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The Role of Radiography in Diagnosing Some Canine thoracic Affections

Torad, F.A.; Abu-Sieda, A. M. and El-Tookhy, O.

Department of Surgery, Anesthesiology & Radiology, Faculty of Veterinary Medicine, Cairo Uni.

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SUMMARY

Radiographic images of the thorax are important for evaluating patients with known or suspected thoracic diseases. Thoracic radiography provides direct information about lesions or abnormalities in lung parenchyma, airways, and pleural and mediastinal spaces. **Methodology**: The present study was carried out between October 2006 and June 2009. Plain thoracic radiography was done on 82 clinical cases of dogs diagnosed clinically as having respiratory disease. Contrast media was used where indicated. **Results:** The recorded affections were; pectus excavatum (2), tracheal collapse (5), esophegeal dilatation (9), mediastinal foreign body (2), pneumomediastinum (2), tension pneumothorax (5), pneumothorax (12), hydropneumothorax (1), pleural effusion -mild- (4), moderate (9), severe (15), primary lung neoplasm (3), focal metastatic pulmonary neoplasia (7), metastatic tracheobronchial lymphadenopathy (2), metastatic rib neoplasm (1), and pulmonary bullae (3). **Conclusion:** Thoracic radiography serves to verify the diagnosis, document the extent and location of the lesion, assist in detecting complication and also helps in classifying the lesions.

INTRODUCTION:

Thoracic radiographs are important when evaluating patients with

known or suspected thoracic disease (Burk and Ackerman, 1996). The appearance of the thorax varies depending on the position of the patient and the best radiographs for thoracic evaluation are those in which the animal is most comfortable and therefore can be symmetrically positioned (Pechman, 1987 and Steyn and Green, 1990).

Pectus excavatum (Funnel chest, chondrosternal depression) is a reduction in the dorsoventral thoracic diameter due to displacement of the sternum dorsally into the thorax (Fossum et al. 1989 and Rahal et al, 2008). The cardiac silhouette displaced to one side and creates soft tissue shadows that overlie the lung and create difficulty in cardiac and pulmonary evaluation (Risselada et al, 2006 and Grigel and Moissonnier, 2005).

Radinsky and Fossum (2000) reported that, tracheal collapse occurred most commonly in small dogs such as Yorkshire terriers and Pomeranians. Owens et al (1982) added that narrowed tracheal diameter commonly involves the caudal cervical or cranial thoracic trachea and may be more apparent on lateral expiratory radiograph.

In esophageal dilatation, the esophagus may become distended with air, fluid or food material. The fluid -or food- filled esophagus may be recognized because of the increased density or granular pattern of gas, bone and tissue density located in the region through which esophagus passes (Leib and Sartor 2008).

Air maybe accumulates within the mediastinum (pneumomediastinum) as a result of tracheal or esophageal perforation. Air within the mediastinum will delineate the normally unidentifiable mediastinal structures (Van Den Broek, 1986).

Schultz and Zwingenberger (2008) mentioned that pneumothorax is most often secondary to trauma and can occur with or without rib fractures. White et al. (2003) found that spontaneous pneumothorax refers to that occurs in the absence of trauma resulting from rupture of lung tumor, abscess or bulla or from pleural tears.

Baumann et al. (2001) and Puerto et al. (2002) reported that tension pneumothorax occurs when a tear in the visceral pleura functions as a one-way valve and air continues to accumulate within the pleural space.

The radiographic appearance of pleural fluid (hydrothorax) depends upon

the nature and amount of the fluid and the presence or absence of co-existing thoracic disease. Pleural fluid will obliterate normal fluid-dense structures and will high light air-containing structures. The lung lobes will retain their normal shape and fluid will accumulate in the interlobar fissures producing a scalloping or leafing appearance of the lobes (Groves and Ticer, 1983).

Metastatic pulmonary neoplasia occurs more frequently than primary lung tumors and appeared radiographically, as multiple, well defined, variable size nodular densities located in the middle or peripheral portion of the lung (Suter, et al., 1974). Radiographic differentiation of primary from metastatic neoplasia or other forms of nodular pulmonary diseases is difficult.

Tracheobroncheal lymphadenopathy is an uncommon finding with primary or secondary lung tumors; it occurs most often in association with multicentric lymphosarcoma or granulomatous disease (Lang, 1986 and Miles, 1988).

Rib tumors may be primary or metastatic.

Fibrosarcoma, chondrosarcoma and osteosarcoma may arise from the ribs or costal cartilage and sometimes produce large extra pleural masses (Burk and Ackerman, 1996).

Pulmonary bulla is an area of vesicular emphysema within the lung substance and thought to result from destruction of alveolar walls and septa resulting in confluence of many air spaces (Brissot, et al 2003).

The aim of the present study is to evaluate the importance of radiography in diagnosis of some canine thoracic affections excluding the cardiac diseases.

MATERIAL AND METHODS:

In the present study, 82 dogs were diagnosed clinically as suffering respiratory diseases. These dogs were admitted to the surgery clinic at Faculty of Veterinary Medicine, Cairo University and some private clinics.

The affected animals were of both sexes and their age varied between 3 months and 13 years. These dogs were of different breeds including: German shepherd (20), Rottweiler (16), Labrador retriever (12), Griffon (12), Boxer (8), Yorkshire terrier (6), Chihuahuas (4), Bulldog (2) and Doberman pinscher (2).

Thoracic radiographs obtained in the routine ventrodorsal and right-lateral projections were screened for abnormalities. The radiographs were taken during inspiration except cases of

tracheal collapse where the radiographs were taken during expiration.

Positive contrast radiography (Barium meal) was used in 3 cases suspected to have esophageal dilation. The x-ray machines used were "Toshiba, KXO-15E" and "Fischer, EMERLAD-125".

RESULTS:

1) Thoracic wall and rib cage affections Pectus excavatum (Chondrosternal depression):

It was recorded in two dogs; one of them was suffering reduced exercise tolerance and recurrent bouts of respiratory disease.

Radiographically, the caudal portion of the sternum displaced into the thoracic cavity with increased sternal contact of the heart (Fig. 1). In ventrodorsal projection, the rib cage appeared widened and the cardiac silhouette abnormally displaced to one side (Fig. 2).

2) The Tracheal affections: Tracheal collapse:

This affection was diagnosed in five dogs. The clinical signs included varying degrees of respiratory distress and a paroxysmal, chronic, dry cough.

In lateral thoracic radiograph, the lumen of the trachea was narrow at the collapsed area compared with the normal parts and the dorsal margin was indistinct in outline. The collapse affects the caudal cervical trachea extending to the thoracic inlet (Fig. 3).

3) Esophageal affections: Esophageal dilation (Mega esophagus):

It was reported in 9 dogs suffered regurgitation of food, weight loss and sometimes foetid mouth odor. In lateral thoracic radiograph, dilated esophagus appeared as tubular structure located dorsal, lateral and sometimes ventral to the trachea or dorsal to the heart base between the aorta and caudal vena cava. The air –filled esophagus showed decreased thoracic density beyond the trachea determined by a pair of thin linear densities corresponding to the dorsal and ventral esophageal walls (Fig. 4), while the fluid or food-filled esophagus showed increased density in the region through which the esophagus passes (Fig. 5).

Positive contrast radiograph showed the full extent of the dilatation and a large quantity of barium may be required to outline the esophagus fully (Fig. 6).

4) Mediastinal affections:

a-Mediastinal foreign body:

This affection was imaged in two dogs; one of them suffered dyspnea and paroxysmal cough. Lateral thoracic radiograph revealed presence of radio-dense food particles cranial to the heart (Fig. 7). The other dog showed the presence of radio-dense rubber tube at the level of mid heart and accompanied with pneumomediastinum which delineate the trachea, esophagus and aorta (Fig. 8).

Mediastinal foreign bodies occurred as a result of esophageal perforation in both dogs.

b-Pneumomediastinum:

It was recorded in two dogs. The clinical signs were varying degrees of dyspnea and diminution of normal heart sound. In one dog, the head, neck and trunk were swollen due to presence of air in the subcutaneous tissue.

Lateral thoracic radiograph showed marked accumulation of air within the cranial mediastinum and the cranial mediastinal structures were clearly identified. The dorsal and ventral walls of the trachea were outlined (Fig. 9).

5) Pneumothorax:

a-Tension Pneumothorax:

Tension pneumothorax was reported in 5 dogs resulting from trauma. The dogs showed severe respiratory distress with very rapid shallow, gasping open mouth respiration.

Radiographically, the thorax appeared widened (barrel chest) with caudal displacement of the diaphragm into the abdomen and tenting of the diaphragm at its costal attachments (Fig. 10).

In lateral thoracic radiograph, the diaphragm appeared flattened with visualization of the scalloped insertion of the diaphragm at the rib attachments (Fig. 11).

b-Pneumothorax:

It was diagnosed in 12 dogs and usually occurred secondary to trauma. Out of 12 cases, two cases occurred in association with rib fracture. The primary presenting symptoms were dyspnea and reduced exercise tolerance.

On the lateral radiograph, the heart shadow was moved away from the sternum and no vascular markings were visible between the sternum and the heart. The edges of the lung lobes were retracted from the sternum, diaphragm

and diaphragmaticolumbar recess and an air density outlined the lung edges. The lungs had an increased density due to atelectasis (Fig. 12).

In ventrodorsal view, the lung lobes appeared separated from the lateral thoracic wall by air density and sometimes, air was seen in the interlobar fissures (Fig. 13). Idiopathic pneumothorax was recorded in one dog (without history of trauma) and was associated with emphysematous bullae (Fig. 14).

c-Hydropneumothorax:

It was seen in one dog with a history of severe thoracic trauma followed by severe respiratory distress.

In ventrodorsal view, the right lung lobes appeared radiodense and collapsed while the left one was radiolucent (Fig. 15).

6) The Pleural

a-Pleural effusion:

Twenty eight dogs had pleural effusion in the present study. The affected animals were classified according to the amount of pleural fluid into: small pleural effusion (4 cases), moderate pleural effusion (9 cases), and large pleural effusion (15 cases).

In small pleural effusion, a small amount of fluid accumulated between the middle and caudal lobes and between the caudal and diaphragmatic lobes of the lungs (fig. 16).

In moderate pleural effusion, the ventral lobar borders became more rounded, the interlobar fissures appeared as dense wedges or curved lines and the ventral third of the heart became obscured. A scalloped border is formed at the ventral interface of air-filled lung lobes and the dense fluid (Fig. 17).

In large pleural effusion, the lung lobes collapsed to half or less of their original volumes. Large amount of pleural fluid totally obscured the heart, mediastinum and diaphragm.

7) Thoracic neoplasia

a-Pulmonary neoplasia:

This affection was recorded in 13 dogs classified as follow: primary lung neoplasm (3 cases), focal metastatic pulmonary neoplasia (7 cases), metastatic tracheobronchial lymphadenopathy (2 cases) and metastatic rib neoplasm (1 case).

In primary lung neoplasm, a large soft tissue-dense mass was present

just cranial to the heart with an overall increase in the radiographic density of the lung and clearly identified pulmonary blood vessels (Fig. 19).

In focal metastatic pulmonary neoplasia, a multiple well defined, variable size nodular densities located mostly in the cranial and middle portion of the lung. The nodules were not cavitated and did not displace or obstruct the bronchi. Some nodules were located in the course of blood vessels (Fig. 20).

Focal metastatic pulmonary neoplasia accompanied by tracheobronchial lymphadenopathy where the tracheobronchial lymph nodes appeared as enlarged radiodense masses at the tracheal bifurcation (Fig. 21).

b-Rib neoplasm

One case of metastatic rib neoplasm was recorded in a 12-year-old dog which suffered a primary femoral-bone neoplasm. Metastasis involved both the ribs shaft and costochondral junctions. More than one rib was affected. Osteolysis of the ribs was evident as the ribs appeared radiolucent with an irregular periosteal reaction (Fig. 22).

8) Pulmonary bullae:

Traumatic, non pathogenic bullae were reported in 3 dogs. Pulmonary bullae appeared as oval, round or spherical radiolucent areas with a thin smooth tissue dense margin (Fig. 23).

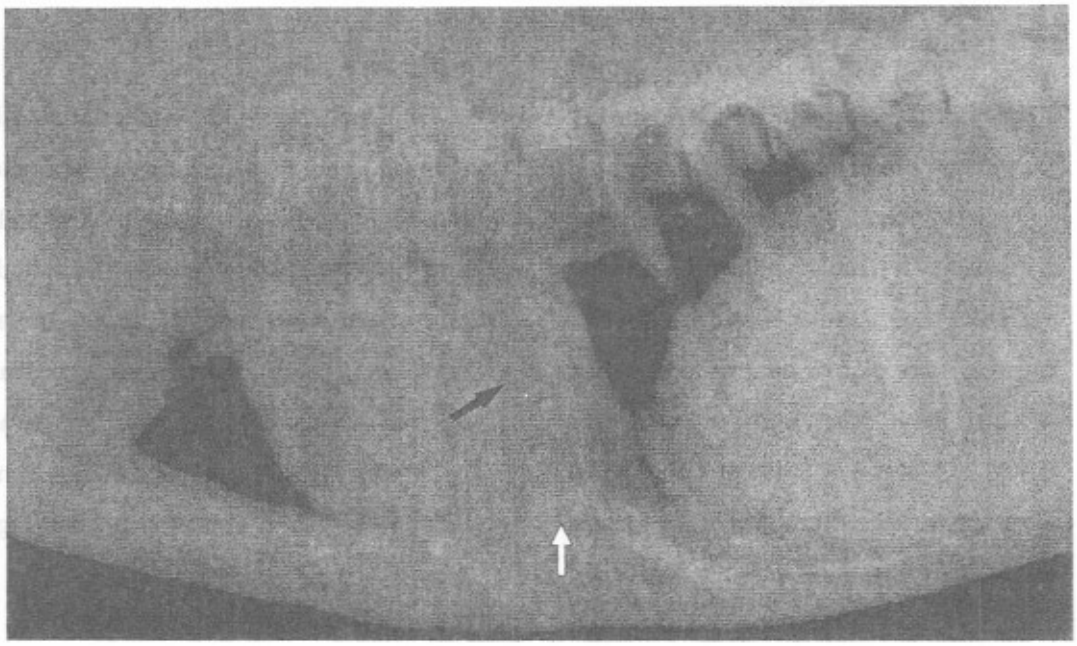

Fig (1): Right lateral thoracic radiograph of a 3-year-old Pekingese with pectus excavatum showed dorsal displacement of the caudal part of the sternum (white arrow). The cardiac silhouette and the trachea are displaced dorsally. Small, rounded radiolucent Bulla was incidentally identified (arrows).

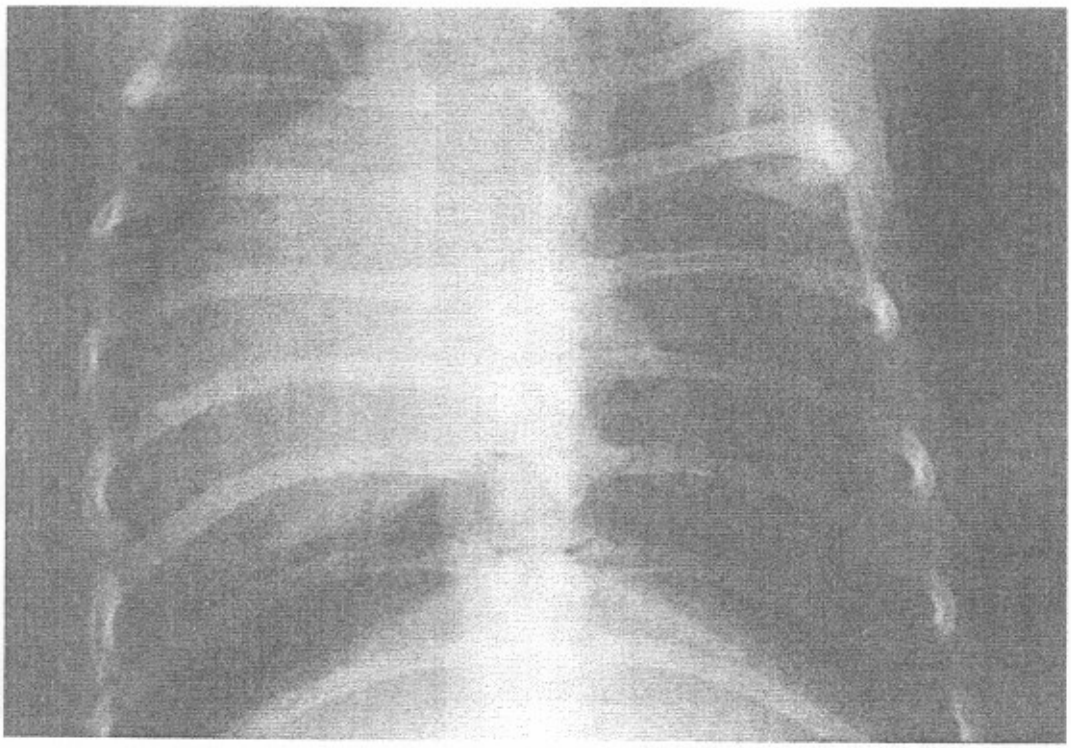

Fig (2): Ventrodorsal thoracic radiograph of the same dog with pectus excavatum showed shifting of the cardiac silhouette into the left hemithorax.

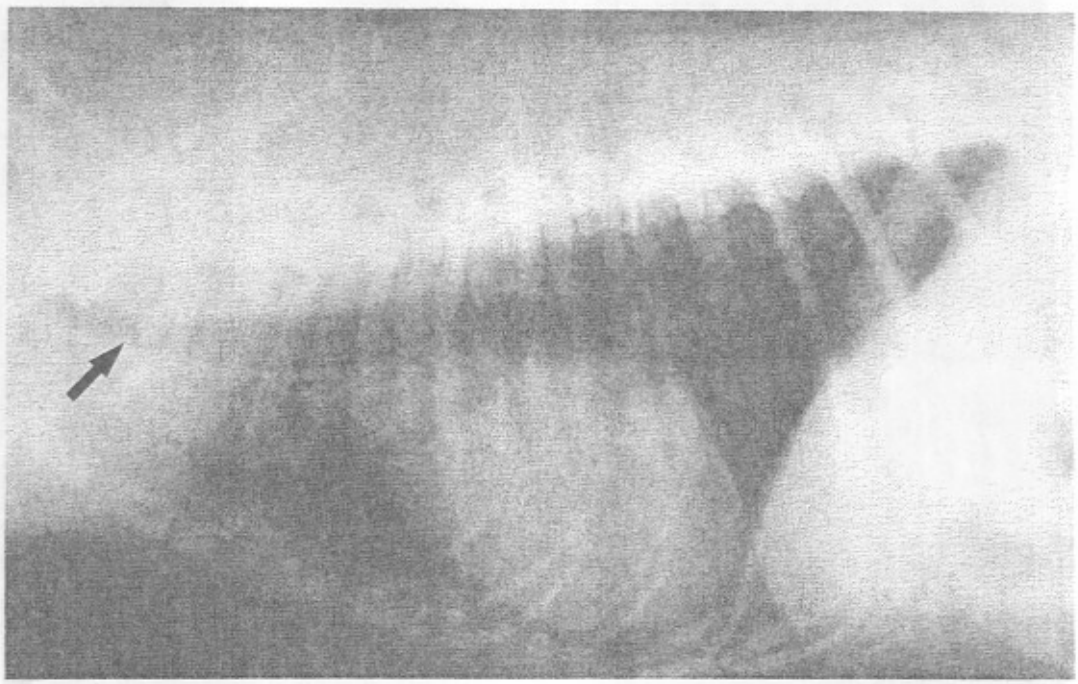

Fig (3): Right lateral thoracic radiograph of a 13-year-old Griffon bitch with tracheal collapse showed marked narrowing of the caudal cervical part of the trachea which extended through the thoracic inlet into the intra-thoracic part (arrow).

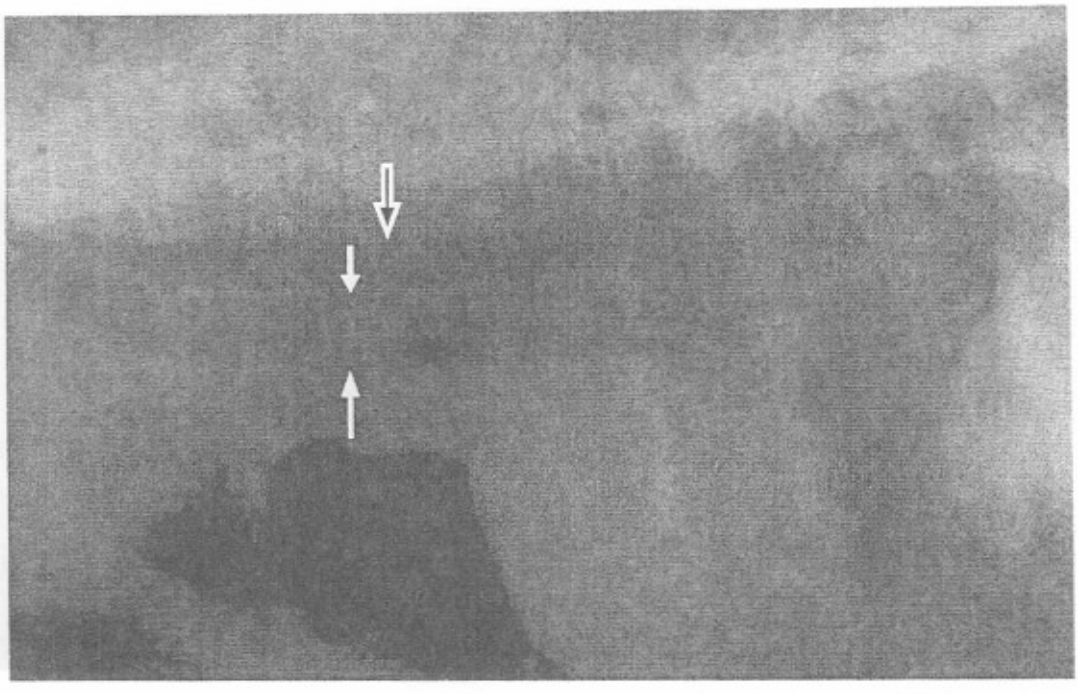

Fig (4): Right lateral thoracic radiograph of a 3-year-old German shepherd with esophageal dilatation showed dilated radio-lucent esophagus (black arrow) displacing the aorta dorsally and the trachea ventrally (white arrows).

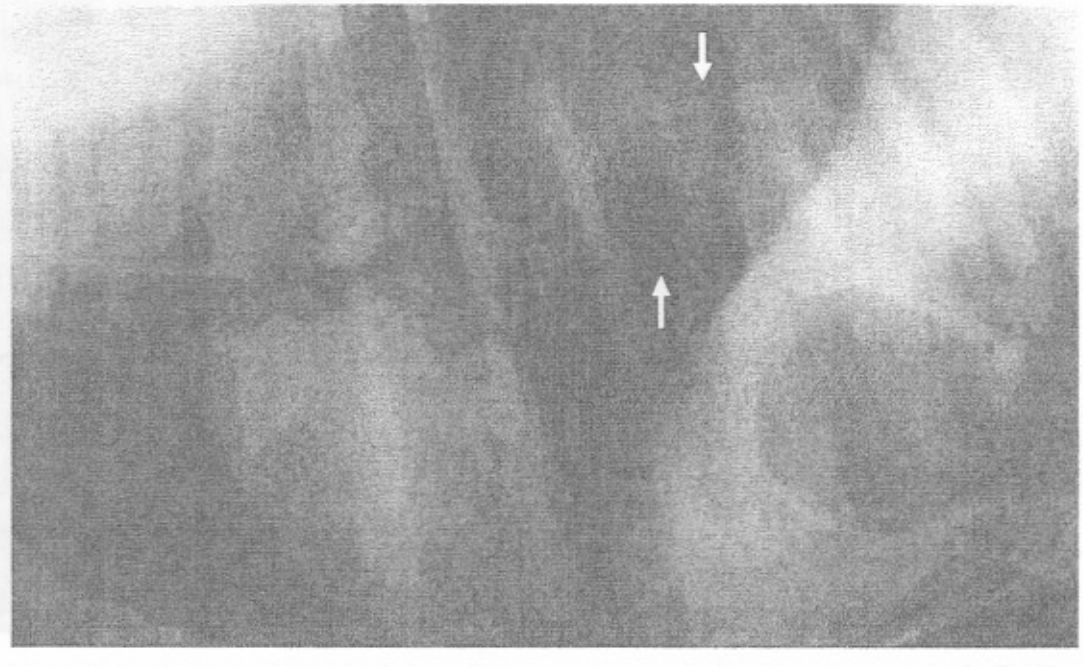

Fig (5): Right lateral thoracic radiograph of a 6-year-old German shepherd with esophageal dilatation. The fluid or food-filled oesophagus showed increased density in the region through which the esophagus passes (arrows).

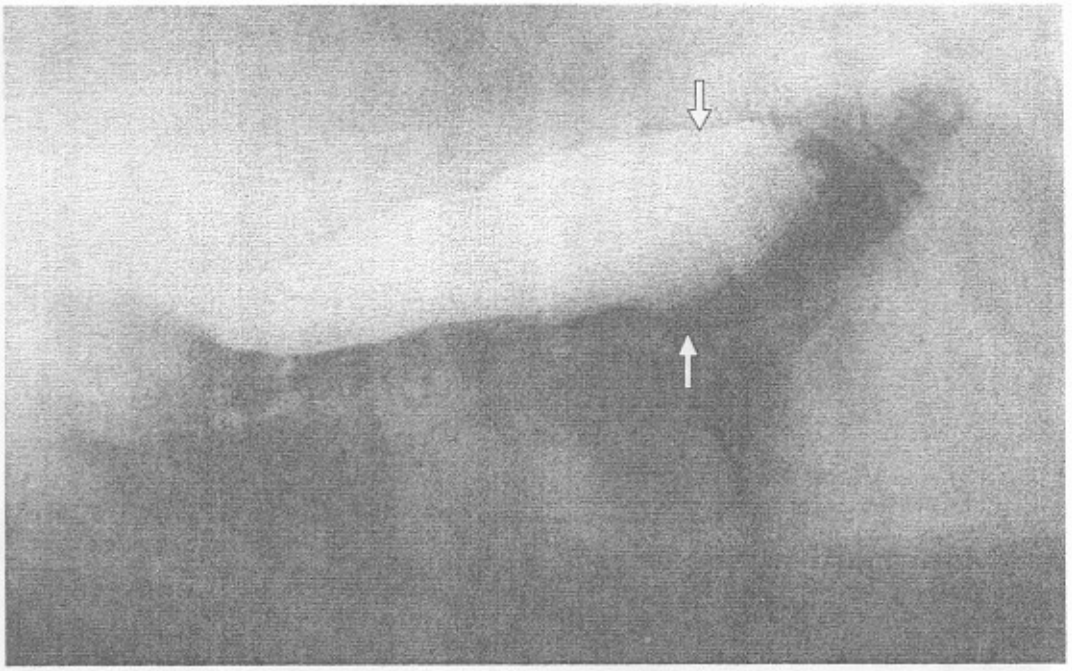

Fig (6): Right lateral thoracic radiograph of a 3-year-old Rottweiler bitch with esophageal dilatation revealed the contrast media (Barium meal) outlined the dilated thoracic esophagus (arrows).

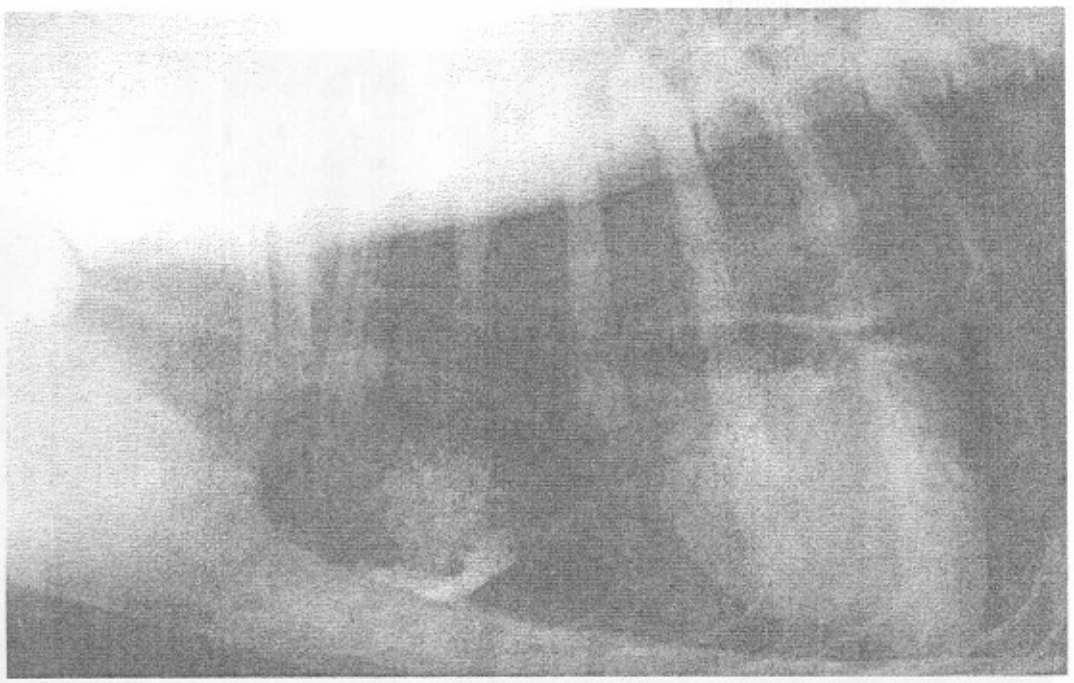

Fig (7): Right lateral thoracic radiograph of a 3-year-old German shepherd dog with mediastinal foreign body revealed presence of radio-dense food material cranial to the heart

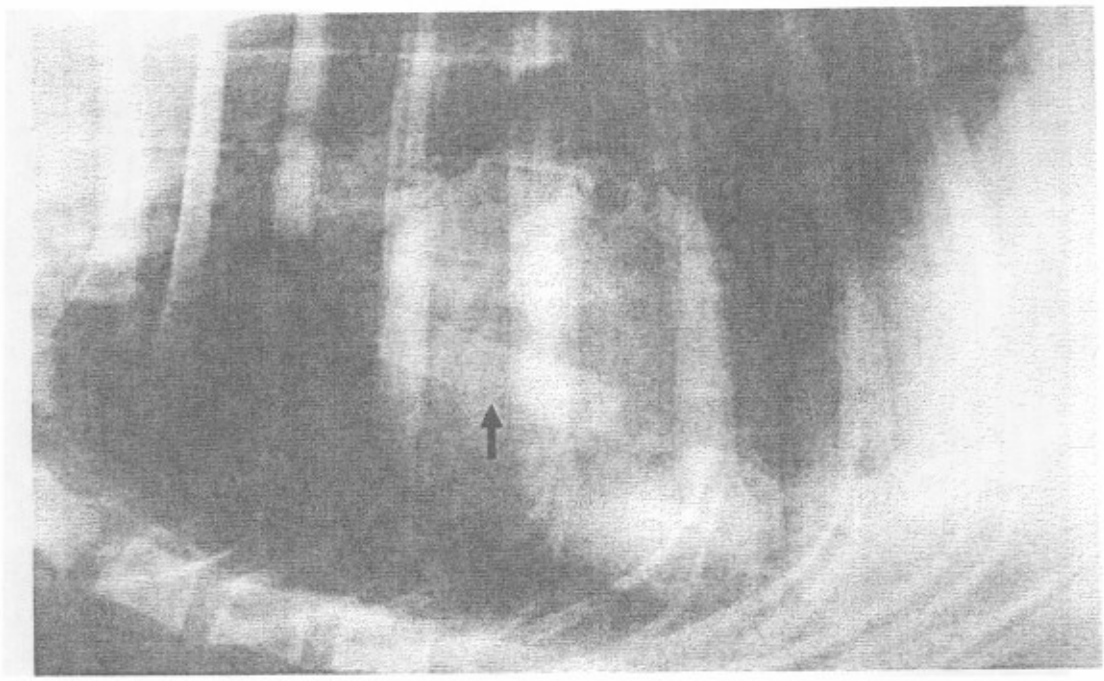

Fig (8): Right lateral thoracic radiograph of a 5-year-old German shepherd dog with mediastinal foreign body revealed presence of radio-dense rubber tube super-imposed on the heart (black arrow).

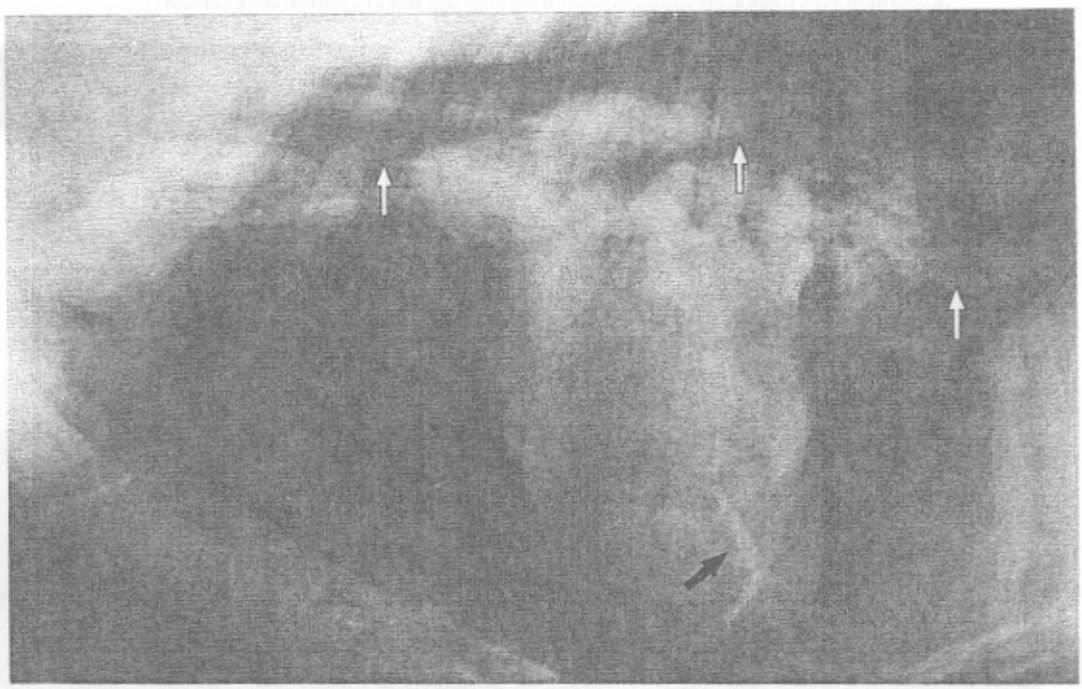

Fig (9): Right lateral thoracic radiograph of a 4-year-old Labrador retriever bitch with pneumo-mediastinum,The external tracheal margin, aortic arch, aorta and caudal vena cava are sharply defined (arrows). Notice that, the case is associated with pneumothorax and moderate pleural effusion (black arrow).

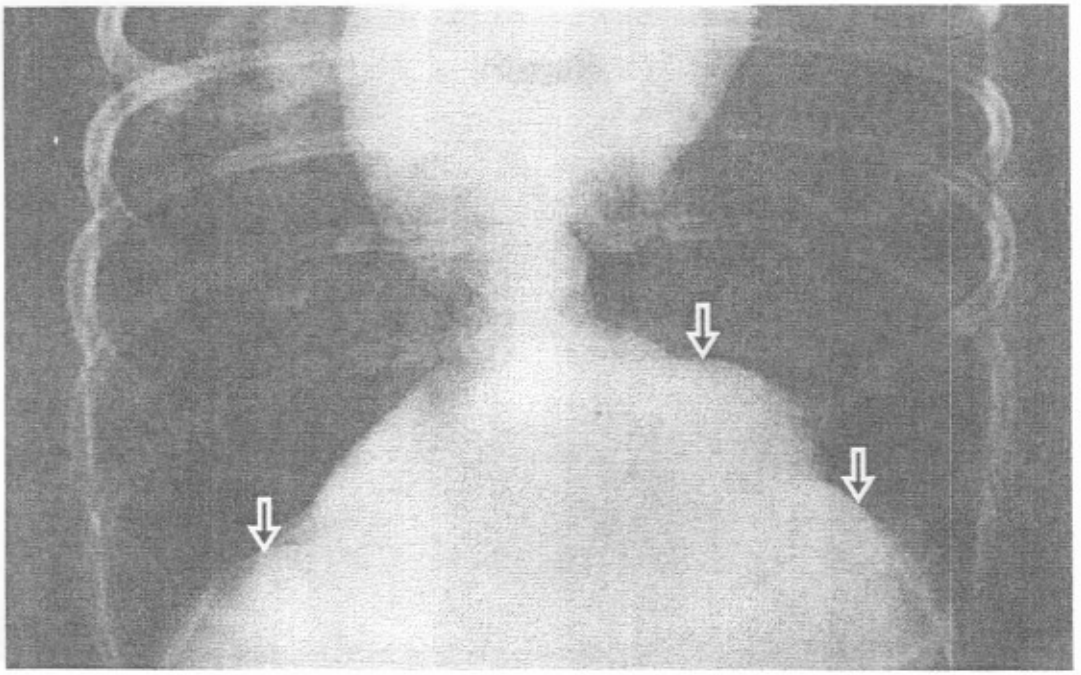

Fig (10): Ventro-dorsal thoracic radiograph of a 5-year-old Yorkshire terrier with tension pneumothorax, the lung appeared separated from the thoracic wall and the caudal lung lobes were collapsed. The diaphragm was displaced caudally with irregular and tenting appearance (arrows).

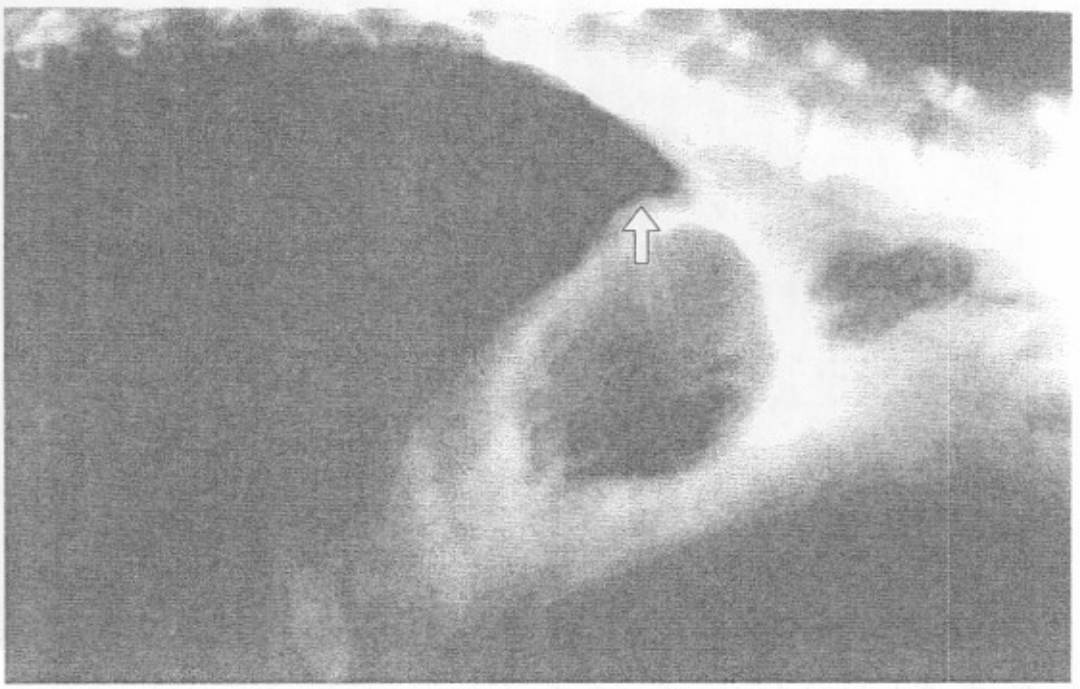

Fig (11): Right lateral thoracic radiograph of a 7-year-old Dopermann pincher dog with tension pneumothorax showed lung collapse with tented clearly identified caudally displaced diaphragm (arrow).

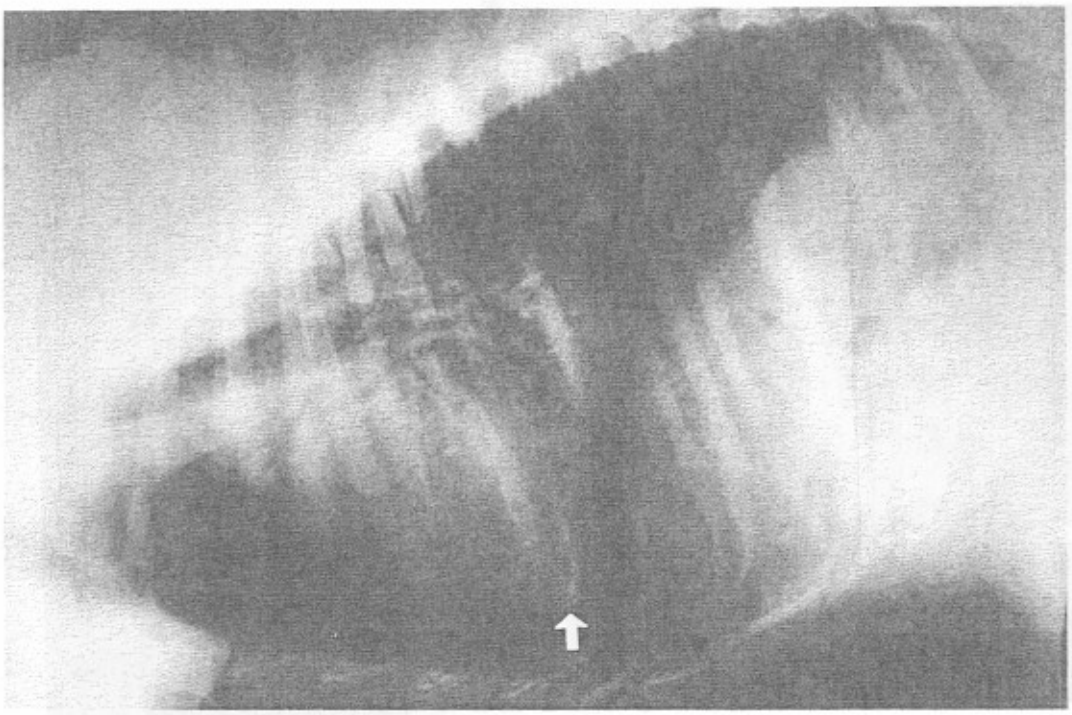

Fig (12): Right lateral thoracic radiograph of a 2-year-old Boxer with pneumothorax showed collapsed caudal lung lobes. The cardiac silhouette is separated from the sternum (arrow).

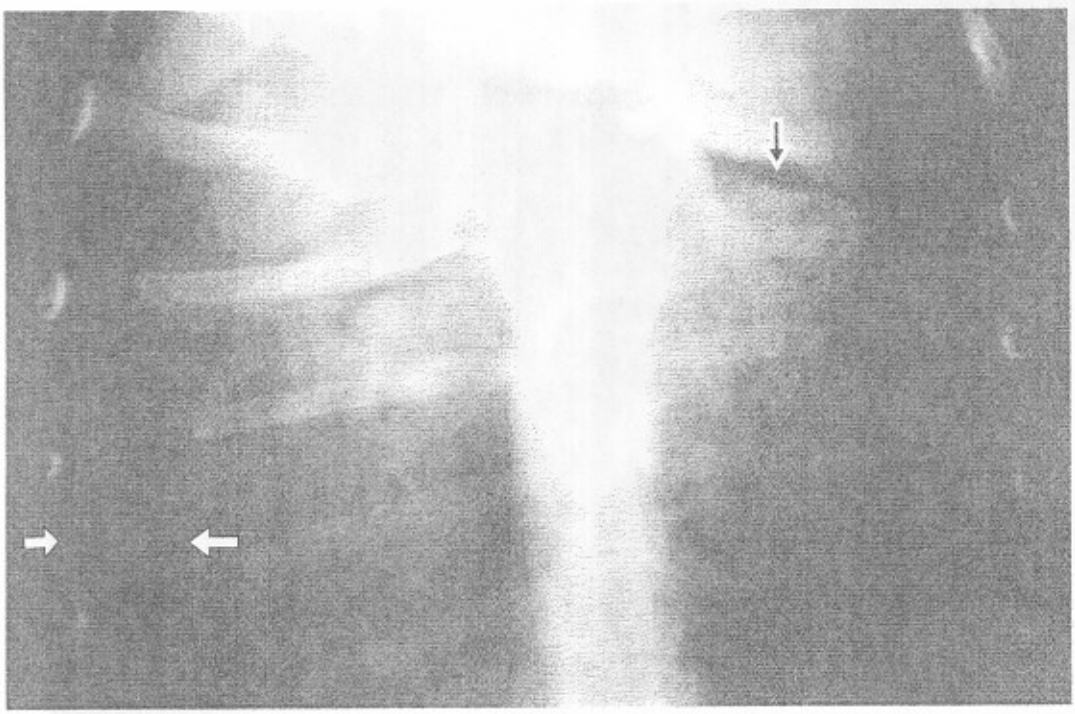

Fig (13): Ventro-dorsal thoracic radiograph of a 2-year-old Rottweiler dog with pneumothorax showed radiolucent areas separating the dense collapsed lung lobes from the thoracic wall (arrows) and the lung lobes separated from each other by radiolucent air fissures (black arrow).

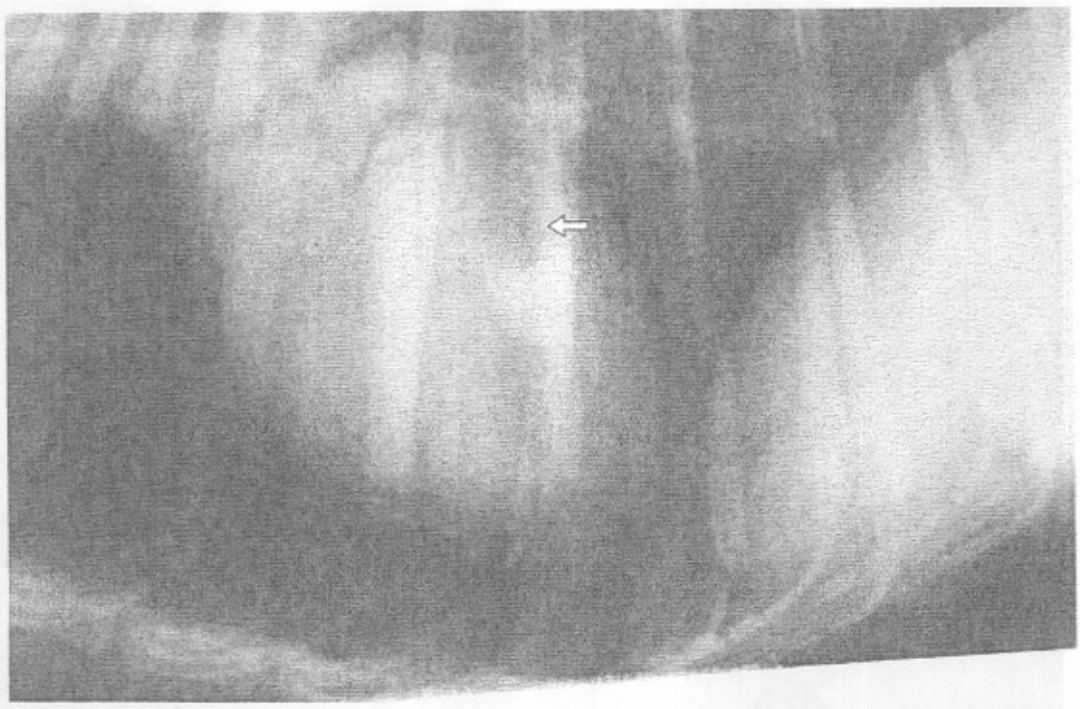

Fig (14): Right lateral thoracic radiograph of a 5-year-old Griffon dog with idiopathic pneumothorax showed fluid and air filled structure evident and superimposed on the cardiac silhouette (Bulla) (arrow). The cardiac silhouette was widely separated from the sternum.

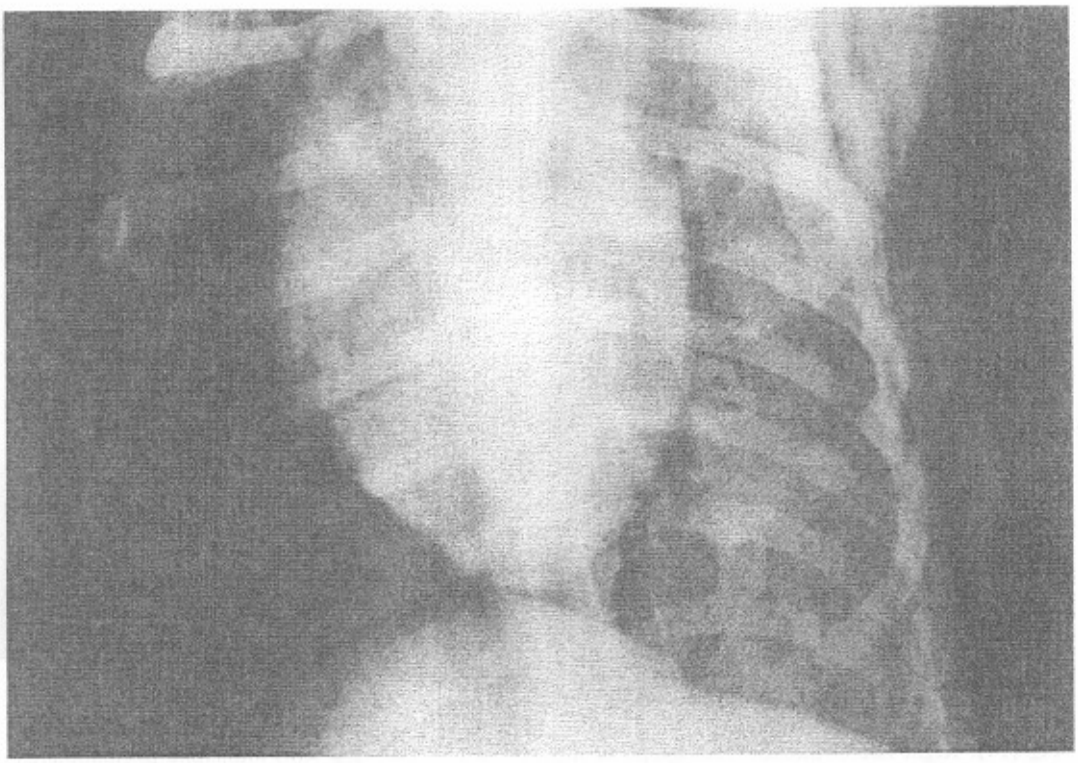

Fig (15): Ventro-dorsal thoracic radiograph of a 2-year-old German shepherd dog with hydropneumothorax showed radiodense collapsed left lung lobes and right radiolucent lung lobes.

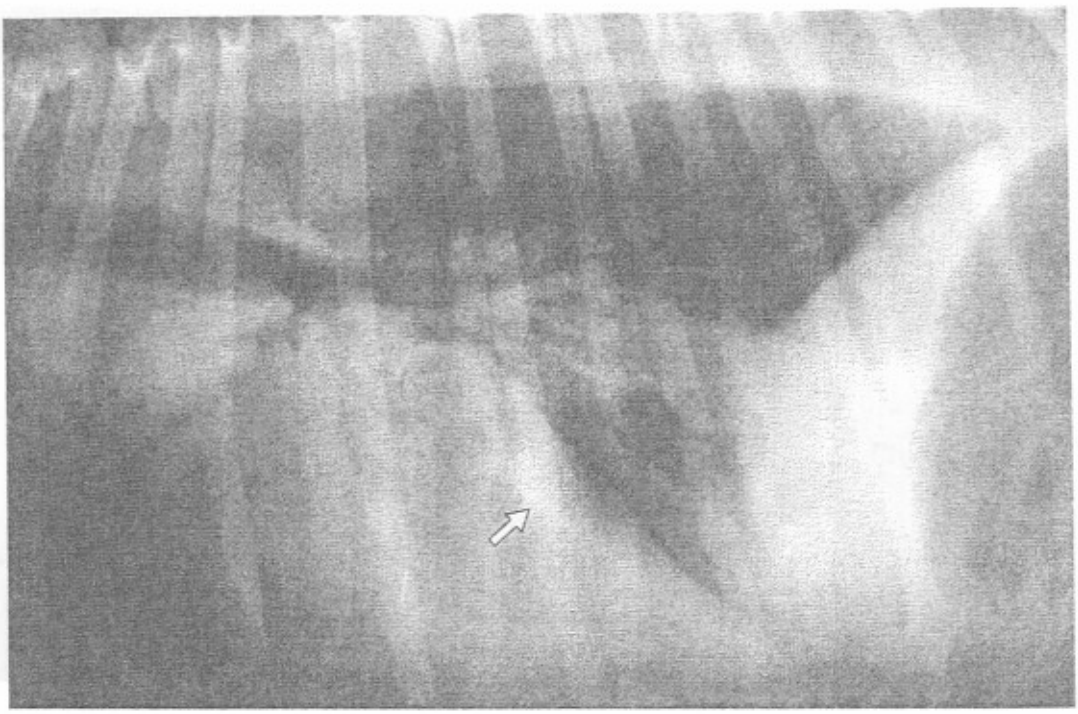

Fig (16): Right lateral thoracic radiograph of a 10-year-old Yorkshire terrier dog with small pleural effusion showed thin radiodense line between the caudal and diaphragmatic lobes of the lung (arrow).

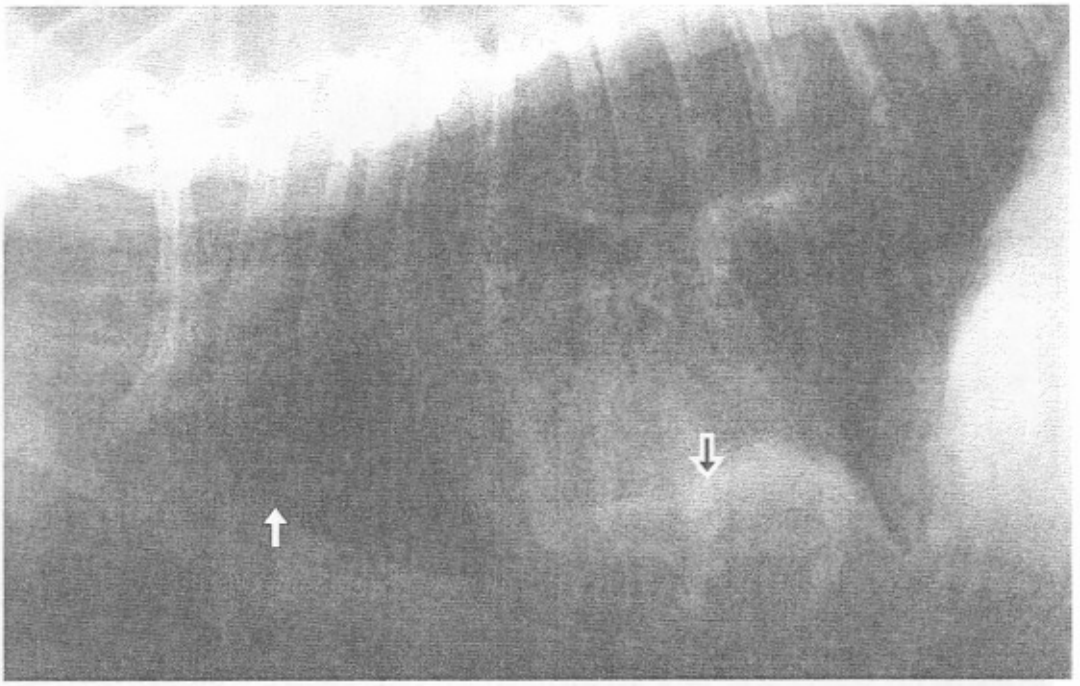

Fig (17): Right lateral thoracic radiograph of a 3-year-old Griffon with moderate pleural effusion. The margins of the lung lobes were visible (white arrow) and outlined by a fluid density that separated them from the lateral thoracic wall. A "Scalloped" border was formed at the ventral interface of the air-filled lung lobes and the dense fluid (arrow).

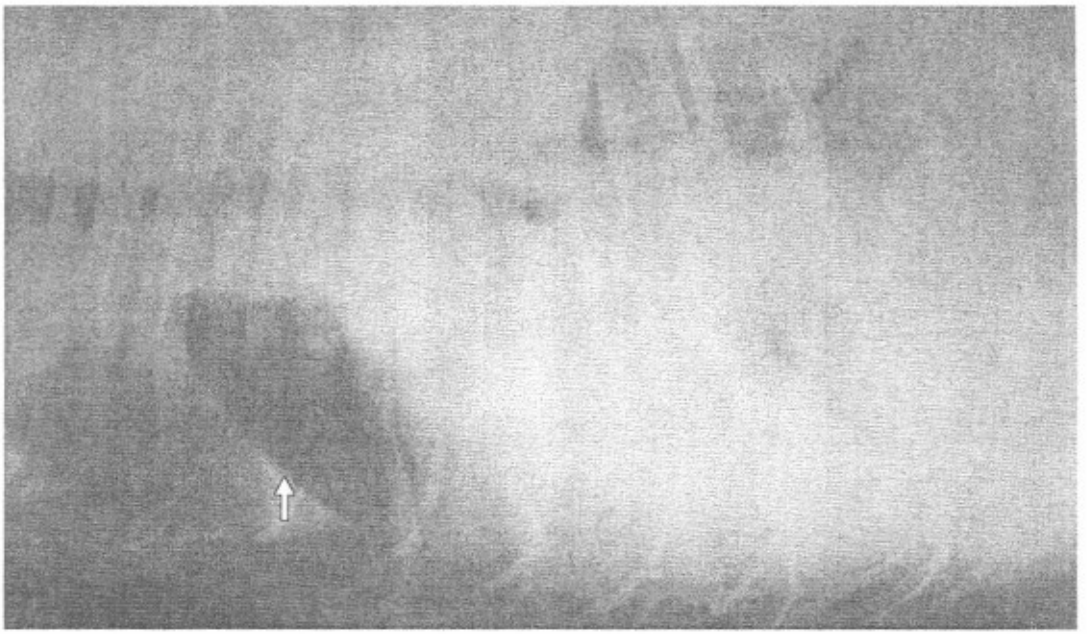

Fig (18): Right lateral thoracic radiograph of a 6-year-old Griffon dog with large pleural effusion. The cardiac silhouette was obscured and the lung lobes reduced to about third of its original volume and appeared as a radiolucent "leaves" against the homogenous background of the pleural fluid (arrow).

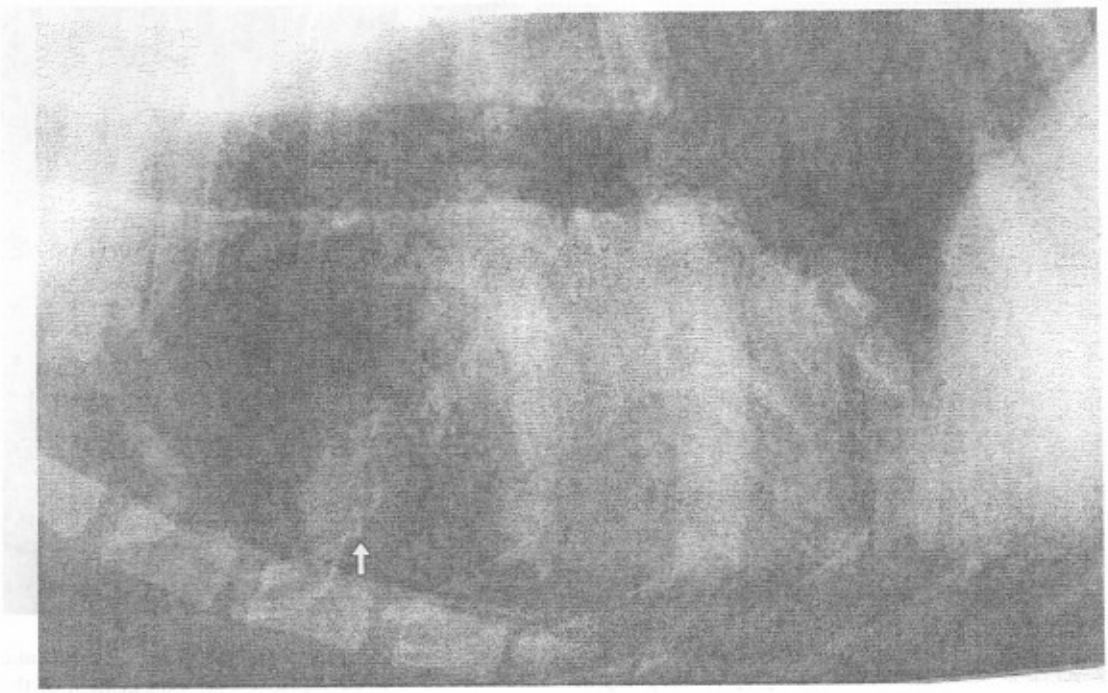

Fig (19): Right lateral thoracic radiograph of a 7-year-old German shepherd with primary lung neoplasm. A large well-defined dense tissue mass just cranial to the heart could be identified (arrow)

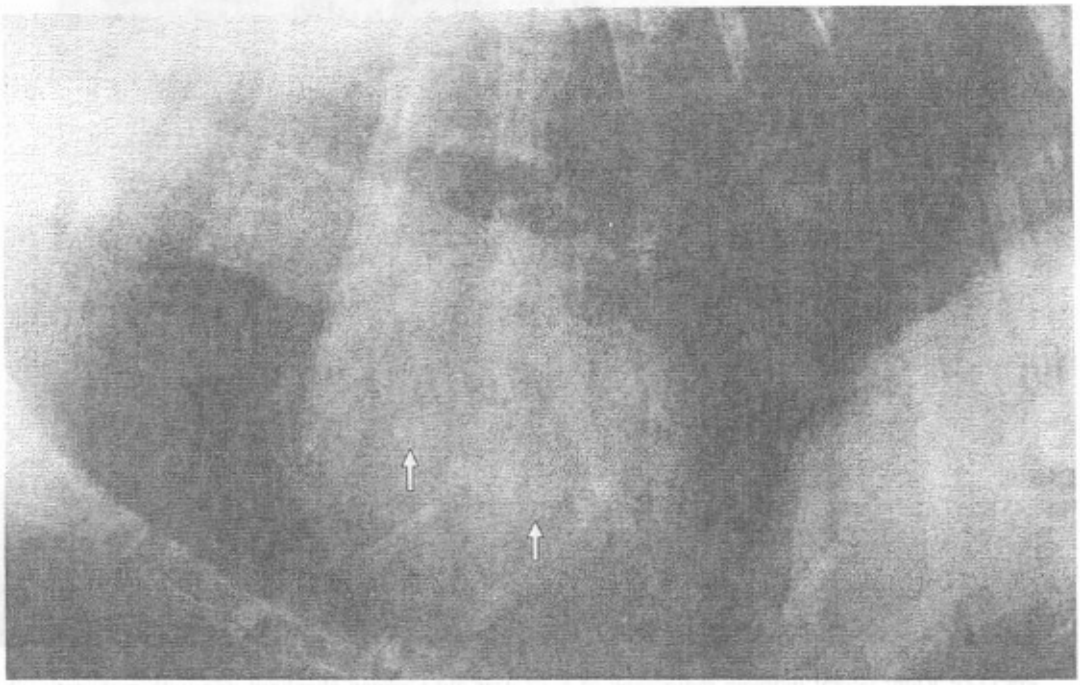

Fig (20): Right lateral thoracic radiograph of a 9-year-old Doberman pincher dog with focal metastatic pulmonary neoplasia showed multiple well-defined nodular densities located at the cranial and middle portion of the lung along the terminal portion of the blood vessels (arrows).

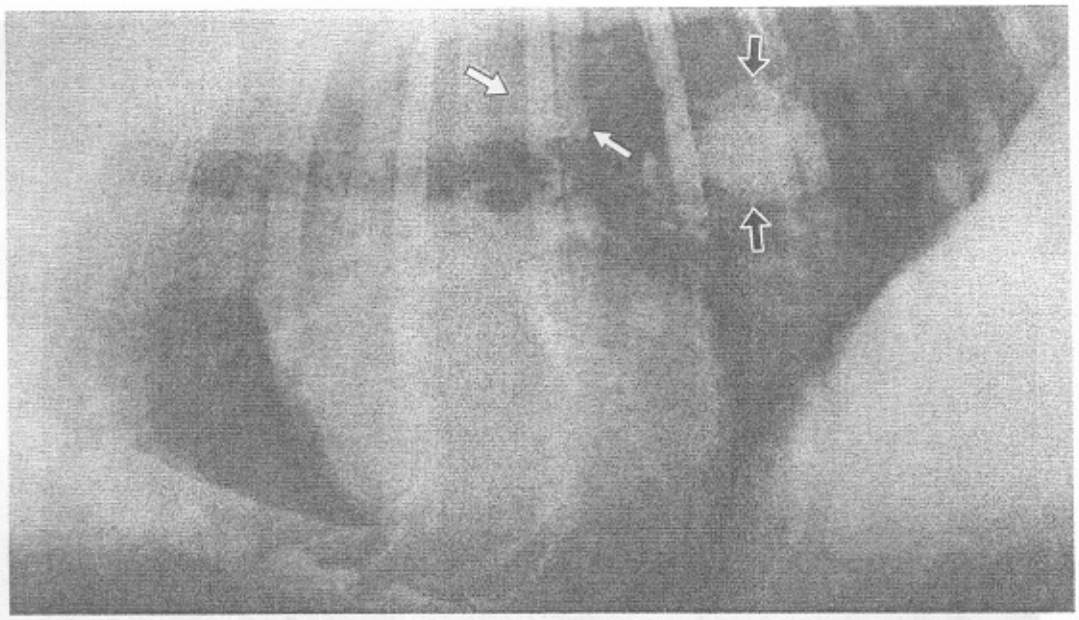

Fig (21): Right lateral thoracic radiograph of a 7-year-old Rottweiler bitch with metastatic tracheobroncheal lymphadenopathy showed focal metastatic neoplasia with enlargement of the tracheobroncheal lymph nodes (white arrows). A round radiodense mass was recorded in the parenchyma of the lung (black arrows).

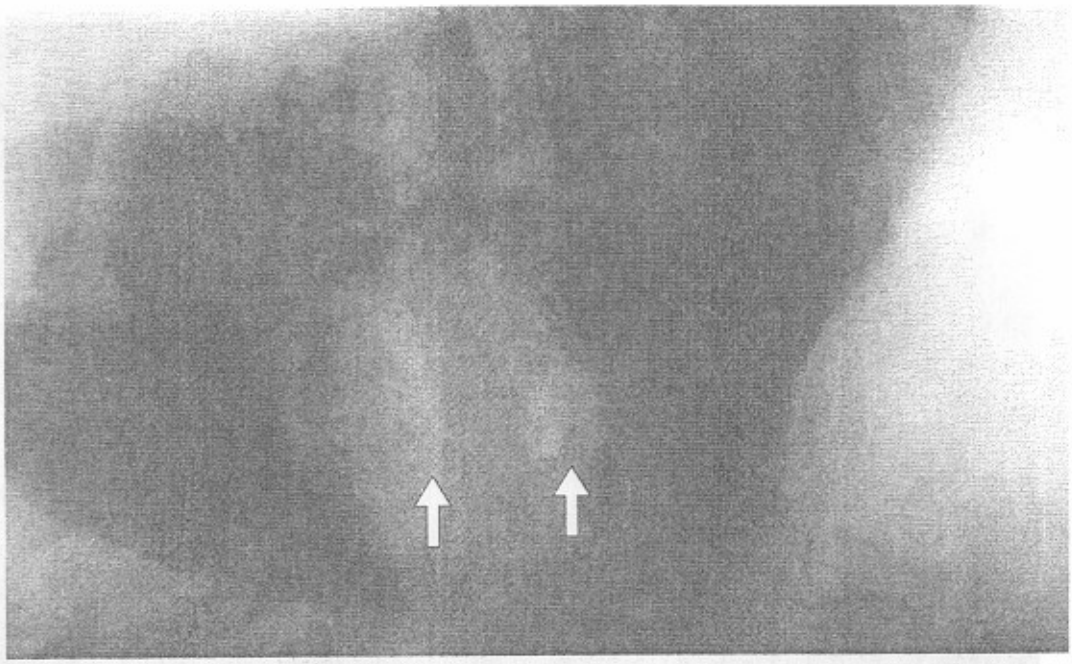

Fig (22): Right lateral thoracic radiograph of a 12-year-old German shepherd dog with metastatic ribs neoplasm. The ribs appeared radiolucent (osteolysis) with irregular periosteal reaction (arrow).

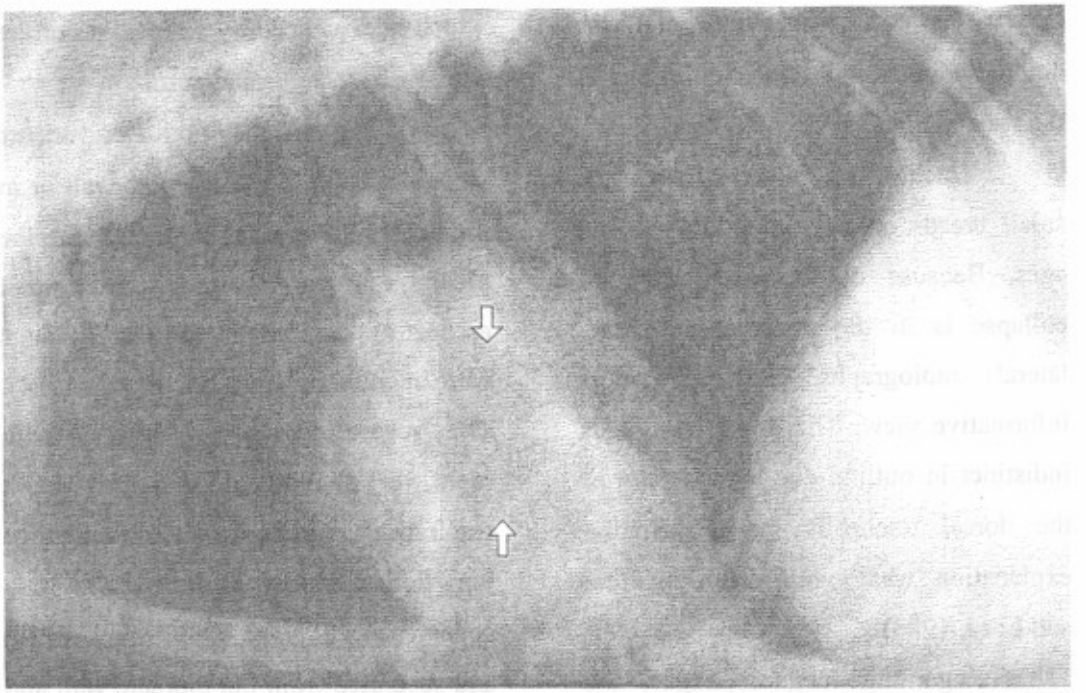

Fig (23): Right lateral thoracic radiograph of a 2-year-old Pekingese dog with Bullus emphysema showed a round radiolucent area with a thin smooth tissue dense margin (arrows) superimposed the cardiac silhouette.

DISCUSSION:

An abnormal thoracic radiograph can provide the sole evidence of the presence of disease, the radiographic findings can serve to verify the diagnosis, document the extent and location of the lesions and help in classifying such lesions. There are slight differences between right lateral and left lateral thoracic radiograph but right lateral thoracic radiographs are more familiar while ventrodorsal thoracic radiograph was preferable than dorsoventral thoracic radiograph as the animal appeared more stable and comfortable (Burk and ackerman,1996).

Pectus excavatum is a congenital dorsal depression of the caudal portion of the sternum and the associated cartilages (Suter and Lord, 1984). It is best seen on lateral radiographs. It may cause no clinical signs or it may be associated with reduced exercise tolerance and recurrent bouts of respiratory disease. There is no relation

between pectus excavatum and the emphysematous bulla reported in one of the studied dogs.

Tracheal collapse affects the small breeds of dogs in middle to old ages. Because of the usual type of collapse is in the dorsoventral plane, lateral radiographs are the most informative view. The dorsal margin is indistinct in outline due to inversion of the dorsal trachealis muscle. Similar explanation was mentioned by (Suter and Lord, 1984).

Regarding megaesophagus, the dilated esophagus was recognized due to increased density or granular pattern of gas, food, fluid and tissue density located in the region through which the esophagus passes. This is in agreement with Zawie, (1987) and Leib and Sartor (2008). Idiopathic megaesophagus is the most common cause in young animals while in adults; the possible causes include various neuromuscular and central nervous system disorders (Bartges and Nielson, 1992).

Mediastinal foreign body is a rare condition which results from esophageal perforation. The condition may be accompanied by pneumomediastinum which is evidenced by delineation of the trachea, esophagus and aorta.

Tension pneumothorax occurs when a wound in the thoracic wall or in the lungs allows air to be forced into the pleural space at inspiration that cannot escape at expiration. Similar findings were mentioned by Kern et al. (1994). The severe respiratory distress with rapid, very shallow, gasping open-mouth respiration could be attributed to massive lung lobes atelectasis where the lung appeared radiographically more dense and separated from the thoracic wall and the diaphragm by radiolucent area and subsequently the diaphragm appeared tented (scalloping appearance).

Pneumothorax is most often secondary affection to trauma and can be associated with or without rib fracture. Spontaneous pneumothorax occurs in the absence of trauma as a result of rupture of emphysematous bullae. Similar findings were reported by (Michel, 2000). The increased lung lobes density could be attributed to lung lobes atelectasis and air may be identified between the lung lobes and between the lung and lateral thoracic wall.

Hydropneumothorax refers to the presence of fluid and air within the

pleural cavity. In the recorded case, the right lung lobes appeared denser while the left ones appeared separated from the thoracic wall by a radiolucent area which may be due to accumulation of air. This is in agreement with (Suter and Lord, 1984).

In small pleural effusion, the pleural fluid was accumulated in the interlobar fissures, dorsal and ventral to the lung lobes producing linear or triangular-shaped densities at the anatomic sites of the interlobar fissures. Similar results were mentioned by (Bunch et al., 1989).

In moderate pleural effusion, the pleural fluid was accumulated in the most dependent portion of the thoracic cavity producing the characteristic scalloping appearance while in the presence of large amount of fluid, the heart moves toward the most dependent portion of the thoracic cavity, so the trachea appears elevated in lateral view which creates the false impression of cardiomegaly. Similar findings were observed by (Snyder et al., 1990 and Glaus et al., 1993).

In large pleural effusion, the pleural fluid totally obscures the heart, mediastinum and the diaphragm causing loss of architectural details of the thorax.

Primary lung neoplasm characterized by solitary nodules with circumscribed or non-circumscribed borders where there is a large soft tissue-dense mass with an overall increase in the radiographic density of the lung. Burk and Ackerman (1996) and Crews et al. (2008) mentioned similar results.

Metastatic pulmonary neoplasia occurs more frequently than primary lung tumors and appears radiographically as multiple well-defined variable size nodular densities. These nodules were not cavitated and did not displace or obstruct bronchi. Similar findings were mentioned by (Miles, 1988).

Focal nodular metastasis may be associated with tracheobronchial lymphadenopathy. This is disagreed with Suter et al. (1974).

Metastatic rib neoplasms were both productive and destructive bony lesions characterized by flattening of the rib arches with widening of the intercostals spaces. Rib fracture associated with metastatic rib neoplasm may be attributed to the destructive nature of the neoplasm.

A bulla is an area of vesicular emphysema within the lung substance and usually appears within few hours after blunt chest trauma. Traumatic bullous lung lesions may result from lung laceration. Similar results were mentioned by (Suter and Lord, 1984).

The absence or mild clinical signs in dogs with bullous lung lesions may be due to small size of the bulla but rupture of these bullae maybe lead to a condition of closed pneumothorax.

In conclusion, chest radiography is one of the most important methods for diagnosis of thoracic diseases. It can serve to verify the diagnosis, document the extent and location of the lesions and finally assist in detecting the possible complications.

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دور الأشعة في تشخيص بعض اصابات الصدر في الكلاب

فيصل عبد الصمد محمد مراد،اشرف محمد عبد الرحمن ابو سعده ، عمر صلاح الطوخى

قسم الجراحة و التخدير و الاشعة كلية الطب البيطرى جامعة القاهرة

يعتبر التصوير الأشعاعي للصدر ذا اهمية في تقييم الحالات المصابة او التي يحتمل اصابتها بامراص صدرية.فالتصوير الأشعاعي للصدر يقدم معلومات مهمة ومباشرة عن الاصابات والتغيرات غير الطبيعية في نسيج الرئتين والممرات الهوائية والغشاء البلوري وكذا الفراغات الحيزومية.ولقد تم اجراء الدراسة الحالية في الفترة من اكتوبر 2006 الي اكتوبر2009 حيث تم عمل اشعة صدرية عادية علي عدد 82 حالة اكلينيكية تم تشخيصها اكلينيكيا حيث كانت تعاني امرض تنفسية.ولقد تم استخدام الاشعة بالصبغة في الحالات التي تستوجب استخدامها.ولقد تم تسجيل الاصابات الآتية:الصدر القمعي(2),انكماش القصبة الهوائية(5) اتساع المرئ (9) الجسم الغريب بالحيزوم(2) الاسترواح الحيزومي(2) الاسترواح الصدري المشدود(5) الآسترواح الصدري(12) استرواح الصدري المائي(1) الانسكاب البلوري-البسيط (4)-المتوسط(9)-القوي (15), ورم الرئتين الأولي (3) ورم الرئتين الآنتقالي المحدود (7) ورم اعتلال عقد القصبة الهوائية الشعبي الآنتقالي(2) ورم الضلع الآنتقالي(1) والفقاعة الرئوية (3). وقد خلصت الدراسة الي أن التصوير الآشعاعي للصدر يساعد في تأكيد وتوثيق مدي وموضع الاصابة ويساعد في تحديد المضاعفات وكذلك يساعد في تصنيف الاصابات .