Journal of Animal Research: v.9 n.4, p. 527-532. August 2019

DOI: 10.30954/2277-940X.04.2019.5

Ultrasound Anatomy of the Thyroid Gland in Dogs

S. Rajathi[1*], Geetha Ramesh[1], T. A. Kannan[1], D. Sumathi[2] and K. Raja[1]

[1]Department of Veterinary Anatomy, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, INDIA

[2]Department of Veterinary Clinical Medicine, Madras Veterinary College, Tamil Nadu Veterinary and Animal Sciences University, INDIA

[*]Corresponding author: S Rajathi; Email: srajathi9936@yahoo.in

Received: 22 May, 2019 **Revised:** 12 July, 2019 **Accepted:** 21 July, 2019

ABSTRACT

Ultrasonography is a method of choice for imaging visceral organs in animals. The aim of the study was to determine the ultrasonographic characteristics of the thyroid gland in healthy dogs and to correlate the relationships of thyroid gland size and volume with body weight. A total of 24 apparently healthy dogs of different breeds were grouped into four groups (each with 6 animals) based on their body weight viz., less than 7 Kgs, 7-15 kgs, 15-30 kgs and more than 30 kgs. Each thyroid lobe was ultrasonographically observed in both transverse and longitudinal planes. The maximal length, width and height of each lobe and thyroid volume were measured. The data were analyzed statistically. In all the groups, thyroid lobes were round to oval in transverse images and fusiform or elliptical in longitudinal images with the smooth capsule. The parenchyma of the thyroid lobes had a homogenous echogenic pattern. There was no significant difference observed between the mean height, length, width and volume of both the lobes of the thyroid gland with body weight among the four groups at 5% level of significance ($p< 0.05$).

Keywords: Ultrasound anatomy, Thyroid gland, Dog, Clinical anatomy

In dogs, ultrasonography is the method of choice for imaging visceral organs, whether located within the body cavity or superficially. The thyroid gland, because of its superficial location of approximately 1.5-2 cm below the surface of the skin, high-frequency transducers of at least 10 MHz can be used to examine the gland. This results in a high spatial resolution of the image, which makes ultrasonography, a very well suited imaging modality for the examination of the thyroid gland. The other advantages of ultrasonography are its widespread availability, cost-effectiveness, absence of ionizing radiation and short duration for examination. Sedation or anaesthesia is rarely required for ultrasonography. The advent of high-resolution ultrasonography and Fine Needle Aspiration (FNA) has decreased the indications for radioisotope thyroid scanning in people (Hopkins and Reading, 1995).

Mayer and MacDonald (2007) stated that infrequently, an isthmus located ventral to the trachea connected the lobes and the right lobe was in close proximity to the common carotid artery, the internal jugular vein, and the vagosympathetic trunk; the left lobe was in close proximity to the caudal laryngeal nerve and the esophagus. The thyroid gland secretes thyroxine and triiodothyronine hormones which regulate basal metabolism, oxygen use, nutrient metabolism, the production of ATP, and calcium homeostasis. The normal thyroid gland in canine consisted of a right lobe, which extended from the caudal border of the cricoid cartilage of the larynx to the level of the 5th tracheal ring, and a slightly more caudal left lobe, which extended from the level of the 3rd to 8th tracheal ring. The study was undertaken with the following objectives namely to study the ultrasonographic characteristics of the thyroid gland in healthy dogs and to correlate the

How to cite this article: Rajathi, S., Ramesh, G., Kannan, T.A., Sumathi, D. and Raja, K. (2019). Ultrasound anatomy of the thyroid gland in dogs. *J. Anim. Res.*, **9**(4): 01-06.

relationships of thyroid gland size and volume with the body weight. The objectives of the present study were to study the ultrasonographic characteristics of the thyroid gland in healthy dogs and to correlate the relationships of thyroid gland size and volume with the body weight.

MATERIALS AND METHODS

Selection of Animals

The study consisted of apparently healthy dogs of different breeds brought to the Madras Veterinary College Teaching Hospital.

Design of study

The dogs were grouped into four groups based on their body weight as follows:

Group 1: Apparently healthy dogs with body weight less than 7 kg (n=6)

Group 2: Apparently healthy dogs with body weight between 7 and 15 kg (n=6)

Group 3: Apparently healthy dogs with body weight between 15 and 30 kg (n=6)

Group 4: Apparently healthy dogs with body weight above 30 kg (n=6)

Ultrasonography of the Thyroid gland

Hair was clipped from the ventral aspect of the neck, in a region from the larynx to 10-15 cm more caudally. Dogs were placed in dorsal recumbency without anaesthesia or sedation and were restrained manually. Both the lobes of the thyroid gland was scanned with a linear array high-frequency transducer (7-12 MHz) to increase the spatial resolution of the images. Each lobe was first observed in a transverse plane (Fig. 1).

Scanning with minimal transducer pressure was started in the midline, just caudal to the larynx, followed by a slow gliding motion of the probe caudally. Landmarks used for localization of each lobe were the common carotid arteries laterally, medially the trachea, and ventrally the sternothyroideus muscle. An additional landmark for the left lobe was the dorsally located esophagus (Wisner *et al.,* 1991). The maximum height and width of each lobe were measured on transverse images by use of electronic calipers with a precision of one-tenth of a millimeter.

Fig. 1: Photograph showing positioning of the transducer on the ventral side of the neck

Following this, a longitudinal image of each lobe was obtained either by slowly rotating the probe by 90° or by using a longitudinal image of the common carotid artery (Fig. 2) and the trachea as landmarks as per Wisner *et al.* (1991). The maximum length of each lobe, excluding the cranially located external parathyroid gland if visible, was obtained in this plane.

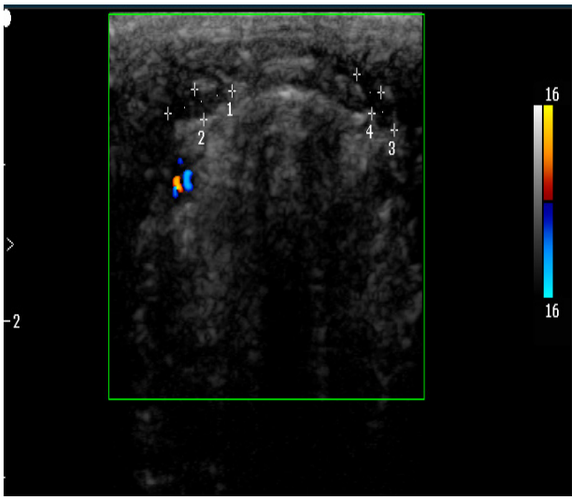

Fig. 2: Colour Doppler Ultrasonographic image showing thyroid gland in Group 3. Red colour – Carotid artery, Blue colour – Jugular vein. Measurements 1 showing the height of the right lobe, 2 – width of right lobe, 3 - height of the left lobe, 4 – width of left lobe on transverse images.

Data analysis

The maximum width, height and length of each lobe were used to calculate the volume of each lobe according to a formula of a rotation ellipse [volume (cm^3) = length (cm) × width (cm) × height (cm) × 0.479] (Taeymans *et al.*, 2007). Total thyroid volume was given by the sum of right and left thyroid lobe volumes (Bromel *et al.*, 2005).

Statistical analysis

The derivation of the 95 % confidence interval was based on the binomial distribution assumption. Student 't' test was conducted to find out the significant difference between the mean length, width, height, volume of the left and right lobes with body weight. The Spearman rank correlation coefficient between the mean length, width, height, volume of the left and right lobes and total thyroid volume with the body weight was calculated. All analyses were performed in microsoft excel software at a significance level of 5% (Rice, 2006).

Measurements of thyroid glands

The maximal length, width and height of each lobe were measured on a frozen image. The maximum length was measured in a sagittal plane and both the width and height were measured in a transverse plane.

RESULTS AND DISCUSSION

In the present study, in all groups, thyroid lobes appeared round to oval in shape with transverse images (Fig. 3). It appeared fusiform or elliptical in shape with longitudinal images (Fig. 4).

Fig. 3: Ultrasonographic image showing thyroid gland in Group 2. RT – Right lobe, LT – Left lobe T - Trachea. Measurements 1 showing the height of the right lobe, 2 – width of right lobe, 3 - height of the left lobe, 4 – width of left lobe on transverse images.

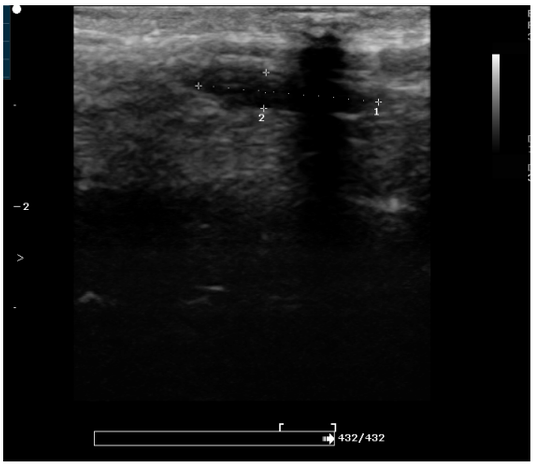

Fig. 4: Ultrasonographic image showing thyroid gland in Group 1. RT – Right lobe. Measurements 1 showing length of the right lobe and 2 – width of right lobe on longitudinal images.

This was similar to the findings of Bromel *et al.* (2005) in 36, 68 and 46 per cent of thyroid lobes in healthy, hypothyroid and euthyroid dogs and was triangular shaped in rest of the dogs with above disease. Whereas, Bromel *et al.* (2006) observed thyroid gland as round to oval structures in longitudinal images in Akitas, Golden retrievers, Beagles and Toy poodles. It appeared as fusiform or elliptical in shape in longitudinal images. The fusiform shape was also observed in 72, 77 and 70 per cent of thyroid lobes in healthy, hypothyroid and euthyroid dogs with non-thyroid illness (Bromel *et al.*, 2005). Bilateral symmetry was observed in the shape of thyroid gland lobes in all the groups which was coincident with the finding of Bromel *et al.* (2006) and Taeymans *et al.* (2007).

In the present study, the capsule of the thyroid lobes was smooth in all the groups (Fig. 5). Similar finding was also reported in Golden retriever dogs by Bromel *et al.* (2005). In contrast to this, the irregular capsule was found in Golden retrievers (Bromel *et al*., 2006).

Thyroid lobes were hyperechoic or isoechoic when compared with the surrounding musculature (Fig. 5). Similar finding was recorded in Golden retriever dogs by Bromel *et al.* (2005). The parenchyma of the thyroid lobes

had a homogeneous, echogenic pattern (Fig. 6). Whereas Bromel *et al*. (2006) observed that 33% of hypothyroid dogs showed a heterogeneous echogenic pattern or mottled appearance of both lobes. Bilateral symmetry was observed with regard to echogenicity in the present study (Fig. 7). Within the lobes, there was a uniform pattern of echogenicity throughout the parenchyma in all the groups.

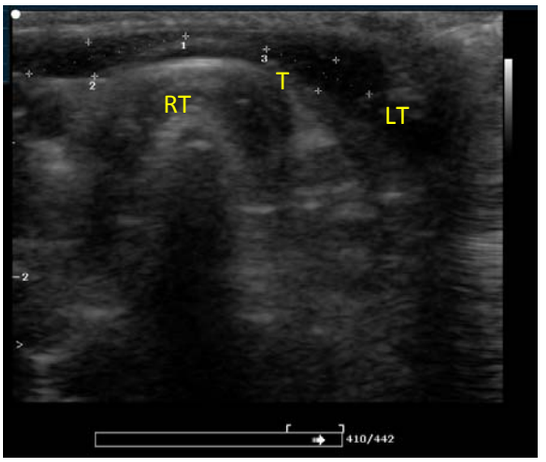

Fig. 5: Ultrasonographic image showing thyroid gland in Group 2. RT – Right lobe, LT – Left lobe T - Trachea. Measurements 1 showing the height of the right lobe, 2 – width of right lobe, 3 - height of the left lobe, 4 – width of left lobe on transverse images

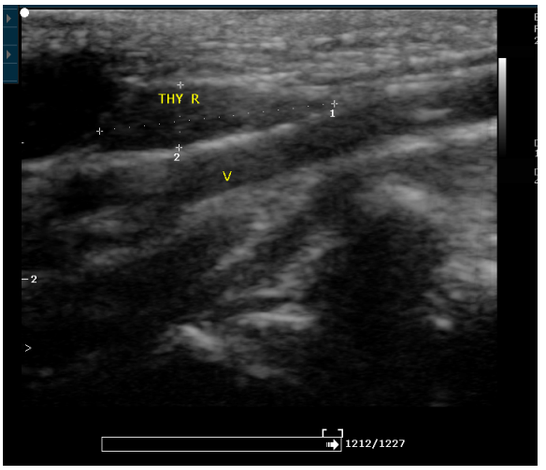

Fig. 6: Ultrasonographic image showing thyroid gland in Group 2. THY R – Right lobe and V – Jugular vein. Measurements 1 showing the length of the right lobe and 2 – width of right lobe on longitudinal images.

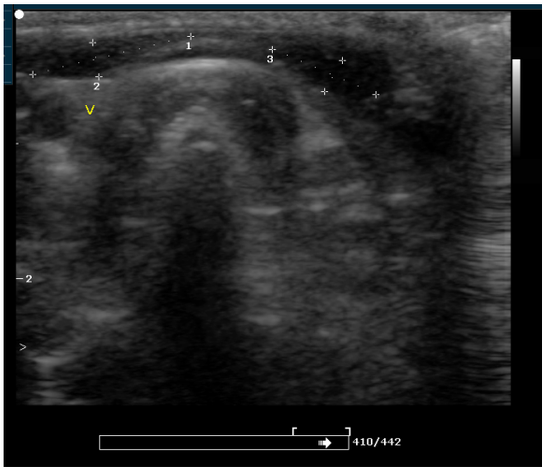

Fig. 7: Ultrasonographic image showing thyroid gland in Group 4. RT – Right lobe, LT – Left lobe V – Jugular Vein. Measurements 1 showing the height of the right lobe, 2 – width of right lobe, 3 - height of the left lobe, 4 – width of left lobe on transverse images.

As body weight increased, the length of the thyroid lobe on both sides was increased gradually with a range of 0.818±0.024 in Group 1 to 2.12±0.276 cm in Group 4. According to Taeymans *et al*. (2007), the mean length of the thyroid lobe was 2.45 cm [2.04-2.85]. (Fig. 8), (Table 1).

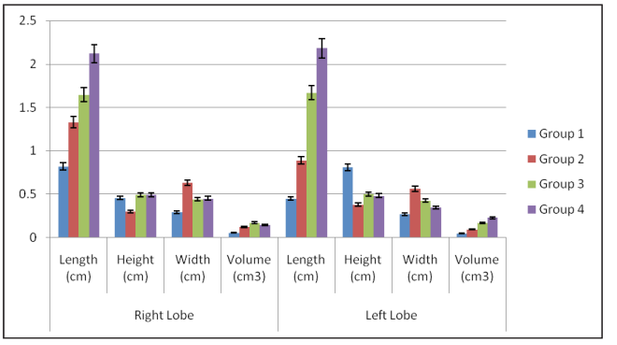

Fig. 8: Comparison of various morphometric parameters between the four groups

The height of the thyroid lobes were in the range of 0.45 ± 0.01 to 0.5 ± 0.01 cm in both the lobes of group 1,3 and 4. In group 2, the height was in the range of 0.3 ± 0.02 to 0.35 ± 0.05 cm (Fig. 8), (Table 1). According to Taeymans *et al*. (2007), the mean height of the thyroid lobe was 0.53 cm [0.33-0.73].

Table 1: Table showing the length, height, width and volume of right and left lobes of thyroid gland and total thyroid volume (Mean ± SE) in four groups of animals

	Right Lobe				Left Lobe				Volume
	Length cm	Height cm	Width cm	Volume cm^3	Length cm	Height cm	Width cm	Volume cm^3	cm^3
Group 1 n=6	0.818 ± 0.024	0.456 ± 0.01	0.29 ± 0.02	0.0523 ± 0.004	0.81 ± 0.062	0.448 ± 0.012	0.268 ± 0.05	0.046 ± 0.01	0.0983
Group 2 n=6	1.33 ± 0.024	0.30 ± 0.018	0.63 ± 0.22	0.121 ± 0.04	0.89 ± 0.036	0.38 ± 0.057	0.56 ± 0.186	0.092 ± 0.034	0.213
Group 3 n=6	1.645 ± 0.039	0.49 ± 0.022	0.44 ± 0.167	0.170 ± 0.067	1.67 ± 0.06	0.5 ± 0.014	0.425 ± 0.069	0.169 ± 0.026	0.339
Group 4 n=6	2.12 ± 0.276	0.493 ± 0.022	0.45 ± 0.12	0.146 ± 0.077	2.18 ± 0.487	0.482 ± 0.023	0.346 ± 0.083	0.228 ± 0.077	0.374

The width of the thyroid lobes on both sides were gradually increased in group 1,3 and 4 but in group 2, the width was highest when compared to the other groups (Fig. 8), (Table 1) The width of the thyroid lobes was in the range of 0.29±0.02 to 0.45±0.12 cm. According to Taeymans *et al*. (2007), the mean width of thyroid lobe was 0.62 cm (0.46-0.78) which was higher than in the present study. The mean length, height and width of both thyroid lobes were smaller in hypothyroid dogs when compared to normal dogs (Bromel *et al.,* 2005).

The volume of the thyroid lobe on both the sides was gradually increasing from Group 1 to Group 4 dogs (Fig. 8), (Table 1). The volume was in the range of 0.05±0.004 to 0.228±0.077 cm3. According to Taeymans *et al*. (2007), the mean volume of thyroid lobe was 0.38 cm3 (0.20-0.55) which was in range with the present study. In the present study, the volume of left thyroid lobe was greater than the right lobe. In contrast to this, right lobe volume was greater than the left as per Bromel *et al.* (2005).

There was no significant difference observed between the mean height, length, width and volume of both the lobes of the thyroid gland with body weight between the groups at 5% level of significance ($p< 0.05$). Thyroid volume was positively correlated with both body weight and age and three times more pronounced correlation with body weight than with age in humans (Hegedes *et al.,* 1983).

High positive correlation was found between mean length of the right lobe (r = 0. 98045), the right lobe volume (r = 0. 827), mean length of the left lobe (r = 0.999), mean height of the left lobe (r = 0. 853) and the left lobe volume with body weight (r = 0. 999). Moderate positive correlation was found between the mean height of the right lobe with body weight (r = 0. 521) and weak positive correlation was found between mean width of the right lobe (r = 0.170) and mean width of the left lobe with body weight (r = 0. 016). There was weak negative correlation between age of the dogs and thyroid lobes length,

width and total thyroid gland volume (Bromel *et al.,* 2006). The size and volume of the gland was highly correlated with the body weight which would provide the details about the activity of the gland. As the body weight increased, the basal metabolic rate also increased (Hegedes *et al.,* 1983) and in the present observation, thyroid gland volume increased as the body weight of the animal advanced which correlated the above statement.

CONCLUSION

On ultrasonography examination, the thyroid lobe shape was found to be variable between longitudinal and transverse images. The capsule showed the smooth hyperechoic pattern. The parenchyma showed uniform hyperechoic or isoechoic pattern. The mean length, width, height and volume of right and left thyroid lobes increased as body weight increases. The total thyroid volume was positively correlated with body weight. Shape and echogenicity of the thyroid gland did not differ between groups. The size and volume of the gland was highly correlated with the body weight which would provide the details about the activity of the gland. These basic parameters may help the clinician to distinguish between the normal healthy thyroid gland from the diseased ones.

ACKNOWLEDGEMENTS

The authors acknowledge the Dean, Madras Veterinary College and Director of Clinics, Madras Veterinary College Teaching Hospital for providing necessary support to carry out this project.

REFERENCES

Bromel, C., Pollard R.E., Kass P.H., Samii V.F., Davison A.P. and Nelson R.W. 2005. Ultrasonographic evaluation of the thyroid gland in healthy, hypothyroid, and euthyroid Golden Retrievers with nonthyroidal illness. *J. Vet. Intern. Med.*, **19**: 499-506.

Bromel C., Pollard, R.E., Kass, P.H., Samii, V.F., Davison, A.P., and Nelson. R.W. 2006. Comparison of Ultrasonographic characteristics of the thyroid gland in healthy small, medium and large breed dogs. *Am. J. Vet. Res.*, **67(1):** 70-77.

Hopkins, C.R. and Reading, C.C. 1995. Thyroid and parathyroid imaging. *Semin Ultrasound CTMR*. **16**: 279-95.

Mayer, M.N. and Mac. Donald, U.S. 2007. External beam radiation therapy for thyroid cancer in the dog. *Can. Vet. J.,* **48**: 761-763.

Rice, J.A. 2006. Mathematical Statistics and Data Analysis (3rd ed.). Duxbury Advanced.

Taeymans, O., Peremans, K. and Saunders, J.H. 2007. Thyroid imaging in the dog: Current status and future directions. *J. Vet. Inern. Med.,* **21**: 673-684.

Wisner E.R., Mattoon, J.S., Nyland, T.G. and Baker, T.W. 1991. Normal Ultrasonographic anatomy of the canine neck. *Vet. Radiol. Ultrasound*., **32**: 185-190.