CLINICAL ANATOMICAL STUDIES ON THE THORAX OF DOG

PRESENTED BY

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INTRODUCTION

Clinicans in both veterinary and humans medicine spend a great deal of time examining the thorax, particularly in auscultation of the lung and heart, there are also other diagnostic procedures, such as percussion of the lungs and heart and palpation of the cardiac area, further more, it can be useful to know how to inject the heart and it is necessary to enter the thorax surgically to drain fluid or remove gas or to carry out larger operations, all of these techniques, both diagnostic and surgical, require a working knowledge of the topographic anatomy of the thorax.

Also the computed tomography, (C.T) had been utilized in the dog since 1980, now the computerized tomography (c.t.) and nuclear magnetic resonance (N.M.R.) imaging is being performed increasingly on dogs and other animals for diagnostic and research purposes also the cross-sectional images resulting from these techniques require an understanding of their anatomical feature. Texts on anatomy of the dog contain few illustrations of the body in cross section. This study provide illustration of the normal thorax in cross section with anatomic structures labeled, also these section may be aid in the interpretation of C.T. and N.M.R. scans of dog, these illustrations may also be of benefit to students of anatomy.

The purposes of the present Study were

1. The most important purpose was how to use the normal anatomical pattern to apply on the lived animal to establish the most clinical application of the thorax in dog.

2. How to observe the normal anatomical pattern of the different organs with the different diagnostic tools especially CT.

3. To establish the basics of the normal X-ray, ultrasonography and CT images of the thorax refering to their normal cross-sectional anatomy.

4. These normal studies were to establish the basics for diagnostic aids to the dog and its studied organs.

REVIEW OF LITERATURE

The thorax:

Assheuer and Sagar (1997) in dog stated that the thorax consists of the thoracic vertebrae, 13 pairs of ribs and the breast bone together with the muscles for respiration. ***Frandson and Spurgeon (1981)*** in domestic animals mentioned that the bony thorax is bounded by the thoracic vertebrae dorsally, ribs laterally and the sternum ventrally.

Douglas (1970) and Dyce; Sack and Wensing (1987) stated that the shape of thorax in dog varies greatly with breed, it is laterally compressed and deep, that's due to the form of the ribs which are long and straight in the Borzoi breed and short and strongly curved in other breeds ***King (1974)*** in domestic mammals mentioned that the thorax of greyhounds breed is narrow and deep, but wide and shallow in bulldogs. He added that invspite of the variation in shape, the topography of lungs and heart remain constant at the all domestic animals.

King (1974); Beaver (1980); Frandson and Spurgeon(1981), Dyce et al. (1987) and Kumar (1998) recorded that the dog generally has 13 pairs of ribs, nine of which are sternal. ***Dyce et al. (1987)*** in dog added that the first three or four ribs are almost vertical, then after the ribs slope increasingly caudoventrally. The ribs are relatively narrow, leaving wide intercostal spaces. The costal cartilages at first continue the direction of the ribs but then bend cranio medially almost at right angles forming the knees of the ribs. The cartilages of the last four asternal ribs are joined by fascia and muscle to form the costal arch. Also he add that the number of sternebrae is nine sternebrae cylindrical and slender, slightly thickened where the costal cartilages attach ***Frandson (1981)*** stated that the dog has eighth sternebrae at which the sternal ribs attached and sometimes the last one or two pair of ribs have no connection with other ribs at the ventral end which called floating ribs.

Dyce et al. (1987) in dog and ***Crouch (1969)*** in cat mentioned that the tips of the thoracic spines are individually palpable, the spines of the cranial thoracic vertebrae are long, decreasing in length to the twelfth and sloping caudad to the tenth, the eleventh vertebra has vertical spine, the twelfth and thirteenth have spines which slope craniad.

I. The thoracic cavity:

Adams (1986) in dog stated that the thoracic cavity is that potential space within the walls of the thorax cranial to the diaphragm.

Miller, Christensen and Evans (1964) mentioned that the shape of the thoracic cavity of the dog appeared laterally compressed with the result that the average dorso-ventral dimension is greater than the average lateral and cranio caudal dimension. The external contour of the thorax differs from the internal limits of the cavity. They added that in crosssection, the thoracic cavity cranial to the diaphragm is heart shaped with the apex directed ventrally. On the other hand ***Hare (1975)*** in dog stated that the cross-sectional outline of the thoracic cavity is more cylindrical than oval because of the greater curvature of the ribs and the greater length and curvature of the costal cartilages of the sternal ribs.

The thoracic inlet:

Hare (1975) in dog mentioned that the thoracic inlet is wide and elliptical in outline.

Miller et al. (1964) and Adams (1986) in dog reported that the thoracic inlet is the roughly oval opening that bounded bilaterally by the first pair of ribs and their cranially extending costal cartilages. Its dorso ventral dimension is about 4 cm, its greatest width is about one-fourth less than its dorsoventral dimension, it is wider dorsally than ventrally. The first thoracic vertebra and the paired longus colli muscles bounded it dorsally, the manubrium of sternum bounds it ventrally. The thoracic inlet contain the trachea, esophagus, vagosympathetic nerve trunk, recurrent laryngeal nerve, phrenic nerve, and several vessels and the apices of the pleural cavities, first two thoracic nerves.

The thoracic walls:

Miller et al. (1964) and Adams (1986) in dog mentioned that the thoracic walls are formed bilaterally by the ribs and intercostal muscles, dorsally by the thoracic vertebrae and intervertebral disc plus the longus colli muscle in the cranial portion of the dorsal thoracic walls and ventrally by the sternum and transverse thoracic muscle. ***Dyce et al.***

(1987) in dog explained that the principal intercostal spaces have the usual construction. The intercostal vessels and nerves lie caudo medial to the ribs, additional follow the cranial borders of the ribs in the ventral parts of the spaces, they added that the epiaxial muscles provide a thick covering to the vertebrae and dorsal parts of the ribs.

Dyce et al. (1987) in dog mentioned that the angle between the scapula and humerus is filled by the fleshy triceps muscle but the lateral parts of the ribs behind the limb are more thinly covered by the serratus ventralis, latissmus dorsi, scalenus and external abdominal oblique muscle.

However ***Ommer and Harshana (1995)*** in ox and ***Ahmad (1999)*** in buffalo reported that the topography of the thoracic wall limited the application of clinical examination of the heart as well as by radiological means because the thoracic wall was covered, in its cranial region by the shoulder and arm as well as their related muscle especially M-triceps brachii.

King (1974) and Smallwood (1992) in all domestic animals recorded that the caudal border of the triceps muscle drops roughly vertically from the caudal angle of the scapula to the olecranon process of the ulna and covered the first five ribs and the point of the elbow close to the fifth costochondral junction.

The muscles of the thorax and their related fascia was listed by ***N.A.V. (1994)*** of domestic animals as follow: M. pectoralis superficialis.

M. intercostalis interni, M. subcostalis, M. retractor costae, M. transversus thoracis,M.rectus thoracis and fascia endothoracica.

Sisson and Grossman (1969), Nickel et al. (1986); Smallwood (1992) in ox, horse and pig, ***May (1977)*** in sheep, ***Nosseur (1981)*** in camel recorded that the Mm..intercostalis externi occupy the spaces between the ribs but do not occupy the intercartilagenous spaces, however ***Getty (1975)*** in dog, ***Bradley and Grahame (1946)*** in horse declared that the Mm. intercostalis interni extend into the inter chondral space and becomes thinner in the intercostal spaces than the Mm.. intercostalis externi.

The thoracic outlet:

Miller et al. (1964) in dog stated that the thoracic outlet is marked by the transverse plane of the diaphragm through the sixth inter-costal space and about 5 cm dorsal to the sternum.

Hare (1975); Adams (1986) and Dyce et al. (1987) in dog stated that the thoracic outlet is the area within the line formed by the costal attachment of the diaphragm and the diaphragmatic attachment to the 3^{rd} and 4^{th} lumbar vertebrae. The costal attachment is along the horizontal parts of the eight and the ninth costal cartilages, to the tenth costal cartilages just ventral to the costochondral junction, to the ventral parts of the twelfth ribs and to the middle of the last ribs.

Watton (2001) and De-Rycke; Gielen; Polis, Van Ryssen; Van bree and Simoens (2001) recorded that in small animals two basic approaches to the thorax are used paraxiphoid-trans diaphragmatic and intercostal approach, and most intra thorax structure of the left and right hem thorax were endoscopically visible after advancing of the cannula and the endoscope into the thoracic cavity via entry of the free upper side in the dorsal third of the eight inter costal space.

II. The diaphragm:

Miller et al. (1964) in dog ***and Crouch (1969)*** in cat denoted that the diaphragm is a musclotendinous plate between the thoracic and abdominal cavities. It projects forward into the thoracic cavity like dome, peripherally the diaphragm attaches to the ventral surface of the lumbar vertebrae, the ribs and the sternum.

Adams (1986) and Dyce et al. (1987) in dog recorded that the thoracic surface of the diaphragm in the median plane extends in gentle curve, with the convexity facing craniodorsal from the body of the twelfth thoracic vertebrae to the level of the sixth pair of ribs just dorsal to their costochondral junction and ventrally till the sternum.

Getty (1975) in dog described that the diaphragm consists of a tendinous central sheet surrounded by radiating muscle includes lumbar, costal and sternal parts, which is a relatively V-shaped small area and is intended dorsally by the tendons of origin of the two lumbar crura, also all the muscle fibers of sternal and costal parts are directed toward the tendinous center.

Delahunta and Habel (1986) and Dyce et al. (1987) in dog reported that the tendinous center transmits the caudal vena cava a little to the right of the median plane, ***Maskar (1957); Solanki and Shama (1964); Etemadi (1966); Taher (1975); Selim (1979) and Smuts and Bezuidenhaut (1987)*** in camel found an osseus structure in the central tendon of the diaphragm in close association with the medial part of the foramen vena cava.

With regarding the muscular part of the diaphragm, ***Miller et al. (1964)*** in dog; ***Raghavan and Kachroo (1964) in ox; Selim (1979)*** in camel and ***Small Wood (1992)*** in horse reported that the muscular part of the diaphragm surrounds the central tendon and its fiber streams into radial direction. It is divided into costal, sternal and lumbar parts, ***Miller et al. (1964)*** in dog added that all the parts with the exception of the lumbar part have uniform thickness of 3 or 4 mm in large dogs.

Simic, Jajic and Miladinovic (1965), ***Miller et al. (1964)*** in dog; ***Raghavan and Kachroo (1964) and Getty (1975)*** in ox stated that the lumbar part of the diaphragm is formed by the right and left crura, which enclose the aortic hiatus which contains the aorta, the azygous and hemi azygous veins and lumbar cistern of the thoracic duct.

However ***King (1974); Grandage (1974) and Bojrab (1975)*** in dog recorded that the esophageal hiatus lies between the right and left crus further away from the tendinous origin. The first auther added that the esophageal hiatus is the weakest point in the diaphragm as it lies in a gap between the left and right crus.

Miller et al. (1964) in dog denoted that the right crus is considerally larger than the left. Each crus arises sagittaly by a long bifurcate tendon, one parts of which is longer and stronger and comes from the cranial edge of the body of the fourth lumbar vertebrae, the shorter and somewhat weaker part of the tendon comes from the body of the third lumbar vertebrae.

Bradley and Grahamme (1964), Kolimeier (1958), Berg (1973) and Nickel et al (1986) in horse reported that the right and left crura originate from the ventral longitudinal ligaments of the first four lumbar vertebrae.

Ahmad (1999) in buffalo reported that the right and left crura were originated by a large common tendon which attached to the ventral longitudinal ligament at the level of the $2^{nd} - 6^{th}$ lumbar vertebrae, at the level of the 3^{rd} lumbar vertebrae, the common tendon subdivided into two tendon, large deep tendon and small superficial one.

Miller et al. (1964) in dog and ***Crouch (1969)*** in cat reported that the costal part on each side consists of fibers radiating from the costal wall to the tendinous center, this muscle arises by in distinct serrations from the medial part of the thirteenth rib, distal part of the twelfth rib, costochondral junction or symphysis of the eleventh rib, as well as the whole length of the tenth and ninth, and at the bend on the eighth costal cartilage, however the sternal part of the diaphragm, ***Miller et al. (1964)*** in dog, ***Nickel et al. (1986)*** in ruminant and ***Ahmad (1999)*** in buffalo stated that the sternal part is an unpaired medial part unseparated from the bilateral costal portions, its fibers arise on the base of the xiphoid cartilage, the adjacent transverse fascia and the eight costal cartilages, and extend dorsally to the apex of the body of the central tendon.

III. The pleura and mediastinum:

Miller et al (1964) and Evans and Delahunta (1988) stated that the pleurae of the dog are the serous membranes that cover the lungs and lined the walls of the thoracic cavity and covers the structures in the mediastinum, the pleura includes right and left sacs that encloses the pleural cavities.

Miller et al (1964), Beaver (1980) and Frandson and Spurgeon (1981) in dog denoted that the pleura that lines the thorax is the parietal pleura, while that covers the lungs is the visceral pleura. The pleural cavity is the potential space between parietal and visceral pleura, mediastinal and visceral pleura.

Adams (1986) and Dyce et al (1987) in dog recorded that the pleural cavity projects a little beyond the first ribs, somewhat further on the left than on the right (cupula pleurae), ***Miller et al (1964) and Evans and Delahunta (1988)*** in dog stated that the parietal pleura is attached to the thoracic wall by the endothoracic fascia that is a thin layer of fascia containing elastic fibers, the parietal pleura divided into costal, diaphragmatic and mediastinal parts, each of these is named after the region or surface it covers and are continous one with another.

Miller et al (1964) in dog ***and El-Hagri (1967)*** in domestic animals stated that the lines of reflection of the parietal pleura are three vertebral, sternal and diaphragmatic. The vertebral line is that line along which the costal pleura is directed ventrally to form the mediastinal pleura. The sternal line is that line along which the costal pleura is reflected dorsally to become the mediastinal pleura, cranially the two previous lines of reflection are close together along the middle of the floor of the thorax but further caudally, they diverge to each side of the pericardium, the second auther added that the reflection of pleura takes place at an acute angle and the narrow angular recess of the pleural cavity here is termed the costomediastinal sinus. The diaphragmatic line as denoted by ***Miller et al (1964)*** in dog, is that a line at which the costal pleura passes to the cranial surface of the diaphragm, the angular space of the pleural cavity here is termed the costodiaphragmatic recess.

Delahunta and Habel (1986) and SmallWood (1992) in dog reported that the diaphragmatic line of pleural reflection marked on the ribs, runs from the knee of the eight rib, across the eleventh rib just above its costochondral junction, to the dorsal part of the thirteenth rib this line is the ventrocaudal limit of the costodiaphragmatic recess. ***Miller et al (1964)*** in dog denoted that the mediastinal pleura may be divided into four parts the ventral, cranial, middle and caudal mediastinal pleura. The ventral mediastinal pleura is the pleura ventral to the heart from the thoracic inlet, attached to the sternum and extend to the diaphragm.

Miller et al (1964) and Adams (1986) in dog recorded that the pulmonary ligament of each lung is caudo dorsal reflection of the dorsal portion of the mediastinum as a triangular fold of pleura on each side attach the hillus of lung to the mediastinum. They added that also the mediastinal pleura reflected to the right and dorsally from the mediastinum around the caudal vena cava to form the plica vena cava, the accessory lobe of the right lung is positioned in the space between the plica and the mediastinum.

Miller et al (1964) in dog mentioned that the middle mediastinal pleura is continuos with the caudal mediastinal pleura, it contains a triangular fold which bridges the space between the heart cranial and the diaphragm caudally called the phrenico pericardiac ligament.

Bedford (1984), Delahunta and Habel (1986), Dyce et al. (1987) and Kumar (1998) in dog recorded that the pleurocentesis for the drainage of fluids from the pleural cavity is performed at the lowest safe point in the seventh or eighth intercostal space in the standing animal this is in the costomediastinal recess caudal to the pericardium and cranial to the diaphragmatic line of pleural reflection.

The mediastinum:

El-Hagri (1967) and Getty (1975) in domestic animals denoted that the mediastinum is the space between the two-pleural sacs, it extends from the sternum ventrally to the vertebral column, and from the thoracic inlet cranially to the diaphragm caudally.

Miller et al (1964); Dyce et al (1986) in dog and ***Mcclure; Dellman and Garrett (1973)*** in cat recorded that the fibrous tissue associated with the thoracic organs and that between the pelural sacs is so scanty that the mediastinum is reduced in several places to very delicate membrane consisting only of the apposed right and left pleural sheets.

Evans et al. (1988) in dog and ***Mcclure et al (1973)*** in cat stated that the mediastinum can be divided into cranial part, that lying cranial to the heart, a middle part, that containing the heart and a caudal part, that lying caudal to the heart.

Dyce et al (1987) in dog mentioned that the cranial mediastinum is wide dorsally where it contains the trachea and esophagus lying side by side as they pass through the thoracic inlet, ventral to these the cranial vena cava and brachiocephalic trunk, with their respective branches, are embedded in generous quantities of fat. The ventral part of the cranial mediastinum contains lymph nodes, fat, the internal thoracic vessels, and in the young animal the thymus. ***Myer (1978)*** in dog recorded that the cranial mediastinum contains the cranial vena cava and azygous vein on the right, the left subclavian artery and the brachio cephalic trunk with its branches left common carotid, right common carotid and right subclavian on the left.

Dyce et al. (1987) in dog reported that the dorsal part of the middle mediastinum is slightly narrower than the ventral part containing the heart and the dorsal part contain the last part of the trachea, the esophagus, the aortic arch, the structure of the roots of the lung and lymph nodes, the right surface of this part is fairly flat but the aorta bulges laterally on the left surface, indenting the left lung, while the ventral part between the pericardium and sternum is overample for the space it bridges and falls into fold somewhat resembling the greater omentum.

El-Hagri (1967) and Dyce et al (1987) in dog denoted that the triangular dorsal part of the caudal mediastinum contains the aorta and the right azygous vein and the esophagus ventrally, the delicate ventral part attaches to the caudal surface of the pericardium and to the diaphragm, they added that the mediastinum at that part is displaced so far to the left and touch the lateral thoracic wall near the ninth costochondral junction.

IV. The thoracic organs

The lungs:

El-Hagri (1967) denoted that the lungs of the canines are relatively wide in conformity with the form of the thorax and the lower costal attachment of the diaphragm than in any other animal. The right lung is about one and quarter times the size of the left lung, ***Beaver (1980) and Dyce et al (1987)*** in dog mentioned that the right lung is the larger of the two, it has cranial , middle, caudal and accessory lobes, the left lung has a divided cranial and a single caudal lobe.

Adams (1986) in dog recorded that the lungs are so deeply divided by fissures into lobes that they are connected only by the bronchi and blood vessels. The lobes are named according to the lobar bronchus that supplies it with air. Two fissures are present on the right lung costal surface, between the cranial and middle lobe and between the middle and caudal lobe, while one fissure is present on the left lung between the cranial and caudal lobe and the cranial lobe is subdivided by an interlobar fissure into cranial and caudal parts ***El-Hagri (1967)*** in dog said that the lobulation of the lungs is not distinct.

Adams (1986) and Dyce et al. (1987) in dog stated that each lung has an apex, a base and hilus, the pulmonary apex is the cranial portion, The left lung extends farther cranially than the right, while the pulmonary base is the concave caudal portion of the lung that makes contact with the diaphragmatic pleura. However ***Adams (1986)*** in dog recorded that the surfaces of the lung are the costal, medial, diaphragmatic and the inter lobar surfaces. ***Hare (1975)*** in dog reported that the costal surface of lung contain costal impressions, while the medial surface is less extensive than the costal surface and divided into small dorsal part related to the bodies of the vertebrae and large ventral part related to the mediastinum and has a deep cardiac impression which is deeper in right lung than in left lung.

Dyce et al (1987) in dog observed that there is a small cardiac notch between the two parts of the left cranial lobe opposite the ventral end of the third intercoastal space, for all practical purposes, covers the lateral surface of the heart. The right cardiac notch between the cranial and middle lobes, is larger but still restricted to the ventral end of the fourth intercostal space, it is recommended site for puncture of the right ventricle of the heart ***El-Hagri (1967)*** in dog stated that the right cardiac notch is triangular in outline and allows the pericardium to come in contact with the lateral wall of the thorax at the fourth and fifth intercostal spaces, and the left cardiac notch is absent.

Reif *(1971); Roudebush (1982); Delahunta and Habel (1986) and Dyce et al (1987)* in dog reported that the projection of the lungs on the lateral thoracic wall produces a triangular field for auscultation and percussion, the cranial border is the fifth rib (caudal border of the triceps and teres major muscle), the dorsal border is the palpable lateral margin of the back muscle (from the fifth rib to the eleventh inter costal space), the caudoventral (basal border) extends from the costochondral junction of the sixth rib, through the middle of the eight rib to the dorsal end of the eleventh intercostal space.

The heart and pericardium:

The pericardium:

Getty (1975) and Evans and Delahunta (1988) in dog denoted that the pericardium is a conical fibroserous sac enclosing the heart. It is externally covered by the mediastinal pleura, it consists of a fibrous pericardium and a serous pericardium. The serous pericardium is comprised of a parietal and a visceral layer, both being continous at the base of the heart, between these layers is the pericardial cavity, containing a scanty amount of pericardial fluid. They added that the fibrous pericardium together with parietal layer of the serous pericardium is reflected on the wall of the large vessels at the base of the heart and the serous layer invests both the pulmonary trunk and the ascending aorta.

Dyce et al (1987) in dog reported that the pericardium presents no special features beyond along and relatively robust phrenicopericardial ligament that connects with the sternal part of the diaphragm, this allow the apex more mobility than in the large species in which the pericardium is firmly attached to the sternum. ***El-Hagri (1967)*** in dog recorded that the pericardium lies in contact with the thoracic wall along narrow area at the ventral parts of the fifth and sixth intercostal space. Whatever ***Delahunta and Habel (1986)*** in ox, ***Tyagri and Singh (1993)*** in ruminant and ***Ahmad (1999)*** in buffalo observed that the most accessible site for drainage of pericardial sac was the 5^{th} intercostal space.

The heart:

Dyce et al (1987) stated that the canine heart is ovoid its long axis is very oblique forms an angle of about 45 degree with the sternum; the base faces cranio-dorsally and the blunt apex lies near the junction of sternum and diaphragm.

Getty (1975) and Evans and Delahunta (1988) in dog denoted that the right atrium is the cranio dorsal part of heart dorsal to the right ventricle and receives the blood from the systemic veins, which are cranial and caudal vena cava, right azygous vein and the coronary veins.

Getty (1975) in dog stated that the right ventricle is triangular and does not extend to the apex of the heart. ***Evans and Delahunta (1988)*** in dog reported that the greater part of the base of the right ventricle communicate with the right atrium through the atrio ventricular orifice which guarded by the right atrio ventricular valve which consists basically of two cusps (parietal and septal cusp) with three or four intervening secondary cusps. They added that the pulmonary trunk leaves the right ventricle at the left cranio dorsal angle of the heart which guarded by the pulmonary valve which consists of three semilumar cusps.

Getty (1975) in dog mentioned that the left atrium is located on the left dorsocaudal part, dorsal to the left verticle, the left auricle is more ventral in position than the right auricle, and truncated with a somewhat serrated margin and receives blood through five or six opening of the pulmonary veins.

Getty (1975) and Evans and Delahunta (1988) in dog reported that the blood pass from the left atrium to the left ventricle by the small, oval left atrioventricular opening which guarded by the left atrio ventricular bicuspid valve (parietal and septal) with four or five secondary cusps at their ends. They added that the left ventricle is conical and form the apex of the heart and the aortic opening is situated near the center of the base of the heart which guarded by three semi lunar cusps.

Delahunta and Habel (1986) and Dyce et al (1987) in dog recorded that the heart extends from the third rib to the sixth intercostal space, the latter limit roughly coinciding with the most cranial extent of the diaphragm. The projection of the base intersects the middle of the four rib, and the most dorsal part of the heart reaches to the line connecting the acromion with the ventral end of the last rib, the apex lies just to the left of the second last sternebrae.

Dyce et al (1987) and Assheuer and Sagar (1997) in dog reported that the heart makes contact with the ventral thoracic wall over a triangular area, the cranial base of the triangle crosses the sternum at the level of the fourth costal cartilages, while the apex lies near the left seventh costal cartilage.

King (1974) in dog reported that the effectiveness of percussion of the heart obviously depends on the extent of the contact between the heart and thoracic wall; the heart is indirect contact with the thoracic wall, as separated from it by only a thin layer of lung, percussion will reveal area of dullness which with differ from the area of resonance where the lung is in contact with the thoracic wall, this area of dullnes called the area of cardiac dullness.

King (1974), Beaver (1980) and Delahunta and Habel (1986) in dog recorded that the area of cardiac dullness on the left side lies beneath the ventral third of the third, fourth and fifth intercostal space but not so far in sixth. The first auther added that on the right side, the area of dullnes is usually smaller, being restricted generally to the third and fourth intercostal space, while ***Delahunta and Habel (1986)*** in dog recorded that the area of dullness on the right side extend only 1 – 2 cm from the sternum in fourth and fifth intercostal spaces.

Ettinger (1971) in dog recorded that the purpose of the heart auscultation is to detect abnormalities of its action also the heart sound can be examined valve by valve, the pulmonary valve, the aortic valve the left and right atrioventri cular valve in sequence.

Whatever King (1974); Beaver (1980); Delahunta and Habel (1986) and Dyce et al (1987) in dog reported that the heart valves are most clearly heard at the following sites, left atrio ventricular valve low (at the costochondral junction) in the left fifth intercostal space, pulmonary valve low in the left third intercostal space, aortic valve high (just below the horizontal plane of the shoulder joint) in the left fourth intercostal space, and right atrio ventricular valve low in the right third or fourth intercostal space.

King (1974) in dog said that the maximum beat of the normal heart can be felt through the thoracic wall, the place where the beat is felt most strongly is called the apex beat, which usually falls some where within zone between the fourth and sixth inter costal spaces on the left side, just dorsal to the sternal border. ***Dyce et al (1987)*** recorded that the apex beat in the standing dog is palpable on each side low in the fifth or sixth intercostal spaces the main contraction is said to be strongest in the lower third of the fourth or fifth inter costal spaces.

Ettinger (1971) and King (1974) in dog reported that the direct intracardiac injection into one of the chambers of the heart can be a useful method for euthanasia of dog and cat, and the best chamber to aim for is the right ventricle.

King (1974); Delahunta and Habel (1986) and Dyce et al (1987) in dog recorded that the thinner-walled right ventricle may be punctured in the right fourth or fifth intercostal spaces at the level with the costo-chondral junctions as close to the sternum as possible at this point the needle will go through the cardiac notch between the cranial and middle lobe of the lung which is larger on the right lung.

The thymus:

El-Hagri (1967) and Dyce et al (1987) in dog reported that the thymus is confined to the thorax in dog, where it occupies the ventral part of the cranial mediastinum from the thoracic inlet to the pericardium up on which it is molded, the larger part extends on the left surface of the pericardium than on the right, producing a characteristic shadow in dorsoventral radiographs of dog under one year of age. The thymus which consists of right and left lobes, is pink when fresh and in-distinctly lobulated.

The Esophagus:

El-Hagri (1967) and Dyce et al. (1986) in dog denoted that the esophagus enters the thoracic cavity to the left of the trachea and gradually assumes a more median position as it rises to the dorsal surface of the trachea within the cranial mediastinium. It here related to the left subclavian artery which intervenes between it and the left lung. The esophagus crosses the heart on the dorsal surface the trachea and then the left bronchus, passing between the aortic arch (on the left) and the azygous vein (on the right). The second author added that the esophagus caudal to the tracheal bifurcation lies first on the left atrium and then on the accessory lobe enclosed between the caudal lobes of both lung.

King (1974) in dog reported that the sites of which large swallowed objects tend to strike in the esophagus at potential the esophageal hiatus, a point just cranial to the base of the heart, where the heart, great arteries and veins, trachea and esophagus compete for space and where the thorax itself is still narrow and at the thoracic inlet. On the other hand, ***Dyce et al. (1987)*** in dog mentioned that cranial to the heart, the esophagus is more easily approached surgically from the left but both sides are equally accessible caudal to the heart, access from the right is preferred over the base of the heart because the azygous vein, unlike the aorta on the left can be ligated without ill effects. ***King (1974)*** recorded that the transthoracic oesophagotomy in dog and cat can be done where the esophagus can be exposed through the thoracic wall between the ribs 7 and 8 on left side or where the esophagus goes through its hiatus at about the level of the dorsal third of the tenth rib.

The trachea:

Dyce et al (1987) in dog denoted that a little more need be said about the trachea, it lies against the longus colli at the thoracic inlet but shifts ventral to the esophagus by the level of the aortic arch, this change in position produce an acute angle, open caudally, between the trachea and the vertebral column that is very obvious in lateral radiograph.

EL-Hagri (1967) and Getty (1975) in dog reported that the thoracic part of the trachea passes caudally through the dorsal mediastinal space and divides into two principal bronchi over the left atrium of the heart and ventral to the fifth thoracic vertebrae.

Adams (1986) recorded that the ventral relation of the trachea are the cranial vena cava, the common brachiocephalic trunk, the common carotid artery, the cardiac and left recurrent nerves and some lymph nodes, while it is dorsally related to the longus colli muscle for a short distance and caudal to this to the esophagus.

Dyce et al. (1987) in dog said that the left principal branchus is slightly more dorsal than the right one, even though the esophagus rests on it. On the other hand ***Kealy and Mcallister (2000)*** in dog added that the trachea divided into left and right primary bronchus. The left primary bronchus is subdivides into cranial and caudal secondary bronchi, the left cranial secondary bronchus divides to supply the cranial and caudal parts of the cranial lobe, while the left caudal secondary bronchus supplies the left caudal lung lobe. The right primary bronchus is divided into four secondary bronchi, which supply the four lobes of the right lung namely to cranial, middle, caudal and accessory bronchus.

V. The great vessels, nerves and lymphatic structures of the thorax:

a- The great vessels within the thorax:

1. The aorta:

Dyce et al. (1987) and Evans and Delahunta (1988) in dog stated that the aorta arises from the left ventricle at the center of the base of the heart between the pulmonary trunk to the left and right atrium to the right. It is slightly expanded (bulbus aortae) at this level providing room for the aortic valve in its interior, and passes craniodorsally before turning back to follow the vertebrae toward the diaphragm. The convexity of the arch gives rise to the brachio cephalic trunk and a short distance further on to the left subclavian artery ***Dyce et al. (1987)*** in dog mentioned that the brachiocephalic trunk lies ventral to the esophagus and trachea and detaches the two common carotid arteries that accompany these organs through the thoracic inlet, it is continued as the right subclavian artery, which shifts gradually to the right before winding around the cranial border of the first rib to enter the fore limb as the axillary artery.

Beaver (1980); Wilkens and Munster (1981); Evans and Delahunta (1988) in dog and ***Mcclure et al (1973)*** in cat reported that the right and left coronary arteries are branches of the ascending aorta. The brachiocephalic trunk is the first branch from the aortic arch, passes obliquely to the right ventral to the trachea. It gives rise to the left common carotid artery and terminate as right common carotid artery and the right subclavian artery.

Adams (1986), Evans and Delahunta (1988) in dog mentioned that both the right and left subclavian artery have simillar branch's although their origins are different, **Miller et al. (1964);** ***Solis and Zabala (1967); Ghoshal (1975); Wilkens and Munter (1981)*** in dog recorded that the left subclaviuan artery arises directly from the aortic arch at the level of the third intercostal space. The branches of each subclavian artery are vertebral artery, costo cervical trunk, internal thoracic artery and superficial cervical artery. All four arteries arise within the thoracic cavity near the level of the first intercostal space. The subclavian artery continues distally past the 1st rib as the axillary artery. They added that the vertebral artery crosses the medial surface of the first rib and disappears between the longus colli and the scalenus muscles. According to ***Miller et al. (1964)*** in dog, the costocervical trunk is divided into, dorsal intercostal artery , supreme intercostal artery, deep cervical artery and transverse colli artery, ***Simoens, Vos and Lauwers (1979)*** in dog described the supreme intercostal artery under the name thoracic vertebral artery. ***Simoens et al. (1979) Adams (1986)*** in dog added that the costocervical trunk arises distal to the vertebral artery, crosses its lateral side and lateral to the esophagus on the left side of the body, lateral to the trachea on the right side of the body then gives the dorsal scapular artery to supply serratus ventralis, deep cervical artery to epiaxial muscle and the thoracic vertebral artery to the intercostal spaces.

Miller et al. (1964); Getty (1975) and Adams (1986) in dog stated that the internal thoracic artery courses caudoventrally from the subclavian artery at the level of 1st rib passing caudally between the transversus thoracis muscle and the costal cartilage, near the attachement of the costal arch with the sternum. The internal thoracic artery terminates into the musculophnic artery and the larger cranial epigastric artery. The musculo phemic artery runs caudodorsolaterally in the angle formed by the diaphragm and lateral thoracic wall.

Attia (1980 and 1987) in camel and buffalo and ***Yossef (1987)*** in goat recorded that the musculophrenic artery pierced the costal part of the diaphragm at the level of 7^{th} intercostal space and continuous its course on the inner surface of the costal arch, ***Getty (1975)*** in dog recorded that the internal thoracic artery near the eighth intercostal space passes through the diaphragm as the cranial epigastric artery which is subdivided at the level of the xiphoid process into the cranial superficial and cranial deep epigastric artery.

Evans and Delahunta (1988) in dog mentioned that the superficial cervical artery arises from the subclavian artery opposite the origin of the internal thoracic artery medial to the 1^{st} rib then emerges from the thoracic inlet to the base of the neck. They added that for each artery of the subclavian arteries there is a comparable vein with a simillar area of distribution.

Adams (1986) in dog stated that the first several intercostal space receive small dorsal intercostal arteries from a branch of the costo cervical trunk. The thoracic aorta provides paired dorsal segmental branches to the caudal nine intercostal spaces as the dorsal inter costal arteries. The artery caudal to the 13th rib is named the dorsalcosto abdominal artery.

Evans and Delahunta (1988) in dog added that the dorsal intercostal artery start with the fourth or the fifth inter costal artery and continue caudally, while the costo cervical trunk supplies the first three or four intercostal space. The bronchoesophageal artery leaves the right fifth inter costal artery close to its origin cross the left surface of esophagus then give esophageal and bronchial branch.

2. The pulmonary trunk:

Getty (1975) and Dyce et al. (1987) in dog stated that the pulmnary trunk arises from the cranial aspect of the base of the heart from the right ventricle to the left of the aorta. It passes dorso-caudally before dividing into divergent left and right pulmonary arteries. Shortly before its division it is connected to the aorta by the ligamentum arteriosum. The right pulmonary artery is longer than the corresponding left artery.

3. The cranial vena cava:

Adams (1986) and Evans and Delahunta (1988) in dog stated that the cranial vena cava which is formed near the cranial thoracic aperture by the confluence of right and left brachiocephalic veins. It receives venous blood draining through the internal thoracic, costo cervical and right azygous veins.

On the other hand ***Evans and Delahunta (1988)*** in dog and ***Mcclure et al (1973)*** in cat added that the brachiocephalic vein is formed on each side by the external jugular and subclavian vein. ***Dyce et al. (1987)*** in dog mentioned that the cranial vena cava passes ventral to the trachea to the right of the brachio cephalic trunk. It is formed by the union of the two subclavian veins, they added that with ***Small Wood (1992)*** the dog has a right azygous vein which join the dorsal surface of the cranial vena cava near its junction with the right atrium, it receives most the dorsal intercostal and the first few lumbar veins. ***While Adams (1986)*** in dog recorded that the right azygous vein sometimes is the last branch entering the cranial vena cava or usually enters the right atrium directly. ***Small Wood (1992)*** in domestic animals added that in dog and horse, the right a zygous vein persists, where as in the artiodactyls, the left azygous vein predominates, the presence of a complete right and left a zygous vein are found in the ox, sheep and goat.

4. The caudal vena cava:

Dyce et al. (1987) and Lehmkuhl; Bonagura; Biller and Hartman (1997) in dog stated that the caudal vena cava spans the short distance between the right atrium and the diaphragm within the plica vena cava, it is a conspicious feature an lateral radiographs of the chest, also the dilation of the caudal vena cava on lateral thoracic radio graphs is after interpreted as suggestive of right side congestive heart failure. Whatever ***SmallWood (1992)*** in domestic animals recorded that the blood from the abdomen, pelvis and hind limbs returns by way of the caudal vena cava while the blood from the thoracic wall can return by way of the internal thoracic vein or can be collected dorsally via the azygous vein.

5. The internal thoracic vein:

According to ***Seidler (1966)*** in ox, ***Ghoshal Koch and Popesko (1981); Schummer; Wilkens, Volimerhaus and Haber Mehi (1981)*** in ruminant and horse, the branches of the internal thoracic vein passed parallel to the correspnding artery, However ***Ghoshal et al. (1981)*** in ox stated that the musculophrenic vein is detached from the parent vessels at the level of the 7th costal cartilage then piercing the diaphragm, however ***Shehata, Ragab, Osman and Labib (1982)*** in buffalo reported that the musculophrenic vein joins the internal thoracic vein at the level of the 5th rib and pierced the diaphragm at the level of 7th rib, ***Ghoshal et al. (1981)*** in ox and ***Shehata et al. (1982)*** in buffalo reported that the cranial epigastric vein gives off phrenic branchs to the sternal part of the diaphragm.

b. The nerves within the thorax:

Dyce et al. (1987) in dog recorded that there are no particular specific features of interest in the formation, course, or distribution of the phrenic, vagus or sympathetic nerves.

1. The phrenic nerve:

Getty (1975); Evans and Delahunta (1986) in dog; ***Rao, Saigal and Sahu (1972)*** in buffalo and ***Small Wood (1992)*** in domestic animals mentioned that the ventral branches of fifth, sixth and seventh cervical nerves unite near the thoracic inlet to form the phrenic nerve proper. The phrenic nerve crosses the pericardium and continue to the diaphragm. The phrenic nerve receives a slender contribution from the caudal cervical ganglion ***(Mckibben and Getty, 1968)*** in dog or from the sympathetic trunk ***(Miller et al., 1964)*** in dog and ***Selim (1979)*** in camel. ***However Small Wood (1992)*** in domestic animals recorded that on the left side, the phrenic nerve remains within the mediastinum to supply the diaphragm, but on the right side, it accompanies the caudal vena cava in the plica vena cava.

2. The vagus nerve:

Evans and Delahunta (1988) in dog and ***Small Wood (1992)*** in domestic animals denoted that the vagus nerve contains parasympathetic preganglionic axons that course caudally down the neck to the thoracic and abdominal organs. At the middle cervical ganglion or slightly caudal to it the right recurrent laryngeal nerve leave the right vagus, then curves dorsocranially around the right subclavian artery to the dorso lateral surface of the trachea. On the left side the left recurrent laryngeal nerve leaves the left vagus caudal to the middle cervical ganglian, then curves medially around the aortic arch and becomes related to the ventrolateral aspect of the trachea and ventro medial aspect of esophagus. ***Evans and Delahunta (1988)*** in dog added that the vagus nerve after coursing the base of the heart between azygous vein and the right bronchus on the right, and caudal to the base of the heart on the left, is subdivided into dorsal and ventral branches, the right and left ventral branches unite to form the ventral vagal nerve trunk, ventral to the esophagus, while the dorsal branches unite caudally near the diaphragm to form the dorsal vagal nerve trunk, dorsal to the esophagus.

3. The thoracic nerves:

The number of the thoracic nerves is varied among different animals, they are thirteen pairs in dog ***(Ghoshal 1975).***

Ghoshal (1975) in dog, ox and horse and ***Abdelmoneim (1983)*** in camel said that each thoracic nerve after its emergence from the vertebral canal is divided into dorsal and ventral branches while ***May (1977)*** in sheep recorded that the divisions of the thoracic nerves occures either within or outside the intervertebral foramen.

Ghoshal (1975) in dog; ***Ali; Abdelmoneim, Ibrahim and Mansour (1990)*** in donkey, ***Skerrit and Mclettand (1984)*** in ox; ***El-Shaieb (1976) and Abuzaid (1980)*** in camel, reported that the dorsal branches divided into medial muscular and lateral cutaneous branch, while the ventral branches are connected with the thoracic part of the sympathetic trunk by communicating branches, then they course as the intercostal nerves at the intercostal space except the thirteenth nerve designated as the costoabdominal while the first two thoracic nerve contribute the brachial plexus.

With regarding the ganglions within the thoracic cavity, there are vertebral ganglion, middle cervical and cervico thoracic (stellate) in dog and cat ganglion ***(Mckibben, 1968).***

Mckibben (1968) and (1969) in dog and cat recorded that the vertebral ganglia is located near the origin of the vertebral artery, it serves as the origin for most, if not all, post ganglionic sympathetic fibers passing to the heart, esophagus, trachea, lungs, great vessels and cranial medistinal lymph nodes.

Evans and Delahunta (1988) in dog, **McCleod (1958)** in ox and ***Small Wood (1992)*** in domestic animals recorded that the cervico thoracic ganglia is formed by the caudal cervical and the first two or three thoracic ganglia on both sides, the sympathetic fibers leaves the vagus nerve and go to the cervico thoracic ganglia thus forming a loop around the suclavian artery what's called the ansasubclavia. They added that the ansasubclavia and the sympathetic trunk join at the middle cervical ganglia which gives off the cardiac nerves that caurses to the heart while the sympathetic trunk leave the stellate ganglia longitudinally across the ventral surface of the neck of the ribs, the small enlargements in these trunk at each intercostal space are the sympathetic trunk ganglia.

c. The lymphatic structures of the thorax:

Saar and Getty (1975) in dog and ***Volimerhaus (1981)*** in domestic animals stated that the lymphcenters of the thoracic cavity are divided into the dorsal thoracic lymphcenter which contain the inter costal lymph nodes, mediastinal lymphcenter which consists of the cranial mediastinal lymph nodes, Bronchial lymph center which consists of the left, right and middle tracheo bronchial lymph nodes and pulmonary lymph nodes.

Alam Eldin (1984) in camel and Singh, ***Tewari and Singh (1998)*** in buffalo recorded that the visceral thoracic lymphatic system consisted of thoracic aortic lymph nodes, intercostal lymph nodes, the cranial sternal and caudalsternal lymphnodes, the cranial, middle and caudal mediastinal lymph nodes, the cranial left, right and middle tracheo-bronchial lymph nodes.

However ***Singhe et al (1998)*** in buffalo added that the pulmonary and pericardial lymph nodes was inconstant and in general the lymph nodes distribution and drainage profile in buffalo was similar to that described in ox and goat.

The intercostal lymph nodes according to ***Saar and Getty* (1975) *and Dyce et al. (1987)*** in dog occasionally found and when present located under the pleura at the dorsal end of the fifth or sixth intercostal space usually one lymph node present, about 0.7 cm, the afferent vessels from the dorsal thoracic wall, the efferent vessels go to the cranial mediastinal nodes.

On the other hand regarding the sternal lymph nodes ***Saar and Getty (1975) and Dyce et al. (1987)*** in dog stated that the sternal lymph nodes are large up to 2 cm in length and embeded in fat beside the sternum at the level of the 2^{nd} rib, occasionally two or more lymph nodes found. Afferent vessels from the ventral chest wall, diaphragm, and the mediastrinum and may collaborate with the axilary nodes in draining the first three pairs of mamary gland, their efferent vessels go to the veins at the thoracic inlet.

With regarding the mediastinal lymph nodes ***Saar and Getty (1975) and Dyce et al. (1987)*** in dog stated that the cranial mediastial lymph nodes are related variously to the large blood vessels infront the heart, two or three lymph nodes found along the ventral face of the trachea, esophagus and the brachiocephalic trunk, one or two present between the trachea and cranial vena cava, they up to 3 cm in length.

Saar and Getty (1975) and Vollmerhaus (1981) stated that the middle and caudal mediastinal lymph nodes are absent in dog.

With regarding the tracheo bronchial lymph nodes ***Saar and Getty (1975) and Dyce et al. (1987)*** in dog mentioned that the tracheo bronchial lymph nodes scattered about the termination of the trachea and the principal bronchi. ***Saar and Getty (1975)*** in dog and ***Alam Eldin (1984)*** in camel stated that the tracheobronchial lymph nodes are the left, right and middle tracheo bronchial nodes. ***Saar and Getty (1975)*** in dog added that the left tracheo bronchial node lies on the left apical bronchus in the angle between the aorta and the left pulmonary artery. The right tracheobronchial node is found cranial to the right apical bronchus and the middle tracheobronchial is situated in the angle divergence of the principale bronchus and the largest of tracheo bronchial nodes about 0.5 – 3.5 cm. ***Saar and Getty (1975)*** in dog stated that the pulmonary lymph nodes on the right side of the angle between the apical and middle branchi, on the left side near the bifurcation of the apical and diaphragmatic bronchi.

With regarding **the large lymph trunks of the thorax**, the cisterna chyli lies on the right and dorsal of the abdominal aorta between the origin of the two crura of the diaphragm from the 2nd lumbar to the last thoracic vertebra as reported by ***Saar and Getty (1975) and Vollmerhaus (1981)*** in dog.

The thoracic duct forms the cranial continuation of the cisterna chyli, which always single in ruminant and pig, while in dog, horse and some exceptinal cases in bovine, it is double as recorded by ***Vollmerhaus (1981).***

Saar and Getty (1975) and Dyce et al. (1987) and Mcclue, et al (1978) in dog stated that the thoracic duct courses cranially on the right side of the thoracic vertebrae between the right side of the aorta and the ventral surface of the azygous vein, at about the sixth thoracic vertebrae passes between these vessels to the left side and into the cranial mediastinum, it follow the esophagus to the thoracic inlet where it opens in the left common jugular vein as a single duct or by several branches. The duct has a diameter of 2 to 3 mm in medium sized dog.

While ***Birchard; Cantwell and Bright (1982) and Delahunta and Habel (1986)*** in dog stated that the thoracic duct terminates by one or more branches in the left brachiocephalic vein or adjacent veins. Variations in the course, termination and number vessels that compose the duct arevommon. However ***Vollmerhaus (1981)*** reported that the termination of the thoracic duct always at the level of the 1st rib or imediataly (up to 2 cm) cranial to it, he added also the termina part of the thoracic duct dilates in dog, horse and often in ox to form an ampulla.

MATERIAL AND METHODS

Fifteen stray dogs of 3 month to 9 month ages and weight from both sexs were used for the dissection of the thorax.

A. The clinical anatomy of the thorax:

All the animals after being bled were injected by the ordinary routine method of preservation using 10% formalin, 2% phenol and 1% glycerine. For the dissection of the thorax and to study the course and distributions of blood vessels, the arteries and veins were injected with gum milk latex coloured red with carmine stain and colured blue with mythelene blue **(Tomposet and Wakeley 1970)** via the common carotid artery and the caudal vena cava and the external jugular vein respectively.

B. **To study the lymphocenters of the thoracic cavity:** two live dogs were injected with evans blue stain 1% solution in the subcuts, muscles, superficial lymph nodes to reach the viscera and other structures and the animal was allowed to exercise for about 30 minute, then after, the animal was injected with 10% formalin solution after being bled ***(Alam Eldin, 1984).***

C. Thoracic Radiography:

One lived healthy dog was used for the lateral thoracic Radiohraphy, employing 25-40 Kilovolt energy source along with a current of 12-20 million pers for 0-2 seconds diandon a distance of 60-80 cm. The thorax of the dog was radiographied in left lateral recumbency with horizontally directed X-ray beam, all radiographs used in the study were judged to represent full inspiration and expiration.

D. Echocardiography:

The apparatus of sonography was scanner 100 vet. Pie medical equipment B.V. philipswegel, 6227 AJ Maastrich, the Nether Lands.

E. The cross sectional Anatomy:

A healthy under one year old dog was sacrified with chloroform solution immediately after a series of C.T. scans was taken, the cadaver was placed in freezer in ventral recumbancy, the same position used for the scans, until solid, thenafter the frozen cadaver was placed on the table with band saw and serial transverse sections were cut approximately 3 cm apart, the slices were numbered and gently cleaned by light brushing soaked in water, they were blocked dry and were photographed immediately with the caudal surface toward the camera ***(Zook; Hitzelberg and Bradley, 1989 and SmallWood and Geogre, 1993).***

F. TheC.T. images:

The healthy was dog used for the C.T.. scans after physical examination, were anaesthetized by using combination of ketamine hydrochlorde 20 mg/kg B.Wt and Xylazine 1-3 mg/kg B.Wt. ***(Abu-Zaid 1995 and Shekidef, 1999)***, the dog was supported sternal recumbancy and a whole body C.T. scan was made using a general diagnostic C.T.system with as lice thickness of 1.5 cm apart intervals on the chest and 1 cm apart intervals on the heart at 120 kv, 200 mps, F 3HF/S and W 200 + 64 was used for all C.T. images, the C.T. images were photographed and compared with the anatomic sections to assist an acute identification of specific structures ***(Abu Zaid, 1995 and Abu Zaid and Imam, 2000).***

Results

I. The thorax:

The shape of the thorax in all investigated dogs was appeared compressed laterally cone shape with large depth due to the ribs were short and curved.

The bony thorax was formed by the thirteen thoracic vertebrae dorsally, thirteen pairs of ribs laterally and nine sternal segment ventrally. The ribs of all studied animals, nine pairs of which were directly attached to the sternum as sternal ribs, four pairs of which were indirectly attached to the sternum by the costal arch and last pair of which asternal ribs was a floating. The ribs were short, curved and narrow in width that leaved a wide intercostal space.

Despite of the length of the thoracic spinous process the dorsal contours of the neck and thorax generally was joined without noticeable elevation at the wither, **(Fig. 1)** and the tips of the spinous process were individually palpable in most studied dogs **(Fig.4/5).** The angles of the scapula were detected on the lateral surface of the thorax, **(Fig.2)** in the standing dog, the cranial angle **(Fig.2/5)** opposite the 1^{st} thoracic spinous process, the caudal angle **(Fig. 2/6)** opposite the 4^{th} rib and fifth thoracic vertebrae, while ventral angle or the shoulder joint was opposite the distal end of the first rib.

II. The thoracic cavity:

The external contour of the thorax was differed from the internal limits of the thoracic cavity due to the thoracic cavity was the potential cavity completely filled with organs within the thorax and limited by the convexity of the diaphragm.

In cross-section, the thoracic cavity was oval in shape **(Fig.2)**, its dorso-ventral dimension was about 12 cm from the body of 8^{th} thoracic vertebrae to the sternum and was greater than the lateral dimension which was about 8.5 cm between the middle part of the 7^{th} and 8^{th} ribs on each side, while the cranio caudal dimension which measured from the thoracic inlet till the center of the diaphragmatic convexity was about 12.5 cm.

1. The thoracic inlet:

The thoracic inlet was oval in shape bounded by the 1^{st} thoracic vertebrae dorsally, the 1^{st} pair of ribs laterally and manubrium sterni ventrally. Its dorsoventral dimension was about 4.0 cm and its width was about 3.5 cm. The thoracic inlet contained from dorsal to ventral, the longus colli muscle, the trachea on the right, the esophagus on the left, the vagosympathetic nerve trunk, the recurrent laryngeal nerve, the phrenic nerve, right and left subclavian arteries, right and left common carotid arteries, and the apices of the pleural cavities (cupula pleurae) which were extended about 2.5 cm forward to the 1^{st} rib on the left side and about 2.0cm on the right side.

2. The lateral thoracic walls:

The lateral thoracic wall was formed by the ribs and the inter-costal muscles, the first five ribs covered laterally by the scapula and the triceps brachii muscle which extended from the caudal angle of the scapula **(Fig. 2/6)** at the level of the 4^{th} rib till the point of elbow **(Fig.2/3)** at the level of the 5^{th} costochondral junction while the lateral parts of the ribs behind the shoulder region were more thinly covered by the serratus ventralis, latissmus dorsi, saclenus and external abdominal oblique muscle **(Fig. 1/2).** The outlines of some of these muscles may be palpable, as they were mainly flat, so that to auscultate or carry out a cardiac ultrasound the limb should be drawn cranially to examined the 3rd and 4th intercostal spaces, also to achieve entry into the thoracic cavity through 3rd, 4th and 5th intercostal spaces during a thoracotomy, these muscles have to parted and the ribs held a part with rib retractors. The intercostal spaces closed by the intercostal externi and interni muscle while latter was the only one extended to the intercartilagenous spaces as shown **(Fig. 2/7).**

3. The thoracic outlet:

The thoracic outlet was closed by the convexity and costal attachment of the diaphragm, dorsally from the last thoracic vertebrae, the last pair of ribs and costal arch laterally and the xiphoid cartilage ventrally.

III. The diaphragm.

The diaphragm in all studied animals was appeared as a dome shaped musculotendinous plate between the thoracic and abdominal cavities with the convex side was directed toward the thoracic cavity. The center of the convexity of the diaphragm was located opposite the middle of the 6th intercostal space while the line of convexity was started from the 6th costochondral junction till the upper end of the 12th rib and the body of the 12th thoracic vertebrae.

The diaphragm of the examined specimens consisted of a small tendinous central part surrounded by a radiating muscle fibers of the fleshy part of the diaphragm which dorsally fromed by the two crura of the lumbar part **(Fig. 9/1-2)**, laterally by the costal part **(Fig. 10/2)** and ventrally by the sternal part **(Fig. 10/1)**, Through the tendinous center the caudal vena cava opening could be observed little to the right of the median plane.

Our study revealed that the lumbar part of the diaphragm was formed by right and left crura. The right crus **(Fig. 9/1)** was larger than the left crus **(Fig. 9/2)**. Each crus was originated sagittaly by a long bifurcate tendon the longer and stronger part of the right crus tendon was attached to the body of the third lumbar vertebrae **(Fig. 9/4)** while its short and weak part was attached to the body of the second lumbar vertebrae, **(Fig. 9/3)**. The left crus was originated by a strong tendon from the body of the second lumbar vertebra and weak tendon from the body of the first lumbar vertebrae **(Fig. 9/2)**. The tendinous origin of the two crura was diverged to let the aorta passed via the **aortic hiatus (Fig. 9/6)**. Ventral to the aortic hiatus by a short distance the esophagus passed through the **esophageal hiatus** between the right and left crus at the level ventral to the tenth thoracic vertebrae, therefor the esophageal hiatus considered more susceptible to hernia than the aortic hiatus which considered to be more resistant to the hernia due to it was supported by the sublumbar muscles in addition to the tendons of the two crura of the diaphragm.

The costal part of the diaphragm **(Fig. 10/2)** consisted of muscle fibers radiating from the costal wall to the tendinous center by indistinct serrations from the 9^{th} rib from its costochondral junction to about 4.5 cm area of attachement, by about 7.5 cm area of attachement to the 10^{th} rib proximal to the costochondral junction, by about 12cm area of attachement proximal to the middle of the 11^{th} rib, by about 14.5 cm area of attachement to the 12^{th} rib and lastly attached to the ventral part of the last rib except the proximal 5.5 cm of it was free. **(Fig. 10)**and **Fig. 11)**

Moreover the sternal part of the diaphragm **(Fig. 10/1)** was unseparated from the costal part. Its fibers were raised on the base of the xiphoid cartilage and attached to the 8^{th} costal cartilage on each side.

IV. The pleura:

The pleura, was the serous membrane that covered the lung and lined the walls of the thoracic cavity and covered the structures in the mediastinum. It was formed by a right and left pleural sac containing the pleural cavity which was the potential space between the parietal and visceral layer of pleura.

The pleural sacs were projected little beyond the first pair of ribs, somewhat further on the left than on the right (cupula pleura) which was about 2.5 cm forward to the first rib in left cupula **(Fig. 7/2)** while the right cupula pleurae was about 2 cm.

The pleural sacs were separated from each other by the mediastinal space. As the pleura in the vental part of the caudal mediastinum is so thin and the connective tissue between the two layers was so delicate that any marked difference at the pressure in the pleural cavities will cause the pleura to rupture and the communication can be take place between the pleural cavities.

The pleura consisted of two layer, visceral and parietal layer **Fig. (7/1).** The visceral layer tightly adhered to the lung surfaces and follow its irregularities in between the all interlobar fissures.

The parietal layer **Fig. (7/1)** was attached to the thoracic wall by endothoracic fascia. This layer was divided into 3 parts costal, diaphragmatic **Fig. (8/4)** and mediastinal parts according to the surface that covered. All the three parts were continuous with each other through the line of pleura reflection through which the costal pleura directed ventrally to form the mediastinal pleura through the vertebral line and reflected dorsally to become the mediastinal pleura through the sternal line and reflected on the cranial surface of the diaphragm to form the diaphragmatic pleura through the diaphragmatic line **Fig. (8/3).** The lines of pleural reflection were form a narrow angular costo mediastinal and costo diaphragmatic recess **Fig. (8/3).** The costodiaphragmatic recess was the most caudolateral region of the pleural cavity, where the diaphragm was in contact with the thoracic wall in the dead animal where the lung is collapsed. This contact was extensive and the recess was largely a potential space only and the caudal lung lobe didn't slide caudally into the enlarged recess and didn't occupy it as they should be during the expiratory pause. With regarding the diaphragmatic line of pleural reflection which was the line along which the parietal pleura is reflected from the diaphragm on the lateral thoracic wall, this line (**Fig. 7/C**) is very important clinically, because it was forming the boundary between the pleural cavity and peritoneal cavity where caudal to this line the diaphragm was attached to the thoracic wall. It was considered the ventrocaudal limits of the costodiaphragmatic recess which is important for surgical purpose as a puncture of the pleural cavity for pleurocentesis. This line in all studied animals run from the eighth costal cartilage, dorsal to the ninth costochondral junction, the middle of 12^{th} rib and extended caudal to the proximal end of the last rib to reach the level of the 1^{st} lumbar vertebrae. This line don't follow the curve of the costal arch but it was cranial to the costal arch by about 2-3 cm that was leaving an area of the caudal thoracic wall without any contact with the pleural sac, so that the best site for application of the pleurocentesis must be performed at the lowest safe point of the 7^{th} or 8^{th} intercostal space in the standing animal at the costomediastinal recess caudal to the pericardium and cranial to the diaphragm as shown **(Fig. 8/5)**.

The mediastinal pleura was divided into dorsal and ventral mediastinal pleura at the level of the pulmonary root. The ventral one was divided into 3 parts, cranial, middle and caudal mediastinal pleura, according to position of heart. The mediastinal pleura was reflected dorsally and to the right around the caudal vena cava and the right phrenic nerve to form the plica vena cava.

The caudal mediastinal pleura contained triangular phrenico pericardiac ligament **Fig. (3/6) and (6/3)** which extended between the pericardium till the sternal part of the diaphragm. The mediastinal content was explained through the cross sectional anatomy **(Fig. 20, 21 and 22).**

V. The cross sectional anatomy of the thorax:

The results of our study denoted six cross sections of the thorax from the manibrium sterni through the xiphoid cartilage. Attempts were made to slice the cadver exactly prependicular to the long axis, not all structures were labeled in every slice, contra lateral structures of symmetrical tissues or paired organs were not labeled if their identification seemed obvious. The cranial mediastinum was wide dorsally and contained the trachea **(Fig. 20/6)** and esophagus **(Fig. 20/5)** lying side by side at the thoracic inlet, ventral to these the cranial vena cava **(Fig. 20/15)** amd brachiocephjalic trunk **(Fig. 20/16)** with their branches. The ventral part of the cranial mediastinum contain lymph nodes, fat and the thymus **(Fig. 20/10).** The dorsal part of the middle mediastinum was slightly narrower than the ventral part. The dorsal part contained the last part of trachea **(Fig. 21/3),** the esophagus **(Fig. 21/2)** the aorta **(Fig. 21/4,5)** while the ventral part contained the heart **(Fig. 21/6,7 and 8).** The caudal mediastinal region formed by triangular dorsal part so far to the left contain the aorta **(Fig. 22/2)** the esophagus ventrally **(Fig. 22/1).**

VI. The thoracic organs:

VI.(A): The lungs:

In all investigated animals in this work the lungs were relatively wide in conformity with the form of the thoracic cavity and the lower costal attachment of the diaphragm. The right lung was about one and quarter times the size of the left lung and the left lung was extended farther cranially than the right lung.

The lungs were divided by fissures into lobes named according to the lobar bronchus supplied it. There were two fissures on the right lung **Fig. (5/6)** where the lung divided into cranial, **Fig. (5/4)** middle **(Fig. 5/8)** and caudal lobes in addition to the accessory lobe. One fissure on the left lung where it was divided into cranial **Fig. (3/7 and 8)** and caudal lobe in additions to the cranial lobe was subdivided by an interalobar fissure into cranial **Fig. 3/7)** and caudal part. The lobulation of the lungs was not distinct as shown in **Fig. 3 and 5**.

Regarding with the position of the lung lobes in our study, as shown in **Fig. 3, 4 and 5** the left cranial lobe (cranial part) **Fig. (3/7)** was located at an area from the 1st costochondral junction till the proximal part of the 4th rib, the left cranial lobe (caudal part) **Fig. 3/8)** occupied an area from the proximal part of the 4th rib till the 6th costochondral junction by about 2.2 cm, the left caudal lobe **Fig. (3/9)** was at a triangular area from the proximal part of the 5th rib, the middle of 6th intercostal space till the proximal part of the 10th intercostal space, moreever the right cranial lobe was located at a triangular area from the ventral end of the 1st intercostal space to, the fourth intercostal space till the proximal end of the fourth and fifth intercostal spaces, the right middle lobe **Fig. (5/5)** was at an area from the ventral parts of the 4th, 5th, 6th intercostal space till the middle of the 5th and 6th intercostal space, the right caudal lobe **Fig. (5/6)** was located at an area from the ventral part of the 6th intercostal space and the 7th costochondral junction till the proximal parts of the 6th till the 10th intercostal space, and the accessory lobe was under the right caudal lobe from the middle of the 6th intercostal space to the 10th intercostal space at longitudinal position.

Whatever the left cardiac notch which was presented between the two parts of the left cranial lobe was located opposite the ventral third, fourth and fifth intercostal space, while **the right cardiac notch Fig. (12/6)** which was located between the cranial and middle lobe was restricted to the ventral end of the fourth and fifth intercostal space which was the best site for right ventricle puncture for the heart injection.

With regarding the area of percussion and ausculation of the lung which determined in our study by the extent of the contact between the lung and the lateral thoracic wall, which appeared by the projection of the lungs on the lateral thoracic wall by a triangular area this area increased due to the movement of the lung into costo diaphragmatic recess **Fig. (8/3)** during inspiration than expiration the cranial border of the area of percussion and auscultation of the lung is the caudal edge of the triceps brachii muscle, **Fig. (17/)** which was the line passed on the 5th rib vertical between the caudal angle of the scapula and the olecranon process in standing dog, the dorsal border of the area was roughly parallel to the vertebral column through the palpable lateral margin of the back muscles from the 5th rib at the level of the caudal angle of the scapula to the eleventh intercostal space, whatever the caudoventral or the basal border of the area available and formed by the base of diaphragmatic lobe of the lung and was extended from the 6th costochondral junction till the dorsal end of the eleventh intercostal space as explained in **(Fig. 17)** and this line was curved toward the costal arch. In case of lived dog the basal border in the expiration phase was from the 6th costochondral junction till the proximal part of the 11th intercostral space **(Fig. 18/A)** while in the inspiration phase was from behind the 6th costo chondral junction till the proxmal end of the 11th inter costal space **(Fig. 18/B)** and the caudal lobes extended into the costo diaphragmatic recess till behind the 6th costo chondral junction.

VI.b The heart and pericardium: (Fig. 10/3) (6/3):

In all dogs under study the pericardium was a conical fibroserous sac enclosing the heart, and consisted of two layers, outer fibrous and inner serous layer. At the base of the heart the two layers of the pericardium were reflected on the wall of the origin of the aorta and pulmonary trunk.

Our study revealed that the pericardium do not present any special features except they extended to the apex of heart caudally to connected with the stremal part of the diaphragm by relatively robust phrenicopericardiac ligament **Fig. (3/6)** that was allowed the apex to be more mobile **(Fig, 6/3 and Fig. 10)**.

The heart of dog under investigation was ovoid in shape, its long axis was very oblique formed an angle of about 45 degree with the sternum. The base was faced craniodorsally and the blunt apex was lied near the junction of the sternum and diaphragm a little to the left of the midline. The left surface presented the auricles embraced the pulmonary trunk and below the level of the coronary groove. The paraconal interventricular groove, the right surface presented the atria and the subsinuosal interventricular groove. Moreover the left surface was rotated a little more toward the sternum, while the right one faced a little more dorsal.

In most studied dogs **the heart position** was located at an area from the 3rd rib till the 6th intercostal space. The base of the heart intersected the middle of the 4th rib, the most dorsal part of the heart reached to the imaginary line extended from the acromion process of the scapula till the ventral end of the last rib while the apex of the heart was located just left to the 7th sternebrae. Moreever in most investigated dogs the heart contact with the ventral thoracic wall. It was determined by a triangular area, the cranial base of the triangle crossed the sternum at the level of the 4th costal cartilage, while the caudal apex of the triangle was located just to the left of the 7th sternebrae.

However our study denoted that the **area of cardiac dullness** which considered to area of heart contact with the thoracic wall was differed from the area of resonance where the lung was in contact with the thoracic wall. The area of cardiac dullness on the left side located beneath the ventral 1/3 of 3rd, 4th and 5th inter costal space, while on the right side, it was restricted to the 3rd and 4th inter costal space just about 2 cm from the sternum as shown in **Fig. (17/B)**.

The auscultation of the heart which is important for the examination of the heart abnormalities, was performed by the examination of valve by valve, the pulmonary valve, aortic valve, left atrioventricular valve and the right atrioventricular valve at the following sites, the left atrioventricular valve at the level of the costochondral junction of the left fifth inter costal space **Fig. (13/7)**. The pulmonary valve at the left third intercostal space **Fig. 13/5)**. The aortic valve at the level of the hartizontal plane of the shoulder joint at the left 4th inter costal space, **(Fig. 13/6)**and the right atrioventricular valve at the right third and fourth intercostal space.

With regarding **the sites of the intra cardiac injection** which is the useful method for obtaining the blood or injection of drugs within the heart, the best site for intracardiac injection was the right ventricle because it ventricle has a much thinner wall than the left ventricle which has a very thick wall and the point of needle tends to enter the wall rather than the lumen. The atria also have a thin walls but being more dorsal than the ventricles and deeper within the thoracic cavity and less accessible, so that the right ventricle punctured in the right fourth or fifth intercostal spaces, from the level of the costochondral junction till the sternal border. The needle directed through the right cardiac notch obliquely in a cranio-dorsal direction the dog should be standing or lying on its left side, the length of needle should be 2-3 cm for mini sized dog, 4 cm for small and 6 cm for large sized **(Fig. 12)**.

VI.C. The thymus:

The thymus was observed in the studied dogs under 4 month as lobulated structure consisted of right and left lobes. It occupied the ventral part of the cranial mediastinum from the thoracic inlet till the left surface of pericardium, from the 1^{st} rib till to 4^{th} or 5^{th} intercostal space as in b **(Fig. 16/1)**.

VI.D. The esophagus:

The esophagus of the most investigated dogs was detected when enter the thoracic cavity to the left aspect of the trachea and gradually assumed a more median position on the dorsal surface of the trachea within the cranial mediastinum **Fig. (14/21)** at the level of the second thoracic vertebrae.

The esophagus crossed the base of the heart on the dorsal surface of the trachea and then the left bronchus between the aortic arch on the left and azygous vein on the right, the ability of esophagus to expand was locally restricted by these vessels and the slight rise it appear over the tracheal bifurcation at the level of the 5th rib which considered the predisposing site for **foreign body obstruction**. The esophagus caudal to the tracheal bifurcation passing on the left atrium then on the accessory lobe of lung then enclosed between the caudal lobe of both lungs to penetrate the diaphragm at the esophageal hiatus at the level of the 10th thoracic vertebrae which considered another predisposing site for the esophageal obstruction.

So that our study revealed that the best site through which the esophagus was more easily approached surgically for the trans thoracic oesophagotomy from the left side cranial to the heart but both sides more equally caudal to the heart, while over the base of the heart the right side preferred because the azygous vein unlike the aorta on the left can be lighted without ill effects.
Moreover we can open the esophagus at the base of the neck and pushing or retracting the obstructed materials from the esophagus instead of incising the esophagus at any site cranial to the heart.
The best site on the left side caudal to the heart where the esophagus can be exposed through the thoracic wall between the 7th and 8th , rib while exposing the esophagus before entering the esophageal hiatus at the level of 10th rib was obviously anatomical difficult in approach as the esophagus was deep within the thoracic cavity, so preferred at these sites caudal to the heart to

avoid the dorsal and ventral vagal nerve trunk and pushing the obstruction into the stomach without incission of the esophagus.

VI.E. The trachea (Fig. 16/9):

The trachea in our studied dogs was located against the longus colli muscle at the thoracic inlet, and ventral to the esophagus by the level of the aortic arch and passed caudal through the dorsal mediastinium and divided into two principal bronchi over the left atrium of the heart ventral to the 5^{th} thoracic vertebrae. The left principal bronchus was higher dorsally, than the right one.

The trachea was related ventrally to the cranial vena cava, the common brachiocephatic vein and left recurrent nerve and the longus colli muscle then the esophagus dorsally.

VII. The great vessels within the thoracic cavity:

A. The aorta and its branches:

As shown in **Fig. (14)** the aorta a rose from the left ventricle and appeared the center of the base of the heart between the pulmonary trunk on the left and the right atrium on the right. It passed craniodorsally before turning back to follow the vertebrae toward the diaphragm. The convexity of the aortic arch **(Fig. 14/1)** gave the brachiocephalic trunk **(Fig. 14/2)** and a short distance farther on gave the left subclavian artery **(Fig. 14/3)**.

The descending thoracic aorta detached the paired dorsal intercostal branch **(Fig. 14/13)** to the caudal nine intercostal spaces. The dorsal costoabdominal artery was caudal to the last rib, while the first three or fourth intercostal branches were detached from the costocervical trunk to supply the first three or four intercostal space. In addition the bronchoesophageal artery detached from the right fifth inter costal artery close to its origin then crossed the left surface of esophagus and gave the esophageal and bronchial branches.

Moreover the brachiocephalic trunk **(Fig. 14/2)** passed obliquely to the right ventral to the trachea, where gave the left common carotid artery and terminated as the right common carotid and the right sub clavian arteries **(Fig. 14/10)**.

The right and left subclavian artery gave a the same branches **Fig./33** shows the left subclavian artery **(Fig. 14/3)** which firstly detached the vertebral artery **(Fig. 14/4)** at the level of the 1st intercostal space which crossed the medial surface of the 1st rib and disappeared under scalenus muscle. After that the left subclavian artery gave the costocervical trunk which crossed the lateral surface of the esophagus and gave the dorsal scapular artery to the serratus ventralis muscle, and the deep cervical artery to the epiaxial muscle where terminated in the muscles of the neck and the thoracic vertebral artery to the intercostal space.

However the left subclavian turned **(Fig. 14/5)** ventrally and medial to the 1st rib gave the internal thoracic artery **(Fig. 14/17)** to inside and the superficial cervical artery to outside and then finally ended as the axillary artery toward the thoracic limb, over. The internal thoracic artery passed under the transverse thoracic muscle then near to the attachment of the costal arch with the sternum gave the musculophrenic artery and the cranial epigastric artery.

B. The pulmonary trunk:

It arose from the right ventricle and appeared the cranial aspect of the base of the heart to the left of the aorta, then passed dorsocaudal and connected with the ascending aorta by the ligamentum arteriosum, thenafter divided into long right pulmonary artery toward the hillus of the right lung and short left pulmonary artery toward the hillus of the left lung as shown in **(Fig. 14/22)**.

C. The cranial vena cava (Fig. 14/4):

The cranial vena cava in our studied dogs was formed near the thoracic inlet ventral to the trachea and to the right ventral to the brachiocephalic trunk by the right and left brachiocephalic veins which formed by the external jugular vein and the subclavian vein on each side at the thoracic inlet. Moreover the cranial vena cava received draining from the internal thoracic vein **(Fig. 14/16)** from its ventral surface and the costocervical vein **(Fig. 14/15)** form the dorsal surface at the same level of costocervical trunk detaching .rom the left subcalvian artery then accompanied its course.
The right azygous vein joined the dorsal surface of the cranial vena cava near its junction with the right atrium. The internal thoracic vein accompanied the simillar name artery and received the blood from the musculophrenic vein and the cranial epigastric vein.

D. The caudal vena cava (Fig. 14/20):

The caudal vena cava was occupied the short distance between the right atrium and the diaphragm within the plica vena cava with the right phrenic nerve where it ended in the caudal aspect of the right surface of the right atrium.

VII. The nerves within the thoracic cavity:

A. The phrenic nerve:

The phrenic nerve **(Fig. 15/1)** arose from the ventral branches of the 5^{th}, 6^{th} and 7^{th} cervical nerves and joined branch from the sympathetic trunk at the thoracic inlet. It crossed the pericardiium and continued caudally to the fleshy part of the diaphragm. The left phrenic nerve remained within the medaistinum to supply the diaphragm. However the right phrenic nerve was accompanied the caudal vena cava in the plica vena cava. The left phrenic nerve passed ventral to the root of the lung while the vagus nerve passed dorsal to it this can be used for easy surgical differentiation between them.

B. The vagus nerve:

On each side where the middle cervical ganglia located at this union of the ansa and vagosympathetic trunk, **(Fig. 15/2)** then we found that slightly caudal to the middle cervical ganglia or the ansa by about 1.5 cm, the right vagus gave the right recurrent laryngeal nerve which curved dorsocranially around the right subclavian artery and coursed cranially on the dorso lateral surface of the trachea, while the left recurrent laryngeal nerve **(Fig. 15/9)** leaved the left vagus and curved medially around the aortic arch and coursed cranially on the ventro lateral aspect of the trachea after that the vagus nerve at the level of the base of the heart between the azygous vein and the right principal branchus on the right and caudal to the base of the heart on the left approximately at the level of the 8^{th} thoracic vertebrae was divided into dorsal and ventral branchs **(Fig. 15/10-11)** then after the right and left dorsal and ventral branches united to form the dorsal and ventral vagal nerve trunk near the diaphragm on the dorsal and ventral aspect of esophagus, respectively.

The vagus nerve at the level of the middle cervical ganglion as it leave the vagosympathetic trunk to continue its couse caudally gives the cardiac nerve to innervate the heart **(Fig. 15/12)**.

C. The thoracic part sympathetic chain:

The cervical sympathetic nerve trunk at the thoracic inlet detached the cranial and caudal branch of the ansa subclavia around the vertebral and costocervical artery of the subclavian artery toward the cervico thoracic ganglia (stellate ganglia) **(Fig. 15/6).** The sympathetic chain started by the cervicothoracic (stellate) ganglia at the dorsal end of the 1st intercostal space close to the lateral surface of the body of the 1st thoracic vertebrae on each side and continued caudally on the lateral surface along the length of the vertebral column **(Fig. 15/7)**.

VIII. The lymphatic structures within the thoracic cavity:

In most investigated dogs we found that the lymphocenters of the thoracic cavity were the dorsal thoracic lymphocenter which confirmed by the intercostal lymph node, **(Fig. 16/2).** The ventral thoracic lymphocenter was confirmed by the sternal lymph nodes **(Fig. 16/3).** The mediastinal lymphocenter consisted of only the cranial mediastinal lymph nodes while the middle and the caudal medistinal lymph nodes **(Fig. 16/4)** were not observed in all studied dogs. The bronchial lymphocenters consisted of the right, left and middle tracheobronchial lymph nodes and the pulmonary lymph nodes.

- **The intercostal lymph node: (Fig. 16/2)**

The intercostal lymph node was located under the pleura at the dorsal end of the 5th intercostal space. Only one lymph node was present about 0.5 cm and drained the dorsal thoracic wall.

- **The sternal lymph nodes: (Fig. 16/3)**

The sternal lymph nodes were two large node about 1.2 cm in length and embedded in fat beside the sternum at the level of the 2nd costal cartilage where they drained the muscles of the ventral thoracic wall.

- **The cranial mediastinal lymph nodes: (Fig. 16/4)**

We found two large cranial medistinum lymph nodes medial to the aortic arch and dorsally to the trachea, another node was located between the trachea and the cranial vena cava they about 1.5 cm in length drain the thoracic viscera.

- **The tracheobronchial lymph nodes: (Fig. 16/5. 6 and 7)**

The tracheobronchial lymph nodes which observed in our studied dogs were three lymph nodes scattered about the termination of the trachea. The left tracheobronchial lymph node **(Fig. 16/5)** was located on the left cranial bronchus. The node **(Fig. 16/6)** was found cranial to the right cranial bronchus and was about 0.8 cm in length. The middle tracheobronchial lymph nodes **(Fig. 16/7)** was situated at the angle of the tracheal bifurcation and it was the largest one about 1.8 cm in length.

- **The pulmonary lymph nodes:**

They were small nodes located between the right cranial and middle bronchi and also observed between the left apical and caudal bronchi.

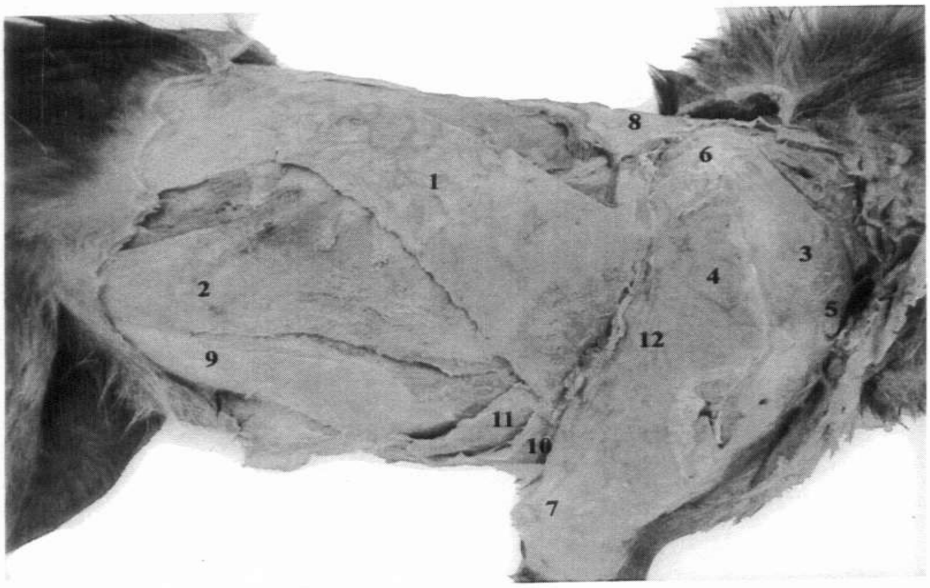


Fig. (1): Right lateral view of the muscles attached to the thorax.

1. Latissimus dorsi muscle.
2. External abdominal obliqus muscle.
3. Supra spinatus muscle.
4. Infra spinatus muscle.
5. Cranial scapular angle.
6. Caudal scapular angle.
7. Olecranon process.
8. Trapezius muscle.
9. Internal abdominal obliqus muscle.
10. Transverse pectoral muscle.
11. Ascending pectoral muscle.
12. Triceps brachii muscle.

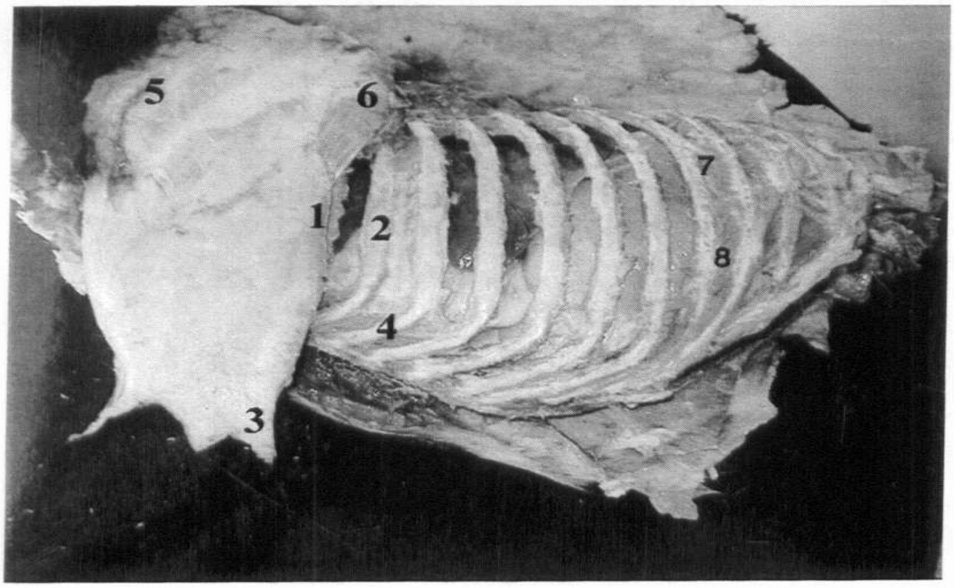


Fig. (2): Lateral view of the left thoracic wall after removing the muscles.

1. Triceps brachii muscle.
2. The 4th rib.
3. Olecranon process.
4. The 6th costal cartilage.
5. The cranial scapular angle.
6. The caudal scapular angle.
7. External intercostal muscle.
8. Internal intercostal muscle.

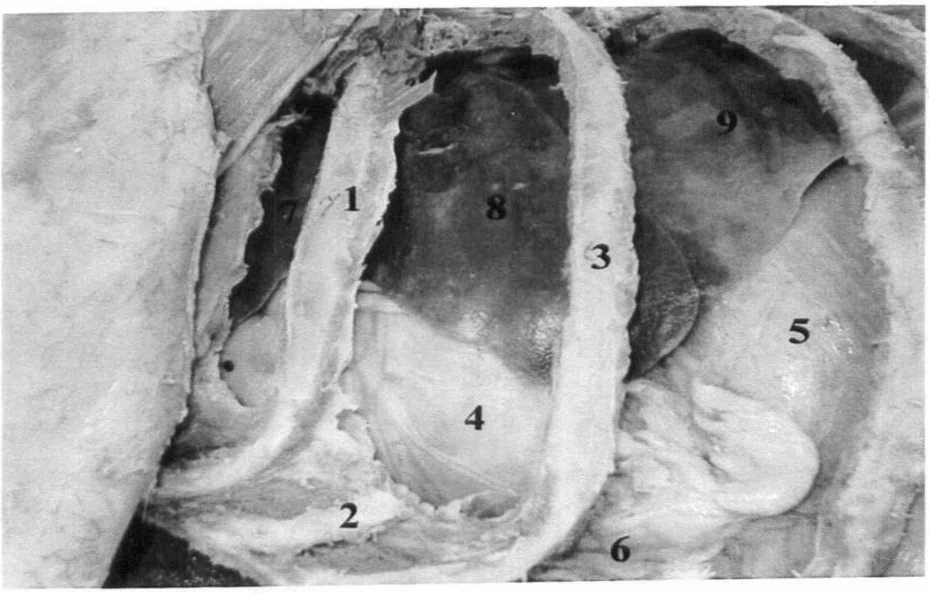


Fig. (3): Left lateral view of the thorax show position of the heart.

1. The 4th rib.
2. The 5th costal cartilage.
3. The 6th rib.
4. The heart with pericardium.
5. The diaphragm covered with diaphragmatic pleura.
6. Phrenicoperiardial ligament.
7. (Cranial part) of Left cranial lobe } of lung
8. (Caudal part) of Left cranial lobe }
9. Left caudal lobe. }

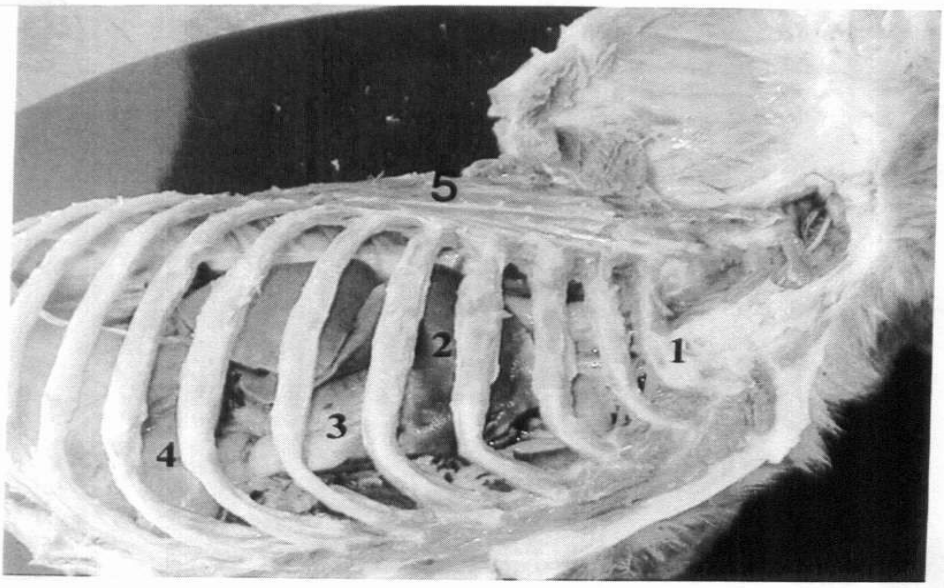


Fig. (4): Right lateral view of the thoracic wall without muscles.

1. The 1st rib.
2. The right lung.
3. The heart.
4. The diaphragm.
5. Spinous process.

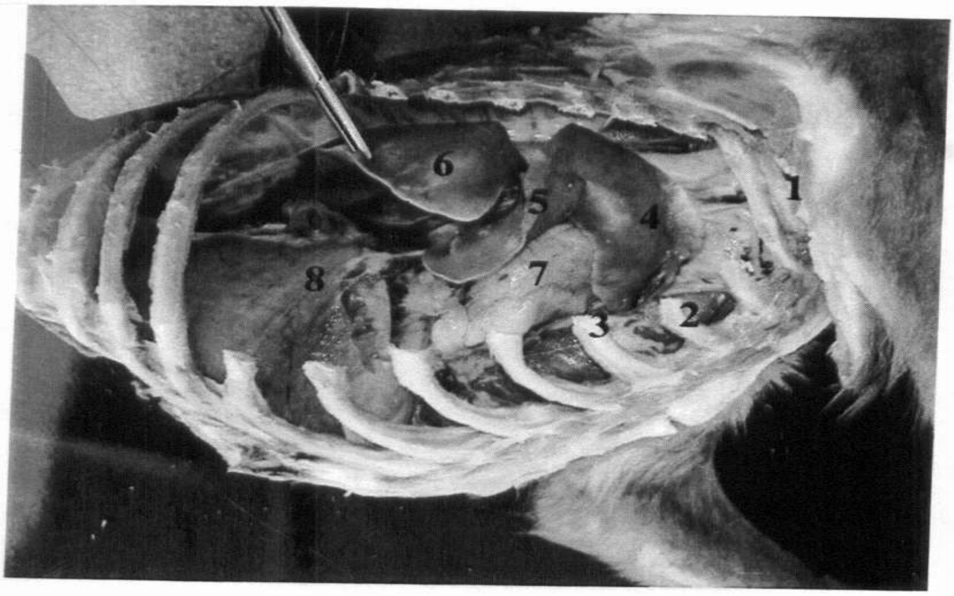


Fig. (5): Right lateral view of the thoracic wall cutting ribs showing the thoracic organs.

1. The 1st rib.
2. The 4th costal cartilage.
3. The 5th costal cartlage.
4. The cranial lobe of the right lung.
5. Middle lobe.
6. The caudal lobe of the right lung.
7. The heart.
8. The diaphragm.

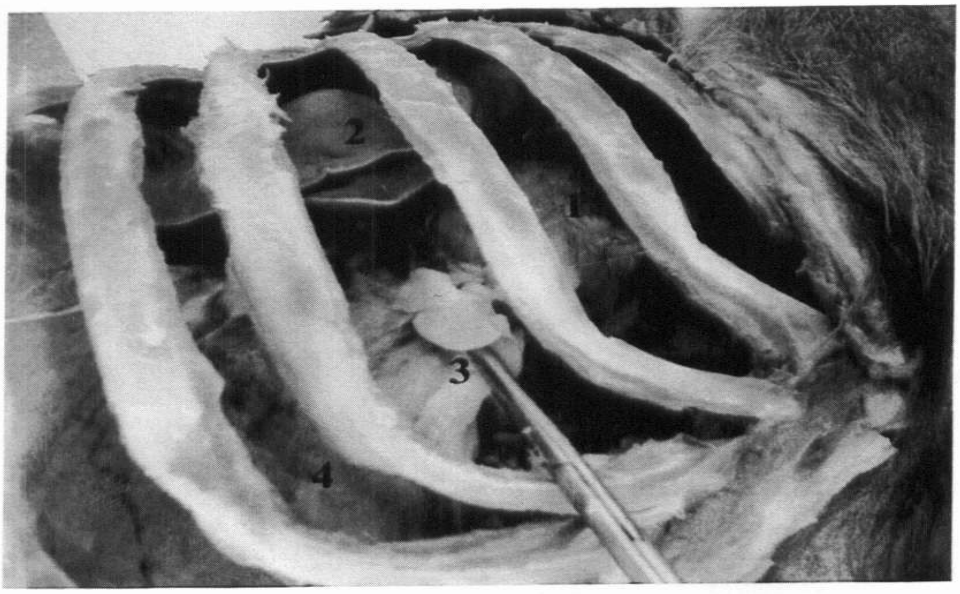


Fig. (6): Right lateral view of the thorax.

1. The heart.
2. The right lung.
3. The phrenicopericardiac ligament covered by the pericardial pleura.
4. The diaphragm.

Fig. (7): Left lateral view of the thoracic wall.

1. The parietal pleura.
2. The needle showing the cupula pleurae extension.
3. The cupula pleurae.

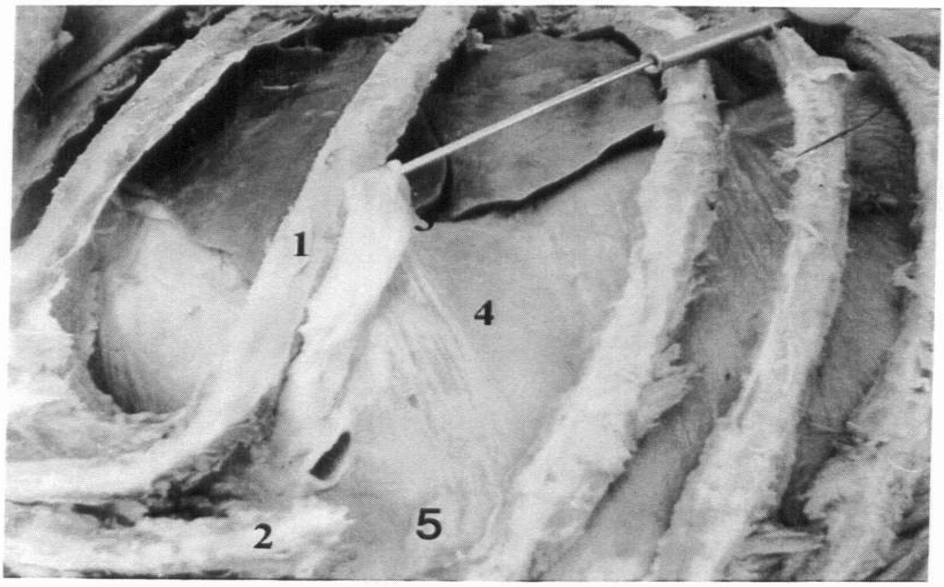
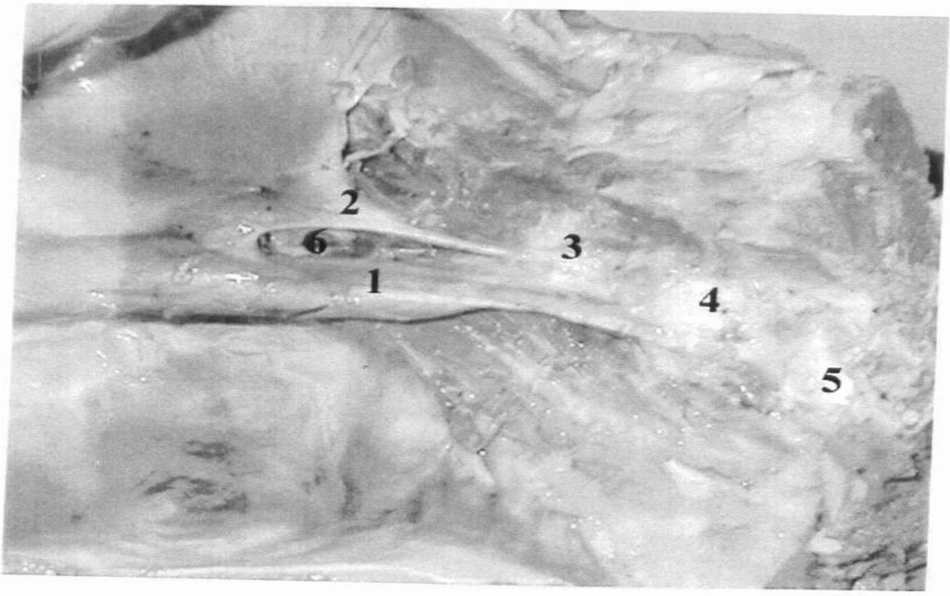


Fig. (8): Left lateral view of the thoracic wall. the needle showed the diaphragmatic pleura.

1. The 6th rib.
2. The 7th costal cartilage.
3. The costodiaphragmatic recess of the pleural reflection.
4. Diaphragmatic pleura.
5. Site of pleurocentesis.



(**Fig. (9)**: Caudal view of the diaphrgm.

1. The right crus.
2. The left crus.
3. The 2nd lumbar vertebrae.
4. The 3rd lumbar vertebrae.
5. The 4th lumbar vertebrae.
6. The aortic hiatus.

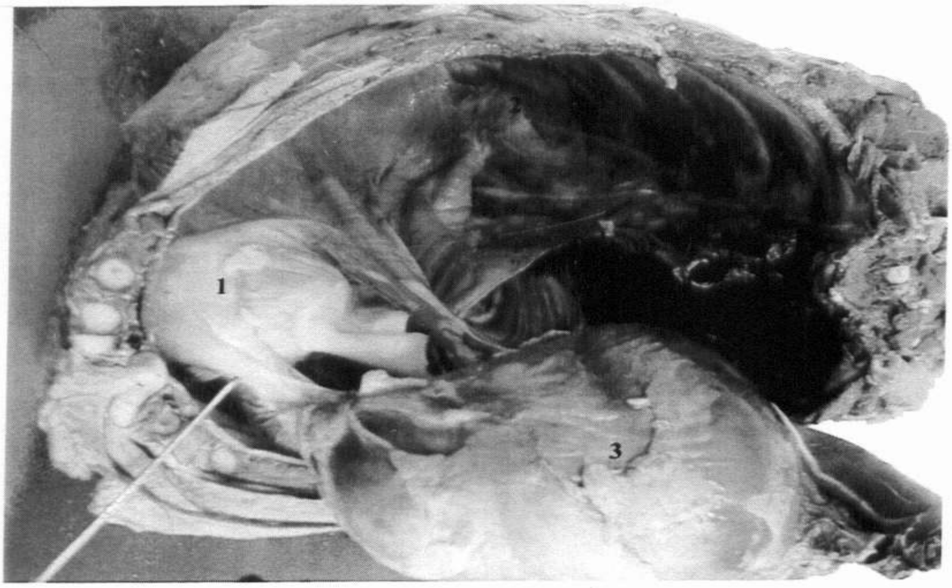


Fig. (10): Cranial view of the diaphragm. the needle showing the phrenico-pericardiac ligament.
1. The diaphragmatic sternal part.
2. The diaphragmatic costal part.
3. The heart with pericarium.

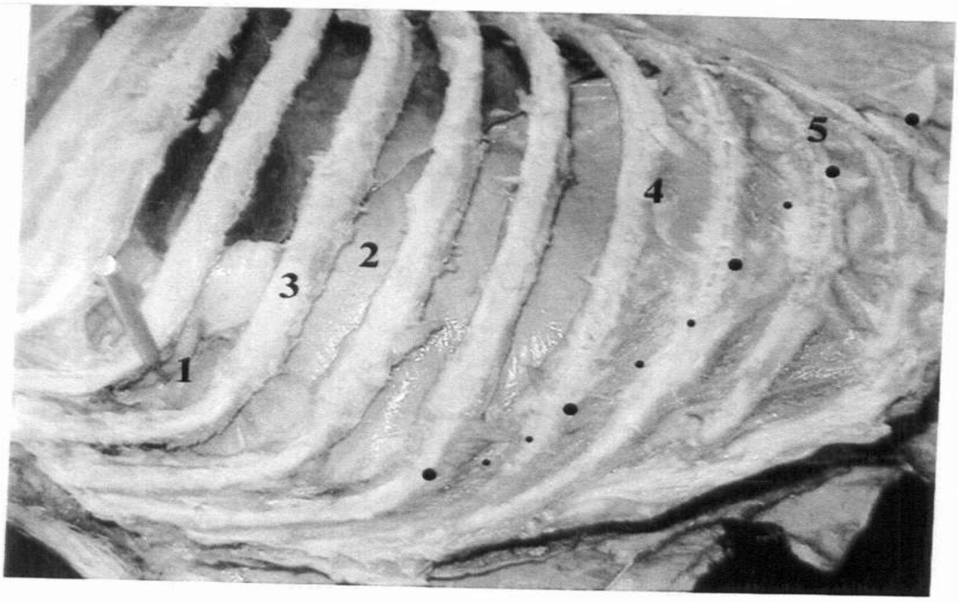


Fig. (11): Left lateral view of the thorax showed the costal attachement of the diaphragm by the dotted line.

1. The 6th intercostal space.
2. The diaphragm.
3. The 7th rib.
4. The 10th rib.
5. The 12th rib.

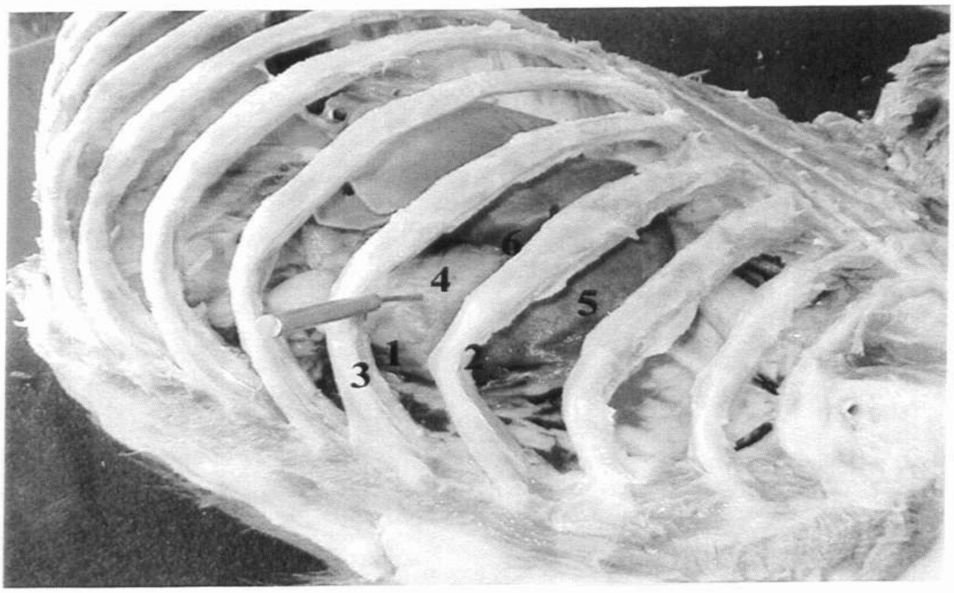


Fig. (12): Right lateral view of the thorax, the needle showing the site of the right ventricle for intra cardiac injection.

1. The 4th intercostal space.
2. The 4th costochondral junction.
3. The 5th costochondral junction.
4. The heart.
5. Right cranial lung lobe.
6. Right cardiac notch.

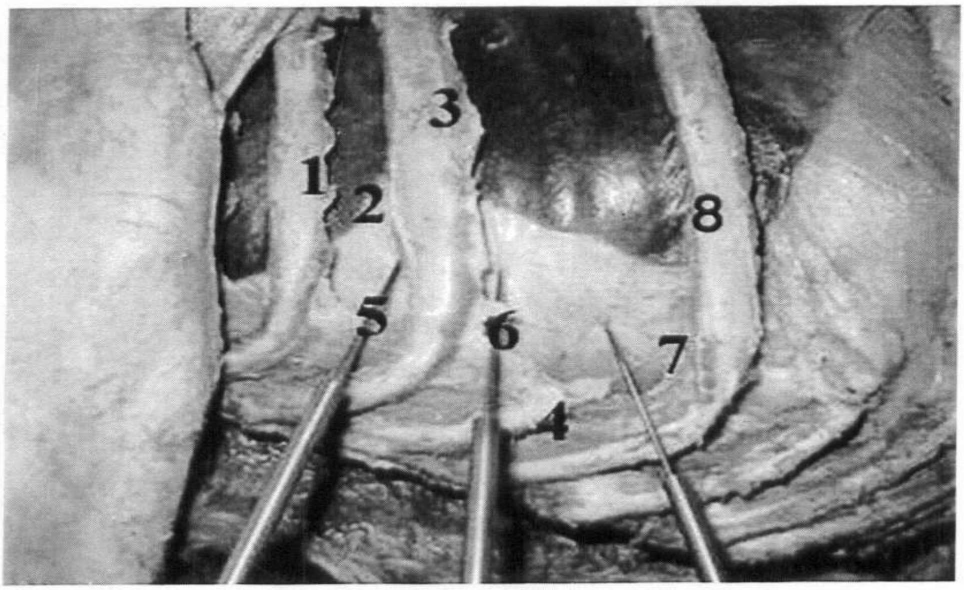


Fig. (13): Left lateral view of the thorax, the needles showing the position of the heart valves.

1. The 3rd rib.
2. The 3rd intercostal space.
3. The 4th rib.
4. The 5th costochondral junction.
5. The needle showed the site of the pulmonary valve.
6. The needle showed the site of the aortic valve.
7. The needle showed the site of the left atrioventricular valve.
8. The 6th rib.

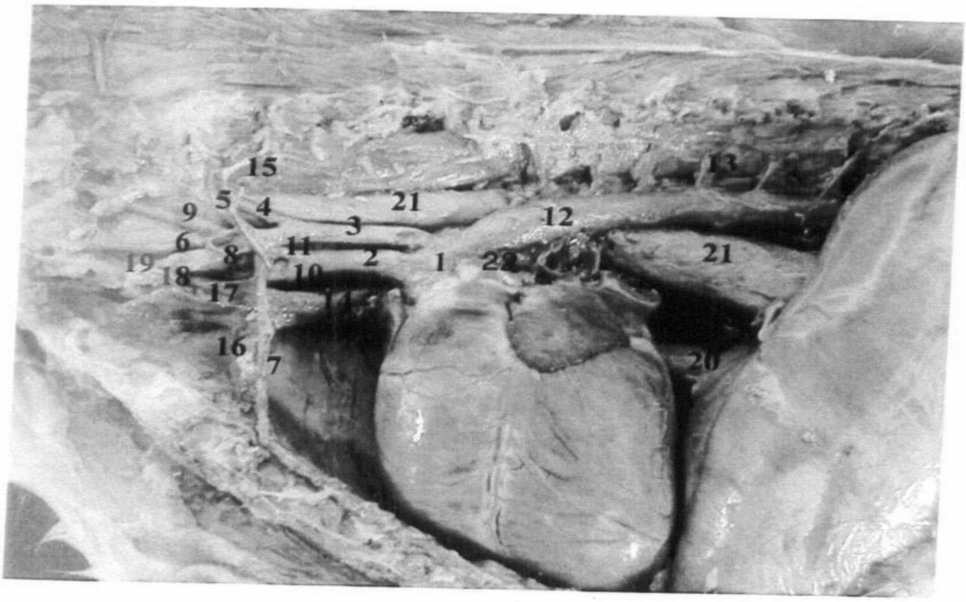


Fig. (14): The blood vessels of the thoracic cavity.

1. Aortic arch.
2. Brachiocephalic trunk.
3. Left subclavian artery.
4. Vertebral artery.
5. Costocervical artery.
6. Superficial cervical artery.
7. Internal thoracic artery.
8. Axillary artery.
9. Left common carotid artery.
10. Right subclavian artery.
11. Right common carotid artery.
12. Thoracic aorta.
13. Dorsal intercostal artery.
14. Cranial vena cova.
15. Costocervical vein.
16. Internal thoracic vein.
17. Brachiocephalic vein.
18. axillary vein.
19. Jugular vein.
20. Caudal vena cava.
21. The esophagus.
22. The pulmonary trunk.

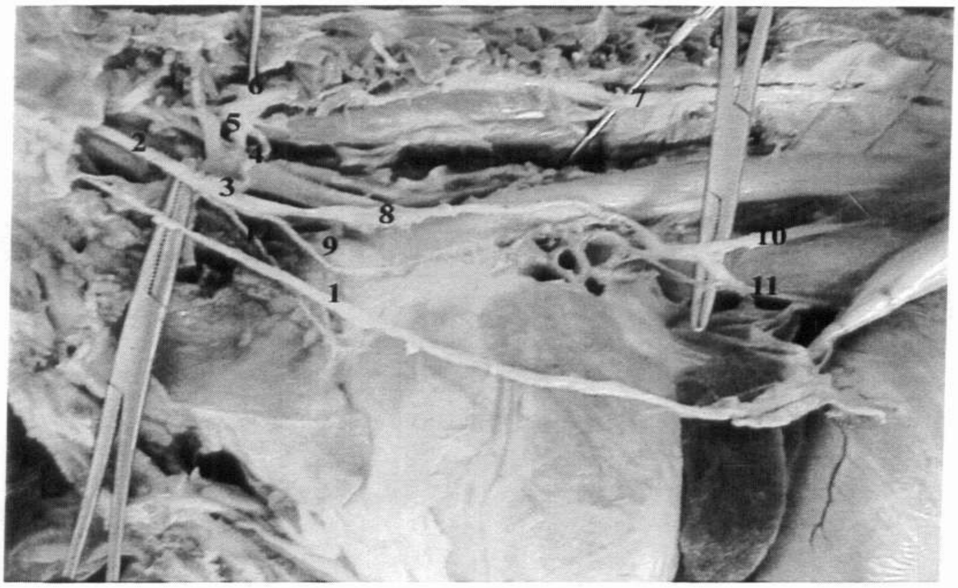


Fig. (15): Left lateral view of the thoracic cavity showing the nerves within the thoracic cavity.

1. The left phrenic nerve.
2. The vagosympathetic nerve trunk.
3. The middle cervical ganglia.
4. The ansa subclavia caudal branch.
5. The ansa subclavia cranial branch.
6. The stellate ganglia.
7. The sympathetic chain.
8. The left vagus nerve.
9. The left recurrent laryngeal nerve.
10. The dorsal branch of the left vagus.
11. The ventral branch of the left vagus.
12. The cardiac nerve.

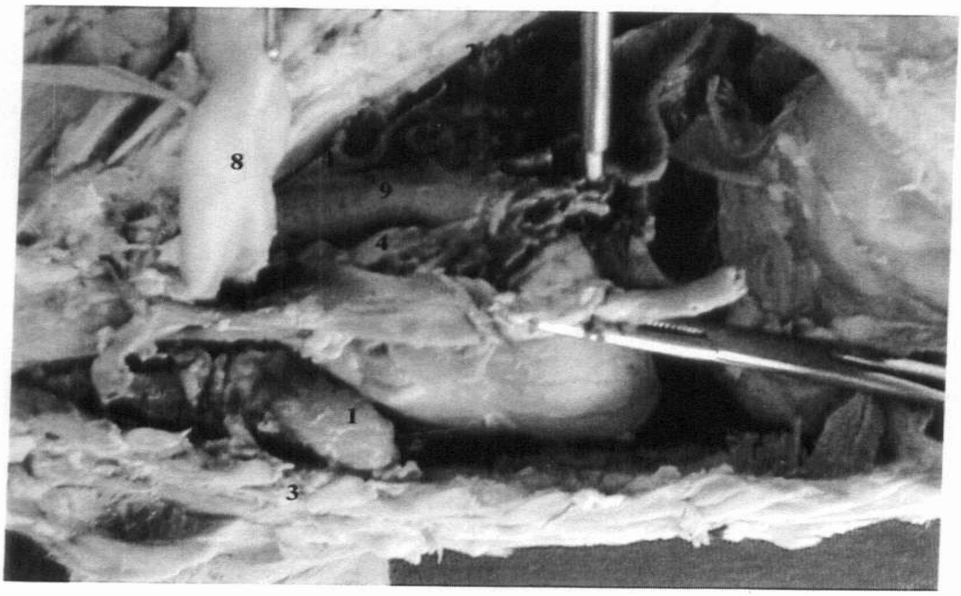


Fig. (16): The lymphatic structures of the thoracic cavity of dog under 4 months age.

1. The thymus.
2. The inter costal lymph node.
3. The sternal lymph node.
4. The cranial mediastinal lymph node.
5. The right tracheo bronchial lymph node.
6. The left tracheo bronchial lymph node.
7. The middle tracheo bronchial lymph node.
8. The esophagus.
9. The trachea.

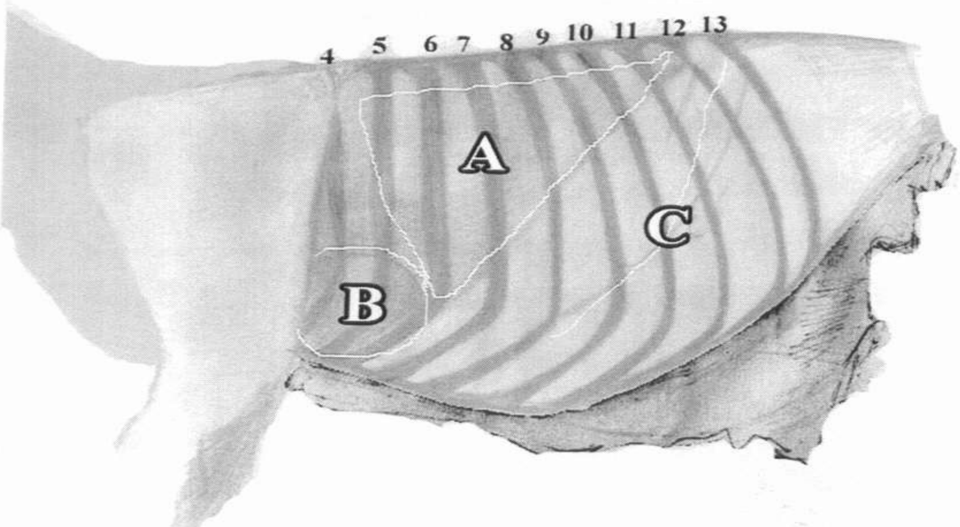


Fig. (17): Diagram showing.

A. The area of auscultion and percussion of the lung.
B. The area of cardiac dullness.
C. The costodiaphragmatic line of pleural reflection.

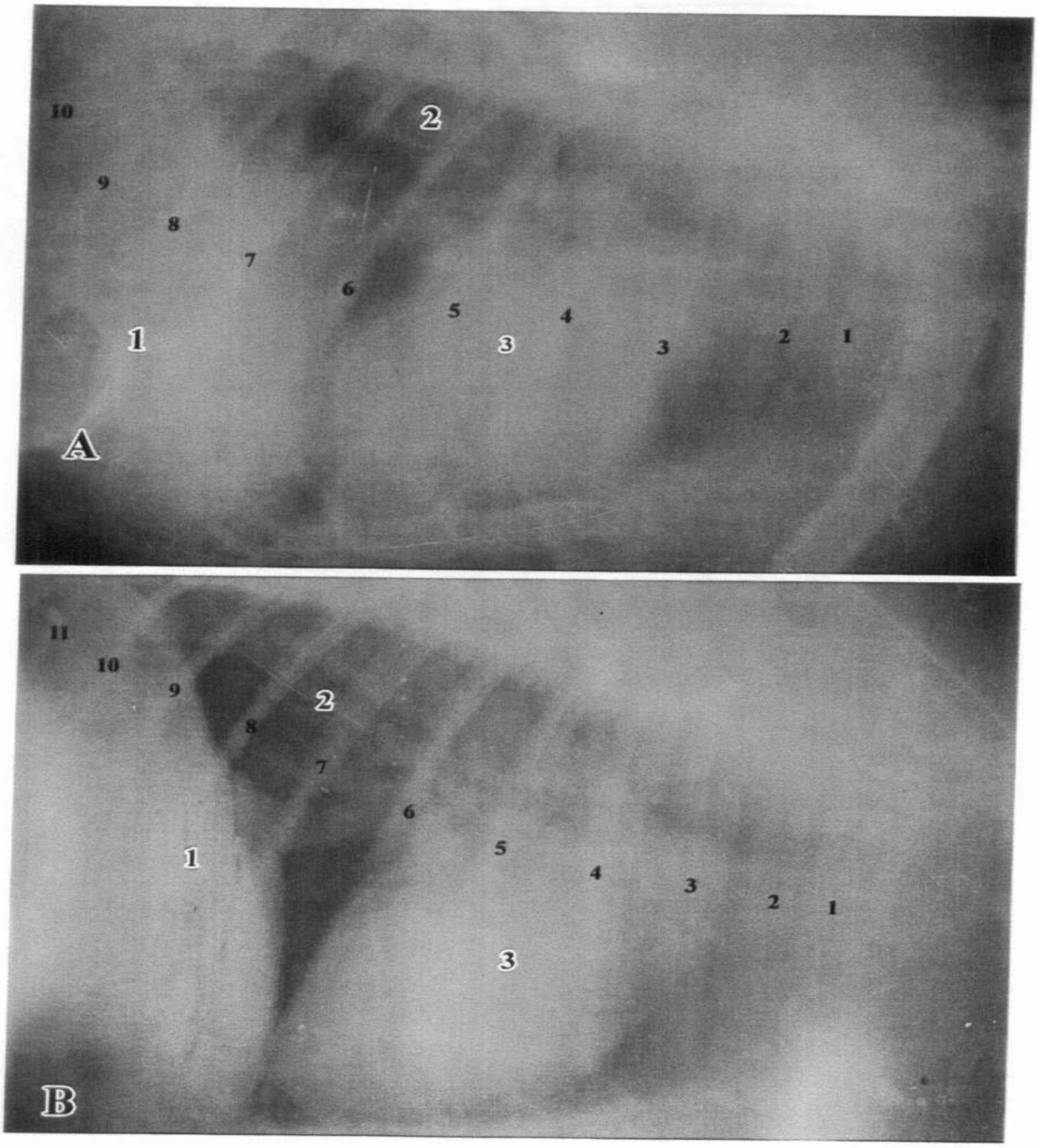


Fig. (18): Left lateral thoracic radiography in case of expiration phase (A) inspiration phase (B).

1. Diaphragm.
2. Left caudal lung lobe.
3. Heart.

(Number from 1 – 11 numbered ribs from the 2nd ribs till the 12th rib).

IIX. Echo cardiography:

The images were obtained from the recumbent side was of superior quality than that obtained from the above. The best reliable satisfactory images was obtained from the right lateral recumbancy and the transducer was positioned below. The cardiac contact area with the chest wall (echo. Window) was larger in the recumbent side. The potential echo window varied from the second to fifth intercostal spaces and from 1 to 10 cm dorsal to the sternum. The best images were obtained from the third to fourth intercostal spaces with 7 cm from the sternal edge short axis (cross sectional) views, the right parasternal short axis views of the left ventricle were obtained by rotating the transducer and beam plane to be vertical on the long axis of the heart and at the aortic valve level. As shown in **Fig. (19/A),** the right parasternal short axis views where the transducer was directed at the level of 8^{th} intercostal space and with slightly rotation caudally to indicate the heart and diaphragm as shown in **Fig. (19/B).**

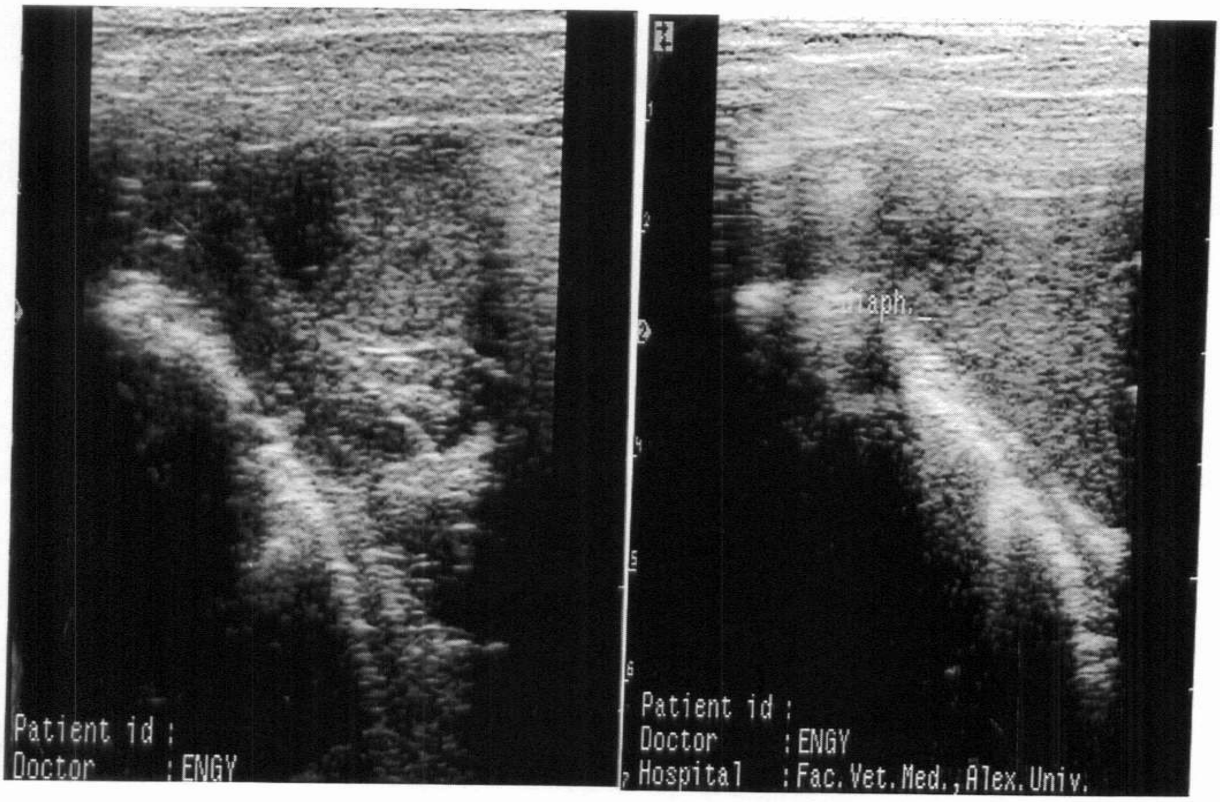
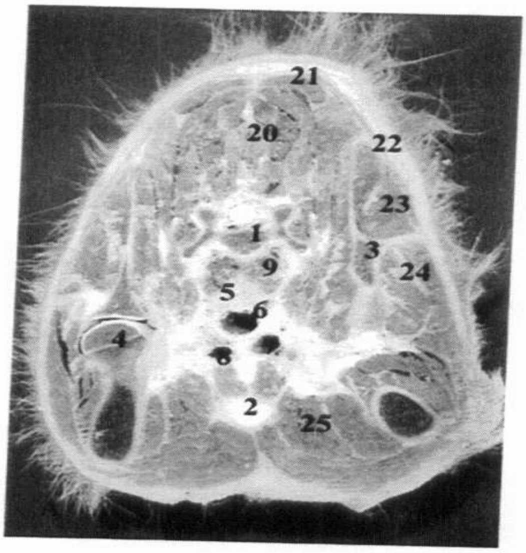


Fig. (19): Right parasternal Echo Cardiogram short axis at aortic valve level (4^{th} intercostal space (A). axis views (7^{th} intercostal space showing the diaphragm convexty (B).

1. Aortic valve.
2. Left ventricle.
3. Right ventricle.

Fig. (20) (A and B): Cros section of the caudal cerival region and the cranial mediastinal region.

1. 7th cervical vertebrae.
2. Manubrium sterni.
3. Scapula.
4. Humerus.
5. Esophagus.
6. Trachea.
7. Common carotid artery.
8. Axillary artery.
9. Longus colli muscle.
10. Thymus.
11. 2nd thoracic vertebrae.
12. Sternum.
13. Costal cartilage.
14. Body of left rib.
15. Cranial vena cava.
16. Brachiocephalic trunk.
17. Left subclavian artery.
18. Cranial lung lobe.
19. Vertebral artery.
20. Nuchal ligament.
21. Right rhomboideus muscle.
22. Right trapeziene muscle.
23. Right supra spinatus muscle.
24. Right infrospinatus muscle.
25. Right pectoral muscle.
26. Right ilio costalis muscle.
27. Longissmus thoracic muscle.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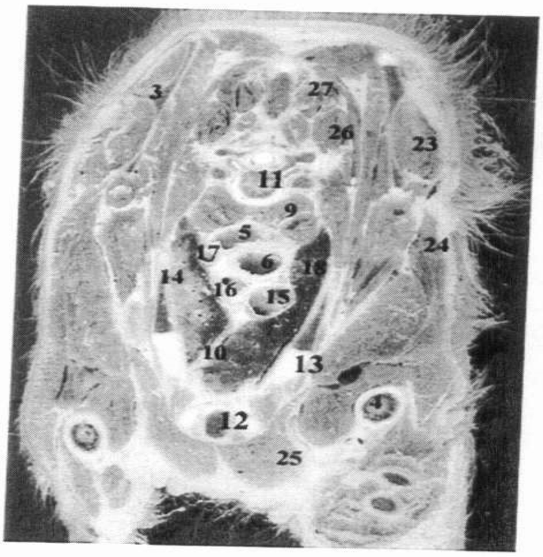
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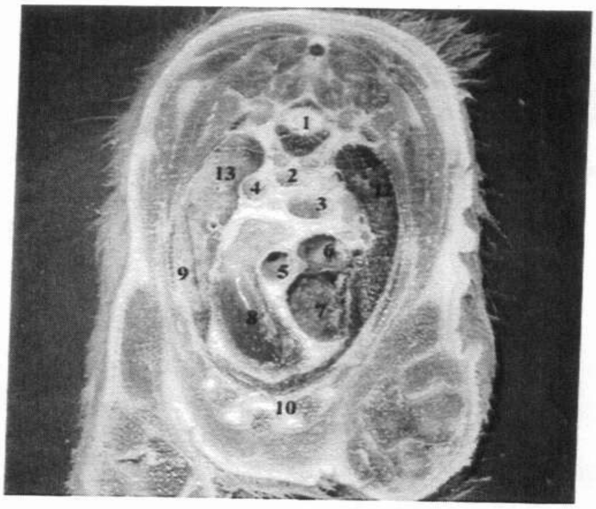
Fig. (21 A and B): Cross sections of middle mediastinal region.

1. 4th thoracic vertebrae.
2. Esophagus.
3. Trachea.
4. Descending aorta.
5. Ascending aorta.
6. Right atrium.
7. Right ventricle.
8. Left ventricle.
9. Left rib.
10. Sternum.
11. Costal cartilage.
12. Right cranial lung lobe.
13. Left cranial lung lobe.
14. Caudal vena cava.
15. Pulmonary veins.
16. Left atrium.
17. Left principal bronchus.
18. Accessory lung lobe.
19. 6th thoracic vertebrae.
20. Right middle lung lobe.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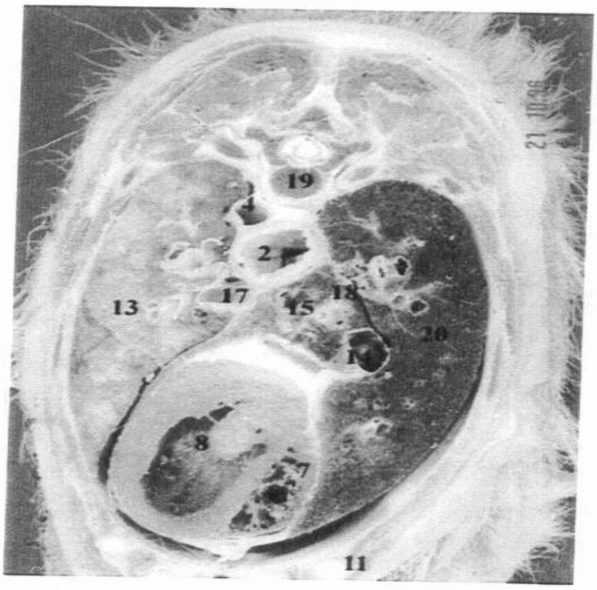
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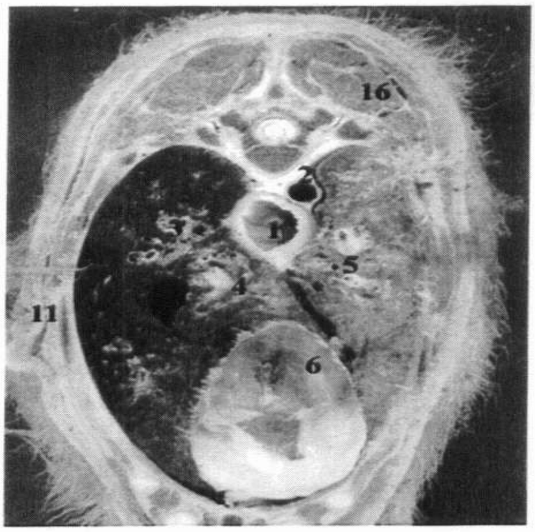
Fig. (22 A and B): Cross section of the caudal mediastinal region.

1. Esophagus.
2. Aorta.
3. Right lung middle lobe.
4. Right lung accessory lobe.
5. Left lung caudal lobe.
6. Diaphragm
7. Left liver lobe.
8. Quadrate lobe of the liver.
9. Gall bladder.
10. Costal cartilages.
11. Ribs.
12. Stomach.
13. Duodenum.
14. Right caudal lung lobe.
15. Right liver lobe.
16. Right longissmus thoracic muscle.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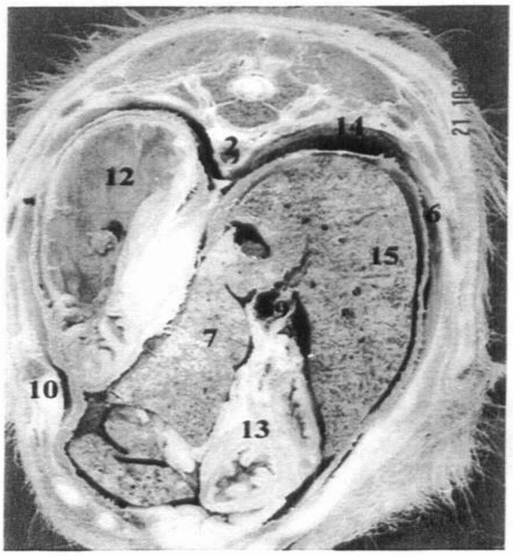
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IX. Computed tomography of the thorax

The results of our study consisted of eleven-photo C.T. image, arranged in four figures:

- **Figure (1):** C.T. frontal scanogram of dog in a sternal recumbency with lines indicating the approximate levels of each C.T. scan on the long axis of the thorax.

- **Figure (2)**. Consisted of three photos of C.T. image of the cranial mediastinal region.

- **Figure (3).** Consisted of four photos of C.T. image of the middle mediastinal region.

- **Figure (4).** Consisted of three photos of C.T. image of the caudal mediastinal region.

- The C.T. scanning of the thoracic wall displayed clearly the muscles of the thoracic wall between the subcutaneous and endo thoracic fascia layer, in the cranial medistinal region, the high dense costal bony segments (Fig. 2/9, 3/38) and the costal arch (Fig. 4/14) were embedded between the soft tissue dense muscular elements, which were determined in all C.T.images.

- Regarding the internal thoracic organs, their shape and Tomography were varied according to the imaging position and scanning level moreover, the radio-density pattern of the visceral organs and large blood vessels increase in some scans than others.

- C.t. imaging of the cranial mediastinal region (from the first rib trill the third rib) demonstrated the esophagus on the left side (Fig. 2/5), the trachea on the right (Fig. 2./6) ventral to the thoracic vertebrae.

- The cupula pleurae (Right and left) contain the apices of the right and left lung and they declared that the left cupula pleurae larger than the right one (Fig. 2. /7,8).

- The thymus (Fig. 2/12).
- The right and left cranial lung lobe (Fig. 2./10,11).
- The cranial vena cava (Fig. 2/16).
- The brachio cephalic trunk (Fig. 2/14).
- The C.T. images of the middle mediastinal region (from the 3^{rd} rib till the 6^{th} intercostal spce) declared the esophagus doro lateral to the trachea and the tracheal bifurcation (Fig. 3/14) the right middle lung lobe (Fig. 3/19).

- The right and left caudal lung lobe (Fig. 3/24,25), the heart differentiated and their parts destinguished separately through this region at the middle part of the images where the right ouricle, left auricle, right ventricle, left ventricle, the conus arteriosus, aortic bulb and valve, the pulmonary artery, the aortic arch were detected, in addition to the caudal vena cava was demonstrated (Fig. 3/22) at the right side away from the heart between the accessory lung lobe and the right caudal lung lobe.

- The aorta (Fig. 3/15) was seen ventral to the vertebrae and dorso lateral to the esophagus on the left side.

- The C.T. scanning of the caudal mediastinal region (from the 6^{th} intercostal space till the disappearance of the diaphragm at the cranial abdominal region) demonstrated the right caudal lung lobe, the accessory lung lobe and the left caudal lung lobe, and the diaphragm Fig. 4/7).

- The liver (Fig. 4/8,9 and 10) occupied the intrathoracic part of the abdominal cavity and contact the diaphragm, and the visceral surface of the liver showed some clefts representing the interlobar fissures and the gall bladder).

- In addition to the esophagus demonstrated (Fig. 4 /1) opened straight in the stomach and the stomach contact with the diaphragm by which one reasonof the dog easily vomited.

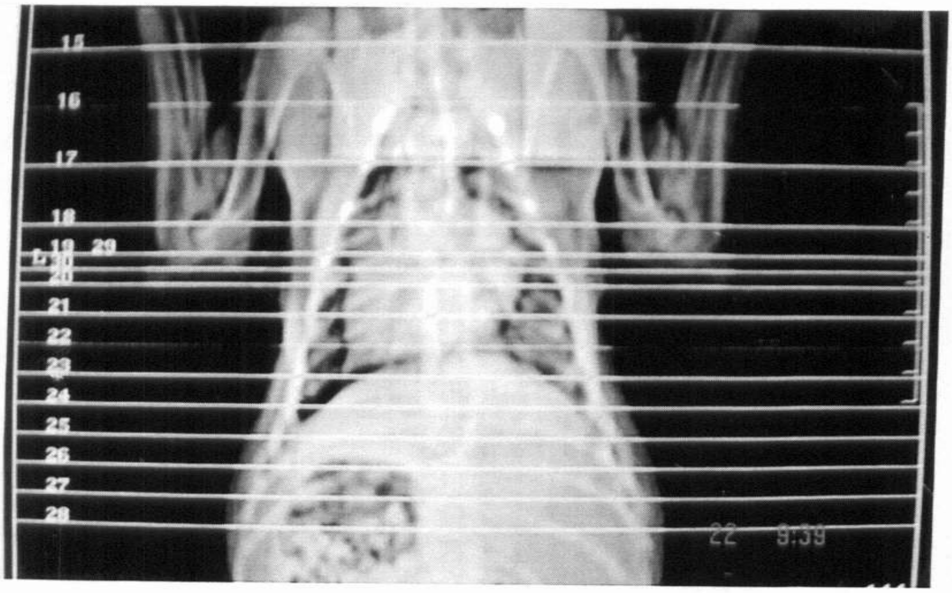
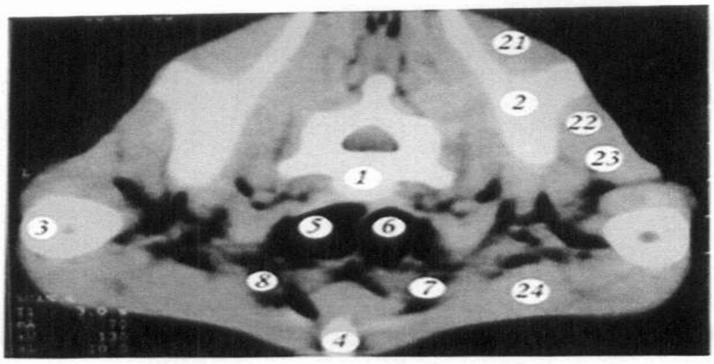


Fig. (1): C.T. frontal scanogram of dog insternal recumbent position, the numbered lines indicate the approximate level of each c.t. scan on the thorax long axis.

Fig. (2): C.T. image of the cranial mediastinal region.

1. 7th cervical vertebrae.
2. Scapula.
3. Humerus.
4. Manubrium sterni.
5. Esophagus.
6. Trachea.
7. Apex of cranial lobe of right lung in the right cupula pleurae.
8. Apex of the cranial lobe of left lung in the left cupula pleurae.
9. 1st rib.
10. Left cranial lung lobe.
11. Right cranial lung lobe.
12. Thymus.
13. Longus colli muscle.
14. Branchio cephalic trunk.
15. Left subclavian artery.
16. Cranial vena cava.
17. 1st thoracic vertebrae.
18. 2nd thoracic vertebrae.
19. Nuchal ligament.
20. Right spinalis cervicis muscle.
21. Right supraspinatus muscle.
22. Right infraspinatus muscle.
23. Right triceps brachii muscle.
24. Right deep pectoral muscle.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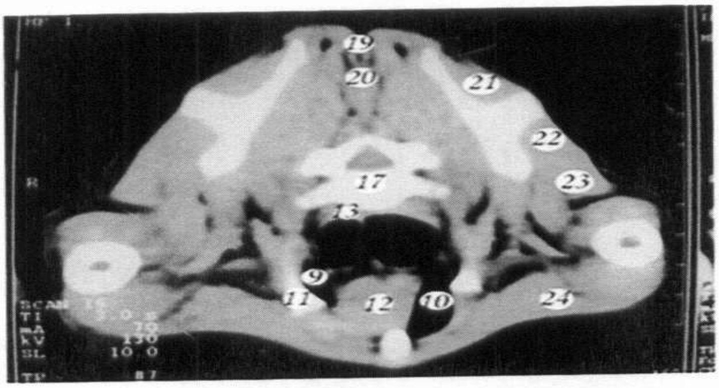
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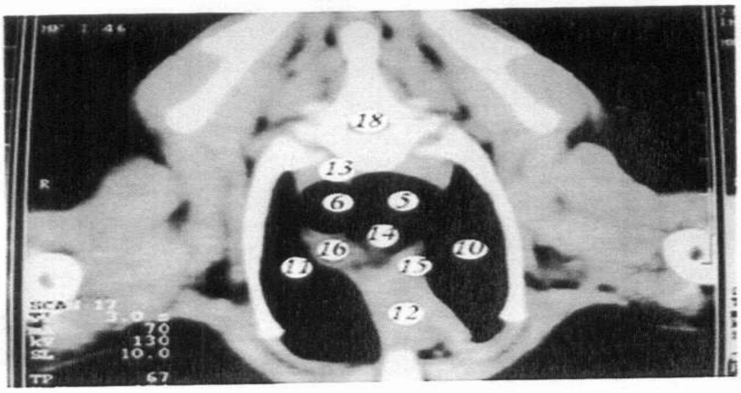
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Fig. (3): C.T. image of the middle mediastinal region.

1. Longus colli muscle.
2. Esophagus.
3. Trachea.
4. Left cranial lung lobe.
5. Right cranial lung lobe.
6. Thymus.
7. Right auricle.
8. Right ventricle.
9. Cranial vena cava.
10. Aortic arch.
11. Conus arteriosus just proximal to pulmonary valve.
12. Left ventricle.
13. Sternum.
14. Bifurcation of the trachea into right and left principal bronchi.
15. Descending aorta.
16. Left pulmonary artery.
17. Aortic bulb and aortic valve.
18. Left ouricle.
19. Right middle lung lobe.
20. Right pulmonary artery.
21. Caudal part of left cranial lung lobe.
22. Caudal vena cava.
23. Caudal wall of the left ventricle.
24. Right caudal lung lobe.
25. Left caudal lung lobe.
26. 4^{th} thoracic vertebrae.
27. 5^{th} thoracic vertebrae.
28. 6^{th} thoracic vertebrae.
29. 7^{th} thoracic vertebrae.
30. Right azygous vein.
31. Caudal lobar branch of right pulmonary artery.
32. Accessory lung lobe.
33. Right spinalis thoracic muscle.
34. Right rhomboideus thoracic muscle.
35. Right latissmus dorsi muscle.
36. Right iliocostal is muscle.
37. Right longissmus thoracic muscle.
38. Left rib.

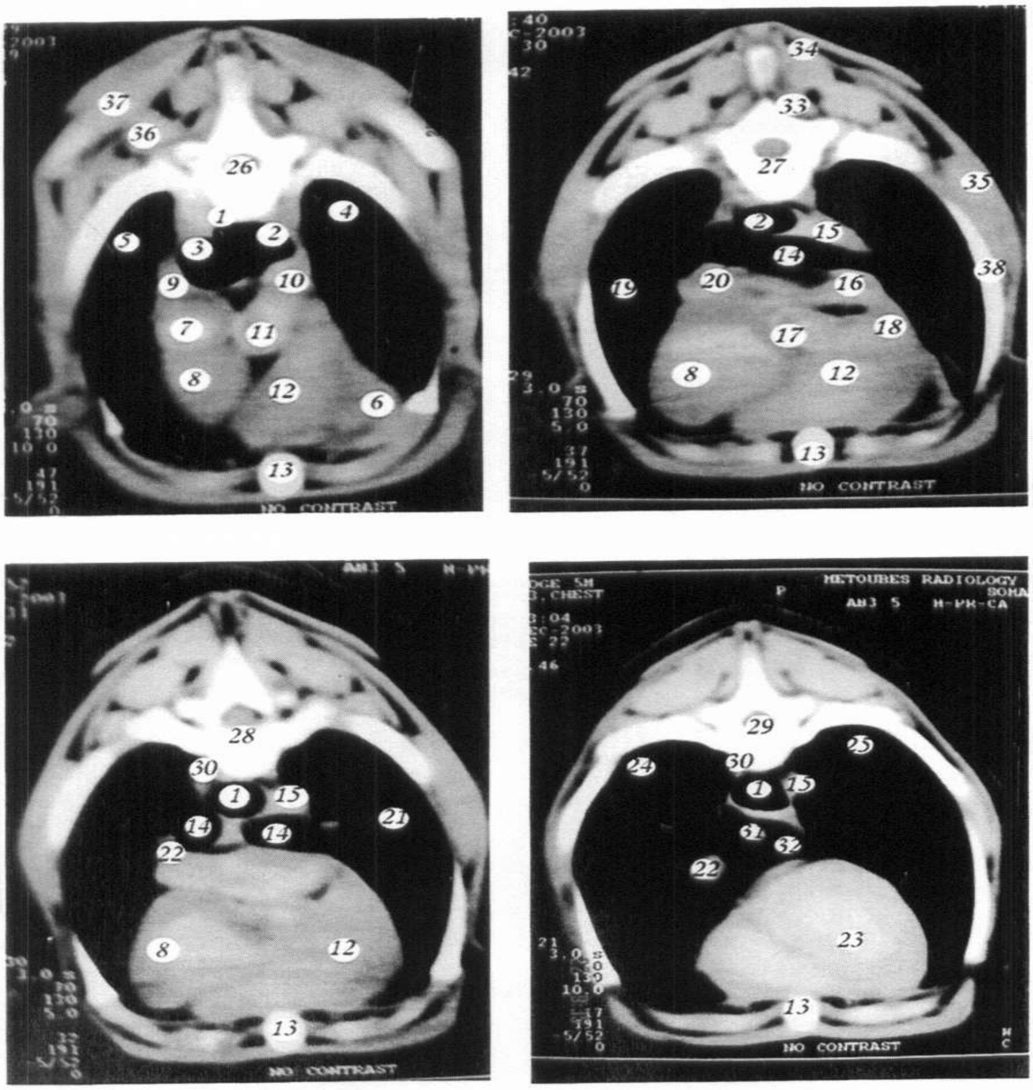
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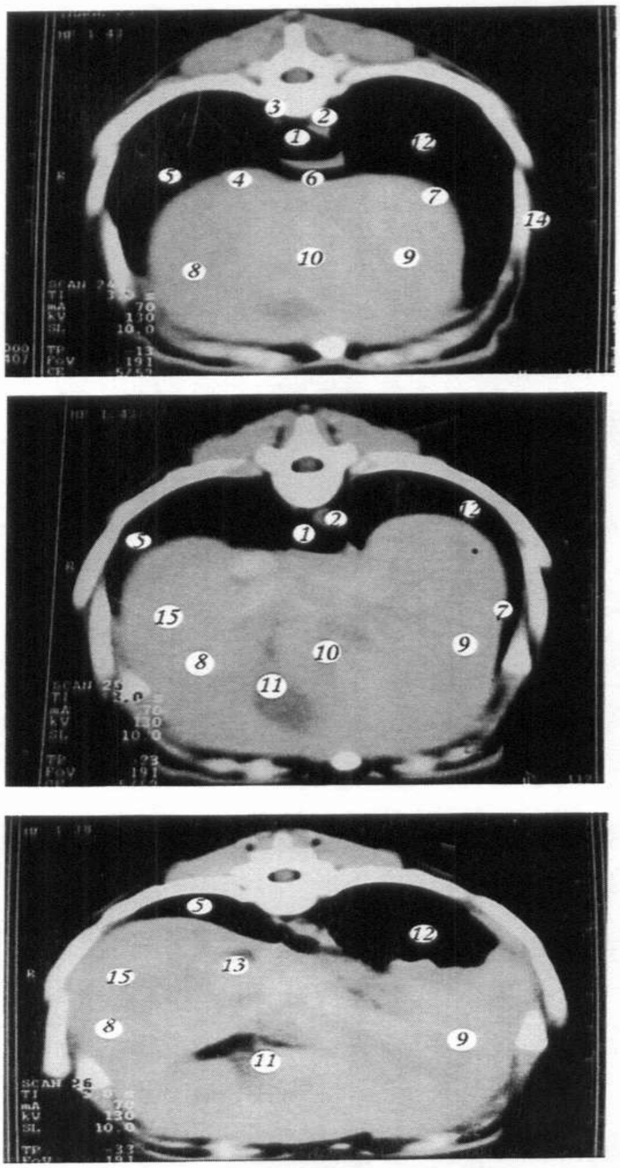
Fig. (4): C.T. image of the caudal mediastinal region..

1. Esophagus.
2. Aorta.
3. Right azygous vein.
4. Caudal vena cava.
5. Right caudal lung lobe.
6. Accessory lobe of the lung.
7. Diaphragm.
8. Right medial lobe of the liver.
9. Left medial lobe of the liver.
10. Quadrate lobe of liver.
11. Gall bladder.
12. Left caudal lung lobe.
13. Gas within cranial part of duodenum.
14. Right costal arch.
15. Stomach.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DISCUSSION

The thorax:

Our results denoted that the shape of the thorax in all investigated dogs was appeared compressed laterally cone shape with large depth due to the ribs were short and curved. The bony thorax was formed by the thoracic vertebrae dorsally, thirteen pair of ribs laterally and nine sternal segment ventrally, the ribs were a nine pair sternal ribs directly attached to the sternum, four pair asternal ribs and one pair of them was a floating rib. The ribs had a narrow width that lead to a wide intercostal space. These findings were in agreement with that obtained by ***Douglas (1970); King (1974); Dyce et al. (1987) and Assheuer and Sagar (1997) in dog, while Frandson (1981)*** recorded that the dog has eight sternebrae at which the sternal ribs attached and sometimes the last one or two pair of ribs are floating.

Our study revealed that despite of the length of the thoracic spinous process the dorsal contour of the neck and thorax generally joined without a noticeable elevation at the wither and the tips of the spinus process were individually palpable. Also the angles of the scapula were detected on the lateral surface of the thorax, where the cranial angle was at the level of the first spinous process, the caudal angle was opposite the 4^{th} rib and the ventral angle was at the level of the first rib, these results were similar to that mentioned by ***Dyce et al. (1987).***

I. The thoracic cavity:

In the present work, the external contour of the thorax differed from the internal limits of the thoracic cavity due to the thoracic cavity was limited by the convexity of the diaphragm. The shape of the thoracic cavity in the cross section was oval in shape, its dorsoventral dimension was larger than its lateral dimension, these findings were in agreement with that obtained by ***Miller et al. (1964),*** on the other hand these results were different results were obtained by ***Hare (1975)*** who recorded that the cross-sectional outline of the thoracic cavity is more cylindrical than oval.

Our results mentioned that the thoracic inlet was oval in shape, its dorsoventral dimension was larger than its width and contained the longus colli muscle dorsally, the trachea on the right, the esophagus on the left, the nerves and vessels and the apices of the cupula pleura, these results were in accordance with that reported by ***Miller et al. (1964) and Adams (1986).***

The lateral thoracic walls were formed by the ribs and the intercostal muscles, the first five ribs were covered laterally by the scapula and the triceps brachii muscle. The rest of the lateral wall, covered by the latissmus dorsi, serratus ventralis and the external abdominal obliqus muscles. The intercostal externi and interni muscles located between the intercostal space, only the intercostal interni extend to the intercartilagenous space, similar observation was reported by ***King (1974), Getty (1975), Dyce et al. (1987), Boyd and Paterson (2001)..***

The thoracic outlet in the current study was marked by the convexity and costal attachment of the diaphragm from the second and third lumbar vertebrae dorsally the proximal part of the last rib, along the ninth rib till its costal cartilage, the tenth costal cartilage, the eleventh costochondral junction and the ventral parts of the twelfth ribs, these findings were in agreement with that recorded by ***Hare (1975); Adams (1986) and Dyce et al. (1987).***

The diaphragm:

In this respect, the diaphragm was appeared a dome shaped musculotendinous plate between the thoracic and abdominal cavities with its convex side directed toward the thoracic cavity. The center of the convexity of the diaphragm was located at the middle of the 6^{th} intercostal space and the line of convexity was passed from the 6^{th} costochondral junction till the upper end of the 12^{th} rib and the body of the 12^{th} thoracic vertebrae, this finding was in aline with that recorded by ***Dyce et al. (1987).***

Our study denoted that the diaphragm consisted of a small tendinous central part surrounded by radiating muscles of the fleshy part which can be divided into the lumbar part dorsally, the costal part laterally, the sternal part ventrally. The right crus of the lumbar part of the diaphragm was larger than the left and originated sagittaly by a long bifurcate tendon. The tendon of the right crus was attached to the body of the second and third lumbar vertebrae, while the tendon of the left crus was attached to the first and second lumbar vertebrae. These results were differed from that recorded by ***Miller et al. (1964)*** in dog. They recorded that the right and left crura arise sagittaly by a long bifurcate tendon from the 4th and 3rd lumbar vertebrae respectively.

Whatever the costal fleshy part of the diaphragm in our study was consisted of muscle fibers which radiated from the costal wall to the tendinous center by indistinct serrations from the 9th costochondral junction, proximal to the 10th costochondral junction, the middle of the 11th rib to the proximal part of the last rib, this finding was in a line with that reported by ***Miller et al. (1964).***

Similar to that recorded *by* ***Miller et al. (1964) and Nikel et al. (1986)*** the sternal fleshy part of diaphragm appeared on the base of the xiphoid cartilage and on each side to the eighth costal cartilage.

The pleura:

In agreement with ***Miller et al. (1964), Adams (1986) and Evans and Delahunta (1988)*** the pleura covered the lung and lined the thoracic cavity and covered the structures in the mediastinum. It was formed by right and left pleural sac. The sacs were projected forward to the first pair of ribs more on the left than on the right. The pleural sacs were separated from each other by the mediastinal space, this space was so thin in the ventral part of the caudal mediastinum which more susceptible to rupture and communication, simillar observation was reported by ***Getty (1975).***

Our current work revealed that the diaphragmatic line of the pleural reflection considered the very important line of the pleural reflection lines because it formed the boundary between the pleural and peritoneal cavity, where caudal to this line the diaphragm was attached to the ribs. So this line was detected through the 8^{th} costochondral junction, dorsal to the 9^{th} costochondral junction, the middle of the 12^{th} rib till the proximal part of the last rib, these findings were in accordance with that obtained ***by Miller et al. (1964) Bedford (1984); Delahunta and Habel (1986) and Dyce et al. (1987).***

Similar to that recorded ***by Miller et al. (1964) and Dyce et al. (1987)*** the mediastinal pleura was divided into dorsal and ventral parts the dorsal part was divided into cranial, middle and caudal mediastinal pleura, while the ventral was lined the ventral area to the heart from the thoracic inlet till the diaphragm, the diaphragmatic pleura was reflected to the right around the caudal vena cava and the right phrenic nerve to form the plica vena cavae and reflected also on the triangular phrenicoperi cardiac ligament.

- **The thoracic organs:**

1. The lungs:

Our investigation denoted that the lungs of all studied dogs were relatively wide in conformity with the form of the thorax and the lower costal attachment of the diaphragm, the right lung was larger than the left lung and the left lung was extended cranially more than the right one, similar observation reported by ***El-Hagri (1967), Beaver (1980) and Dyce et al. (1987).***

The lungs were divided by deep interlobar fissures while the lobulation of the lungs was not distinct. The left lung consisted of divided cranial lobe and one caudal lobe, but the right lung consisted of cranial, middle, caudal and accessory lobes. The cardiac notch on the left side was located between the left cranial lobe parts opposite the ventral end of the 3^{rd} intercostal space, while the right cardiac notch was located between the cranial and middle lobe opposite the ventral end of the 4^{th} and 5^{th} intercostal space which considered the best site for heart injection, these findings were in agreement with that obtained by ***Hare (1975); Adams (1986) and Dyce et al. (1987);*** on the other recorded ***El-Hagri (1967)*** who stated that the right cardiac notch come in contact with the 4^{th} and 5^{th} intercostal space and the left cardiac notch is absent or lies in contact with the ventral parts of the 5^{th} and 6^{th} inter costal spaces.

In this respect the area of percussion and auscultation of the lung was determined by the projection of the lungs to the lateral thoracic wall by a triangular area, the cranial border of this area detected by the caudal border of the triceps brachii muscle at the level of the 5^{th} rib from the dorsal border the level of the caudal angle of the scapula till the 11^{th} intercostal space, and the basal border was formed by diaphragmatic lobe of the lung from the 6^{th} costochondral junction till the dorsal end of the 11^{th} intercostal space, these results were similar to that mentioned ***by Reif (1971), Roubebush (1982); Delahunta and Habel (1986) and Dyce et al. (1987).***

2. The heart and pericardium.

In agreement with that recorded by ***Dyce et al. (1987),*** our study declared that the pericardium was consisted of two layers fibrous and serous layer continuos at the base of the heart and reflected on the root of the aorta and pulmonary trunk. The pericardium extended caudally to connect the sternal part of the diaphragm by the phrenicopericardiac ligament.

The heart of dog of the present work was ovoid in shape, its direction was very oblique formed an angle about 45 degree with sternum. The heart occupied an area from the 3rd rib till the 6th intercostal space cranial to the diaphragm. The base of the heart intersected the middle of the 4th rib. The most dorsal part of the heart reached to the line extended from the acromion process of the scapula till the ventral end of the last rib, while the apex of the heart was located just to the left 7th sternebra. The heart was contact with the ventral thoracic wall by a triangular area, its cranial base was crossed the level of the 4th costal cartilage and its apex was directed caudally just to the left of the 7th sternebra. These findings were in agreement with that reported by ***Delahunta and Habel (1986); Dyce et al. (1987) and Assheuer and Sagar (1997).***

The present work denoted that the area of cardiac dullness where was the area of heart contact with the lateral thoracic wall on the left side located beneath the ventral third of 3rd ,4th and 5th intercostal space, while on the right side was at the 3rd and 4th

intercostal space just about 2 cm from the sternum. These results were similar to that recorded by ***King (1974); Beaver (1980) and Delahunta and Habel (1986).***

We found that the sites of auscultation of the cardiac valves were located at the following sites, the pulmonary valve was at the left third intercostal space, the aortic valve was at the level of the horizontal plane of the shoulder joint at the left 4^{th} intercostal space, the left atrioventricular valve at the level of the costochondral junction of the left fifth intercostal and the right atrioventricular valve at the right third and fourth intercostal space. These findings were in accordance with that demonstrated by ***Ettinger (1971); King (1974); Beaver (1980); Delahunta and Habel (1986) and Dyce et al. (1987).***

In this respect, we found that the best site for intracardiac injection was the right ventricle because it has a much thinner wall than the left ventricle and more accessible than the atria which more dorsal than the ventricle. The best site for the right ventricle puncture was the right 4^{th} or 5^{th} intercostal space from the costochondral junction till the sternal border, these investigations were in a line with that investigated by ***Ettinger (1971); King (1974); Delahunta and Habel (1986) and Dyce et al. (1987).***

3. The thymus:

The thymus was observed in the studied dogs under 4 month age, lobulated structure consisted of right and left lobes, it was occupied the ventral part of the cranial mediastinum from the thoracic inlet till the left surface of the pericardium simillar results were obtained by ***El-Hagri (1967) and Dyce et al. (1987).***

4. The esophagus:

The esophagus of most investigated dogs was observed inside the thoracic inlet to the left of the trachea and then gain a dorsal position to the trachea at the level of the 2nd thoracic vertebrae, then crossed the heart dorsal to the trachea and the left bronchus between the aortic arch on the left and the a zygous vein on the right, this site considered the 1st place susceptible for esophageal obstruction, while the second place was at the level of tracheal bifurcation. After that the esophagus crossed the left atrium and accessory lobe of the lung and between the caudal lobes of both lungs and penetrate the diaphragm at the esophageal hiatus at the level of the 10th thoracic vertebrae, this site considered the third place susceptible for esophageal obstruction, these findings were in agreement with that recorded by ***El-Hagri (1967) King (1974) and Dyce et al. (1987).***

In agreement with that reported by ***King (1974),*** we found that the best site through which the esophagus was more easily approached surgically for the transthoracic oesophagotomy from the left side cranial to the heart but both sides more equally caudal to the heart, the right side preferred because the azygous vein unlike the aorta on the left can be ligated without illeffects or we can avoid incision of the esophagus cranial to the heart by approaching the esophagus at the base of the neck and retracting the obstructed materials from the esophagus, while caudal to the heart we can approach the esophagus at the 7^{th} and 8^{th} rib level and pushing the obstructed materials to the stomach without incision of the esophagus.

5. The trachea:

The trachea in our studied dogs were located against the longus colli muscle at the thoracic inlet, and ventral to the esophagus by the level of the aortic arch and passed caudally through the dorsal mediastinum and divided into two bronchi over the left atrium of the heart ventral to the 5^{th} thoracic vertebrae, these results were in the same line with that recorded ***by El-Hagri (1967); Getty (1975) and Dyce et al. (1987).***

- The great vessels within the thoracic cavity:

- The aorta and its branches.

Our work demonstrated that the aorta arose from the center of the base of the heart between the pulmonary trunk on the left and the right atrium to the right. It passed craniodorsally before arched back, the convexity of the arch gave the brachiocephalic trunk and a short distance farther on, the left subcalavian artery. The descending thoracic aorta detached paired nine dorsal inter costal branches, while the first three branches were detached from the costocervical trunk. The branchoesophageal branch was detached from the right 5th intercostal artery. These results were in agreement with that obtained by ***Adams (1986); Dyce et al. (1987) and Evans and Delahunta (1988).***

The brachiocephalic trunk after a rose from the aortic arch passed obliquely to the right ventral to the trachea then gave the left common carotid artery and terminated as the right common carotid artery and the right subclavian artery, this finding was similar to that obtained by ***Beaver (1980); Wilkens and Munster (1981); Evans and Delahunta (1988).*** On the other hand ***Dyce et al. (1987)*** recorded that the brachiocephalic trunk detachs the two common carotid arteries accompany the esophagus and trachea to the thoracic inlet and it is continued as the right and left subclavian arteries whose had the similar branches, where they detached the vertebral artery, the costocervical trunk which gave the dorsal scapular branch, the deep cervical branch and the thoracic vertebral branches and the internal thoracic artery and finaly the superficial cervical artery before continued the axillary artery to ward the fore limb, these investigations were in agreement with that recorded by ***Solis and Zabala (1967), Ghoshal (1975), Simoens et al. (1979) and Wilkens and Munster (1981), on the other hand Miller et al. (1964)*** recorded different investigation, where they recorded that the costocervical trunk is divided into dorsal intercostal artery I, supreme intercostal artery, deep cervical artery and transverse colli artery.

The pulmonary trunk was arisen from the cranial aspect of the base of the heart to the left of the aorta, then passed dorso caudally and connected with the ascending aorta by ligamentum arteriosum, then after divided into long right pulmonary artery and short left another one toward the hillus of the lungs, this result was in a line with that obtained by ***Getty (1975) and Dyce et al. (1987).***

The cranial vena cava in our studied dogs was formed near the thoracic inlet ventral to the trachea and to the brachiocephalic trunk by the right and left brachio cephalic veins which formed by the external jugular vein and the subclavian vein on each side at the thoracic inlet, also it was received draining from the internal thoracic vein, the costocervical vein and the azygous vein near its junction with the right atrium, this investigation was similar to that reported by ***Adams (1986) and Evans and Delahunta (1988).*** On the other hand it was not agreement with ***Dyce et al. (1987)*** who recorded that the cranial vena cava formed by the union of the two subclavian vein at the thoracic inlet.

The caudal vena cava: in the current work was occupied the short distance between the right atrium and the diaphragm within the plica vena cava with the right phrenic nerve and join the caudal surface of the right atrium, this finding was in agreement with that recorded by **Dyce et al. (1987).**

The nerves within the thoracic cavity: The phrenic nerve was arisen from the ventral branches of the 5th , the 6th and 7th cervical nerves and a branch from the sympathetic trunk at the thoracic inlet, the left phrenic nerve remain within the mediastinum till the diaphragm, while the right one accompanied the caudal vena cava in the plica vena cava. The left pherenic nerve passed ventral to the root of the lung while the vagus nerve passed dorsal to the root of the lung, this investigation was similar to that demonstrated by **Getty (1975) and Smallwood (1992).**

The right vagus nerve by about 1.5 cm from the middle cervical ganglia gave the right recurrent laryngeal nerve which curved dorsocranially around the right subclavian artery and coursed cranially on the dorsolateral surface of the trachea. The left recurrent laryngeal nerve leaved the left vagus and curved around the aortic arch. The right and left vagi caudal to the base of the heart were divided into dorsal and ventral branchs. the two branch of each side were united to form the dorsal and ventral vagal nerve trunk near the diaphragm on the dorsal and ventral aspect of the esophagus, these investigations were in accordance with that denoted by ***Evans and Delahunta (1988) and Smallwood (1992).***

The lymphatic structures of the thoracic cavity. In the current work we found that the lymphocenters of the thoracic cavity were the dorsal thoracic lymphocenter which confirmed by the inter costal lymph node, the ventral thoracic lymphocenter which confirmed by the sternal lymph node, the mediastinal lympho center which consisted of only the cranial mediastinal lymph node while the middle and the caudal mediastinal lymph nodes were not observed in all studied dogs. The bronchial lymphocenters which was consisted of the right, left and middle tracheo bronchial lymph nodes scattered about termination of the trachea addition to the pulmonary lymph nodes which were located on the right apical and middle bronchi and left apical and caudal bronchi these results were in the same line with that demonstrated by ***Saar and Getty (1975) and Volimerhaus (1981).***

SUMMARY

The present work was carried out on clinicaly healthy fifteen stray dogs of different ages and weight, from both sexs for the dissection of the thorax, cross sectional anatomy and C.T. images of the thorax.

The shape of the thorax was appeared cone shape compressed laterally, the external contour of the thorax differed from the internal limits of the thoracic cavity due to the convexity of the diaphragm. The thoracic cavity which appeared oval in shape, its dorsoventral dimension was greater than its lateral dimension.

The diaphragm was a dome shape between the thoracic and abdominal cavities. The center of diaphragm convexity was located opposite the middle of the 6th intercostal space, while the costal attachement of the diaphragm was from the 9th costo chondral junction, 10th rib proximal to the costochondral junction, proximal to the middle of 11th rib and the last rib.

The pleura covered the lung and lined the thoracic walls, and was formed by right and left pleural scas, which they were projected forward to the first pair of ribs by the cupula pleurae about 2.5 cm on the left side and 2.0 cm on the right side.

The pleura consisted of visceral and parietal layer, the latter layer consisted of 3 parts costal, diaphragmatic and mediastinal parts. The diaphragmatic line of pleural reflection was the most clinically

important line because it formed the boundary between the pleural cavity and peritoneal cavity.

The mediastinal content was explained through the cross sectional anatomy figures.

The lungs were relatively wide in conformity with the form of the thoracic cavity and the lower costal attachement of the diaphragm. The right lung was larger than the left lung and the left lung was extended cranially than the right lung. The lobation of the lungs was distinct while the lobulation was not distinct. The area of percussion and auscultation was recorded.

The heart was fixed to the diaphragm through robust phrenico pericardiac ligament, the heart was ovoid in shape and was located at an area from the 3^{rd} rib till the 6^{th} inter costal space. The area of cardiac dullness, the auscultation of the heart valves and the sites of the intra cardiac injection were detected in our work.
The thymus was observed in the studied animal, under one year aged dogs.

The esophagus was detected with its course and sites susceptable for the esophageal obstructions.

The trachea was located against the longus colli muscle and ventral to the esophagus and the tracheal bifurcation was ventral to the 5^{th} thoracic vertebrae and over the left atrium of the heart.

SUMMARY

The aorta arose from the center of the base of the heart. The aortic arch gave the brachiocephalic trunk and the left subclavian artery. The brachiocephalic trunk gave the left common carotid artery and terminated by the right common carotid and the right subclavian arteries. The right and left subclavian arteries gave a simillar branches; the vertebral, costocervical, internal thoracic and superficial cervical arteries.

The cranial vena cava was formed by the right and left brachio cephalic veins which formed by the external jugular and subclavians veins and received the internal thoracic, the costocervical and the right azygous veins.

The phrenic, vagus nerve were detected in this work and they did not appear any special difference.

The lymphocenters of the thoracic cavity were the intercostal, sternal, cranial mediastinal, right, left and middle tracheobronchial, and the pulmonary lymph nodes.

The computed tomography demonstrate the typical anatomical findings in cross sectional images that are helpful in localization of the abnormalities.

The Conclusions

- The external contour of the thorax was differed from the internal limits of the thoracic cavity due to the convexity of diaphragm. The thoracic cavity was oval in shape, its dorsoventral dimension was greater than the lateral dimension.

- To auscultate or carry out a cardiac ultrasound, or during thoracotomy the forelimb should be drawn cranially to examined the 3rd and 4th inter costal space under the triceps brachii muscle.

- The esophageal hiatus of the diaphragm considered more susceptible to hernia than the aortic hiatus which considered to be more resistant to the hernia as it was supported by the sublumbar muscles in addition to the tendons of the two crura.

- The pleural sacs were projected at the base of the neck by the right and left cupula pleura 2 cm and 2.5 cm respectively of forward to the 1st pair of ribs, whatever the ventral part of the caudal mediastinum is so thin which considered more susceptible to rupture and communication can be done between the two sacs. The diaphragmatic line of the pleural reflection is very clinically important because it was forming the boundary between the pleural and peritoneal cavity where caudal to this line the diaphragm was attached to the thoracic wall that considered the best site for pleurocentesis cranially to the 7th or 8th costal cartilage.

- The area of percussion and auscultation of the lung in case of the lived dogs was determined by the contact between the lung and the lateral thoracic wall by a triangular area appeared due to the movement of the lung into costo diaphragmatic recess during inspiration than expiration whoch was defected by the aid of the lateral thoracic radiography during inspiration and expiration.

- The area of cardiac dullness on the left side located beneath the ventral third of 3rd, 4th and 5th intercostal space, while on the right side, it was restricted to the 3rd and 4th intercostal space, whatever the ausculation of cardiac valves (pulmonary, aortic, left atrioventricular and right atrioventricular valves) at the following respectively sites, left 3rd, left 4th , left 5th and the right 3rd and 4th intercostal spaces, the best intracardiac injection was the right ventricle in the right 4th and 5th intercostal spaces.

- There were three sites susceptible to the esophageal obstruction, the 1st site was between the aortic arch and the azygons vein, the 2nd site was at the level of the tracheal bifurcation caudal to the left atrium of the heart, the 3rd site was the esophageal hiatus of the diaphragm.

- The computed tomography of the thorax demonstrated the typical anatomical findings which were appeared in the cross sectionalimages that are helpful in localization of the abnormalities.

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الملخص العربى

دراسات تشريحية إكلينيكية على الصدر فى الكلاب

أجريت هذه الدراسة على خمسة عشر من الكلاب الضالة مختلفة الأعمار و الجنس لأتمام

١٠ تشــريح الصـــدر ٠

٢٠ التشريح المقطعى ٠

٣٠ الأشعة المقطعية ٠

و لقد أوضحت الدراسة ما يلى :

١٠ التشـريح الطبوغرافى للصـدر و كذلك التجويـف الصـدرى و جميـع القياسـات الداخليـة لمدخل التجويف الصدرى و التجويف الصدرى عامة ٠

٢٠ التشريح الطبوغرافى للحجاب الحاجز و أجزاؤه التشريحية و أماكن إلتصاقه بالضلوع و ذلك لتحديد مخرج التجويف الصدرى ٠

٣٠ البلورا و التى تتكون من طبقتين : طبقة خارجية تبطن السطح الداخلى للتجويف الصدرى و تعرف بـالبلورا الجدارية و طبقة داخلية تغطـى الرئـة و تلتصـق بسطحها و تسـمى البلورا الحشوية و الطبقتين يكونان كيسا مقفلا حول الرئة عند خارج التجويف الصدرى أمام الضلع الأول بحوالى ٥ر٢ سم على الجانب الأيسر و حوالى ٢ سم علـى الجـانب الأيمن ٠

٤٠ التشريح الطبوغرافى للرئتين أظهر أن الرئة اليمنى أكبر من الرئة اليسرى و تتكون مـن أربعة فصوص بينما الرئة اليسرى أطول و أقل سمكا من الرئـة اليمنـى و تتكـون مـن ثلاثة فصوص و قد تم تحديد منطقة سماع الرئة من على السطح الخارجى للصدر ٠

٥٠ القلب من حيث الموقع طبوغرافيا و أماكن سماع الصمامات و كذا حقن القلب حيث وجد أفضل مكان للحقن فى البطين الأيمن ٠

٦٠ المرىء و القصبة الهوائيـة داخل التجويـف الصـدرى و كـذا الأمـاكن المتوقعة لأنسـداد المرىء و أفضل الأماكن لجراحة إنسداد المرىء ٠

٧٠ أوضحت دراسة الأورطـى و تفرعاتـه و مـن الشـرايين الهامـة التـى تخـرج مـن القـوس الأورطى الشريان العضدى الرأسى و يتفرع الى الشـريان السـباتى المشـترك الأيسـر و ينتهى بالشريان السباتى المشترك الأيمن و الشريان تحت الترقوى الأيمن أما الشـريان

SUMMARY

تحت الترقوى الأيسر فيخرج من القوس الأورطى مباشرة ٠ و كذلك تـم دراسـة الوريـد الأجوف الأمامى و الخلفى ٠

٨٠ تم دراسة تفرعات العصب الحائر و عصب الحجاب الحاجز ٠

٩٠ تم دراسة العقد الليمفاوية داخل التجويف الصدرى ٠

١٠٠ تم عمل التشريح المقطعى العيانى لمنطقة التجويف الصدرى و ذلك لمقارنتـها بالأشـعة المقطعية٠

١١٠ أوضحت الدراسة بالأشعة المقطعية قـدرة تصويريـة دقيقـة للتركيبـات التشـريحية للأعضاء المختلفة داخل الصدر حيث أظـهرت منـاطق التجويـف الصدرى و أعضائـها المختلفة ٠

بسم الله الرحمن الرحيم

قالوا سبحانك

لا علم لنا

الا ما علمتنا

إنك أنت العليم الحكيم

صدق الله العظيم

سورة البقرة آية ٣٢

لجنة الأشراف

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دراسات تشريحية إكلينيكية على الصدر في الكلاب

مقدمه من

ط.ب / محمد الصافى محمد الصافى
(ماجستير فى العلوم الطبية البيطرية ٢٠٠١)

للحصول على

درجة دكتور الفلسفه فى العلوم الطبية البيطرية
(تشريح)

جامعة الإسكندرية
كلية الطب البيطرى
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(٢٠٠٥)