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Research Article

Sensitivity of Radiographic Views for Assessment of Extra Thoracic and Mediastinal Lesions in Geriatric Dogs

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ABSTRACT

The present study was aimed for assessment of difference in the views and documented the observed radiological signs of aged dogs and classified them as per organ. Thoracic radiographs with left lateral, right lateral, dorso ventral and ventro dorsal views were studied to identify the lesions. The lesions identified on thoracic radiographs were classified as extra thoracic, mediastinal, trachea, pleural, diaphragmatic, heart and pulmonary lesions in geriatric dogs and evaluated for roentgen signs and the results are initially calculated by tally marks and then subjected to statistical analysis using fisher test for any significant difference in between the views.

Key words: Aging, radiographic views, extra thoracic, mediastinum, Geriatric dogs.

INTRODUCTION

Radiographic examination is considered as the first modality, after the clinical examination and most useful non- invasive technique and provide rapid and valuable information in the diagnosis (Rudolf *et al.,* 2008). Geriatric dogs experience many changes in the functions of their body systems than other age groups. The criterion for considering a dog as geriatric is the one that has completed 75-80 percent of one's anticipated life span (Shearer *et al.,* 2010). One view may be preferred over another for area sensitivity of that particular view for describing the different areas of interest or different disease conditions (Brinkman *et al.,* 2006). As per the standard radiographic procedures orthogonal projections will be obtained to read the radiological features in any part of the body but, this is not true in case of thoracic radiography hence the present study was undertaken to assess the efficacy of views to detect the radiological signs of extra thoracic and mediastinal lesions in geriatric dogs.

MATERIALS AND METHODS

A 500 mA X-ray machine (Seimens co Ltd) with computed radiography system (Care stream) was utilized to undertake the radiographic study in 153 clinical cases of geriatric dogs. Aged dogs randomly selected with irrespective of sex and breed with age of 7-14 and above years. The dogs were radiographed in different views Viz. right lateral (RLV), left lateral (LLV), Ventrodorsal (VD) and Dorsoventral (DV) views with required recumbence as per the standard positioning principles. A sand bag was placed on either side of thorax or beneath the sternum as per need to make the thoracic spine and sternum parallel to each other and to prevent movement. The observed radiological features were documented and discussed in detail. The exposure was given when the dog was in full inspiration phase with the range of 55-65 Kvp, 80 mA. The radiographs evaluated for roentgen signs and the results were initially calculated by tally marks and then subjected to statistical analysis fisher test for any significant difference in between the breeds.

RESULTS AND DISCUSSION

Radiographic features of the different organs and any specific pathology noted in various organs of thorax was described in terms of radiological features related to exrathoracic and all the mediastinal structures. Radiographic procedure followed in the present study i.e recording four views for the prospective study yielded in satisfactory data. Kealy and McAlister (2005) opined that for a comprehensive study of thorax two oppositional lateral views and either a dorsoventral or ventrodorsal views are useful and the radiographs should be made

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during inspiratory phase. The radiographs available for retrospective study are more with lateral views and with less number of dorsal or ventral radiographs. Identification of the lesions are very less and occasional on these lesions as evidenced by the present study and majority of the lesions were identified on the lateral views. Examination of the thorax in a systematic way will provide details of the appearing radiological signs without any missing lesions as reported by Berry (2010). Kealy and McAlister (2005) suggested either an organ approach or area approach for the interpretation of any radiograph. The study with a review form and noting them with tally marks to record the number of positive signs on a particular view and an organ approach like extra thoracic parts, mediastinum, trachea, pleura, diaphragm, heart and pulmonary structures followed in the present study facilitated the study as suggested by Suter and Lord (1984).

Extra thoracic structures

On right lateral views 34.82, 42.85 and 18.75 percentage of lesions were identified as vertebral spondylosis, lesions of ribs and sternal spondylosis respectively while the percentages were 19.78, 40.65 and16.48 on left lateral views for the same. The extra thoracic masses accounted for 7.14 percentage and could be viewed only on right lateral views. Both the lateral views clearly showed these radiological signs while the ventrodorsal or dorsoventral views did not revealed any of these lesions. The statistical analysis revealed significant difference between the views ($P<0.05$) In the present study, the extra thoracic parts like the vertebra, ribs, sternum and thoracic wall in geriatric dogs were evaluated and identified vertebral and sternal spondylosis (Fig. 1), lesions of the ribs like exostosis, biparturate ribs and extra thoracic masses. The lateral views clearly showed these radiological signs while the venrodorsal or dorsoventral views did not showed any of these lesions as reported by Kealy and McAlister (2005). The lateral radiographs were clearly demonstrated the bony osteophytes that project ventrally and are the common findings in spondylosis as observed in the present study which are in agreement with Newton and Nunamaker (1985). The dorsoventral or ventrodorsal radiograph did not showed these lesions as these are superimposed by abdominal contents.

Mediastinum

The right lateral views of the thorax obtained from the geriatric dogs revealed 40.17, 6.25 and 16.07 percentage of cranial, caudal and middle mediastinum opacity respectively while 5.35 and 3.57 percentage of lesions were with widening and narrowing of the mediastinum. The mediastinal masses (Fig .2) accounted for 5.35 percentages. The left lateral views of the thorax obtained from the geriatric dogs revealed 28.57,5.49 and 16.48 percentage of cranial, caudal and middle mediastinum opacity respectively while 6.59 and 4.39 percentage of radiographs were with masses and widening of the mediastinum. The lateral views were useful to study the mediastinal lesions as observed in the present study while the ventrodorsal or dorsoventral views did not showed any of mediastinal lesions. On the contrary, Brinkman *et al.* (2006) suggested VD view for evaluation

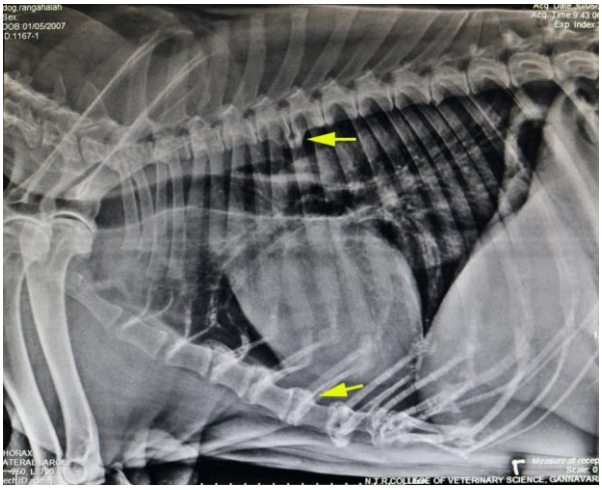

Fig. 1: Skiagram of right lateral view showing spondylosis of vertebra and strernum.

Fig. 2: Skiagram of ventro dorsal view showing the superimposition of the mediastinal structures with masking of spondylosis.

of the cranial and caudal mediastinum. Thrall (2011) mentioned that on ventrodorsal (VD) or dorsoventral (DV) thoracic radiographs, most of the cranial mediastinum was superimposed on the spine i.e., in the midsagittal plane of the thorax. Kirberger and Avner (2006) reported that craniodorsal mediastinum was better delineated on DV radiographs and was wider on VD radiographs. The cranioventral mediastinum was more visible left lateral and VD radiographs. The normal width of the cranial mediastinum in VD or DV views was usually less than approximately twice the width of the vertebral column. In obese patients, the cranial mediastinum may become enlarged because of fat accumulation and be confused with an abnormal mediastinal mass. A mediastinal shift occurs when the mediastinum was displaced by pressure differences between the right and left pleural cavities. The ventrodorsal or dorsoventral views are more useful than the lateral view in deciding whether an abnormal mass was located in the mediastinum versus lung which usually lie in a position lateral to the mediastinum while Mellanby *et al.,* (2002) identified the canine pleural and mediastinal effusions in old dogs.

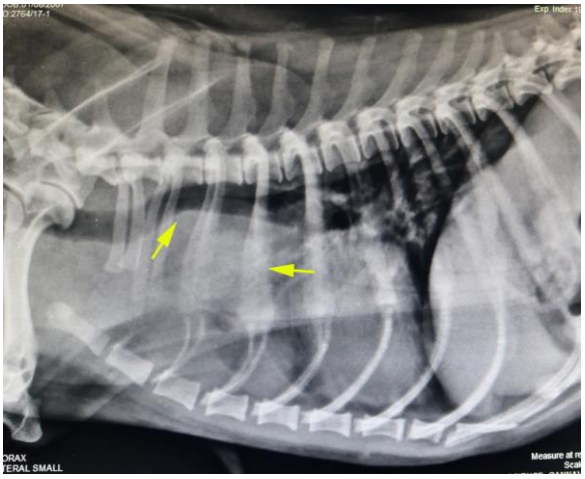

Fig. 3: Skiagram of right lateral view showing dorsal deviation of the trachea and cranial mediastinal mass.

Fig. 4: Skiagram of dorsaventral view showing increased density of the mediastinum and difficulty in visualizing the deviation and exact position of the deviation of trachea and mediastinal mass.

Trachea

The right lateral views of thorax obtained from the geriatric dogs revealed 12.50; 6.25; 10.71; 23.21; 12.50 and 2.67 percentage of dorsal deviation (Fig. 3), ventral deviation, irregular margins, calcification, dilatation and narrowing of the trachea respectively whereas, the left lateral views of the thorax obtained from the geriatric dogs revealed 6.59, 2.19, 15.38 and 3.29 percentages of dorsal deviation, irregular margins, calcification and narrowing of the trachea respectively. The trachea was a tubular structure that extends from the level of the body of axis to the 5th thoracic vertebrae and bifurcates in to stem bronchi over the base of the heart. The radiological features of the trachea observed in geriatric dogs were the deviation of the trachea either ventrally or dorsally, irregular margin of the trachea, calcification, dilatation and narrowing. On lateral views tracheal calcification was the prominent radiological signs followed by dorsal deviation, dilatation, irregular margins, and ventral deviation and narrowing of the trachea. The trachea was visualized clearly in the lateral views and on VD / DV the trachea was more difficult to observe because of super imposed vertebra and sternum. On the lateral view the trachea was closer to the spine in the caudal cervical region than cranial as reported by Muhlbauer and Kneller (2013).

Pleura

The thoracic radiographs obtained from the geriatric dogs revealed 22.32 and 4.39, 58.03 and 31.86, 25.89 and 9.89 percentages of pleural effusions, pleural thickening and increased pleural density on right and left lateral views respectively. The pleural masses were identified on left lateral views in 2.19 percentage of radiographs. Among the lesions, pleural thickening was the prominent lesion appeared followed by increased pleural density and pleural effusions. The lateral radiographs were useful to detect the pleural lesions effectively. The normal pleural space was not visible on radiographs and was actually a potential space formed between the visceral and parietal pleural layers, which were represented by a single line at the periphery of the lung lobes. The potential pleural space becomes a real space and visible with the addition of air or fluid.

The prominent sign noticed in the present study regarding pleura was pleural thickening which was in accordance with the findings of Rief and Rhodes (1966) who correlated the radiographic and morphological findings of the aged canine lungs and noted the radiographic pattern consisting of pleural thickening and an increase in nonvascular linear markings of the lungs while Lord *et al.* (1972) reported a radiographic approach to detect pleural, extra pleural and pulmonary lesions in small animals. The pleural effusions observed in the present study may due to various pathologies related to the cardiovascular diseases which are common in old age as observed by Kittleson (1998) who diagnosed effusions in the body cavities. Pleural effusion was the abnormal accumulation of fluid in the pleural space as reported by Kealy and McAlister (2005). Fluid in the pleural space can be an exudate, transudate, or modified transudate and can result from many causes. In DV radiographs, fluid gravitates ventrally and causes border effacement of the heart. In VD radiographs, pleural fluid usually does not obscure the heart because the fluid is in the dorsal aspect of the thorax, where it does not make contact with the heart and cause border effacement (Grover *et al.,* 1983).

Pneumothorax was the accumulation of air within the pleural space. Radiographic changes seen with pneumothorax include a widened, radiolucent pleural space, atelectasis of lung lobes, and absence of vascular and interstitial markings outside the collapsed lung (may need a hot light to check definitively). The heart often appears separated from the sternum on lateral films, with free air outlining the caudal lung lobes. Pneumothorax can sometimes be misdiagnosed when skin folds are mistaken for collapsed lung lobes. In deep chested dogs, the heart may normally be separated from the sternum on lateral views, without free air in the pleural space. Air can enter the pleural space from the outside or from the lung or mediastinum. In general, pneumothorax will be more conspicuous in lateral radiographs than in VD or DV radiographs. Retraction of the lung from the thoracic wall because of air in the pleural space can be seen in lateral, VD, and DV radiographs. With a small volume of pleural air, this separation was small and appears as a thin radiolucent line. A mild pneumothorax may also result in air collection against the cardiac apex Kealy and McAlister (2005).

Diaphragm

The right lateral views of the thorax in geriatric dogs revealed 3.57, 4.46 and 4.46 percentages of cranial, caudal displacement of the cupula and loss of visualization of the diaphragm while, 8.79 and 6.49 percentages of cranial displacement of the cupula and loss of visualization of the diaphragm were observed on left lateral views. Among the lesions, caudal displacement of the cupula and loss of visualization were the prominent lesions followed by cranial displacement of the cupula. The cranial or caudal displacement of the cupula and loss of visualization of the diaphragm are the features observed on different views of the radiographs. The diaphragmatic lesions were less when compared to the other lesions in geriatric dogs. Thrall and Robertson (2011) opined that radiographically, only a small portion of the diaphragm can be seen on any one view. Radiographic visualization of the diaphragm depends on adjacent structures being of different opacity. On the lateral view, the right crus of the diaphragm blends with the caudal vena caval border, and the gastric fundus may be seen adjacent to the abdominal surface of the left crus. The intercrural cleft was a shorter, convex, opaque line caudal and ventral to the crura. The cupula is the most cranial convex portion of the diaphragm on both the lateral and the dorsoventral or ventrodorsal views. Several normal variations of diaphragmatic position and shape may be seen radiographically (Thrall (2013). Cranial diaphragmatic displacement is usually associated with abdominal disease or generalized diaphragmatic paralysis, which should be confirmed by fluoroscopic observation. Caudal diaphragmatic displacement was usually associated with severe respiratory disease. The caudally positioned diaphragm was an attempt by the animal to increase the level of systemic oxygenation, which may be low because of ventilation or perfusion deficiencies in the lungs. Bilateral tension pneumothorax may also cause a caudally displaced diaphragm from increased pleural pressure. Morooka *et al.* (2004) conducted radiographic evaluation of obesity caused oppression of the thoracic cavity by measuring the cranial shift of the diaphragm.

Conclusions

The thoracic structures like mediastinum, trachea, pleura, and diaphragm and extra thoracic structures were studied for difference in the sensitivity of one view over another view for approaching clinical diagnosis. Lateral views were clearly demonstrated the lesions than the VD and DV which are less accurate due to superimposition of organs like trachea, oesophagus and vertebral column. In case of positional and structural changes in cases of mediastinum mass, shift and also dome of the diaphragm dorsoventral and ventrodorsal views are best for the purpose of diagnosis.

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