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Lung lobes pattern in indigenous gazelle (*Gazella subgutturosa*)

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Abstract

The study was based on a group of seven gazelle (local, adult and healthy), which were devoted to the anatomical study of parts of the lung.
Anatomical study for lungs showed that lungs were look like two soft spongy parts (paired) embraced the heart, they located on the both side of mediastinum and covered by pleura , its color pinkish red and they were took the largest field of the thoracic cavity. The pattern and arrangement of lungs lobes were four lobes of right lung: divided apical lobe (had cranial and caudal parts), middle, accessory and caudal parts while the left one appeared by only two lobes, divided apical lobe (had cranial and caudal parts) and caudal lobe.
In conclusion, Lungs have very clear lobes are being divided by deep fissures, these lobes are distributed into four lobes for right lung (divided apical lobe for cranial and caudal parts, middle lobe, accessory and caudal lobe) and two lobes for left lung (divided apical lobe for cranial and caudal parts and caudal lobe).

Keywords: Lung, gazelle, lobe.

Introduction

Our country has large numbers of wild animals. The gazelle are one of these animals, which are need to find a methods for reproduction and preservation, as there are many parks and reserves especially in Al-Massad reserve in Al-Rutba city in Al-Anbar province, which belong to the General Company for livestock which contains large numbers of deer of *Gazella subgutturosa* and addition to other reserves (Al-kubaysi and Ulaiwy, 2009).

Only Four subspecies of *Gazella subgutturosa* was classified on all over the world in the Red List of the international union for conservation of and theses subspecies were *Gazella subgutturosa marica*, *Gazella subgutturosa hillieriana*, *Gazella subgutturosa yarkandensis*, and *Gazella subgutturosa subgutturosa* (Kingswood and Blank, 1996; Mallon and Kingswood, 2001; Clark *et al*., 2006). Identification of subspecies is based on morphological characters. Although *Gazella subgutturosa marica* is reported to be closer to the Slender-horned Gazelle (Hammond *et al*., 2001).

The respiratory system is important apparatus consisting of specific organs and structures, its function for the process of respiration in an organism (it's called also, ventilation system). The respiratory system is taking part in the intake and exchange of oxygen and carbon dioxide between an organism and external environment (Maton*et al*., 2010).

And there are also other activities for respiratory organs as well as being responsible for conduction and exchange of gases, they take part in vocalization, olfaction, balance of body temperature (Sellnow, 2006; Baba and Choudhary, 2008).

In the mammals, the anatomical structures of the respiratory system include specific conduct portion, consisting of nasal cavity, nasopharynx, larynx, trachea, bronchi, while the respiratory portion, where air exchange takes place in the respiratory bronchioles, alveolar ducts and alveoli (Getty and Grossman, 1972).

Conducting airways and all structures of the lower respiratory tract are vary in the anatomical features among different animals' species and among the same individuals. Therefore, the anatomical differences are important for the veterinarian (Chunder et al., 2010; Legaspi, 2010).

The lung of mammals is a very complex structure, which are showed differences in lobation and structure (Schlesinger, and Mcfadden, 1981; Tyler, 1983).

The lung is the organ that responsible for the gaseous exchange in the body and which were a couple of organs of a spongy nature, were located and occupied most of the thoracic cavity but it's not directly attached to the ribs and surrounded by pleura (Getty, 1975; Legaspi, 2010).

Many factors are effect on the shape and dimensions of respiratory system in mammals, Therefore, this recent study will aim to be a source to provide a scientific data on the anatomy of the lower respiratory system of the gazelle so as to provide needed information for future clinical and comparative anatomy of the lower respiratory system for indigenous breed of gazelle.

Materials and Methods

Animals:

1. Seven healthy animals of adult indigenous gazelles (*Gazella subguttrosa*) which brought from Al-Madaen nature reserve.
2. The body weight mean of animals was about 17.28±1.67 kg.
3. All number of gazelle (seven) was used for anatomical study.

The anatomical part:

1. This part of study had included seven animals.

2. Six animals had prepared by free slaughtering and one of them prepared by euthanasia after sedation and general anesthesia for it. Blood was emptied from the common carotid artery after make a longitudinal dissecting in it. Then replace the blood with formalin 10% by a special pump. The purpose of this technique was:

a. To stabilize and preserve the lung within the thoracic cavity and then have been anatomically examined within the cavity.

3. Induced longitudinal section on the midline of neck at the point of larynx toward the chest.

4. Preview the lung to make topographical study(lung boundaries with adjacent organs and all structures that surround it and it had recorded the color, position, pattern of lobes, fissures and lungs' impressions), so it's used for this purpose a camera (Canon /G12/zoom Lens 5X).

Results and Discussion

In this study, the lungs of adult gazelle appeared to look like two soft spongy parts (paired) embraced the heart and located on the both side of mediastinum, and covered by double layers of pleura (visceral and parietal). Lungs color was pinkish red and they were took the largest field of the thoracic cavity, so in situ, they were appeared restricted with thoracic cavity wall laterally and medially with mediastinum and heart and with boundaries of first-second rib (cranially with lung apex) until to the tenth-eleventh ribs caudally (with the basal border line of both lungs) and with the of boundaries of the sternum ventrally up to thoracic vertebrae dorsally (Fig.1 and 2).

The lungs were seen attached with the diaphragm by pulmonary ligament which is appeared as a fused triangular-shaped sheet of parietal and visceral mediastinal pleura that extended from the hilum to the cupola of the diaphragm (Fig.3).

Grossly, the both lungs were in comparable in shape, and right lung was evermore the largest. They were similar to a half cone in their shape to match with the shape of the thoracic cavity.

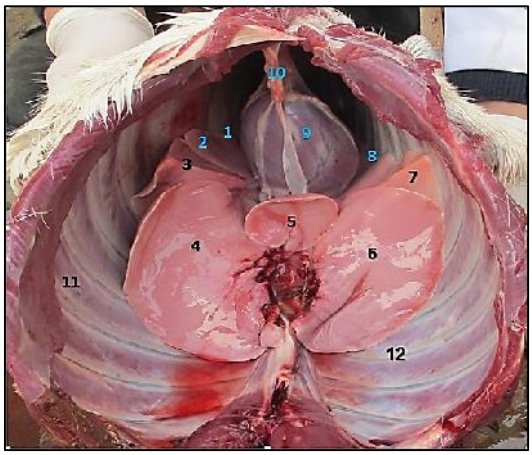

Figure 1: In situ (caudal view), the lungs of gazelle in the thoracic cavity on both side of thoracic cavity and its relation with heart.

1. Cranial part of apical lobe of right lung.
2. Caudal part of apical lobe of right lung.
3. Middle lobe.
4. Caudal lobe of right lung (diaphragmatic surface).
5. Accessory lobe of right lung.
6. Caudal lobe of left lung (diaphragmatic surface).
7. Caudal part of left apical lobe.
8. Cranial part of left apical lobe.
9. Heart.
10. Sternopricardial ligament.
11. Internal inter costal muscle.
12. Tenth ribs.

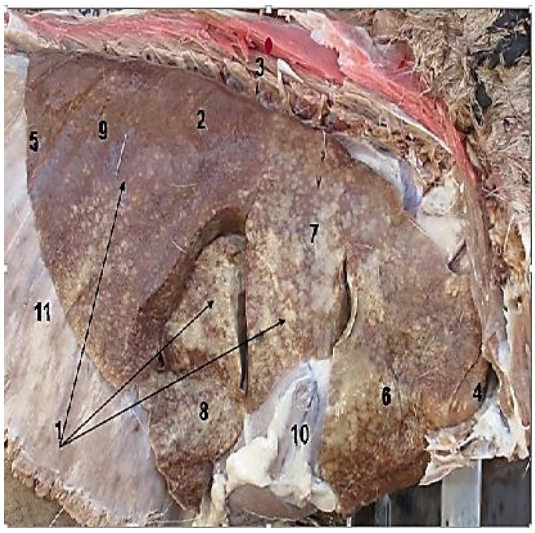

Figure 2: In situ (right lateral view of thoracic cavity of gazelle, shows lung boundaries.

1. Costal surface of the right lung.
2. Costal impression.
3. Ribs.
4. Right lung apex.
5. Base
6. Cranial part of apical lobe.
7. Caudal part of apical lobe.
8. Middle lobe.
9. Caudal lobe.
10. Heart with pericardium.
11. Diaphragm

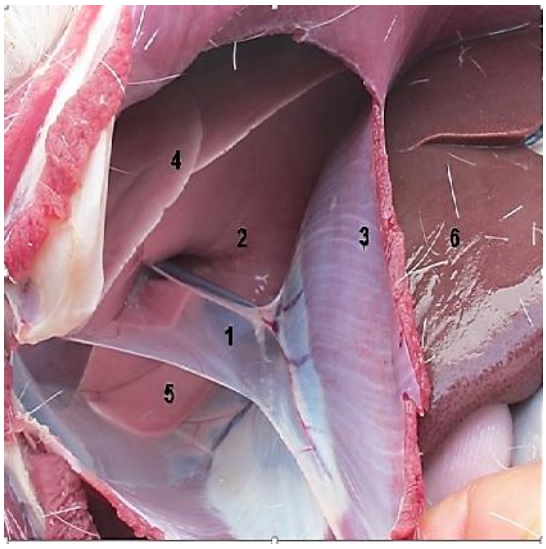

Figure 3: in situ (attachment of pulmonary ligament with copula of diaphragm in gazelle.

1. Pulmonary ligament.
2. Lung diaphragmatic surface
3. Diaphragm.
4. Right Lung.
5. Left lung.
6. Liver.

The current results showed that the both lungs were a trihedral structures so they possesses three surfaces according to topographical relation, these surfaces were; wide convex costal surface, narrow medial surface and large basal or concave diaphragmatic surface. The wide convex costal surface was opposite the internal surface of the thoracic wall (ribs and inter costal muscles), narrow medial surface included two faces; the vertebral face which was opposite to thoracic vertebral bodies and the mediastinal face which was opposite the mediastinum and contained a low triangular area called the hilus, which was a site of the entrance of some structures and exit the others into and from the lungs like the bronchus pulmonary arteries, pulmonary veins, pulmonary plexuses of nerves and lymphatic vessels and moreover, the medial surface characterized by present the area of heart location and cardiac notch. The basal or concave diaphragmatic surface was opposite the convex surface of the diaphragm and it was more or less oval in outline and bounded by the basal border (Fig. 2 and 4).

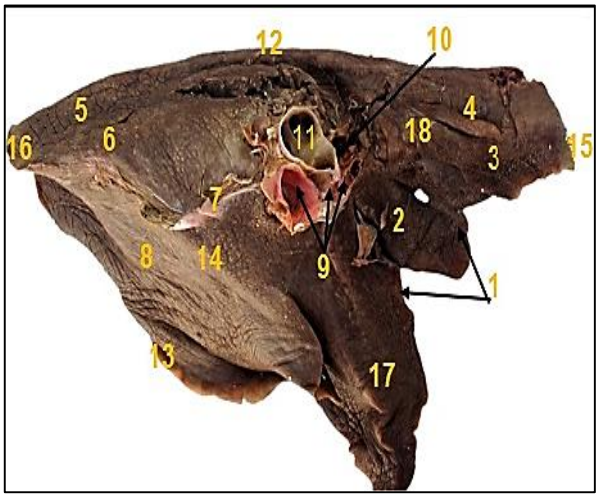

Figure 4: left lung of gazelle (medial view):

1. Cardiac notch.
2. Cardiac impression.
3. Cranial vena cava impression.
4. Tracheal impression.
5. Aortic impression.
6. Esophageal impression.
7. Mediastinal pleura insertion.
8. Diaphragmatic surface (caudal lobe).
9. Pulmonary veins.
10. Pulmonary artery.
11. Principle bronchi.
12. Dorsal border.
13. Ventral border.
14. Basal border.
15. Apex.
16. Base.
17. Cranial part of left apical lobe.
18. Caudal part of left apical lobe.

In situ, many impressions were observed on both lungs due to effects of neighboring and related organs after death. These impressions were cardiac impression, tracheal impression, aortic impression, esophageal impression costal impressions, diaphragmatic impression and impression of cranial vena cava (Fig.2 and 4).

The lung had an anterior apex and posterior base (Fig.2 and 4). The apex of right lung was more progress and more extensive than the left one which were small and more eminent. The outlines of both lungs were dorsal, ventral and basal borders, each border or margin had a specific property, so that the dorsal border showed as more thick with lateral curved surface while the ventral border was more extrovert with irregular sharp edge and basal border with less acute or sharp edge (Fig. 4).

A study of the external appearance of the lungs have shown that they possesses a pattern or numbers of arranged lobes which were clearly separated by profound fissures (Fig 5 and 6)**.** The lobes of the right lung were apical**,** middle**,** accessory and the caudal or diaphragmatic lobes (Fig**.**7)**.** The apical lobe subdivided into cranial and caudal part**.** The cranial part of apical lobe was extended forwards in thoracic cavity and cranially to the heart and it was twisted more than 180 degree toward left side and across the midline to embrace the trachea and the cranial aspect of the heart (Fig 2**,** 6 and 8)**,** the middle lobe was resembles the shape of the spearhead while the accessory lobe was the smallest one and look like a pyramidal or cone in shape with clear notch on its convex base and it was situate on the medial surface of caudal lobe of the right lung while the caudal or diaphragmatic lobes in both lungs characterized by its trapezoidal shape**.**

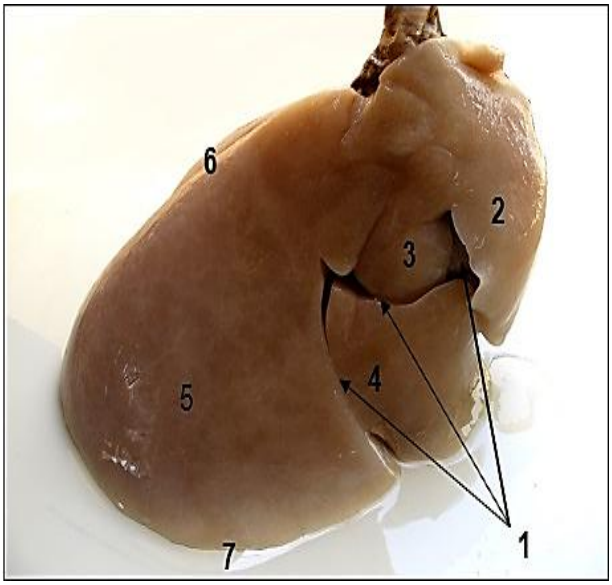

Figure 5: The lobes fissure of right lung of gazelle:

1. **Deep inter lober fissures.**
2. **Caudal part of apical lobe.**
3. **Middle lobe.**
4. **Twisted cranial part of apical lobe.**
5. **Caudal lobe.**
6. **Dorsal border.**
7. **Ventral border.**

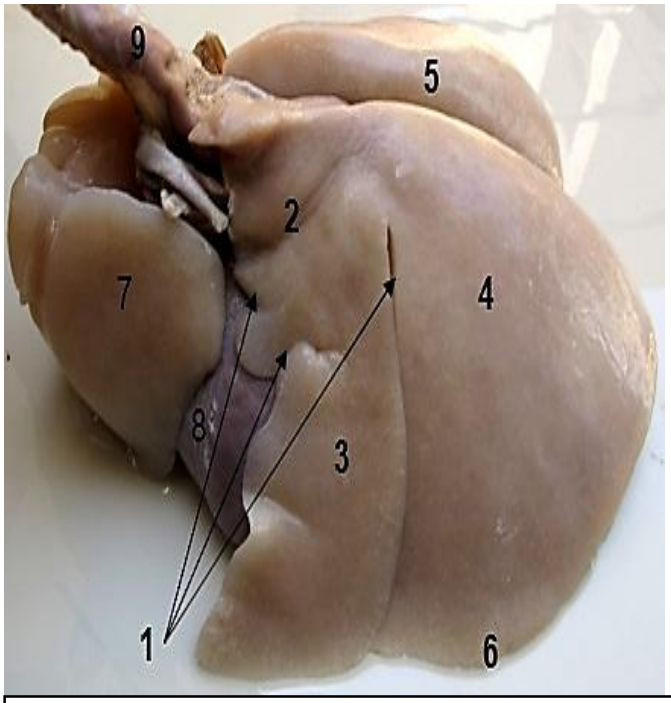

Figure 6: The lobes fissure of left lung of gazelle:

1. **Inter lobe fissures.**
2. **Cranial part of left apical lobe.**
3. **Caudal part of left apical lobe.**
4. **Caudal lobe.**
5. **Dorsal border.**
6. **Ventral border.**
7. **Twisted cranial part of right apical lobe.**
8. **Heart.**
9. **Trachea**

The left lung possesses apical subdivided lobe for cranial and caudal part and caudal or diaphragmatic (Fig**.**7)**.**

Grossly**,** the right lung was greater than the left one because of extra lobes of right lung (possesses middle and accessory)**,** as well as the relation of the heart which was more closely to the left lung than the right lung**.**

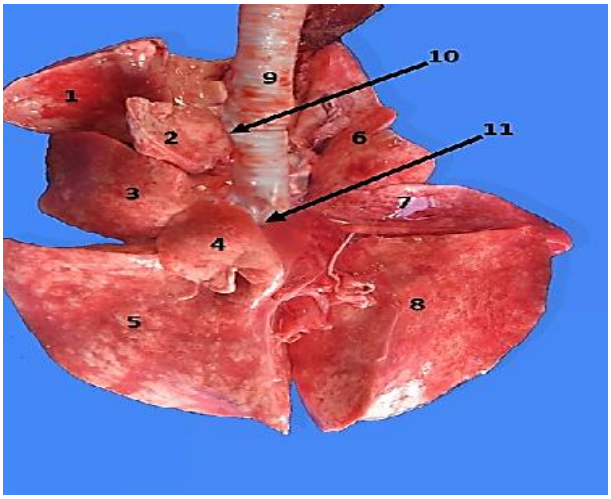

Figure 7: Lung lobes of gazelle:

1. **Cranial part of apical right apical lobe.**
2. **Caudal part of right apical lobe.**
3. **Middle lobe (right lung).**
4. **Accessory lobe (right lung).**
5. **Caudal lobe (right lung).**
6. **Cranial part of apical lobe.**
7. **Caudal part of apical lobe.**
8. **Caudal lobe.**
9. **Trachea.**
10. **Tracheal bronchus.**
11. **Bifurcation**

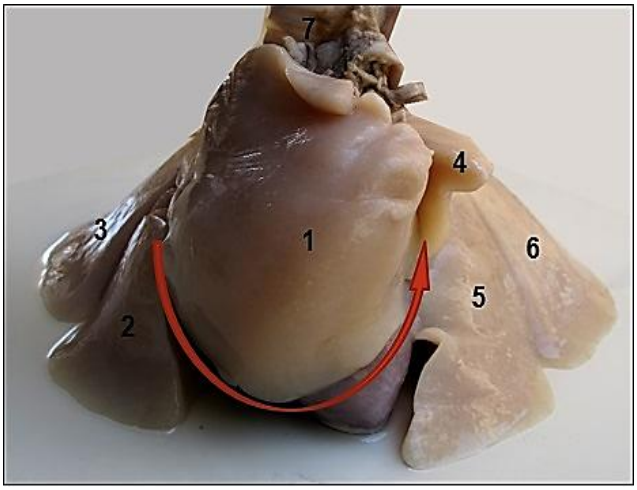

Figure 8: Cranial view of lung gazelle shows, cranial part of right apical lobe is wrapped (the red arched arrow).

1. **Twisted cranial part of right apical lobe**
2. **Middle lobe (right lung)**
3. **Caudal lobe (right lung)**
4. **Cranial part of left apical lobe.**
5. **Caudal part of left apical lobe.**
6. **Caudal lobe (left lung).**
7. **Trachea.**

In this study, the lung of the gazelle was made up of two spongy parts (right and left) with reddish pink color and characterized by large size Therefore, the lung was occupying the largest space of the thoracic cavity, it has been shown this result was match with a results that recorded by Pasquini *et al* (1997) in the domestic animals and Nzalak*et al*. (2013) in Red Sokoto goat, while the lung color in this study was quite different from color of the lung in sheep and goat (AL-Sadi, 2005) which was pink grey and grey blue respectively.

In situ (inside the thoracic cavity), the outlines of the lung were with the vertical level of the second rib cranially up to eleventh ribs caudally while dorsal boundaries were with thoracic vertebrae and proximal parts of the ribs and ventrally with border of sternum. This was agree with the findings of May (1970) and Hare, (1975) in domesticated animals.

This study showed that the lung has three surfaces which were large convex costal, narrow medial and large diaphragmatic surfaces, this description was similar to description in lung of domesticated animals (Getty, 1975) and it's also similar to lungs of ruminants (Thrall, 2002).

The lung of the gazelle appeared consisting of three borders (blind dorsal, acute ventral and acute basal so this result was not agree with (hare 1975; Aspinal and Oreilly 2000; Louis and Waugh 2002) in domesticated animals and Al-Sadi (2005) in sheep and goat, those researchers recorded only two borders.

Several impressions that related to pressure of neighboring organs and structures had observed on the lung surfaces especially, when the lung was insitu; costal, cardiac, diaphragmatic, tracheal and aortic impressions as well as the hilus, the same description was proven by Getty (1975) in domesticated animals.

Description of pulmonary ligament as a fused triangular-shaped sheet of parietal and visceral mediastinal pleura that extended from the hilum to the cupola of the diaphragm, was similar to description of (Albertin, 1982; Albertine, 1984) in sheep and Legaspi (2010) in dog.

Current result of the gazelle lung showed there were profound inter lobar fissures that detect the pattern of lobes, so the right lung appeared by four lobes; the apical lobe was separated by shallow fissure into two parts (cranial and caudal part), the middle lobe, accessory and the caudal or diaphragmatic lobe while the left lung showed with divided apical lobe (had cranial and caudal part) and the caudal lobe while the accessory lobe and the middle lobe was missing, this pattern was comparable with the pattern of AL-Sadi (2005) in the sheep and goat and it was not comparable with the pattern of the Formosan Reeve's muntjac lung (Liao *et al.*, 2009) , the cranial lobe was not divided into cranial and caudal part.

The lungs of gazelle was differ from other species due to the numbers of lobes and the pattern of its distribution was different in other animals, this variation was recorded by many researchers, so that the left lung of Japanese deer had undivided apical lobe (was not divided into cranial and caudal part), middle lobe and the accessory lobes was lacked (Nakakuki,1993), it's the same manner in the left lung of Holstein cattle (Nakakuki, 1994b), While in the horse and camels the right lung possesses three lobes (apical ,accessory and caudal) and the middle lobe was not there (Oliveira *et al.*, 2001) and (Al-Abasi and Mirhish,2001) respectively. While Nzalak *et al.* (2013) reported the existence of cranial and caudal part in apical lobe of both lung of Red Sokoto goat with middle lobe in the left one and missing the accessory lobe, the same pattern was in Baladi goats, (Alsafy,2008)and in angora goat (Habib and Mohammed, 2010).

While the apical lobes of the right and left lungs were not divided in the carnivores (Aspinall *et al.*, 2009).

The cranial lobe of gazelle was convoluted around the trachea across the median line to the left side, this feature was observed by Swindle and Smith, (1998); Lee Wilke *et al.* (2009) in pigs and Nzalak *et al.* (2013) in Red Sokoto goat.

Lobes fissures of gazelle lungs were very clear and very deep. This result was agreed with AL-Sadi (2005) in sheep and goat and also agreed with Liao *et al.* (2009) in Formosan reeve's muntjac and with Adams (2004) in dogs, fissures may extend to the bronchi, while in horses, fissures were not clear (Bone, 1988).

The right lung was larger than the left lung, this result supported by AL-Sadi (2005) in sheep, Nzalak *et al.* (2013) in Red Sokoto goat, Amis and Mckiernan (1986), in dog and Legaspi (2010) in dog and monkey.

In conclusion, Lungs have very clear lobes are being divided by deep fissures, these lobes are distributed into four lobes for right lung (divided apical lobe for cranial and caudal parts, middle lobe, accessory and caudal lobe) and two lobes for left lung (divided apical lobe for cranial and caudal parts and caudal lobe).

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