

SOME ANATOMICAL STUDIES ON THE BRONCHIAL TREE AND PULMONARY TRUNK OF THE LUNG OF THE PIG

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ABSTRACT

The bronchial tree and pulmonary trunk have been investigated in thirteen lungs of pigs of different age and sex. Preparation of corrosion epoxy casts and radiological examination were used for investigation. Detailed description of the lobar and segmental bronchi of different pulmonary lobes has been presented. The course and topography of the pulmonary arteries as well as their lobar and segmental branches have been thoroughly examined and described.

Key words: Pig- lung- pulmonary

INTRODUCTION

Pigs are commonly used in human medicine for training purposes as in therapeutic and diagnostic bronchoscopy. The bronchial tree among the mammals was previously discussed by a large number of authors, *Stamp (1948)* in bovine, *Guzsal (1952 & 1955)* in domestic animals, *Nickel, Schummer & Seiferle (1973)* in mammals, *Osman (1974)* in camel, *Hare (1975)* in dog, *Swielim (1981)* in goat, *Hagras (1982)* in buffalo & *Nakakuki (1993)* in horse, while few researches studied the pig as *Talanti (1958) & Wolfgang, John, Justin and Guy (1999)*. This study clarifies the anatomy of the bronchial tree and the pulmonary trunk ramification in the pig.

MATERIAL AND METHODS

Thirteen lungs with attached hearts from pigs of different age and sex were used in this study. The lungs were collected from the Cairo slaughter house. *Corrosion cast technique* was choice to demonstrate ramification pattern and the termination of the bronchial tree and pulmonary trunk, by using Colored epoxy 151 yellow for the bronchial tree and red for the pulmonary trunk. (The technique of *Swielim (1981)* in goat & *Hagras (1982)* in buffalo). A radiological examination also done on the lungs by injecting a mixture of 40gm lead oxide and 100 ml milky latex solution, X-ray potential 40 k. v. p., 100 m. A., 60 cm. (The technique used after, *Tomsett & Wakeley (1965)*). The nomenclature adopted followed the *Nomina Anatomica Veterinaria (2005)*

RESULTS

I- Bronchial tree

The trachea was bifurcated into right & left principle bronchi about (3cm) caudal to the eruption of the tracheal bronchus. The right principle bronchus gives off the middle and accessory lobar bronchi and continued to be distributed in the right caudal lobe as right caudal lobar bronchus.

The left principle bronchus extended caudolaterally for about (2cm) to give the left cranial bronchus and continued caudally as the left caudal lobar bronchus.

1. *Bronchus trachealis (Bronchus lobi cranialis dexteri)*:- (Figs: 1/2,2/8&3/2)

The right cranial lobar bronchus (tracheal bronchus) emerged from trachea cranial to the tracheal bifurcation by about (3cm). It passed in a

caudolateral direction for a distance about (1-1.5cm) reaching the base of the right cranial lobe then it bifurcated into cranial & caudal segmental bronchi to ventilate the corresponding segments of the right cranial lobe.

1.1. Bronchus segmentalis cranialis lobi cranialis dexteri :- (Figs: 1/3, 2/9 & 3/3)

The cranial segmental bronchus is the larger, directed cranioventrally inside the cranial segment of the right cranial lobe where it gives off about eight subsegmental bronchi to ventilate the different parts of the segment.

1.2. Bronchus segmentalis caudalis lobi cranialis dexteri :- (Figs: 1/4, 2/10 & 3/4)

The small caudal segmental bronchus of the right cranial lobe was directed caudoventrally towards the tip of this segment, where it is distributed. Along its course, it gave (3-4) smaller subsegmental bronchi to be ramified in the remaining parts of the segment.

2. Bronchus principalis dexter :- (Figs: 1/5, 2/11 & 3/5)

The right principle bronchus extended in a caudolateral direction for about (3-4cm), then curved medially towards the tip of the right caudal lobe as the right caudal lobar bronchus. Along the course of stem bronchus, the middle & accessory lobar bronchi were separately erupted.

2.1. Bronchus lobaris medius:-(Figs: 1/6, 2/12 & 3/6)

The middle lobar bronchus sprang out from the ventrolateral aspect of the right principle bronchus about (1-1.5 cm) from the tracheal bifurcation. In all examined cases, the bronchus originated independently

before the eruption of the accessory lobar one. The middle lobar bronchus is directed toward the base of the middle lobe and extended for about (1-1.5cm) where it divided into small lateral and larger medial segmental bronchi.

2.1.1. *Bronchus segmentalis lateralis lobi medii* (Figs: 1/7 &2/14)

The small lateral segmental bronchus, extended for a short distance inside the corresponding segment where it branched into (5-6) subsegmental bronchi, which are consequently distributed through the lateral segment.

2.1.2. *Bronchus segmentalis mediais lobi medii* (Figs: 1/8 &2/13)

The medial segmental bronchus could be considered as the further continuation of the lobar bronchus, regarding its size and direction, it extended axially toward the end of the segment, where it ramified into (3-4) smaller subsegmental bronchi. Along its course, the medial segmental bronchus detached (3-4) cranial & (2-3) caudal subsegmental bronchi to ventilate the corresponding parts of the segment.

2.2. *Bronchus lobaris accessorius*:- (Figs: 1/17 ,2/15 &3/14)

The accessory lobar bronchus derived from the ventromedial aspect of the right principle bronchus. (1-1.5cm) caudal to the eruption of the middle lobar bronchus. The bronchus passed in a curved manner for about (1-1.5cm) where it gave the caudal segmental bronchus and continued as the cranial segmental bronchus.

2.2.1. *Bronchus segmentalis caudalis lobi accessorii* :-

The small caudal segmental bronchus is directed in a caudomedial direction to be distributed into (4-6) subsegmental bronchi that ventilate the different parts of this segment.

2.2.2. *Bronchus segmentalis cranialis lobi accessorii* :-

The cranial segmental bronchus is the direct continuation of the lobar one. It entered the cranial segment and curved in a craniolateral direction to be ramified into (5-7) smaller subsegmental bronchi to ventilate the different parts of the cranial segment.

2.3. *Bronchus lobaris caudalis dexter*: (Figs: 1/9, 2/16 &3/7)

The right caudal lobar bronchus could be considered as the caudal continuation of the right principle bronchus. The bronchus extended caudolaterally for about (2-3cm), where it detached the 1st segmental bronchus of the ventral group and then curved slightly medially and continued caudally to terminate within the distal end of the right caudal lobe. Along the course, the right caudal lobar bronchus, gave off a large number of segmental bronchi. These segmental bronchi could be divided into four groups, ventral, dorsal, lateral & medial groups.

2.3.1. *Bronchi segmentales ventrales lobi caudalis dexteri*:- (Figs: 1/11, 2/7 &3/8)

Represented by large four ventral segmental bronchi spread out along the ventral border of the parent lobar bronchus. The bronchi distribute inside the caudal lobe in a caudoventral direction to ventilate each corresponding segment of the lobe. The first segmental bronchus is the largest and longest among the ventral segmental system and all the rest of the other systems, so it is considered as the largest segmental bronchus in the lung. The interval between the existences of each segmental bronchus is nearly about (1.5-2cm). The first segmental bronchus arose at the level of the mid point between the first and second

lateral segmental bronchi. Only in two examined cases, it erupts at the same level of 1st lateral segmental bronchus. Each segmental bronchus redistributes into 1- 2 cranial, one lateral and one medial, subsegmental bronchi to supply its respective pulmonary subsegmental portion of the pulmonary segment.

2.3.2. *Bronchi segmentales dorsales lobi caudalis dexteri*:- (Fig: 2/18)

The dorsal system is represented by 2-3 segmental bronchi emerged along the dorsal border of the caudal lobar bronchus, by an interval nearly about (1-1.5cm). They pass in a caudodorsal direction. The first dorsal segmental bronchi arose approximately at the level of the third ventral segmental bronchus. only in two examined cases, the 1st dorsal bronchus was absent.

2.3.3. *Bronchi segmentales laterales lobi caudalis dexteri*:- (Fig: 1/10)

The lateral segmental bronchi is represented by 4-5 segmental bronchi originated along the lateral border of the right caudal lobar bronchus with an interval about 1-1.5cm. Each segmental bronchus is furtherly divided into dorsal & ventral subsegmental bronchi to the corresponding portions of the pulmonary segment. The size and diameter of the bronchi diminished where the parent trunk progress toward the apex of the lobe. In one of examined cases, the 1st lateral segmental bronchus of the right lateral segmental system could not be observed.

2.3.4. *Bronchi segmentales mediales lobi caudalis dexteri*:- (Fig: 2/17)

The medial segmental bronchi represented by 3-4 medial segmental bronchi were given off along the medioventral border of the right caudal lobar bronchus. They pass in a caudomedial direction with an interval

about 1.5cm between each other. The first segmental bronchus arose at the same level of existence of the second lateral segmental bronchus. Each segmental bronchus subdivided into two subsegmental bronchi ventral & caudomedial.

3. *Bronchus principalis sinister*:- (Figs:1/12,2/2 &3/9)

The left principle bronchus pierced the left pulmonary hilus in a caudolateral direction; for about (2-2.5cm). It detached the left cranial lobar bronchus and continued within the caudal lobe as left caudal lobar bronchus.

3.1. *Bronchus lobaris cranialis sinister*:- (Figs:1/14,2/3 &3/10)

The left cranial lobar bronchus arose from the left principle bronchus (3-4) cm caudal to the tracheal bifurcation. It directed laterally for about (1cm) where it detached the cranial segmental bronchus and continued in a same direction as a caudal segmental bronchus.

3.1.1. *Bronchus segmentalis cranialis lobi cranialis sinister*:- (Figs:1/15, 2/4 & 3/11)

The small left cranial segmental bronchus passed toward the tip of the segment of the cranial lobe in cranioventral direction. Along its course within the segment, it detached (5-7) subsegmental bronchi that subsequently divided within the different parts of this segment.

3.1.2. *Bronchus segmentalis caudalis lobi cranialis sinister*:- (Figs: 1/16,2/5 & 3/12)

The caudal segmental bronchus could be considered as direct continuation of the lobar one. It extended centrally toward the tip of this segment. Along its course, it gives off (3-4) craniolateral and (3-4) caudolateral subsegmental bronchi.

3.2. Bronchus lobaris caudalis sinister:- (Figs:1/13,2/6 &3/13)

The left caudal lobar bronchus is the direct continuation of the parent principle bronchus. In all examined cases it has been observed the great similarity of the number, eruption & arrangement of the segmental bronchi of the right & left caudal lobes. (In 90%) of examined cases, there were small differences between the branching patterns of the lateral segmental system in both lungs. So the 1st lateral segmental bronchus of the left lateral segmental system is absent.

The ventral segmental system (Bronchi segmentales ventrales lobi caudalis sinisteri) represented by large four ventral segmental bronchi spread out along the ventral border of the parent lobar bronchus. The bronchi distributes inside the diaphragmatic lobe in a caudoventral direction to ventilate each corresponding segment of the lobe. The first segmental bronchus is the largest among the ventral segmental system and all the rest of the other systems, so it is considered as the largest segmental bronchus in the lung. The interval between the existences of each segmental bronchus is nearly about (1.5-2cm). The first segmental bronchus arose at the level of the mid point between the first and second lateral segmental bronchi. (In some cases, it erupts at the same level of 1st lateral segmental bronchus). The 1st segmental bronchus redistributes into two cranial, two ventral, one lateral and one medial, while the arrangement differs in the rest of the segmental bronchi, as two ventral, one lateral, one cranial and one medial subsegmental bronchi to airate its respective pulmonary subsegmental portion of the pulmonary segment.

The dorsal segmental system Bronchi segmentales dorsales lobi caudalis sinisteri) represented by (two-four) segmental bronchi emerge along the dorsal border of the diaphragmatic lobar bronchus, by an interval nearly about (1-1.5cm) between each other. The bronchi pass in a caudodorsal direction and the first dorsal segmental bronchi arose approximately at the level of mid point between the second and third lateral segmental bronchi. (In 20% of examined cases, the 1st dorsal bronchus is absent).

The lateral segmental system Bronchi segmentales laterales lobi caudalis sinisteri) represented by four segmental bronchi emerges along the lateral border of the right diaphragmatic lobar bronchus with an interval nearly about (1.5cm) between each other. The level of eruption of the 1st lateral segmental bronchus caudal to that of 1st lateral segmental bronchus of the right side, in case of absence of the latter bronchus, the 1st lateral segmental bronchus emerges at the same level. Each segmental bronchus redivides into dorsal & ventral subsegmental bronchi to airiate the corresponding subsegmental pulmonary portion of the pulmonary segment. The size and diameter of the bronchi diminish where the parent trunk progress toward the end point of the lobe.

The medial segmental system Bronchi segmentales mediales lobi caudalis sinisteri) represented by four medial segmental bronchi extends along the medioventral border of the left diaphragmatic lobar bronchus. They pass in a caudomedial direction with an interval about (1.5cm) between each other. The first segment of that system arose at the same level of existence of the second lateral segmental bronchus. Each segmental bronchus subdivides into two subsegmental bronchi ventral & caudomedial.

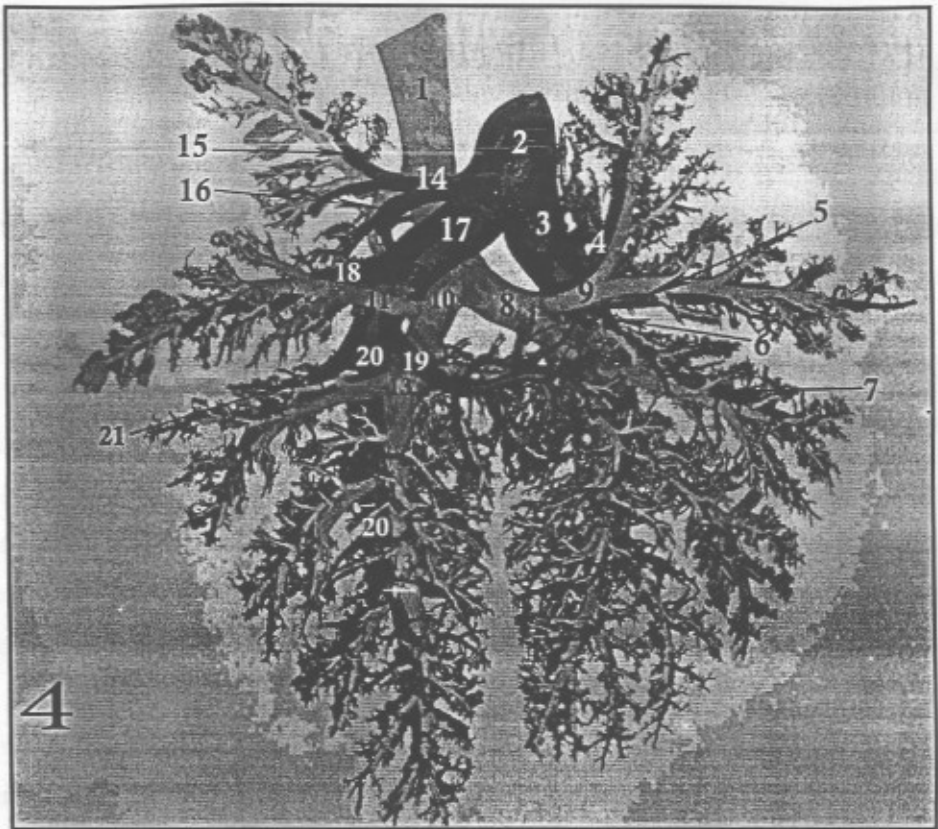


Fig. (1): A photograph showing the bronchial tree (epoxy cast, dorsal view).

- | | |
|---|--|
| 1- Trachea | 10- Bronchi segmentales laterals lobi caudalis dexteri |
| 2- Bronchus trachealis | 11- Bronchi segmentales ventrales lobi caudalis dexteri |
| 3- Bronchus segmentalis cranialis lobi cranialis dextri | 12- Bronchus principalis sinister |
| 4- Bronchus segmentalis caudalis lobi cranialis dextri | 13- Bronchus loabris caudalis sinister |
| 5- Bronchus principalis dexter | 14- Bronchus loabris cranialis sinister |
| 6- Bronchus lobaris medius | 15- Bronchus segmentalis cranialis lobi cranialis sinister |
| 7- Bronchus segmentalis lateralis lobii medii | 16- Bronchus segmentalis caudalis lobi cranialis sinisteri |
| 8- Bronchus segmentalis medialis lobi medii | 17- Bronchus lobaris accessories. |
| 9- Bronchus loabris caudalis dexter | |

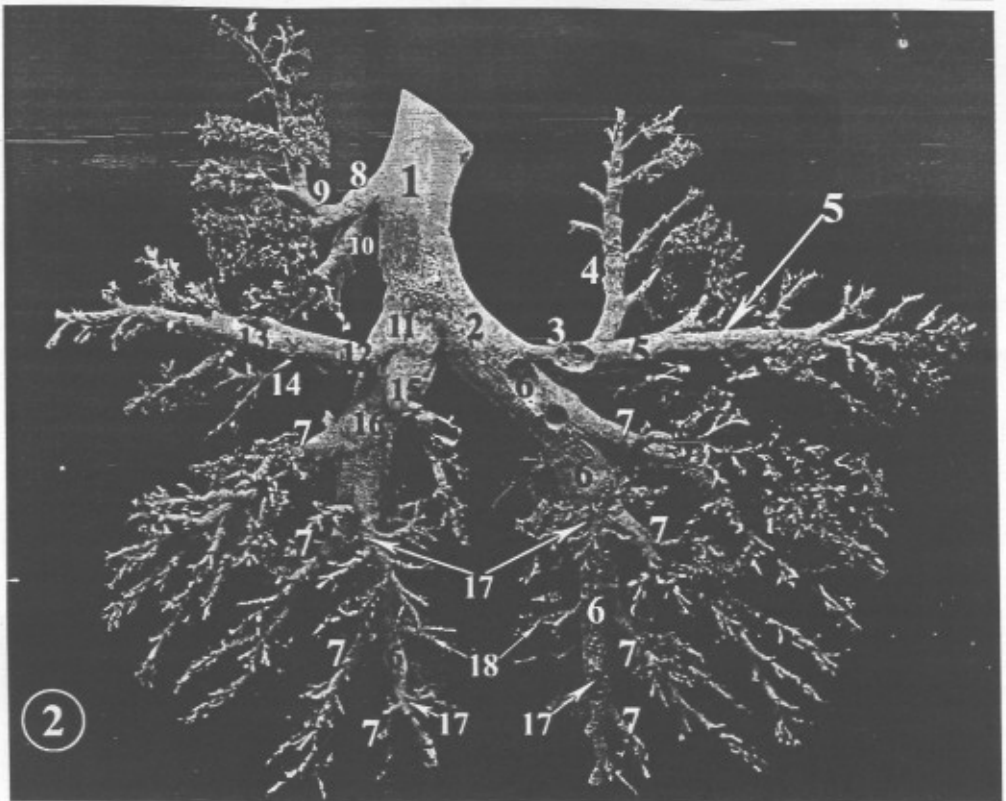


Fig. (2): A photograph showing the bronchial tree (epoxy cast, ventral view).

- | | |
|---|---|
| 1- Trachea | 10- Bronchus segmentalis caudalis lobi cranialis dextri |
| 2- Bronchus principalis sinister | 11- Bronchus principalis dexter |
| 3- Bronchus loabris cranialis sinister | 12- Bronchus lobaris medius |
| 4- Bronchus segmentalis cranialis lobi cranialis sinister | 13- Bronchus segmentalis medialis lobi medii |
| 5- Bronchus segmentalis caudalis lobi cranialis sinister | 14- Bronchus segmentalis lateralis lobi medii |
| 6- Bronchus loabris caudalis sinister | 15- Bronchus lobaris accessories |
| 7- Bronchi segmentales ventrales lobi caudalis dexteri | 16- Bronchus loabris caudalis sinister |
| 8- Bronchus trachealis | 17- Bronchi segmentales mediales lobi caudalis dexteri |
| 9- Bronchus segmentalis cranialis lobi cranialis dextri | 18- Bronchi segmentales dorsales lobi caudalis dexteri |

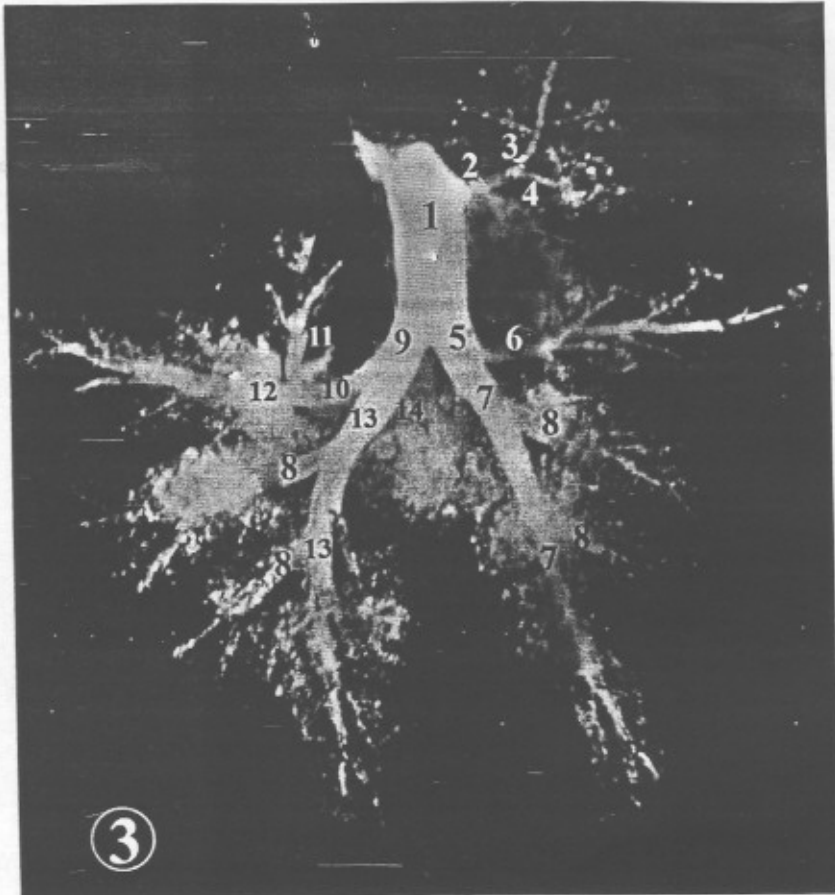


Fig. (3): x- ray film describing the distribution pattern of bronchial tree (injected with lead oxide).

- | | |
|---|---|
| 1- Trachea | 8- Bronchi segmentales ventrales lobi caudalis dexteri |
| 2- Bronchus trachealis | 9- Bronchus principalis sinister |
| 3- Bronchus segmentalis cranialis lobi cranialis dextri | 10- Bronchus loabris cranialis sinisteri |
| 4- Bronchus segmentalis caudalis lobi cranialis dextri | 11- Bronchus segmentalis cranialis lobi cranialis sinisteri |
| 5- Bronchus principalis dexter | 12- Bronchus segmentalis caudalis lobi cranialis sinisteri |
| 6- Bronchus lobaris medius | 13- Bronchus loabris caudalis sinister |
| 7- Bronchus loabris caudalis dexter | 14- Bronchus lobaris accessorius |

II- Pulmonary trunk:

The right and left lungs received right and left pulmonary arteries respectively. The later arteries split out from a common trunk (pulmonary trunk) that arose from the conus arteriosus of the right ventricle of the heart. The pulmonary trunk ascended dorsally with a slight caudal inclination toward the root of the lung. It followed the ventrolateral aspect of the trachea where it was divided into right and left pulmonary arteries, about 2.5- 3 cm cranial to the tracheal bifurcation.

A. PULMONALIS DEXTER:- (FIGS. 4/17, 5/3 &6/10)

The right pulmonary artery was a large stout trunk, arose from the pulmonary trunk. It is larger than the left one. It traversed the trachea from its ventrolateral aspect, proceed on its ventral surface cranial to the tracheal bifurcation by about 2-3 cm, the artery passed obliquely in a caudolateral direction in slightly curved manner, and followed the lateral border of right principle bronchus for about 1-1.5 cm and reached the right pulmonary hilus. The right pulmonary artery detached the right cranial, middle, accessory lobar pulmonary arteries and continued as caudal lobar pulmonary artery.

1.1. *A. pulmonalis lobi cranialis dextri*:- (FIGS. 4/14 &6/7)

The right cranial lobar artery arose from the right pulmonary artery about 0.5-1 cm from its origin. It crossed the ventral aspect of the trachea cranial to the tracheal bifurcation by about (3-3.5cm) toward the root of the right cranial lobe nearly in horizontal direction. The artery reached the right cranial lobe from the caudoventral aspect of the tracheal

bronchus by about (1-1.5cm), the artery entered the base of the lobe where it divided into cranial (ascending) & caudal (descending) segmental branches.

1.1.1. *R.segmentalis cranialis lobi cranialis dextri*: (FIGS. 4/15, 5/4 &6/8)

The cranial segmental branch of the right cranial lobar pulmonary artery passed inside the cranial segment of the right cranial lobe from the base to its apex. It guarded the craniodorsal border of the bronchus segmentalis cranialis lobi cranialis dextri, with slightly deviation to the lateral aspect of the later bronchus. It gave (3-4) craniodorsally subsegmental branches alternated in their origin with the same caudoventrally directed ones which follow their correspondence subsegmental bronchi.

1.1.2. *R.segmentalis caudalis lobi cranialis dextri*: (FIGS.4/16, 5/5 &6/9)

The caudal segmental pulmonary branch of the right cranial lobar pulmonary artery swirled caudodorsally toward the root of the caudal segment of right cranial lobe, where firstly join the ventromedial border of the caudal segmental bronchus, for a distance (1-1.5cm), then it extended along the dorsal border of that bronchus, distributing its subsegmental branches in accordance with that of subsegmental bronchi.

1.2. *A. pulmonalis lobi medi*: (FIGS.4/18, 5/7 &6/11)

The middle lobar pulmonary artery erupted from the ventrolateral aspect of the right pulmonary artery at the point of entrance of the latter to the right pulmonary hilus, just cranial and slightly dorsal to the point of diversion of the middle lobar bronchus. The artery is very short in length; soon it split into two branches; long medial and short lateral

segmental branches. The former followed the medial segmental bronchus of the middle lobar bronchus in a curved course, as the artery joins the bronchus from its craniodorsal aspect; traversed its dorsal border obliquely in a caudolateral direction, till reach the caudal border of the bronchus, where it guarded that border to the distal end of its termination. Along that course the artery gives rise to cranial & caudal subsegmental branches. They extended with their correspondence subsegmental bronchi to the substance of the lobe. The short lateral segmental branch tracks the caudolateral border along the extension of the lateral segmental bronchus and furnishes subsegmental branches in accordance with that of the bronchus.

1.3. *A. pulmonalis lobi accessorii*:- (FIGS.4/19 &5/12)

The accessory lobar pulmonary artery erupted from the ventromedial aspect of the right pulmonary artery caudal to the emergence of the proceeding artery by about (1.5-1.75cm) and just caudal to the caudal border of the middle lobar bronchus. The artery crossed that bronchus toward the root of the accessory lobe in a caudoventromedial direction, for about (1.25-1.5cm), where it faced the caudoventral border of the accessory bronchus. It gave off cranial and caudal segmental branches followed their correspondence of segmental bronchi.

1.4. *A. pulmonalis lobi caudalis dextri*:- (FIGS.4/20, 5/6 &6/13)

The right caudal lobar pulmonary artery considered as the direct continuation of the right pulmonary artery after detached the right accessory lobar pulmonary artery. The artery extended along the

ventrolateral border of the extension of the right caudal lobar bronchus. It has wider diameter near its origin, and gradually diminished toward its termination. The artery branched into ventral, lateral, medial and dorsal segmental groups of branches.

1.4.1. *Rr. Segmentalis ventralis lobi caudalis dexteri*:-(FIGS.5/8 &6/14)

They are the largest (4-5) branches of the right caudal lobar pulmonary artery among other branches of other groups. They project from the ventral border of the parent trunk. The 1st one is the largest, while the last is smallest among the branches of the group. They run in a caudoventral direction toward the basal border of the lobe. Each segmental branch emerges nearly at the same level of existence of its correspondence ventral segmental bronchus. They follow the latter from their craniolateral border from the origin to their termination. Many subsegmental branches follow their correspondence subsegmental bronchi.

1.4.2. *Rr. Segmentalis lateralis lobi caudalis dexteri*:- (FIG.5/17)

There were four lateral branches erupt from the dorsolateral border of the parent artery, distributed in a caudodorsolateral attitude. The size of the arteries differed; so the largest one was the first and the smaller one was the last among branches of the group. The level of existence of the first branch nearly at the same level of tracheal bifurcation, exceeding the level of emergence of that of the opposite side by approximately (0.5cm). The level of projection of each artery differed in the group; so that the first branch arose slightly cranial to the point of existence of first

lateral segmental bronchus, but the second artery erupted nearly at the same level of eruption of its correspondence bronchus. While the existence of 3rd and 4th ones occurred slightly in a caudal level to the existence of their correspondence bronchi. Each artery of this group passed on the cranioventrolateral border of their correspondence bronchi. The subsegmental branches of the 1st segmental artery was derived directly from the parent artery, but this arrangement differed in the rest of the lateral segmental branches, as the subsegmental branch which supplied the dorsal subsegmental bronchus of 2nd, 3rd and 4th lateral segmental bronchi, arose directly from the right caudal lobar pulmonary artery, at the cranioventral angle to the eruption of their correspond bronchus, and at craniodorsolateral angle from the emergence of their parent lateral segmental artery by about (0.5cm).

1.4.3. *Rr. Segmentalis medialis lobi caudalis dexteri*:- (FIG.6/16)

The right caudal lobar pulmonary artery gave four medial segmental branches from its medial border, to their correspondence medial segmental bronchi. The arteries ran in a caudomediodorsal direction. Each artery existed just caudal to the angle formed between the right caudal lobar bronchus and the emergence of its ventral segmental bronchi. The first branch was the largest, while the last was smallest branch among the group. The arteries followed their correspondence bronchi from their cranioventrolateral angle, extended along the ventral border of those bronchi and distributed their subsegmental branches in accordance to their subsegmental bronchi.

1.4.4. *R. Segmentalis dorsalis lobi caudalis dexteri*:- (FIG.6/17)

There were (1-2) dorsal segmental branches projected from the dorsal border of the parent artery, supplied the dorsal segmental bronchi. The existence of the first branch just caudal to the point of eruption of 3rd lateral segmental artery by about (0.5cm). While the second one emerged beyond the level of projection of 4th lateral segmental artery. Each artery ascended nearly in a vertical direction to guard the caudolateral border of correspondence dorsal segmental bronchus, in their extension and subsegmental ramification.

2. A. PULMONALIS SINISTER:- (FIGS.4/3, 5/11 &6/2)

The short left pulmonary artery arose from the pulmonary trunk and was directed caudolaterally and dorsally in company with corresponding bronchi. It continued caudally crossing the dorsal aspect of the left cranial lobar bronchus, where it divided into three branches; two for the left cranial lobe and one to the caudal one. {R. Ascendens (*R. segmentalis cranialis lobi cranialis sinistri*), R. Descendens (*R. segmentalis caudalis lobi cranialis sinistri*) & A. Pulmonalis lobi caudalis sinistri).

2.1. (*R. segmentalis cranialis lobi cranialis sinistri*) R. Ascendens:- (FIGS. 4/4, 5/4, 6/3)

The left cranial segmental branch arose directly from the dorsolateral aspect of the left pulmonary artery. It followed the craniomedial aspect of its corresponding segmental bronchus till its termination. Along its course, it released the same number of the subsegmental bronchi.

2.2. (*R. segmentalis caudalis lobi cranialis sinistri*) R. Descendens:-
(FIGS. 4/5, 5/5 &6/4)

The caudal segmental branch was larger than the cranial one in all examined cases. The artery arose separately from the ventrolateral aspect of the left pulmonary artery, caudal to the origin of the preceding branch by about (0.5-1cm). It descended laterally on the caudolateral aspect of the caudal segmental bronchus of the left cranial lobe, along its course it gave a number of subsegmental branches that accompany the subsegmental divisions of the segmental bronchus

2.3. *A. pulmonalis lobi caudalis sinistri*:- (FIGS. 4/6, 5/14 &6/5)

The left caudal lobar artery could be considered as the direct continuation of the left pulmonary artery. Similarly to that of the right side, the artery furnished four main groups of segmental branches; ventral, lateral, medial and dorsal. (*Rr. Segmentalis ventralis lobi caudali sinistri*, *Rr. Segmentalis lateralis lobi caudalis sinistri*, *Rr. Segmentalis medialis lobi caudalis sinistri* & *Rr. Segmentalis dorsalis lobi caudalis sinistri*.)

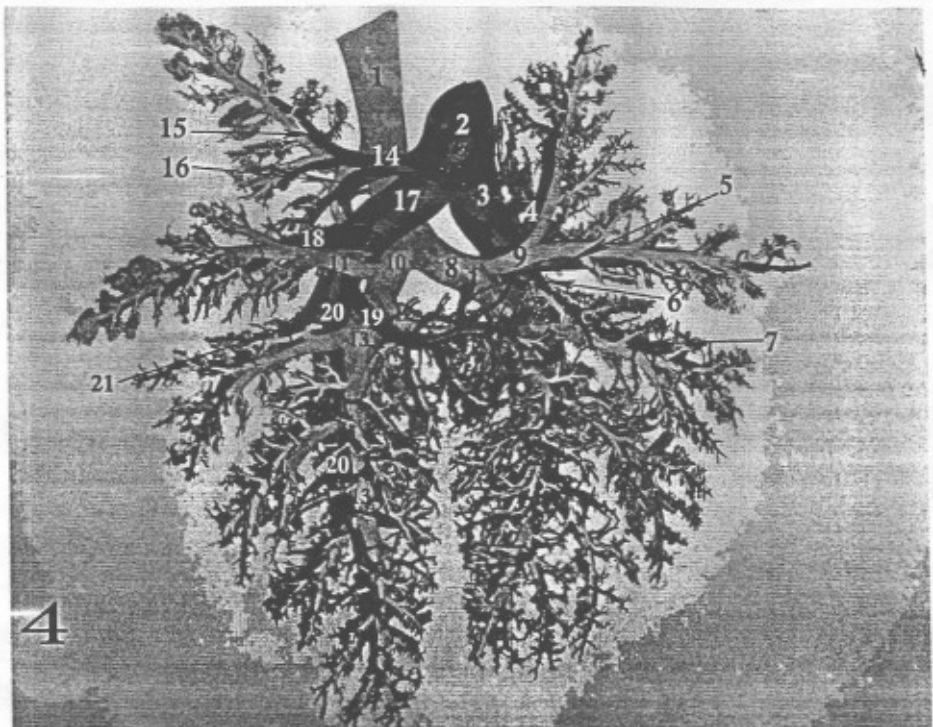


Fig.(4): A photograph showing the distribution of the bronchial tree & pulmonary arteries (epoxy cast, visceral view).

- | | |
|---|---|
| 1- Trachea | 12- Bronchus lobaris accessorius |
| 2- Truncus pulmonalis | 13- Bronchus lobaris caudalis dexter |
| 3- Arteria pulmonalis sinister | 14- Arteria pulmonalis lobi cranialis dexteri |
| 4- Ramus Ascendens (<i>R.segmentalis cranialis lobi cranialis sinistri</i>) | 15- Ramus Ascendens (<i>R.segmentalis cranialis lobi cranialis dexteri</i>) |
| 5- Ramus Descendens (<i>R.segmentalis caudalis lobi cranialis sinistri</i>) | 16- Ramus Descendens (<i>R.segmentalis caudalis lobi cranialis dexteri</i>) |
| 6- Arteria pulmonalis lobi caudalis sinistri | 17- Arteria Pulmonalis dexter |
| 7- Ramii Segmentalis ventralis lobi caudalis sinistri (I) | 18- Arteria pulmonalis lobi medi |
| 8- Bronchus principalis sinister | 19- Arteria pulmonalis lobi accessorii |
| 9- Bronchus lobaris cranialis sinister | 20- Arteria pulmonalis lobi caudalis dexteri |
| 10- Bronchus principalis dexter | 21- Ramii Segmentalis ventralis lobi caudalis dexteri (I) |
| 11- Bronchus lobaris medii | |

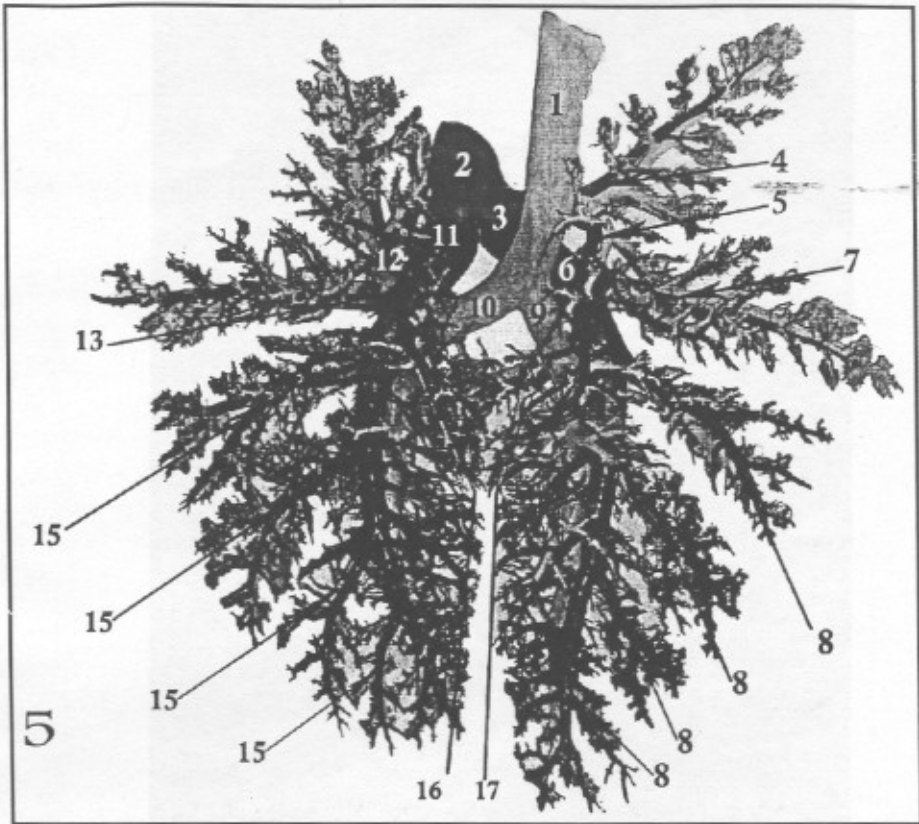


Fig.(4): A photograph showing the distribution of the bronchial tree & pulmonary arteries (epoxy cast, dorsal view).

- | | |
|---|--|
| 1- Trachea | 10- Bronchus principalis sinister |
| 2- Truncus pulmonalis | 11- Arteria pulmonalis sinister |
| 3- Arteria Pulmonalis dexter | 12- Ramus Ascendens (<i>R.segmentalis cranialis lobi cranialis sinistri</i>) |
| 4- Ramus Ascendens (<i>R.segmentalis cranialis lobi cranialis dextri</i>) | 13- Ramus Descendens (<i>R.segmentalis caudalis lobi cranialis sinistri</i>) |
| 5- Ramus Descendens (<i>R.segmentalis caudalis lobi cranialis dextri</i>) | 14- Arteria pulmonalis lobi caudalis sinistri |
| 6- Arteria pulmonalis lobi caudalis dexteri | 15- Ramii Segmentalis ventralis lobi caudalis sinistri |
| 7- Arteria pulmonalis lobi medi | 16- Ramii Segmentalis lateralis lobi caudalis sinistri |
| 8- Ramii Segmentalis ventralis lobi caudalis dexteri | 17- Ramii Segmentalis lateralis lobi caudalis dexteri |
| 9- Bronchus principalis dexter | |

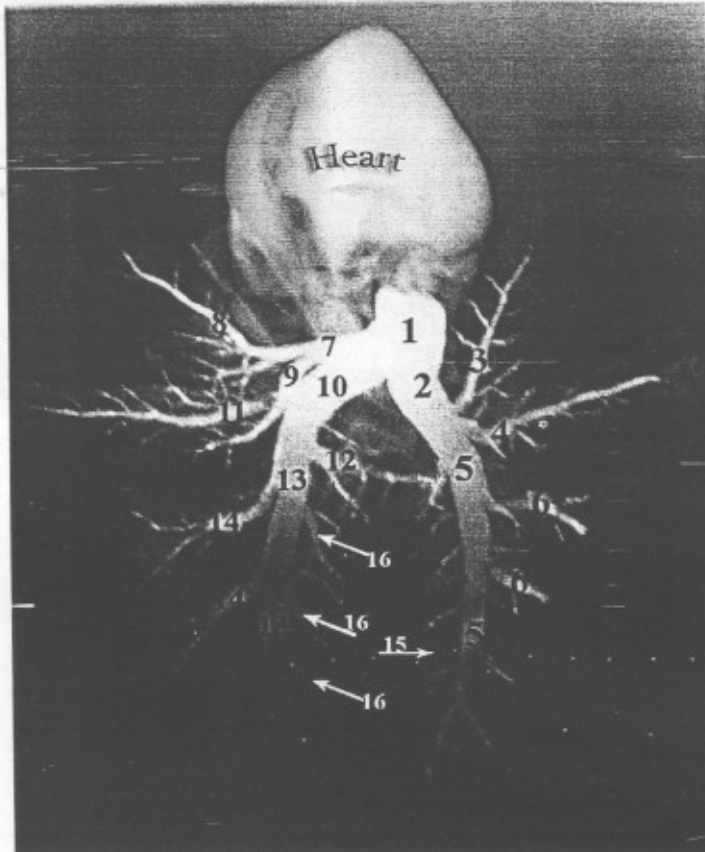


Fig.(4): Angiography showing the distribution of the pulmonary trunk (injected lead oxide). Ventral view.

- | | |
|---|--|
| 1- Truncus pulmonalis | 10- Arteria pulmonalis dexter |
| 2- Arteria pulmonalis sinister | 11- Arteria pulmonalis lobi medii |
| 3- Bronchus segmentalis cranialis lobi cranialis sinister | 12- Arteria pulmonalis lobi accessorii |
| 4- Bronchus segmentalis caudalis lobi cranialis sinister | 13- Arteria pulmonalis lobi caudalis dextri |
| 5- Arteria pulmonalis lobi caudalis sinistri | 14- Rami Segmentales ventrales lobi caudalis dextri |
| 6- Rami Segmentales ventrales lobi caudalis sinistri | 15- Rami Segmentales dorsales lobi caudalis sinistri |
| 7- Arteria pulmonalis lobi cranialis dextri | 16- Rami Segmentales mediales lobi caudalis dextri |
| 8- Ramus Ascendens (<i>R.segmentalis cranialis lobi cranialis dextri</i>) | 17- Rami Segmentales dorsales lobi caudalis dextri |
| 9- Ramus Descendens (<i>R.segmentalis caudalis lobi cranialis dextri</i>) | |

DISCUSSION

The present study revealed that the tracheal bronchus (right cranial lobar bronchus) erupted from the right side of the trachea cranial to the tracheal bifurcation by about (3cm). a study which in agreement with that of *Hare (1955)* in sheep, *Talanti (1958)* in pig, *Fath El-Bab (1970)* in camel, *El-Hagari (1967)*, *Sisson (1968)*, *Guzsal (1952)*, *Berg (1973)* and *Nickel et al. (1973)* in ruminants, *Swindle (1998)*, *Wolfgang et al. (1999)* in pig, *Nanda and Malik. (1968)* in goat and buffalo, *Swielim (1981)* in goat, *Osman (1989)* in deer and *Nakakuki (1993)* in deer, (1994) in pig & cow. However, *Wolfgang et al. (1999)* in pig found in 50% of examined cases the emergence of the tracheal bronchus from the left side.

The tracheal bronchus subdivided into cranial and caudal segmental bronchi to ventilate their corresponding cranial and caudal segments of the right cranial lobe. nearly similar findings were achieved by *Hare (1955)* in sheep, *Talanti (1958)* in pig & *Neurand (1970)* in pig, *Kock (1970)*, *Berg (1973)* & *Nickel et al. (1973)* in ruminants, *Swielim (1981)* in goat, *Hagras (1982)* in buffalo, *Osman (1989)* in deer and *Cabral et al. (2001)* in boar. While *Guzsal (1952)* in ox, sheep & pig, *Nanda & Malik (1968)* in buffalo & *Osman (1974)* in camel observed four segmental bronchi spread inside the right cranial lobe (anterior, ventral, dorsal & posterior).

The middle lobar bronchus originated independently before the eruption of the accessory lobar one. A result which was confirmed by *Talanti (1958)*, *Neurand et al. (1970)* in pig and *Schaaake (1974)* in dog, *Ehram (1957)* in horse, *El-Hagary (1967)* in cattle, *Bitter (1974)* in cat. *Osman and Ibrahim (1974)* in camel and *Osman (1980)*. And in contrary

with that of *Hare (1955)* in sheep, *Nanda & Patel (1968)* & *Swielim (1981)* in goat and *Osman (1989)* in deer affirmed that a short bronchial trunk (Bronchus medioaccessorius) arose from the right principle bronchus gave the middle and accessory lobar bronchi. Concerning the segmental division of the middle lobar bronchus, the present investigation revealed that the middle lobar bronchus was directed toward the base of the middle lobe and extended for about (1-1.5cm) where it divided into small lateral and larger medial segmental bronchi. Similarly observation was recorded by *Hare (1955)* in sheep. While *Talanti (1958)* in pig, *Nanda & Malik (1968)* in buffalo, *Osman and Ibrahim (1980)* in donkey & *Osman (1989)* in deer have the opinion that cranial and caudal segmental bronchi arose from the middle lobar bronchus. In this respect, *Osman (1974)* in camel named them dorsal & ventral. On the other hand, *Swielim (1981)* in goat, *Hagras (1982)* in buffalo reported that the middle lobar bronchus behave as a segmental one.

The right and left caudal lobar bronchi of the pig were considered as the caudal continuation of their parent principle bronchi. In all examined cases it has been observed the great similarity of the number, eruption & arrangement of their segmental bronchi. A finding which was met by the most of authors, *Hare (1955)* in sheep, *Talanti (1958)* in pig, *Osman (1974)* in camel, *Swielim (1981)* in goat, *Hagras (1982)* in buffalo and *Osman (1989)* in deer, *Felder (1962)* and *Schaake (1974)* in dog *Adrian (1964)* in cat, *Barone (1953)*, *Ehrsam (1957)*, *Berg (1973)* & *Nickel et al. (1973)* & *Smith et al. (1994)* in horse and *Osman and Ibrahim (1980)* in donkey.

The present study affirmed that the right and left lungs receive right and left pulmonary arteries respectively. The later arteries split out from a (pulmonary trunk) and the branches of the pulmonary arteries follow closely the entire course of the bronchi and their various grades of divisions. A result which nearly achieved by most of authors *Alexander (1963)* in cattle, *Sisson and Grossman (1968)*, *Nickel, Schummer & Seiferle (1976)*, *El-Hagary (1977)* in domestic animals, *Osman (1974)* in camel, *Swielim (1981)* in goat, *Osman (1980)* in donkey, *Osman (1989)* in deer & *Nakakuki (1993)* in Japanese deer.

Regarding the distribution pattern of the pulmonary arteries, the work declared that right cranial lobe of the lung gains a short common trunk (Right cranial lobar pulmonary artery) which undergoes further subdivision into ascending and descending segmental arteries to the cranial and caudal pulmonary segments respectively. While those of the left cranial lobe arise separately from the left pulmonary artery. This finding is in agreement with that found by *Hagras (1982)* in buffalo, *Swielim et al. (1987)* in sheep and *Osman (1989)* in deer.

The distribution pattern of the right pulmonary artery in the present investigation revealed that it furnishes the right cranial, middle, accessory and caudal lobar arteries to their correspondence pulmonary lobes. This is in agreement with that of *Guzsal (1955)* in dog, pig and ruminants, *Schorno (1955)* and *Hare (1975)* in cattle, *Ehram (1957)* in horse, *Schummer et al. (1981)* in carnivore, pig and ruminants, *Osman (1974)* in camel, *Swielim et al. (1987)* in sheep, *Osman et al. (1985)* in rabbits, *Ross et al. (1999)* in goat, *Vollmerhaus et al. (1999)* and *Cabral et al. (2001)* in pig. But *Schummer et al. (1981)* in carnivore, pig and ruminants, observed that the accessory lobar pulmonary artery erupts from the right caudal pulmonary artery.

The right and left caudal pulmonary arteries revealed a great similarity in their distribution pattern. They were subdivided into ventral, lateral, medial and dorsal segmental groups of branches. This finding is in agreement with that of *Ehrsam (1957)* in horse, *Adrian (1964)* in cat, *Osman and Ibrahim (1980)* in donkey, *Swielim (1981)* in goat and *Osman (1989)* in deer. However, *Swielim (1981)* in goat mentioned dorsal, ventral and medial groups of segmental division. While *Osman (1989)* in deer recorded the segmental groups as dorsal, ventral, dorsomedial and ventromedial. On the other hand only dorsal and ventral groups of segmental arteries described by *Ehrsam* in horse, *Adrian* in cat and *Osman* in donkey.

The left pulmonary artery in the recent investigation divided into three branches; two for the left cranial lobe and one to the caudal one. {R. Ascendens (*R. segmentalis cranialis lobi cranialis sinistri*), R. Descendens (*R. segmentalis caudalis lobi cranialis sinistri*) & A. Pulmonalis lobi caudalis sinistri}. This is in agreement with the findings of *Adrian (1964)*, *Oliveira et al. (2001)* in cat, *Swielim (1981)* in goat, *Hagras (1982)* in buffalo, *Vollmerhaus et al. (1999)* and *Cabral et al. (2001)* in pig. On the other hand *Swielim et al. (1987)* in sheep and *Ross, Hegner and Vollmerhaus (1999)* in goat, *Schummer et al. (1981)* in horse, *Osman (1974)* in camel & *Osman et al. (1985)* in rabbits mentioned two pulmonary arteries arose from the left pulmonary artery; cranial and caudal lobar branches. *Osman (1974)* in camel named them, apical & cardiacodiaphragmatic lobar arteries. While *Guzsal (1955)* in dog, pig and ruminants & *Ehrsam (1957)* in horse reported in three branches divided from the left pulmonary artery; apical, cardiac and diaphragmatic branches. Concerning the caudal segment of the cranial lobe as a separate lobe.

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الملخص العربي

أجريت الدراسة على عدد 30 رئة كاملة بالقلب لخنازير بالغة مختلفة العمر والجنس تم تجميعها من مجزر القاهرة. تم دراسة شجرة الشعب الهوائية والمدد الوعائي الرئوي الشرياني. تم استخدام طريقة القوالب لتوضيح شكل التشجر الشعبي. وكذا شكل الأمدادات الوعائية الشعبية الشريانية باستخدام مادة الأيوكسي الملون باللون الأصفر (للتشجر الشعبي) واللون الأحمر (المدد الشرياني). كما أجريت الأشعة السينية باستخدام خليط من مادة أكسيد الرصاص في محلول اللاتيكس المطاط.

أوضحت الدراسة أن القصبة الشعبية تنشأ من القصبة الهوائية مباشرة على بعد 3 سم قبل تفرع القصبة الهوائية وهي تقوم بتهوية الفص الأيمن الأمامي. تنقسم القصبة الهوائية إلى فرعين رئيسيين وهما الشعبة الرئيسية اليمنى والشعبة الرئيسية اليسرى. تقوم الشعبة اليمنى الرئيسية بتهوية كلاً من الفص الأوسط والخلفي الأيمن والفص الإضافي. وكذا تقوم الشعبة الرئيسية اليسرى بتهوية الفص الأيسر الأمامي والفص الأيسر الخلفي.

أوضحت الدراسة أن الجذع الرئوي يتفرع على يسار القصبة الهوائية إلى شريان رئوي أيمن وآخر أيسر. يتجة الشريان الأيمن ناحية الرئة اليمنى عابراً السطح البطني لتفرع القصبة الهوائية وعندها ينشأ الشريان الفصي الرئوي الأمامي الأيمن ثم يتجة الشريان الرئيسي مكملاً مسارة في بقية أجزاء الرئة اليمنى حيث يعطي تفرعات تتبع مسارات مثيلاتها من تفرعات الشعب الهوائية. أما الشريان الرئوي الأيسر فهو يتفرع إلى فرع قلبي أمامي للفص الأيسر الأمامي، فرع قلبي خلفي للفص الأيسر الأمامي وشريان فصوي أيسر خلفي.