ANATOMICAL STUDY OF THE TRACHEAL CAST AND LUNG IN LOCAL BREED CATS *Felis Cactus Domesticus.L.*

Shakir Mahmood Mirhish Rabab Abd Alameer Nassar

Department of Anatomy, Histology and Emberyology Veterinary Medicine College.

University of Baghdad , Baghdad ,Iraq.

Keywords; Cast , Trachea ,Ventricle.

(Received 14 April 2013,Accepted 5 June 2013,)

ABSTRACT

Cast technique includes ten cats (5 male, 5 female) used the polymerizing resin (cold acrylic) to study the bronchial tree and blood vessels. the examination of bronchial tree of the cats (felis catus) Lung is done by using cold resin in order to prepare cast specimens. The diameter of right principal bronchi of cats mean (7.34 mm± 0.36) and diameter of left principal bronchi means (6.07mm± 0.36). The right principal bronchi large than left principal. The air flow in right Lung faster than the left. This result is supported by the researcher .These results are obtained from the cast model showing that the pulmonary trunk divides into right and left pulmonary arteries after arising from the right ventricle of heart. The right pulmonary artery the diameter about (4.18 mm) and diameter of left pulmonary artery about (3.40 mm) that the right pulmonary larger than the left pulmonary artery

INTRODUCTION

The pulmonary cast very useful for both teaching and research. They can be used to obtain anatomical models of both normal and abnormal (1,2).

The use of respiratory air way cast is essential for clear conceptualization at the interior of the Lung. numerous methods for the preparation of such specimen using plastics and resin (2,3). preparing casts of the macroscopic air ways of mammalian Lung which both simplified and in expensive in comparison in coml. with previous techniques is described the models are accurate, durable and flexible, and clearly demonstrate the orientation and branching pattern of the bronchial tree (30).the changes in orientation of the bronchi are caused by removal of Lungs from the thoracic cavity before injection is undeniable. However, suspension in water during curing of the injected material has previously been shown to produce casts of sufficient quality for its use in morphometric studies. (3,4).The morphometric measurements on airway cast require two things, on Idealized geometric model and a unique address system that allows each measured air way to be repeatly located (2).amodel and numbering system that has been successfully used (such information include airway length, diameters, branch angles) (5).Choosing the casting material because it has excellent replicative ability, negligible shrinkage, cures of room temperature with insignificant generation of heart and produce a flexible (2).the aim of the study to investigate the branching of trachea and the lung lobes.

MATERIALS AND METHODS

For cast technique obtains ten cats (5 male, 5 female) used the polymerizing resin (cold acrylic) to study the bronchial tree and blood vessels.

A- Used three normal cats (lower respiratory tract):

1) After euthanasia the healthy cats, inserted cannula in to the trachea.
2) The specimens was inflated prior to injection using the disposable syringe 50 ml and injection. The polymer sable prepared acrylic resin, rapid repair self-curing powder and liquid containing methyl methacrylate monomer, 4-dimethyl amino toluene.

The volume of the acrylic material should not be changed during the process of solidification and should ideally be distributed into branches and become becomes so sufficiently rigid that supported after maceration.

B-Using five healthy cats for study the blood vessels (Pulmonary arteries and veins). the resin mixed with red or blue color was used for injection via left atrium for preparing cast of the pulmonary arteries and via right ventricle for pulmonary veins (1).

The cast of the bronchial tree was prepared by using saline solution for washing and then injected the cast material in to bronchial tree. Red color cast was injected into the pulmonary artery, and the blue for pulmonary vein. Solidification of the resin and then the specimens are left for 24 hours before maceration at the room temperature. After the resin then injection, the soft tissue was treated with concentrated Hydrochloric acid (HCl) 70% for (12-24 hours) or until the entire lung tissue is removed. The lung models were obtained after washing in tap water and the resulting cast is then dried.

RESULTS AND DISCUSSION

Cast form of Bronchial tree**:** the examination of bronchial tree of the cats (felis catus) Lung is done by using cold resin in order to prepare cast specimens. after preparing the cast then injecting the cold resin via trachea and maceration by 70% HCl and washing the specimen and cleaned to deliver the bronchial tree pattern which were relatives size of the bronchi and bronchioles that are clearly and faithfully. The trachea is divided into right and left principal bronchi the right principal bronchi then continuous as the lobar bronchi the caudal lobe while the left principal bronchi originates at slightly more acute angle from the trachea.as given(Fig 1,2) this result agrees with the researcher (6) in cat and (7) in dog. The right and left principal bronchi arise both right and left lobar bronchi the last one divided into segmental bronchi for each side and sub segmental bronchi. That followed at regular branching to the bronchiole. The bronchiole tree in cat is composed of each the lobar bronchi give off bronchioles and classified the bronchioles into the dorsal and ventral bronchiole. The right apical lobe is formed by first bronchi of the dorsal bronchi . The right middle lobe is formed by first bronchi of the lateral bronchi (directed ventrally). The caudal lobar bronchi is formed by medial bronchiole as in Fig (3) In the left apical lobar bronchi is formed by the first bronchiole of the lateral bronchiole. The bronchioles of the dorsal, ventral and medial bronchiole constitute the left caudal lobe bronchi as in (Fig 4). This result corresponds the to result (8) in dog at the right Lung but results of bronchial tree of cat revealed that the left lung is different from that results reported by the (9). In pig, (10) in dog because the left apical lobe bronchi are

absent and also remind the middle lobar bronchi. The right principal bronchi are (first order) branches to three secondary bronchi (segmental bronchi) apical, middle and caudal bronchi which was the continuous of principal bronchi. The accessory bronchi arise from caudal bronchi as in (Fig 3). This result agrees with the research by (11) in guinea pig(12) in dog but it is differs from that reported by the researches of (13); in Taiwanese enemas deer, (10). In Japanese deer; (9). In pig, (14). In Giraffe; (15) in Angora goat; (16). In camel which reported a rise of tracheal bronchi from the trachea before the bifurcation. This situation was due to the distance between larynx and tracheal bifurcation is longer than other mammals. The left principal bronchi (first order) gives branches to the two secondary bronchi which the first branching to the cranial lobe which was subdivided into two segmental bronchi supply the cranial part and caudal parts and terminated into the left caudal lobe as in (Fig 4). This result agrees with the (6), in cat; (7) in dog. The diameter of right and left principal bronchi of cats means (7.34 mm± 0.36) ,(6.07mm± 0.36)respectively. The right principal bronchi is larger than left principal. The air flow in right Lung faster than the left. This result is supported by the researcher (17). Table (1): reveals measurement of the Number of Airway Segments from the Trachea to the Terminal Bronchiole for each Lobe in Cats Following (Fig3, 4)

Cast of Blood Vessels distribution of pulmonary artery of cats: These results are obtained from the cast model showing that the pulmonary trunk divides into right and left pulmonary arteries after arising from the right ventricle of heart. The diameter of right and left pulmonary artery about (4.18 mm) ,(3.40 mm)respectively. That the right pulmonary artery larger than the left pulmonary artery shown in (Fig 5) and (table 6). This result is similar as the result of (10) in dog, *Carbral et al*., in wild boar. The right pulmonary artery runs ventral to the bronchial tree and dorsal to the right pulmonary vein as shown in (Fig 5). The right pulmonary artery emits a branches usually irrigates the right apical lobe and runs ventral to right apical lobe and run ventral to right apical bronchi lobe and second the branch which runs across the dorsal side of the right middle lobe bronchi and then along to the dorso-lateral side along the right caudal lobe bronchi. The right accessory lobe artery arises from the ventro– medial side of the right accessory lobe bronchi and then each pulmonary artery is subdivided into small arterioles run along the bronchioles of each lobe as shown in (Fig 13). This result is supported by research of (10) in dog,.

The left pulmonary artery runs across the dorsal side of the left apical lobe bronchi, then run along the dorso-lateral side of the left bronchi as given in fig (6). The left apical lobe artery arise – from the left pulmonary artery which emits two branches one of them arises from lateral side of left pulmonary artery (Fig 6) and appears on the lateral side and second branches arising from the lateral side of the branch. It then runs along the dorso-lateral side of the left caudal lobe as given in (fig 6). This result is also reported by (10) in dog; (18) in cat.

Distribution of Pulmonary Veins: The right apical lobe veins drain the blood area of cranial and caudal parts of the right apical lobe bronchi as in (fig 7). These veins running along the ventral side of right apical lobe bronchi (cranial and caudal bronchi). Finally form a large vein. The right middle lobe vein drain the blood from the area of right middle lobe and form large vein running along to ventro medial side of the right middle lobe bronchi and this vein forms a common large vein together with the right apical lobe and enters the left atrium as in (Fig 7). The right accessory lobe vein drain blood from the area of the right accessory lobe bronchi and run along

the dorsal side of the right accessory bronchi finally meeting with right caudal lobe bronchi vein to from the large vein enter to left atrium. The right caudal lobe vein drain the blood area that of caudal lobe bronchi running dorso-lateral side of right caudal lobe bronchi. This result is supported by (8,19);. The distribution of the pulmonary artery and vein of the (pig , dog, horse, rat) together with their bronchi ramification. The distribution pattern of pulmonary artery and vein of the cats are fundamentally the same as those of domestic animals. While in cats is same as in horse in right apical and middle lobe vein form the large short vein when they enter the left atrium. But the right accessory lobe vein in horse enters the left atrium directly (10). but in cats these vein meeting with right caudal lobe vein and then enters to left atrium.

The left pulmonary veins which drain blood from area of the cranial and caudal part of the left apical lobe. These veins running along the ventral side of cranial and caudal parts the left apical lobe bronchi vein is short vein and enters in left atrium.

The branch drains the blood from area of the caudal lobe bronchi and meeting with right apical lobe vein and enters the left atrium. This results supported by (19). Who noted that in left apical lobe vein In cats differs from the pig because the left apical lobe bronchi is lacking in pig.

Nutritional and blood Supply of Trachea of Cats The right side from the aortic arch which arising from the two branches including.

1. Left subclavian artery.
2. Brachiocephalic trunk: which extends cranially and to the right from the aortic arch ventral to the trachea – and this trunk divided two branches (Fig 8).

a- Common carotid arteries.

b- Right subclavian artery: its termination usually lies medial to the right first inter costal space or first ribs.

3. The trachoesophageal artery arise a secondary branch from the brachio-cephalic trunk which is divided into two braches the cranial branch supply the trachea. This result supported by the (20).

Blood Supply of Lung parenchyma. The bronchoesophageal artery is a pair vessel its left artery usually arise from the thoracic aorta at the level of 5^{th} and 6^{th} ribs as given in (fig 9) while the right artery arises from the fifth or sixth dorsal intercostal this artery divides into bronchial and esophageal.

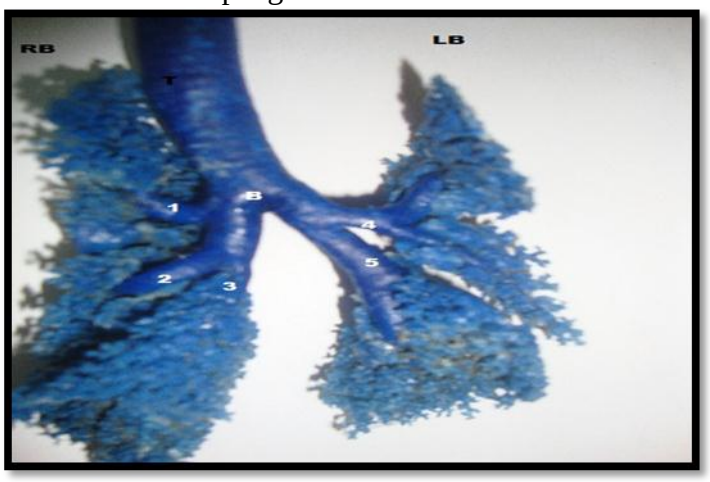

Figure 1: Cast Photograph of the Lung illustrates the Ramification of the Bronchial Tree (ventral aspect). TBI= trachea bifurcation.

1- right apical lobe bronchi. 2- right middle lobe bronchi.

3- right accessory lobe bronchi. 4- left apical lobe bronchi.

5- left caudal lobe bronchi.

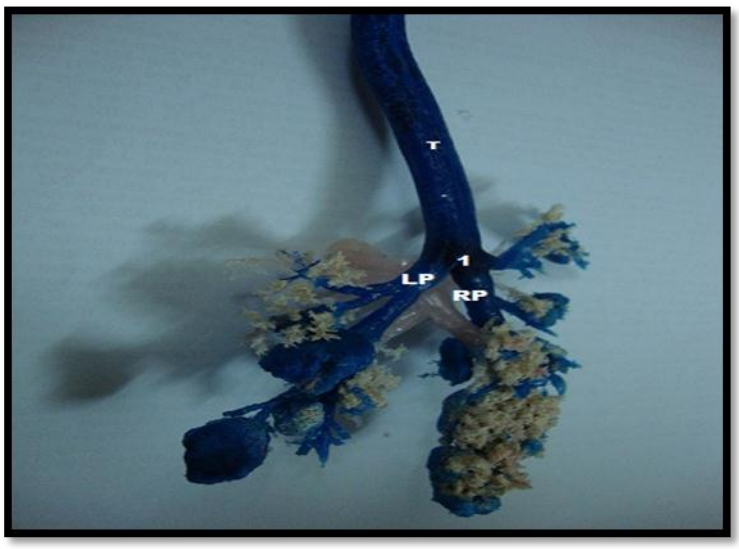

Figure 2: Cast

Photograph of the Lung illustrates the Ramification of the Bronchial Tree (dorsal aspect) LB=left. Bronchial the acute angle with trachea. RB=right bronchial is continuous with trachea. 1=carina

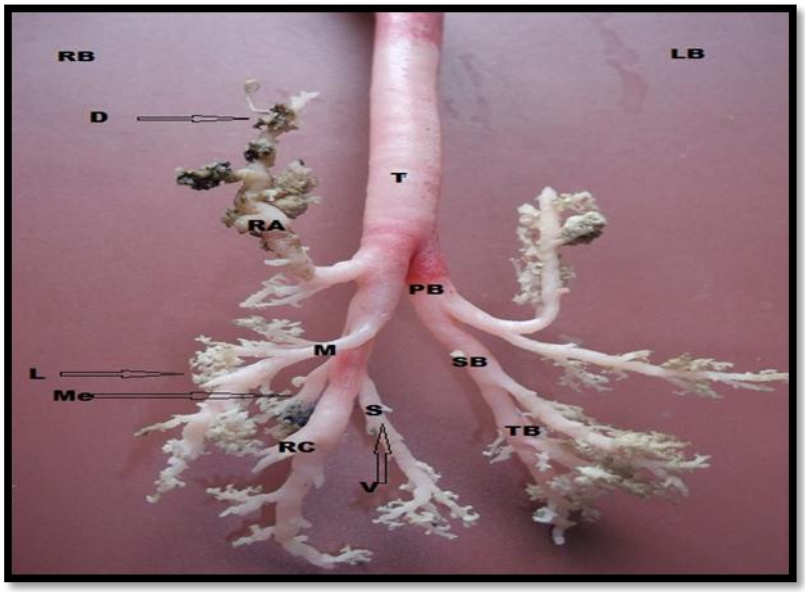

Figure 3: Ventral view of the Cast Bronchial Tree Illustrates the Ramification of the Bronchial, Bronchioles Branches and Directions.

PB=principal bronchi, SB=segmental bronchi, TB=tertiary bronchia, RA=right apical lobe, M=right middle lobe. S=right accessory lobe RC=right caudal lobe. L=lateral, Me=medial, V=ventral, D=dorsal.

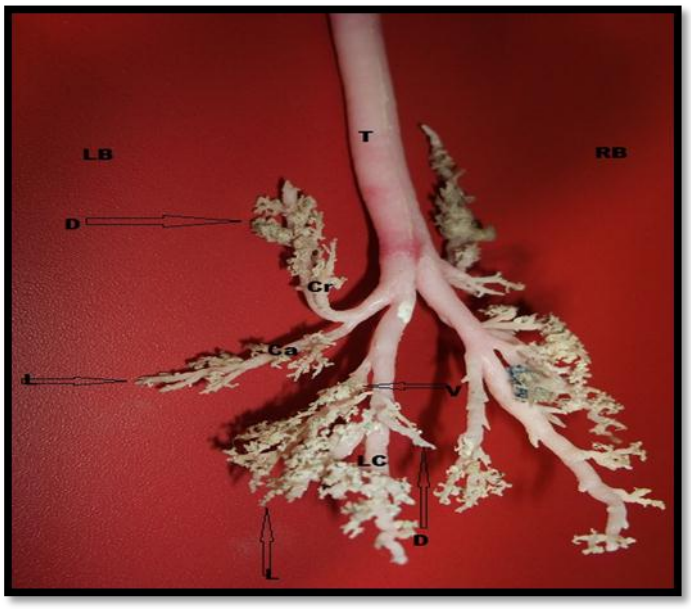

Figure 4: Dorsal view of the Cast for the Left Bronchial Tree which illustrated of the Direction of the Ramification of the Bronchial Tree.

Cr=cranial part of apical lobe. L=lateral, Me=medial, V=ventral, D=dorsal

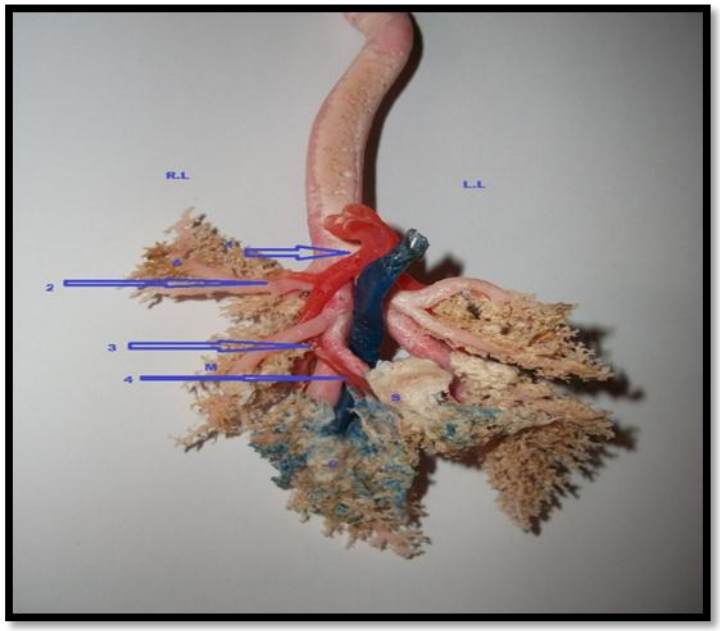

Figure 5: Cast Photograph of the Lung illustrates the Ramification of the Right Pulmonary Arteries (ventral aspect). RL=right lung. LL=left lung. PT=pulmonary trunk. 1-right pulmonary artery. 2-right apical pulmonary artery. 3-right middle pulmonary artery. 4-right caudal pulmonary artery. A-apical lobe, m-middle lobe, Cu-caudal lobe, S-accessory lobe.

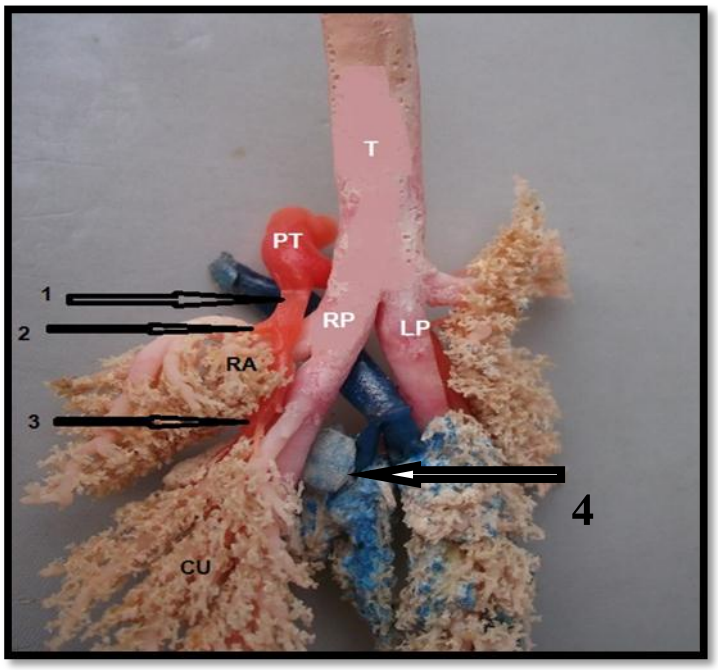

Figure 6: Cast Photograph of the Lung Illustrates the Ramification of the Left Pulmonary Arteries. (dorsal aspect). RL=right lung. LL=left lung. 1-left pulmonary artery. 2- left apical pulmonary artery. 3- left caudal pulmonary artery. 4- Right pulmonary vein A-left apical lobe, Cu-left caudal lobe.

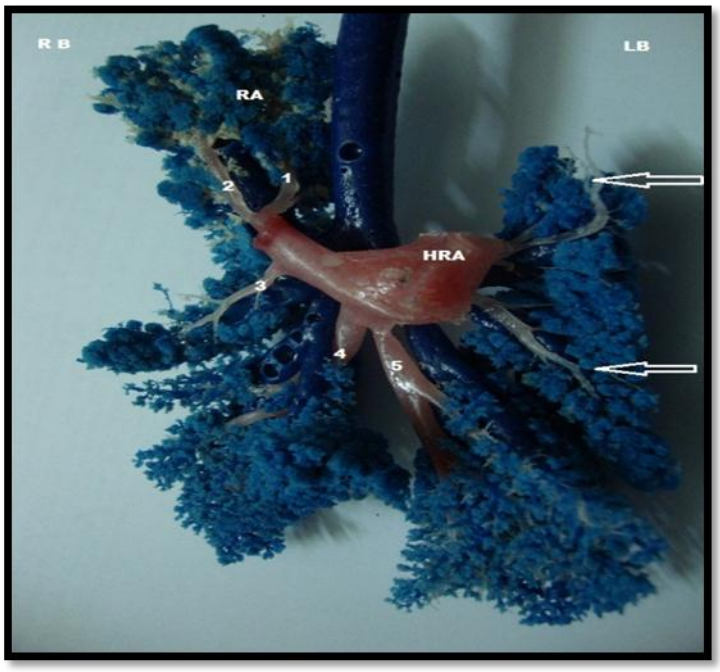

Figure 7: Cast of the Lung Illustrates the Ramification of the Left Pulmonary Veins. (ventral aspect) 1,2=cranial and caudal right apical pulmonary vein. 3=right middle pulmonary vein. 4=caudal pulmonary vein. 5-right caudal pulmonary vein. A=left apical pulmonary vein. LC=left caudal lobe. RC=right caudal lobe. The arrow cranial & caudal branches of left apical pul. vein.

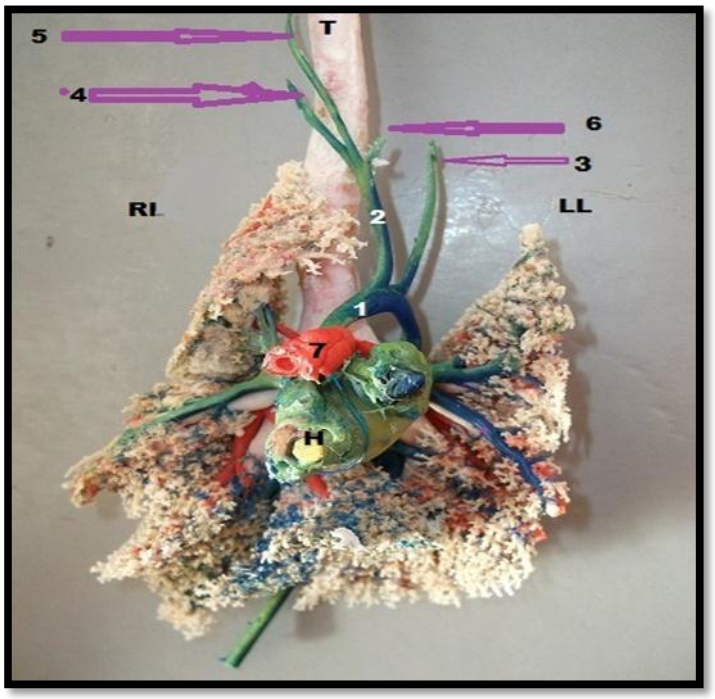

Figure 8: Cast Photograph of the Lung Illustrates the Ramification of the Pulmonary Artery, Vein and Blood Supply of Trachea and Lung Parenchyma. (ventral aspect)

1-asending aorta. 2-brachiocephalic trunk.

3-left subclavain artery. 4-right subclavain artery.

5-common carotid artery. 6- Trachoesophageal artery.

7-pulmonary trunk.

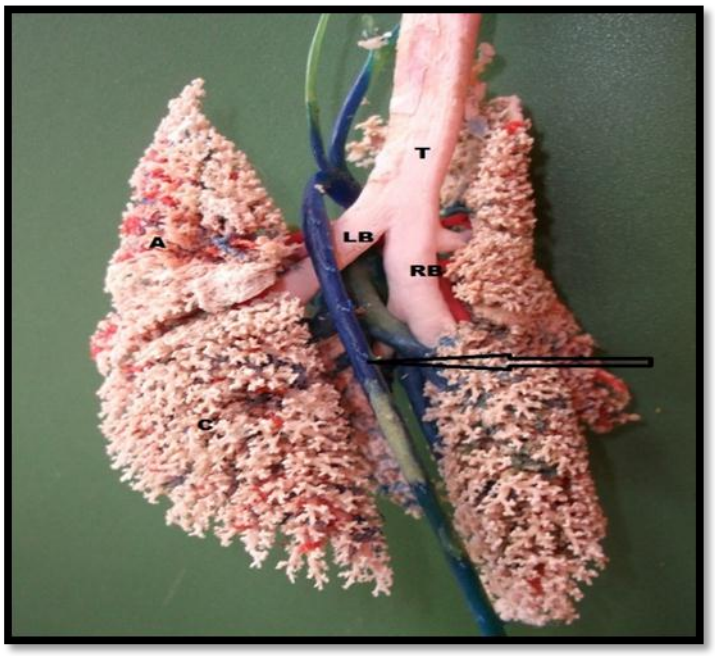

Figure 9: Cast Photograph of the Lung Illustrates the Thoracic Aortic. The arrow dorsal intercostals arteries. RB =right bronchus. LB=left bronchus

T=trachea, H=Heart. RL=right lung. LL=left lung

دراسة تشريحية لقالب الرغامي والرئة لقطط السلالة المحلية *Felis .Domesticus.L s Cactus*

شاكر محمود مرهش رباب عبد الامير ناصر

قسم التشريح والأنسجة والاجنه ، كلية الطب البيطري ، جامعة بغداد ، بغداد، العراق .

الخلاصة

يتضمن تقنية عمل القالب عشرة القطط (5 ذكور و 5 إناث) استخدام الراتنج البلمرة (الاكريليك الباردة) لدراسة تشجرات القصبات الهوائية والأوعية الدموية. فحص تشجرات القصبات الهوائية في القطط والرئة باستخدام الراتنج الباردة من أجل إعداد عينات القالب. اوضحت الدراسة ان قطر الشعب الهوائية الرئيسية اليمنى في القطط بمعدل مقداره(7.34ملم) وقطر القصبات الهوائية الرئيسية اليسرى (6.07ملم)الشعب الهوائية الرئيسية اليمنى اوسع من مثيلتها اليسرى . تدفق الهواء في الرئة اليمنى أسرع من اليسرى. ويتم الحصول على هذه النتائج من نموذج القالب تبين أن الجذع الرئوي يقسم الى اليمين واليسار الشرايين الرئوية المتفرعه عن البطين الأيمن من القلب. قطرالشريان الرئوي الأيمن حوالي (4.18 ملم) وقطر الشريان الرئوي الايسر حوالي (3.40 ملم) أن الشريان الرئويالايمن أكبر من الشريان الرئوي الأيسر.

REFRENCES

1. Nettum, J. A. (1995). Combined vascular-broncho-alveolar casting using formalin-fixed canine lungs and a low viscosity silicone rubber. Anat. Rec. 243: 479-482.
2. Phalen, R.F., Yeh, H.C. Raabe, O.G. and Velasquez. (1973). Casting the lungs in situ. Anat. Rec. 177: 255-263.
3. Smith, B.J., Hollady, S.D. and Hudson, L.C.A. (1990). Simplified method of casting the mecroscopic airway of lungs. Acta. Anat. 137: 109-113.
4. Klipper, R.W. and Stidd, P.J. (1973). A wet lung technique for obtaining silastic rubber casts of the respiratory airways. Anat. Rec. 176: 276-288.
5. Phalen, R.F., Yeh, H.C. Raabe, O.G. and Velasquez. (1973). Casting the lungs in situ. Anat. Rec. 177: 255-263.
6. Caccamo, R.; Twedt, D.C, Buracco, P. and Mxkiernan, B.C. (2007). Endoscopic bronchial anatomy in the cat. Journal of Feline medicine and surgery, 9: 140-149.
7. Amis, T.C., Mckiernan, B.C. (1986). Systemic identification of endobronchial anatomy during bronchoscopy in the dog. Amer. Jour. Vet. Res. 47(12): 2649-2627.
8. Nakakuki, S (1993) . The bronchial tree, lobular division and blood vessels of the Japanese deer (cervus Nippon) lung. J. Vet. Med. Sci. 55(3): 443-447.
9. Schwarzkopf, K, Hueter, L. Preussler, N.P., Setzer, F. Schreiber, T. and Karzai, W. (2010). A special modified, double-lumen tube for one-lung ventilation in pigs. Scand. J. Lab. Anim. Sci. 37(2): 69-72.

10. Nakakuki, S. (2008). Distribution of the pulmonary artery and vien the dog lung. Adv. Amin. Cardio. 33(1): 16-23.
11. Schlesinger, R.B and Mcfadden, L.A. (1981). Comparative morphometry of the upper bronchial tree in six mammalian species. Anat. Rec. 199: 99-108.
12. Horsfield, K, Kemp W, Philips S. (1982). An a symmetrical model of the airways of the dog lung. Jour. Appl. Physio, 52(1): 21-26.
13. Liao, A.T., Chanf, M.H and Chi, C and Kuo, T. (2004). The bronchial tree and lobular division of the Formosan reeve's muntjac (muntiacus reevesi micrurus) lung. Taiwan. Vet. J. 35(1): 29-25.
14. Nakakuki, S (1983). The bronchial ramification and lobular division of the giraffe lung. Anat. Anz. Jena. 154: 313-317.
15. Habib, R.S. and Mahammed F.S. (2010). Histomorphological and radiological study of trachea and lings of angora goat (capra ibex) M.Sc. thesis, Vetarinary Medicine Collage, University of Duhok.
16. Al-Abasi, R.J and Mirhish, M. (2001). Anatomical and Histological Study on the Trachea and Lung of One-Hamped Camel in Middle of Iraq. M.Sc. thesis, Veterinary Medicine Collage, University of Baghdad.
17. Yeh, H.G., Schum, G.M. and Duggan, M.T. (1979). Anatomic models of the tracheobronchial and pulmonary regions of the rat. Anat. Rec. 195: 482-492
18. Oliveira, F.S., Borges, E.M. Machado, M.R.F, Canola, J.C. and Riberio, AA. (2001). Anatomico surgical arterial segmentation of the cat lungs (felis catus domesticus, L., 1758). Braz. Jour. Vet. Res. Anim. Sci. 38(6): 1-8
19. Nakakuki, S (1994). Bronchial tree, lobular division and blood vessels of pig lung. J. vet. Med. Sci. 56: 685-689.
20. Getty, R (1975). The anatomy of the domestic animals. 5th ed. 1, 2. W.B Saunders Company.pp.1559-1575