RESEARCH ARTICLE

Computed Tomography Imaging in Canine Thoracic Disorders: A Review of 30 Cases

Pruthvi Raj Devaraj[1]*, Arun Prasad Arun[1], Tamilmahan Paramasivam[1], Nagarajan Kumaresan[2]

Abstract

Thoracic diseases in dogs comprise a diverse group of conditions affecting the lungs, pleura, esophagus, and congenital thoracic structures, often requiring advanced diagnostic imaging for accurate evaluation. Computed tomography (CT), with its ability to generate high-resolution cross-sectional images, facilitates improved visualization and characterization of intrathoracic structures. The present investigation was carried out on 30 dogs exhibiting clinical signs indicative of thoracic disorders during the year 2025. All cases were initially screened using thoracic radiography, and those with ambiguous or inconclusive radiographic findings were further subjected to CT examination for detailed assessment of pulmonary, pleural, mediastinal, and vascular components. Systematic evaluation of CT images revealed a variety of thoracic abnormalities, among which pulmonary metastasis was the most predominant lesion (13/30; 43.33%), observed across multiple breeds. Esophageal granuloma was identified in 8 cases (26.67%), followed by pleural effusion in 4 cases (13.33%). Additionally, one case each of persistent right aortic arch (3.33%) and peritoneal pericardial diaphragmatic hernia (3.33%) were recorded. CT imaging enabled precise localization as well as detailed characterization of these lesions. In conclusion, while thoracic radiography remains a useful preliminary screening modality, computed tomography provides superior diagnostic clarity in cases with equivocal radiographic findings and serves as an effective tool for comprehensive evaluation of thoracic abnormalities in dogs.

Key words: Computed tomography, Dog, Oesophageal granuloma, Peritoneal pericardial diaphragmatic hernia, Persistent right aortic arch, Pleural effusion.

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Introduction

Thoracic diseases in dogs comprise a wide spectrum of conditions affecting the lungs, pleura, mediastinum, esophagus and major thoracic vessels. These disorders may arise from inflammatory, infectious, neoplastic, traumatic or congenital causes and often present with clinical signs such as dyspnea, coughing, exercise intolerance, regurgitation and reduced appetite. Accurate diagnosis of thoracic abnormalities is essential for appropriate therapeutic planning and prognosis. Diagnostic imaging plays a crucial role in identifying and characterizing thoracic lesions in veterinary patients.

Thoracic radiography is widely used as the primary imaging modality for evaluating thoracic diseases in dogs due to its availability, rapid acquisition and ability to provide an overall assessment of thoracic structures. Radiography is useful for detecting conditions such as pulmonary masses, pleural effusion, mediastinal abnormalities and certain congenital defects. However, radiographic interpretation may sometimes be limited by the superimposition of thoracic structures and reduced ability to clearly delineate small or complex lesions. Consequently, certain thoracic abnormalities may remain inconclusive or difficult to characterize using radiography alone (Thrall, 2018).

Computed tomography (CT) has emerged as an advanced diagnostic imaging modality in veterinary medicine, providing cross sectional images that eliminate the problem of superimposition encountered in conventional radiography. CT allows detailed evaluation of pulmonary parenchyma, pleural cavity, mediastinal structures and major thoracic vessels with improved spatial and contrast resolution. Thoracic radiography may fail to detect small pulmonary metastatic lesions, whereas computed tomography is considerably more sensitive and can identify nodules as small as 1 mm compared with approximately 7-9 mm detection limits in radiography (Otoni *et al.*, 2010). In addition, CT enables quantitative assessment of tissue density using Hounsfield Units (HU), which helps differentiate air, fluid and soft tissue structures,

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thereby improving lesion characterization (Armbrust *et al.,* 2012) This document presents an overall view of computed tomography imaging in 30 cases of canine thoracic disorders.

Materials and Methods

The study was conducted on 30 dogs presented to the Small Animal Clinics of Madras Veterinary College, Chennai, during the year 2025, with clinical signs suggestive of thoracic disease. Dogs of different breeds, ages and sexes showing symptoms such as dyspnea, coughing, exercise intolerance or regurgitation were included in the study.

Radiographic Examination

Initially, all dogs were subjected to thoracic radiographic examination as the primary diagnostic screening method. Standard thoracic radiographs were obtained in right lateral and ventrodorsal projections to evaluate the lungs, pleural cavity and mediastinal structures. Radiographs were assessed for abnormalities such as pulmonary nodules, masses, pleural effusion and mediastinal changes. Cases in which radiographic findings were inconclusive were subsequently selected for computed tomographic examination for further evaluation (Fig. 3, 4).

Computed Tomography Examination

For CT imaging, dogs were premedicated with butorphanol at a dose of 0.2 mg/kg body weight and diazepam at 0.25 mg/kg body weight. General anaesthesia was induced using propofol @ 3 mg/kg body weight and anaesthesia was maintained with isoflurane at a concentration of approximately 2.5%.

Animals were positioned in sternal recumbency during the scanning procedure (Fig. 1). Thoracic CT scans were obtained using third generation, 16 slice multi row detector CT scanner unit manufactured by Toshiba company (Alexon model). Using axial acquisition with 1 mm slice thickness from the thoracic inlet extending caudally, and in selected cases extended to include additional regions as required for evaluation. The scanning parameters were set at 120 kVp and 150 mAs. A non-ionic iodinated contrast agent iohexol @ 350 mg/kg body weight was administered intravenously using automatic injector when contrast-enhanced imaging was required (Fig. 2).

Post-processing of CT images included multiplanar reconstruction (MPR) with sagittal and coronal reformatting, as well as three-dimensional (3D) reconstructions to facilitate detailed evaluation of thoracic structures and detection of pulmonary metastatic lesions. CT images were interpreted using appropriate lung and mediastinal window settings and tissue attenuation values were measured in Hounsfield Units (HU) to differentiate air, fluid and soft tissue densities.

In cases diagnosed with pleural effusion, the volume of pleural fluid was quantified using CT images. The cross-sectional area of pleural fluid was measured in each CT slice and the total effusion volume was determined by summing the measured areas and multiplying by the slice thickness. The pleural effusion volume was calculated using the formula described by Hung *et al,* (2016):

Since 1 cm^3 corresponds to 1 mL, the calculated value provided an estimate of the total pleural fluid present within the thoracic cavity.

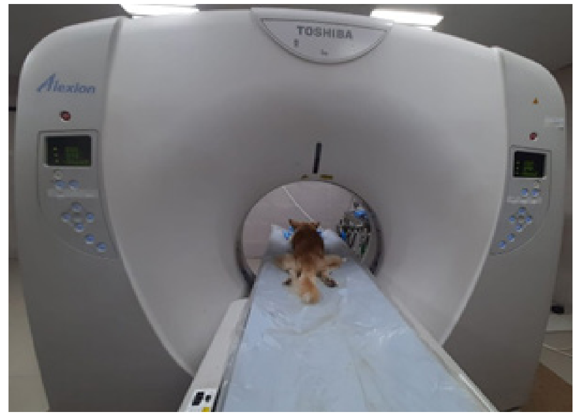

Fig. 1: Animal positioned on CT Gantry

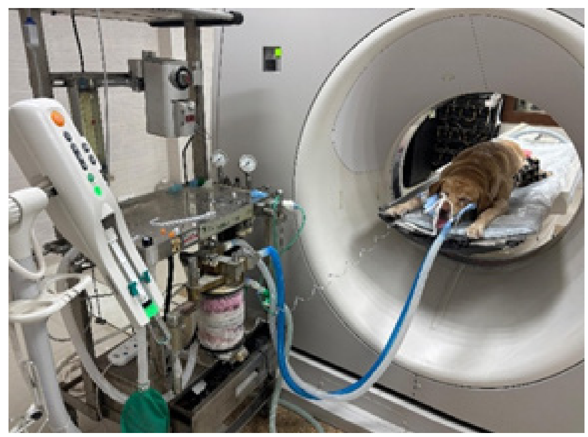

Fig. 2: Inhalant anaesthesia and IV contrast injecting using automatic injector

Results and Discussion

Computed tomographic evaluation of 30 dogs with suspected thoracic disorders revealed a variety of pulmonary, esophageal, pleural and congenital thoracic abnormalities (Table 1).

Table 1: Incidence of thoracic affections of dogs in CT

Thoracic lesion	Number of cases	Percentage
Lung metastasis	13	43.33
Oesophageal granuloma	8	26.67
Pleural effusion	4	13.33
Persistent right aortic arch	1	3.33
Peritoneal pericardial diaphragmatic hernia	1	3.33
Other	3	10.00
Total	**30**	**100**

Thoracic radiography was initially performed in all cases; however, CT examination was undertaken when radiographic findings were inconclusive or required further characterization. CT provided superior visualization of thoracic structures by eliminating the problem of anatomical superimposition encountered in conventional radiography. Among the detected abnormalities, pulmonary metastasis was the most frequently observed lesion (13/30; 43.33%). The affected breeds included Doberman (2), non-descript dogs (4), Rottweiler (2), Labrador Retriever (3), Pomeranian (1) and German Shepherd (1). On CT images, metastatic lesions appeared as multiple soft tissue attenuating nodules distributed throughout the lung parenchyma. The high sensitivity of CT enabled detection of small pulmonary nodules that were not clearly visible on thoracic radiographs (Fig 3-6). Similar observations have been reported previously, where CT was found to detect metastatic lung nodules as small as 1 mm, whereas radiography generally detects lesions only when they reach approximately 7-9 mm in diameter (Otoni *et al*., 2010).

Esophageal granuloma was identified in 8 dogs (26.67%), which included Labrador Retriever (4), German Shepherd (1), Dalmatian (1), non-descript dog (1) and Pug (1). CT imaging demonstrated focal or circumferential soft tissue masses involving the caudal thoracic esophageal wall, occasionally associated with luminal narrowing (Fig. 7-12). The cross-sectional imaging capability of CT enabled improved visualization of esophageal lesions and their relationship with adjacent mediastinal structures (Okanishi *et al.,* 2013; Casoy *et al.,* 2025).

Pleural effusion was observed in 4 dogs (13.33%), comprising Terrier (1), Spitz (2) and Whippet (1). On CT examination, pleural fluid appeared as homogeneous fluid attenuation within the pleural cavity resulting in varying degrees of lung compression. In these cases, the volume of pleural effusion was quantified by measuring the cross-sectional area of fluid in each CT slice and multiplying it by the slice thickness. This quantitative assessment enabled estimation of total pleural fluid volume within the thoracic cavity (Table 2; Fig. 13, 14). Further, the effusion identified based on attenuation was of 4 types, *viz.*, exudate, chyle, purulent and transudate with attenuation of 29.0, 13.3, 27.0 and 8.3 HU, respectively.

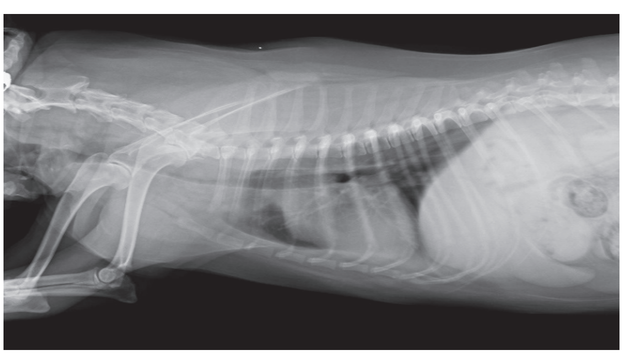

Fig 3: Radiograph revealing mass cranial to heart (case 1)

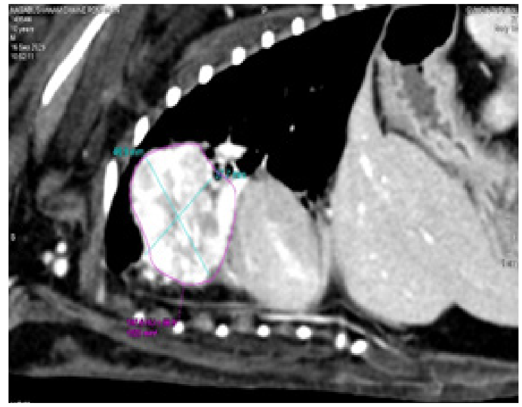

Fig 4: Heterogenous mass cranial to heart in sagittal view of CT (case 1)

Fig 5: Lung consolidation in coronal view (case 2)

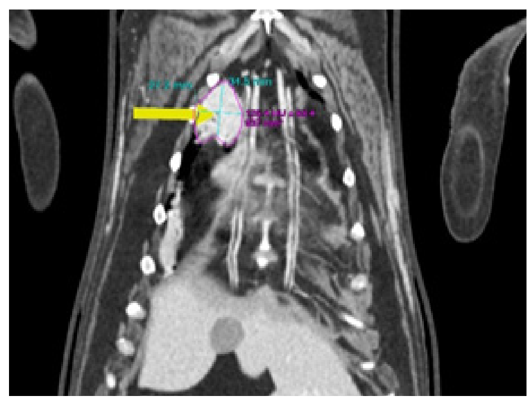

Fig 6: Intrathoracic mass left cranial lobe (case 3)

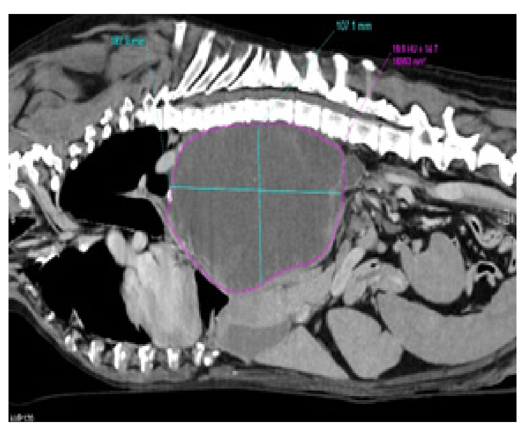

Fig. 7: Hypoattenuating heterogenous mass caudal mediastinum - granuloma

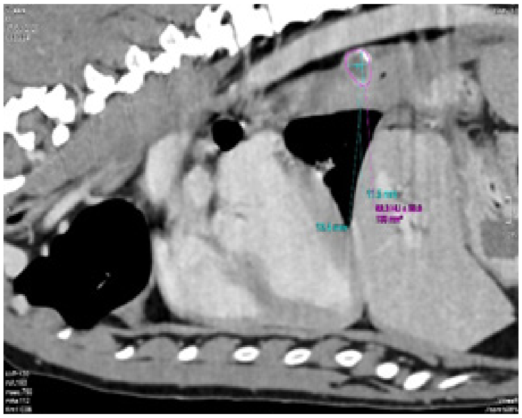

Fig. 8: Aortic calcification in 5 year Labrador

Fig. 9: Barium stasis due to dilatation of esophagus proximal to granuloma

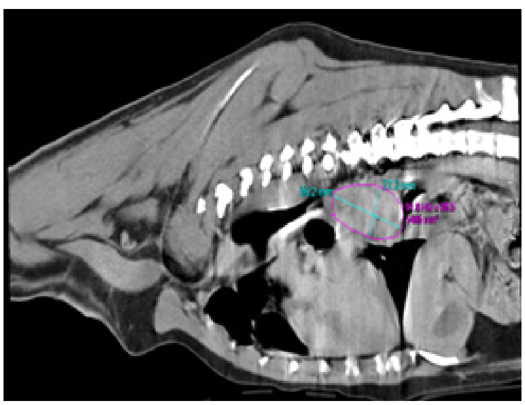

Fig. 10: Heterogenous mass caudal mediastinum

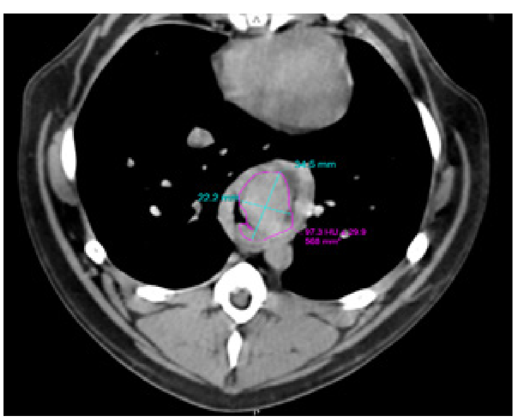

Fig. 11: Intraluminal mass in caudal thoracic esophgaus

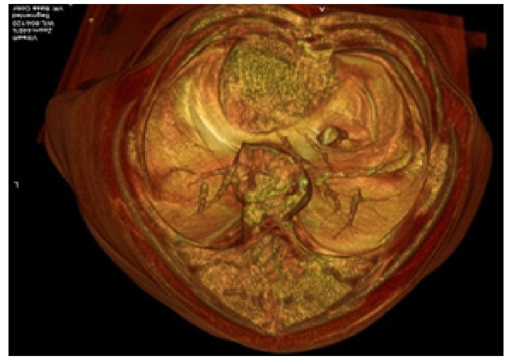

Fig. 12: 3D Reconstruction image

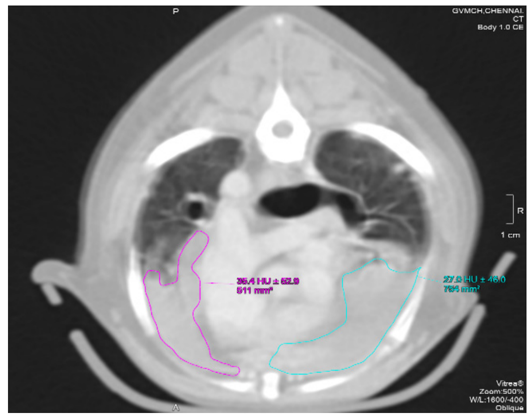

Fig. 13: Homogenous fluid in pleural cavity- pleural effusion (case 1)

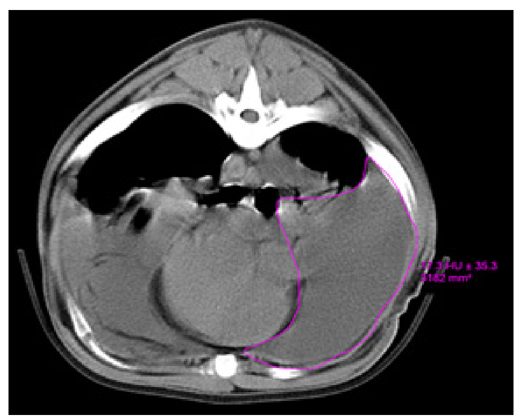

Fig. 14: Pleural effusion (case 2)

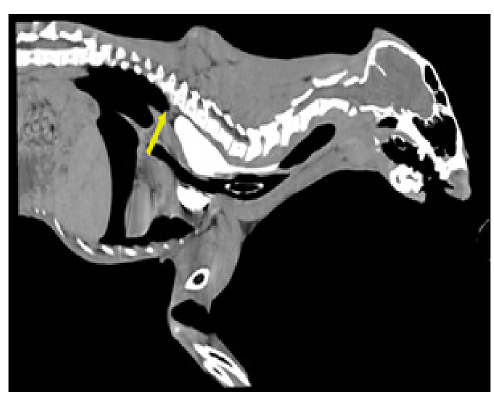

Fig. 15: PRAA- Barium stasis in esophagus cranial base of heart

Table 2: Calculation of effusion volume

Breed	BW (kg)	Slice thickness in CT (mm)	No. of slices	Avg area of slice (mm^2)	Effusion volume (mL)
Terrier	7.5	1	112	1295	145
Spitz	8.6	3	177	5632	2990
Whippet	22.8	3	186	5218	2911
Spitz	11.8	3	177	3300	1752

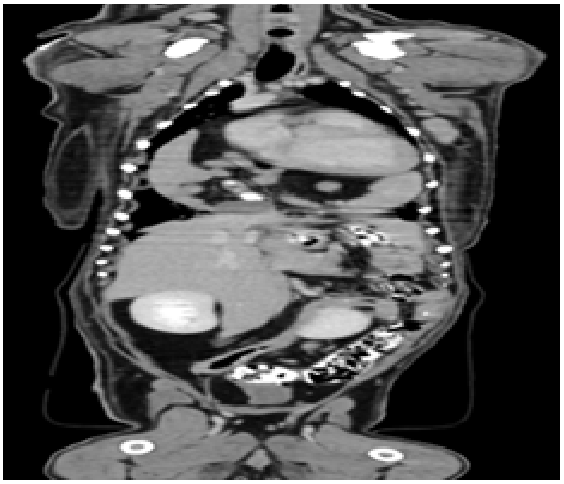

Fig. 16: PPDH - intestines within pericardial sac

In addition to acquired thoracic diseases, one case each of persistent right aortic arch (3.33%) (Fig. 16) and peritoneal pericardial diaphragmatic hernia (3.33%) (Fig. 15) was detected. CT imaging allowed clear visualization of the vascular ring associated with persistent right aortic arch causing esophageal constriction (MacPhail *et al.,* 2001), while in the case of peritoneal pericardial diaphragmatic hernia, abdominal viscera were observed within the pericardial sac (Kumar and Kumar, 2021).

Overall, computed tomography proved to be a valuable diagnostic imaging modality for detecting and characterizing thoracic abnormalities in dogs. The technique provided superior anatomical detail and improved diagnostic accuracy compared to conventional radiography, particularly in identifying pulmonary metastases, esophageal lesions, pleural effusion and congenital thoracic anomalies.

Conclusion

The present study demonstrated that computed tomography is a highly effective diagnostic imaging modality for the evaluation of thoracic disorders in dogs. While thoracic radiography served as an initial screening tool, CT provided superior visualization and accurate characterization of intrathoracic lesions in cases with inconclusive radiographic findings. In the examined cases, pulmonary metastasis was the most frequently detected abnormality, followed by esophageal granuloma and pleural effusion, along with occasional congenital conditions such as persistent right aortic arch and peritoneal pericardial diaphragmatic hernia. CT imaging also enabled quantitative assessment of pleural effusion and improved detection of small pulmonary nodules, thereby enhancing diagnostic accuracy. Overall, the findings indicate that computed tomography is a valuable adjunct to radiography for comprehensive evaluation of thoracic diseases in dogs and can aid clinicians in accurate diagnosis and clinical decision-making.

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