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(Research Article)

Using the silicon (luminal cast plastination technique) for the lower respiratory tract in sheep as an alternative to cement

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Abstract

The lower respiratory tract of sheep was studied to determine the torsion and branching of the bronchial tree. The respiratory system of ruminants and all living organisms is one of the most important organs in the body that controls the amount of gas exchange between the heart and lungs through the airways, it is clear that in sheep it consists of a narrow bronchial tube that reaches the extent of lung tissue repercussions. He used silicon, water, acid, and at room temperature, and the substance was injected with an injection gun through the trachea and was pushed gently to spread and distribute in all parts of the lungs with moderate manual pressure. The results showed that the mold shape in the lung and the bronchial branches of the bronchi is solid and anti-erosion with a very clear and three-dimensional appearance, easy to handle, store and carry for study and presentation purposes in scientific museums, and in scientific presentations as an anatomical method for large-scale teaching.

Keywords: Plastination; Silicon; Bronchial tubes; Museums

1. Introduction

Silicon material (plastic technique) is useful in anatomy as well as models and educational tools. The specimens are maintained in bifurcated morphology by airflow by positive pressure during the curing process, allowing them to be used to teach both endoscopy technique and intestinal anatomy. Considered a teaching method in zoology, the process of plastination allows the study of specimens for a long time. The name "plast" derives from the Greek plasti (from plassei symbolizing shape, to shape, made by Gunther Von Hagens) and may be used to inform comparative anatomy because of its profound importance in the current era of advances in therapeutic sciences that use animals as models for drug testing. During this study it was found that the lungs in mammals and sheep are structurally and anatomically complex, the anatomy of the lung was determined in general, and the information related to the region and the number of branches of the trachea tree and its ramifications were compared to three stages to determine the anatomical part of the lower respiratory tract in detail because it plays an important role in many physiological and pathological conditions such as bronchial diseases caused by acute and chronic respiratory diseases and knowledge of symptoms as well as tumors and metabolism in mammals and compared with the respiratory system region in terms of weight, body size and behavior. In small mammals, resistance is low and body mass decreases in balance with a doubling of the metabolic rate [1]. Including the development of some sports techniques with precision engineering performance to replicate the animal's respiratory physiology to mimic camouflage and fluid conditions. It has been found appropriate to know the comparative anatomy of the lower respiratory tract in mammals characterized by variable habits and multiple dimensions [2]. This technique can be improved in experimental animals with accurate data on the anatomy of the cartilaginous tube. The anatomy of the bronchial tree will be useful for understanding the lower metabolic pathway.

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This technique can be developed in laboratory animals through careful study of the cartilage anatomy data of bronchioles. The anatomy of the bronchial tree is important for understanding the lower metabolic pathway.

Recordedthat the endocast of the lung demonstrated the ramus of the bronchial tree in sheep and pig and the lung position was noticeable with clear segmental organization, vessel and alveoli were also well illustrated by the endocast. The injected peripheral ramus was so high. The branching model of pulmonary airways and vessels was also clear. Asymmetrical bifurcation divisions were predominant in the transference tree. In spite of the large dimensions of the entire bronchial and pulmonary vascular tree of the pig (*Susscrofa*), the resulting cast was very light and stable [3,4].

Reported that the bronchial tree of the left and right lung of goat were demonstrated easily, while the tracheal lumen appeared solid like asoft and pliable straight tube; on the other hand, the apical bronchus was observed on the right bronchial tree just prior to the tracheal bifurcation [5]. Primary, secondary and tertiary bronchi are easily demonstrated, meanwhile [6]. Observed that the branching model vary in dissimilar animals which can be understood only with the help of such corrosion casts that give up is strong, rigid and gives important information of anatomical descriptions as similar to the natural lower respiratory pathway in sheep illustrated clear branching of tracheo-bronchial tree cast pattern after digestion. The bronchi in both right and left lungs were clearly divided. The right lung showed tracheal bronchi and the main bronchus divided into apical and diaphragmatic bronchi. The left lung showed only apical and diaphragmatic bronchi. The fine bronchioles were clearly noticeable. [7], meanwhile in sheep recorded that the trachea split into right and left primary bronchi, separated into secondary bronchi, the secondary split and ended into tertiary bronchi which appeared like well bristle. Whereas, the right lung showed a separation bronchus which is leaving the trachea prior to the branching of right primary bronchus, the apical bronchus providing the apical lobe of the right lung that looks like a unique feature of the ovine lung [8,9].

In sheep recorded that the palatinate tracheobronchial tree revealed a cartilaginous trachea that divided into principal bronchi, lobar bronchi, segmental bronchi up to the alveoli [10]. recorded that the bronchial cast technique showed a bronchus which is given off from the trachea and separated into right and left principal bronchi and then each bronchus subdivided into bronchioles [11].

The result in goat showed an extra bronchus on the right side was coming up in a straight line from the trachea and similar of the lower lobe of the left lung, the extra lobe has five branches which were away from right bronchus about 6 cm of the 1st, 5 cm of the 2nd, 4.5 cm of the 3rd, 4.5 cm of the 4th and 4 cm of the 5th. Also, the extra divided into two bronchi which are secondary and broncho-pulmonary segments of the extra lobe. There are two right and left principal bronchi on each side. The right one is wider, shorter and more vertical than the left, the right lobar (primary) divided into 3 branches: superior, middle and inferior. The superior come up from the lateral aspect of parent bronchus its divides into 3 segmental(secondary), while the middle begins 1 cm beneath the superior from the front of the right bronchus intermediary. The inferior is the continuation of the principal bronchus [12].

The left side division has three branches: superior, middle and inferior, the superior arises from the anteriolateral aspect of its parent stem, curves laterally and soon split into two large segmental (secondary) and two small subsegmental (tertiary), while the middle bronchi arise below superior lobar bronchi and splits in to two segmental (secondary) [12].

The inferior move down posterio-laterally and soon splits to supply regions of the lung. There is another ramification after lobar (primary) bromchus. The posterior secondary bronchus soon splits into a lateral and posterior ramus. Right middle lobar (primary bronchus) soon divides into a lateral and medial secondary bronchus. The right middle lobar (primary) bronchus starts 2 cm below the superior lobar bronchus from the front of aright bronchus. The right inferior lobar (primary) bronchus is, gives off a large superior segmental (secondary) bronchus posteriorly then splits medial-lateral and superior ramus [12].

2. Material and methods

A fresh four specimens of adult sheep lungs were collected from slaughterhouse The specimens delicately detached from the animal with a locality of the larynx. The specimens visualized grossly for any anatomical or pathological defect within each organ, further tracheal duct, the lung was carefully washed by injection of water.

The tracheobronchial tree was cleaned repeatedly with tap water until all the blood clots were drained out of the lung then the lung was exhausted and aspirated by squeezing the lung lobes, therefore, discharge passed within the tracheal duct and quit via the tracheal opening of this duct. The lower respiratory tract was washed by infused distal water through the tracheal opening of the common bronchial duct so squeezed and milking the of the lower respiratory tract for many times. [13.14].

The specimens were injected by silicone resin via the trachea until reached to all parts of the lungs, by fine press manual over the lung surface in order to make the silicon reached to the terminal part, after that the samples were left at standing position for solidification at room temperature for 24 hr. without any changing with its position, the specimens were dipping in concentric hydrochloric acid for 7 hr. according to [5.16] but this author mentioned that the dipping for one day, after that the specimens washed by tap water to remove the remaining tissue and revealed the bronchial tree.

3. Results

Present studyshowed that the bronchial tree of the left and right lung of sheep were demonstrated easily, also the tracheal lumen appeared solid like a soft, pliable straight tube. the 1st tracheal ramus wasprincipal bronchus (additional), sheep was split into lobar (primary) ramus of 5.5 cm, after that divided into 9 segmental (secondary) rami of 3.025 cm caudomedially and caudolaterally (Fig.2), followedby subdivided into 36 subsegmental (tertiary) rami of 2.1 cm in deferent direction then subdivision into several hundred bronchioles of 3mm and terminal bronchioles of 1.5mm in deferent direction (Fig.3 & 4),

Figure 1 The material and tool used in the research

Table 1 Manifests the length and number of tracheal tree of sheep n= (6)

A	**type**	**Sheep**	
Lobar(primary) Bronchi	Right	Left	
	17 cm	18 cm	
Segmental Bronchi (secondary)	Right	Left	
	13 4.49 cm	12 5.45 cm*	
Sub segmental Bronchi Tertiary)	Right	Left	
	193* 2 cm	176* 1.55 cm	
Bronchiole	Right	Left	
	3mm	2.1mm	
Terminal bronchiole	Right	Left	
	1.5mm*	0.5mm	
B	**type**		**sheep**

Accessory lobe Bronchi	Lobar (Primary)	1 3.6 cm
	Segmental Bronchi (Secondary)	4 1.47 cm*
	Sub segmental Bronchi (Tertiary)	17 0.8 cm
	Bronchiole	3mm
	Terminal bronchiole	1.5mm
Tracheal bronchus Bronchi (additional)	Lobar (Primary)	1 5.5 cm*
	Segmental Bronchi(Secondary)	9 3.025 cm*
	Sub segmental Bronchi Tertiary)(	36 2.1 cm*
	Bronchiole	3mm*
	Terminal bronchiole	3mm*

(*) Represents significant difference at (P>0.05)

The accessory lobe bronchi illustrated in sheep a lobar (primary) ramus of 3.6 cm then divided into 4 segmental (secondary) rami of 1.47 cm, after that subdivided into 17 subsegmental (tertiary) rami of 0.8 cm in a deferent course then subdivision into several hundred bronchioles of 3mm and terminal bronchioles of 1.5mm in a deferent course. (Table 1- A&B).

The tracheal tree of the right lung sheep showed lobar (primary) ramus of 7 cm then divided into 13, 14 segmental (secondary) rami of 4.49 cm, 5.92 cm, respectively. After that subdivided into 193subsegmental (tertiary) rami of 2 cm. Followed by a partition into several hundred bronchioles of 3 mm and terminal bronchioles of 1.5mmin. While the left lung demonstrated a lobar (primary) ramus of 7 cm. Then divided into 12 segmental (secondary) rami in both animals of 5.45 cm. After that subdivided into 176subsegmental (tertiary) rami of 1.55 cm. Then splits into several hundred bronchioles of 2.1 mm, and terminal bronchioles of 0.5 mm, (Table 1- A&B).

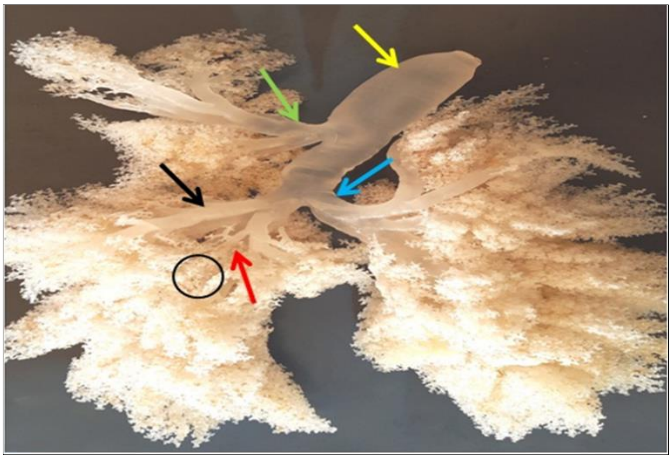

Figure 2 Anatomical viewthe tracheal and lower respiratory tract with the luminal cast plastinationin sheep the yellow arrow (trachea), the green arrow (tracheal bronchus), blue arrow (lobar bronchi), black arrow(segmentalbronchi), that red arrow (sub segmental bronchi) and black circle (the respiratory group: alveolarduct, alveolar sacs and alveoli)

Figure 3 Anatomical view the luminal cast plastination in sheep
the blue arrow (lobar bronchi), the red arrow (segmental bronchi), green arrow (sub segmental bronchi), black arrow (bronchus)and black circle (the respiratory group(alveolar duct, alveolar sacs and alveoli)

Figure 4 Anatomical viewthe luminal cast plastinationin sheep
red astrik(lobar bronchi) ,black astrik (segmental bronchi) ,that green astrik (sub segmental bronchi), the Violet astrik (the terminale bronchi) and red circle (the respiratory group: alveolar duct , alveolar sacs and alveoli)

4. Discussion

Luminal cast plastination technique was used to demonstrate bronchial tree branching, this technique was limited and useful to lower respiratory pathway recognization, regarded as a substitute of formalin that used for cadaveric preservation and also its advantage for teaching. [3,4] in sheep and pig revealed that the endocast of the lung demonstrated the rami of the bronchial tree in sheep and pig. Asymmetrical bifurcation divisions were predominant in the transference tree these results were similar to the present study in both animals, on the other hand [5]in goat stated that the left and right lung of goat were demonstrated easily while the tracheal lumen appeared solid like soft, pliable straight tube and she was demonstrated the lobes ramification (primary, secondary and tertiary) like the present study results.

In sheep [6,7] noticed that the right and left bronchi were clearly divided, the right lung showed and the main bronchus divided into apical and diaphragmatic bronchi, while the left lung showed only apical and diaphragmatic bronchi, fine bronchioles was clearly noticeable like the present study result [4]. The division of trachea into left and right bronchi, secondary and tertiary as well as lobulation were the investigation of [8,9,10,11] in sheepwhich had same results with the present study. in goat showed many similarities and deferences that association with the ramification and measurement were obtained with the present study in both animals, generally the present study showed that the ramification of the bronchial tree of the sheep lung which contained primary, secondary and tertiary, as well as, the bronchioles and terminal bronchioles were more than the goat, thus, our opinion that the efficiency of the sheep lung better than the goat lung [12].

5. Conclusion

Use of silicon material (ballistic technology) molded in the lower part of the respiratory system in sheep as a substitute for the cement material)). showing that the use of silicon in the resin casting technique is perfect, does not corrode, and does not need formalin as a preservative and solves moral and religious knots in issues related to autopsy in some countries. Moreover, it has no health risks. the use of silicon shows that this method meets the minimum use of carcasses and specimens with the standards/codes of the Institutional Animal Ethics Committee (IAEC) below ground level. showing the use of silicon that anatomists can use as one of the educational aids and to compare the differentiation of species, which appears well in the classroom and is easy for students. shows that it replaces x-rays because they appear in three dimensions and without the need for x-rays and the risks of exposure to radiation. can be handled with bare hands without fear of side effects such as contact dermatitis and conjunctivitis it was found in the use of silicone that the samples are odorless and easy to preserve, in contrast to the samples fixed in formalin and the samples in which cement is used. the use of silicone shows a good connection between the digestive system and the tracheal system, through which it can be used to practice performing endoscopic operations. Knowing the study of the comparative anatomy of the trachea tree is very useful as closely resembles human patterns in therapeutic research.

Compliance with ethical standards

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Disclosure of conflict of interest

There was no conflict of interest in this study.

Statement of ethical approval

The present research work does not contain any studies performed on animals/humans subjects by any of the authors.

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