashok Dangi
Department of Veterinary
Anatomy, College of
Veterinary and Animal
Science, RAJUVAS, Bikaner,
Rajasthan, India

Devendra Singh
Department of Veterinary
Anatomy, College of
Veterinary and Animal
Science, RAJUVAS, Bikaner,
Rajasthan, India

Devendra Saran
Department of Veterinary
Anatomy, College of
Veterinary and Animal
Science, Jodhpur, RAJUVAS,
Bikaner, Rajasthan

Mamta Kumari
Department of Veterinary
Anatomy, College of
Veterinary and Animal
Science, RAJUVAS, Bikaner,
Rajasthan, India

Corresponding Author:
Malvika Maru
Department of Veterinary
Anatomy, College of
Veterinary and Animal
Science, RAJUVAS, Bikaner,
Rajasthan, India

Gross morphological study on the thyroid gland of dog (*Canis lupus familiaris*)

**Malvika Maru, Pankaj Kumar Thanvi, Ashok Dangi, Devendra Singh,
Devendra Saran and Mamta Kumari**

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Abstract

Gross investigation into the ten-thyroid gland of dog was done. The dog thyroid gland contained two separate lobes that were right and left. Both the lobes were placed behind the cricoid cartilage and lateral to the trachea. The colour of thyroid gland was reddish brown and the shape was ellipsoidal and roughly triangular. The lobes were situated between the level of first to eighth tracheal cartilage. Right lobe was placed cranially than the left lobe. The gland was cranially related with cricothyroideus muscle, laterally sternoccephalicus and ventrally with sternothyroideus. In the biometrical data, weight, volume, width and thickness were greater in left lobe while length was greater in right lobe. In the present study isthmus was not found.

Keywords: Dog, gross, thyroid gland, trachea

Introduction

Dogs hold symbolic position in many cultures and religions around the globe. Dog (*Canis lupus familiaris*), member of Canidae family and is the domesticated descendent of wolves. Dogs have lived with humans as hunting companions for years and are known as man's best friend. Dogs are loyal, obedient and bring joy and happiness through their affectionate nature and deep emotional bonds with their owner. In social, emotional and practical well-being dogs have multifaceted importance. Wide varieties of dog breeds are grouped into sporting, working and non-sporting. They have been helper for farmers in the protection of flocks, guide for the blind, assets for police and armed forces. Thyroid gland is the largest among endocrine glands and earliest identifiable endocrine structure during development (Abbas *et al.*, 2012) [2]. In dogs, two lobes are present lateral to the first six to seven tracheal rings (Getty, 1975) [7]. Thyroid colloid is surrounded by cuboidal follicular cells, some singly present parafollicular cells and contain protein-iodine complex called thyroglobulin. Follicular cells and parafollicular 'C' cells produce thyroxine and calcitonin respectively (Frandsen *et al.*, 2009) [6]. The detailed anatomical description on the thyroid gland of dog is scanty. Scarce work on the anatomy of thyroid gland of dog evoked interest in undertaking the present study. This investigation will provide the baseline data on the gross details of thyroid gland of dog.

Materials and Methods

Total ten thyroid glands from apparently healthy, recently dead dogs were collected from the Veterinary Clinical Complex, C.V.A.S., Bikaner (RAJUVAS, Bikaner). These samples were devoid of any thyroid-related pathological conditions. The gross studies were done on these samples. Shape and colour were studied just after sample collection. Topographical study was performed 'in-situ' thyroid gland before being dissected out from the animals (Fig. 1, 2). Various measurements were taken Weight was taken with the help of weighing balance. Length and width were measured by measuring scale. Thickness was measured by Vernier caliper. Volume was measured by water displacement method with the help of measuring cylinder.

Results and Discussion

In the present study dog thyroid was bilobed structure contained right and left lobe lateral to

the trachea (Fig. 1). The result was in accordance with Getty (1975) ^[7] in horse, ox, dog and sheep; Hamad (2008) ^[8] in gaddi sheep and gaddi goat; Hussain (2010) ^[10] in goat; Peterson (2012) ^[16] in cat; Joshi and Mathur (2015) ^[11] in goat; Doley and Chakravorty (2016) ^[5] in human, pig and goat; Khaleel and Salih (2017a) ^[12] in gazelle and sheep; Dar (2018) ^[4] in goat, Poobitha (2020) ^[17] in goat; Hammodi and Al Aamery (2023) ^[9] in cat whereas Singh (2007) ^[18] explained the pig thyroid as single lobed gland.

Shape and Colour

The colour of lobes was reddish-brown. Similar findings were reported by Hamad (2008) ^[8] in goat; Joshi and Mathur (2015) ^[11] in goat; Doley and Chakravorty (2016) ^[5] in goat; Khaleel and Salih (2017a) ^[12] in gazelle and sheep; Dar *et al.* (2018) ^[4] in Bakerwali goat; Kumar *et al.* (2018) ^[13] in dog; Hammodi and Al Aamery (2023) ^[9] in domestic cat. While Getty (1975) ^[7] in horse thyroid described that the lobes were large, dark red-brown; in ox and calf pale and dark red coloured respectively; in sheep dark red; Maala and Reynoso (1987) ^[14] in carabao brownish red lobes; Bhardwaj *et al.* (2006) ^[3] noted that in Gaddi sheep and goat dark brown; Singh (2007) ^[18] in pig brown to red colour single lobe was observed; Peterson (2012) ^[16] found that the feline thyroid was cream to tan in colour.

Right lobe was ellipsoidal or elongated and left lobe was elongated or roughly triangular in shape. The lobes had two surfaces and two ends. The medial surface was nearly flat (Fig. 4). The results were in line with the studies done by Getty (1975) ^[7] in sheep; Doley and Chakravorty (2016) ^[5] in goat; Dar *et al.* (2018) ^[4] in Bakerwali goat; Kumar *et al.* (2018) ^[13] in dog and fowl. However, Getty (1975) ^[7] explained that lobes were oval in horse, unevenly triangular in ox and pig. Bhardwaj *et al.* (2006) ^[3] noted that in Gaddi sheep and goat almond shaped lobes whereas Hamad (2008) ^[8] noted that in goat thyroid was oval in shape with cranial extremity round and caudal extremity narrow. Ali *et al.* (2015) ^[1] found oval lobes in sheep whereas Joshi and Mathur (2015) ^[11] found almond shaped dark reddish-brown coloured lobes in goat; Khaleel and Salih (2017a) ^[12] said that the lobes were oval elongated or elliptical in sheep and gazelle. Poobitha *et al.* (2020) ^[17] found fusiform thyroid lobes in goat. Hammodi and Al Aamery (2023) ^[9] described that the cat thyroid lobes were oval to elliptical in shape. Cranial end was thick, rounded and broad while caudal end was comparatively narrow (Fig. 4). The dorsal border was comparatively thicker than the ventral border (Fig. 3).

Isthmus was not observed in the present study which was in line with the results of Hammodi and Al Aamery (2023) ^[9] in feline thyroid, in partial agreement with Getty (1975) ^[7] who found isthmus was inconsistent in dog. In contrast Getty (1975) ^[7] found that in ox isthmus was band like with the width of 0.5-1 cm present, in horse isthmus was attached to the posterior end, in sheep 6 to 8mm broad isthmus was present at fifth tracheal cartilage whereas in pig indistinct isthmus was observed. Maala and Reynoso (1987) ^[14] described that isthmus was present between the cricoid cartilage and first tracheal ring. Bhardwaj *et al.* (2006) ^[3] explained that isthmus was connected about 0.5 cm above from posterior end in Gaddi sheep while just at the caudal end over fifth or sixth tracheal cartilage in Gaddi goat. Khaleel and Salih (2017a) ^[12] said that isthmus was thin tissue connecting the lobes of thyroid and located at the

level of seventh and eighth tracheal cartilage in gazelle while at fourth tracheal cartilage level in sheep. Nandeshwar *et al.* (2023) ^[15] found narrow band, isthmus connecting both the lobes in goat.

Topography

The lobes were found caudal to the cricoid cartilage, lateral to the trachea (Fig. 2). The location of lobes varied between first tracheal cartilage to eighth cartilage and right lobe was found to be comparatively cranial to the left lobe these results were in congruence with Hamad (2008) ^[8] in goat. In contrast, Getty (1975) ^[7] located sheep and dog thyroid between first to six or seven tracheal cartilages; in carabao Maala and Reynoso (1987) ^[14] said that lobes were found attached between cricoid cartilage to third tracheal cartilage. Swindle (1998) ^[20] found thyroid gland at the level of thoracic inlet ventral to the trachea in pig. Bhardwaj (2006) ^[3] found that in gaddi sheep fifth to seventh and ninth tracheal ring and in gaddi goat extended to the fifth tracheal cartilage. Kaleel and Salih (2017a) ^[12] found that gazelle right and left thyroid lobe extended from first to sixth tracheal cartilage and second to seventh tracheal cartilage respectively; in sheep right lobe was found till fifth tracheal ring whereas left lobe till sixth tracheal ring. In the Bakerwali goat Dar *et al.* (2018) ^[4] described that right and left lobes were extended from caudal to cricoid cartilage to fifth and seventh tracheal cartilage respectively. In feline Hammodi and Al Aamery (2023) ^[9] said lobe were extended between first to fifth tracheal ring whereas Nandeshwar *et al.* (2023) ^[15] found lobes between first to fourth tracheal cartilage in goat. The gland was cranially related to the cricoid cartilage and cricothyroideus muscle. The sternocephalicus muscle ran just lateral to the convex surface of each lobe, while the sternothyroideus muscle covered each lobe ventrally (Fig. 1). The dorsal border of the left lobe was related to the esophagus (Fig. 2).

Measurements

Weight and volume

Weight of thyroid lobes were found 1.34 ± 0.07 gms and 1.37 ± 0.11 gms right and left lobe respectively (Table 1). Getty (1975) ^[7] found that ox thyroid weighed about 14-15 gms whereas in horse weighed about 15 gms. Suuroja *et al.* (2003) ^[19] found that mean weight was ranged between 10.3 to 12.8 gm in 0-6month old calves. Bhardwaj *et al.* (2006) ^[3] described weight of left lobe was 1.50 ± 0.17 gm and 1.43 ± 0.20 gm in right lobe of Gaddi sheep further, in Gaddi goat weight was 2.21 ± 0.22 gm in left lobe and 2.14 ± 0.33 gm in right lobe. While Hamad (2008) ^[8] said that the weight of left and right lobe was about 1 gm and 1.5-2 gm in goat. Doley and Chakravorty (2016) ^[5] on the study of thyroid gland found that mean weight was 25.72 gm in human 5.24 gm in pig and 6.93 gm in goat. Poobitha *et al.* (2020) ^[17] described the range of average weight was 0.398 gm to 0.69 gm in goats of up to 3-year-old age.

Volume was 1.32 ± 0.04 ml and 1.33 ± 0.07 ml right and left lobe respectively (Table 1). Suuroja *et al.* (2003) ^[19] found that mean volume ranged between 10.1 ml to 12.2 ml in 0-6 month old calves. Bhardwaj *et al.* (2006) ^[3] described volume of left lobe was 1.57 ± 0.15 ml and 1.30 ± 0.20 ml in right lobe of Gaddi sheep further, in Gaddi goat weight and volume was 2.08 ± 0.08 ml in left lobe and 2.12 ± 0.42 ml in right lobe.

Length and width

Length of right and left lobe was found to be 2.53 ± 0.11 cm and 2.28 ± 0.09 cm (Table 1). Getty (1975) [7] in ox lobes were about 8 cm in length, in horse length was about 5 cm and width about 1.5-2 cm, in pig length was about 5 to 6 cm. Maala and Reynoso (1987) [14] said the length of lobes was 3.6-4.5 cm in carabao. According to the findings of Bhardwaj *et al.* (2006) [3] length of left and right thyroid lobe in Gaddi sheep was 3.68 ± 0.28 and 3.20 ± 0.15 cm whereas in Gaddi goat length was 3.20 ± 0.21 and 2.97 ± 0.21 cm. Hamad (2008) [8] found that left and right lobes were about 1.5-3 cm and 2.5 cm in length in goat. Peterson (2012) [16] found out that feline thyroid was measured about 1 cm in length. Joshi and Mathur (2015) [11] said that right lobe was larger than left lobe and overall measurements were found greater in right lobe. Dar *et al.* (2018) [4] stated the length of left and right lobe was 3.44 ± 0.2 cm and 2.82 ± 0.08 cm in prepubertal group; 4.5 ± 0.026 cm and 3.80 ± 0.39 cm in pubertal group whereas 4.7 ± 0.22 cm and 4.07 ± 0.09 cm in senile group. Poobitha *et al.* (2020) [17] explained that the mean length of goat thyroid ranged between 1.4 cm to 2.6 cm in less than 6month age group to 3-year-old age group.

In this study maximum mean width of right and left lobe was found to be 1.07 ± 0.10 cm and 1.08 ± 0.10 cm (Table 1). Maala and Reynoso (1987) [14] said the width was 2.6-3.7 cm in carabao. According to the findings of Bhardwaj *et al.* (2006) [3] mean width in Gaddi sheep was found 1.28 ± 0.09 and 1.28 ± 0.10 cm while in Gaddi goat 1.30 ± 0.05 and 1.33 ± 0.08 cm in left and right lobe respectively. Hamad (2008) [8] found that left and right lobes were 1 cm and 1.5 cm in width in goat. Peterson (2012) [16] found out that feline thyroid was measured about 3-5 mm in width. Doley and Chakravorty (2016) [5] said that the average length of thyroid in human was 5.35 cm and 5.13 cm in right and left lobe: in pig 5.49 cm and 5.59 cm while 1.46 cm and 1.41 cm in goat. Width observed was 2.96 cm and 2.95 cm in humans, 1.01 cm and 1.03 cm in pig and 0.53 cm and 0.52 cm in goat right and left lobes. Dar *et al.* (2018) [4] stated the width of right and left lobe 1.02 ± 0.03 cm and 1.04 ± 0.17 cm in prepubertal, 1.07 ± 0.05 cm and 1.17 ± 0.11 cm in pubertal and 1.37 ± 0.05 cm and 1.49 ± 0.11 cm in senile group was observed. Poobitha *et al.* (2020) [17] stated the width in the age groups less than 6month to 3-year-old age group ranged between 0.8 cm to 1.0 cm.

Thickness

Average thickness was maximum at middle portion and measured about 0.45 ± 0.07 cm in right lobe and 0.45 ± 0.10 cm in left lobe (Table 1). Maala and Reynoso (1987) [14] found that 0.9-1.2 cm thick lobes in carabao. Bhardwaj *et al.* (2006) [3] reported mean thickness of left and right lobe was 0.57 ± 0.04 and 0.52 ± 0.04 cm in Gaddi sheep while 0.80 ± 0.03 and 0.80 ± 0.05 cm in Gaddi goat. Peterson (2012) [16] found out that feline thyroid was measured about 1-2 mm in thickness. Doley and Chakravorty (2016) found out that mean thickness 1.95 cm and 1.95 cm in right and left lobe of human thyroid, 0.56 cm and 0.54 cm in pig and 0.42 cm and 0.41 cm in goat. Dar *et al.* (2018) [4] found out the thickness of right and left lobe was 0.55 ± 0.02 cm and 0.60 ± 0.05 cm in prepubertal, 0.63 ± 0.04 cm and 0.71 ± 0.04 cm in pubertal and 0.79 ± 0.06 cm and 0.97 ± 0.05 cm in senile group.

The dog thyroid lobes were reddish brown in colour and elliptical elongated and roughly triangular in shape. Cranial

end was broad while caudal end was tapered. The lobes were extended between first to eighth tracheal ring and right lobe was located comparatively cranial than the left lobe. In the biometrical data, weight, volume, width and thickness were greater in left lobe while length was greater in right lobe.

Table 1: Different measurements collected for the gross study of the dog thyroid gland. Mean $\pm$ Standard error

Sample	Right Lobe	Left Lobe
Weight (gm)	1.34 ± 0.07	1.37 ± 0.11
Volume (ml)	1.32 ± 0.04	1.33 ± 0.07
Length (cm)	2.53 ± 0.11	2.28 ± 0.09
Width (cm)	1.07 ± 0.10	1.08 ± 0.10
Thickness(cm)	0.45 ± 0.07	0.45 ± 0.10

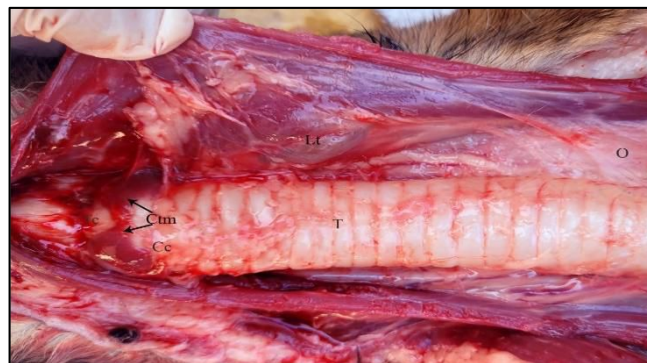


Fig 1: Topographical photograph of Rt-Right lobe and Lt-Left lobe of dog thyroid gland. Scm-Sternocephalicus muscle, Stm-Sternothyroideus muscle, L-Larynx, T-Trachea, Ta-Thyroid artery, Tv-Thyroid vein.



Fig 2: Topographical photograph of left thyroid gland along with T-Trachea, O-Oesophagus. Tc-Thyroid cartilage, Cc-Cricoid cartilage, Ctm-Cricothyroid muscle.

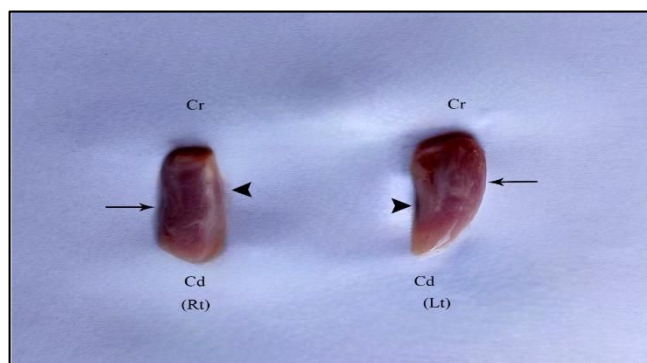


Fig 3: Photograph of dog thyroid gland Lateral surface of right and left lobe. Cr-Cranial extremity, Cd-Caudal extremity, Arrow-Dorsal border, Arrowhead-Ventral border



Fig 4: Photograph of Rt-Right lobe and Lt-Left lobe of dog Thyroid gland showing Medial surface. Cr-Cranial extremity, Cd-Caudal extremity.

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