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Morphological study of bronchial tree and lung in Iraqi weasel (*Herpestes javanicus*)

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Abstract. The current study aimed to identify the morphological description and branches of the bronchial tree and lung for the weasel *Herpestes javanicus* as one of the Iraqi mammals inhabiting the Iraqi environment. In the current study, 10 samples with an mean weight of 288-564 g were used, trachea and lung were removed from the samples and confirmed using proven solutions and laboratory tests were conducted on 5 samples of the study to identify the branches of the bronchial tree using the technique of casting resin and then exposing the samples to erosion. Weasel has a pair of bright pink sponge lungs that occupy most of the thoracic cavity. The lungs look similar to the clover leaf have a top and three surfaces represented by the costal surface that is convex, and the middle surface, characterized by a narrow and diaphragm surface and is identical to the diaphragm. The right lung is larger than the left lung and the right lung consists of four lobes: apical, middle, caudal and an accessory lobe, while the left lung consists of three lobes: apical, middle, caudal lobes the top of the right lung appeared small and semi-sharp, while the left lung is round and blind. The right primary trachea branched into two branches, the upper branch enters into the apical lobe and branches in turn into two secondary branches, while the lower branch entered into three branches, the first of which enters into the middle lobe and the second to the middle lobe, the third branch into two branches enter the accessory lobes, while the primary left trachea branch into three secondary or lobe branches before entering the left lung branch, where the first branch enters into apical lobe when the second enters the middle lobe while the third section enters the caudal lobe.

Keywords. *Herpestes javanicus*, Lung, bronchial tree, Iraqi weasel.

1. Introduction

The Weasel is small animals widespread, carnivores and lives in different environments and he belongs to the family of Herpestidae of order carnivores, there are two types of this family in Iraq, namely the weasel *Herpestes javanicus* that lives in the areas extending along the strand of the Tigris and Euphrates rivers, which is the most widespread, the second type is the Indian grey mongoose (*Herpestes edwardsi*) found in central and northern Iraq and is less prevalent than the first type [1]. Studies have shown that mammalian lungs are a complex of composition organ that shows a variation in form, location and composition in different species, as each lung has its triangular shape and possesses a cranial apex, caudal base and the two sides of costal and middle with three border: dorsal,



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ventral and basal [2]. The color of the lung varies according to the amount of blood it contains, as it is pink during life and in cats appear bright red [3]. The lungs of the carnivores are divided into lobes, where the right lung consists of four lobes, apical or cranial lobe, middle or cardiac lobe, caudal lobes and accessories lobes, which are larger than the left lung consisting of apical and caudal lobes [4]. While [3] study in *Cats domesticus* L. showed the right lung is larger than the left lung by size and weight, the right lung is consist of four lobes as well as accessory lobes, while the left lung is composed of two apical and caudal lobes, dividing the apical lobe into two parts of a cranial or apical and another part of caudal with deep notch. The study of [5] in long-eared hedgehog *Hemiechinus auritus* reported that the lungs are in the form of a spongy pair of organs located inside the thoracic cavity and not directly connected to the ribs, covered with two layers of pleura inside the visceral pleura. Many studies have dealt with weasel in many ways, such as [6] study of the digestive and respiratory system of the grey Indian weasel and [7] study of thyroid gland, and study of a comparison of the appearance and anatomical length and weight of the body and lung and some organs of the digestive system between two types of weasel [8]. The current study aims to identify the morphological description of the bronchial tree and lung in the weasel.

2. Materials and Methods

The study included 10 samples of *Herpestes javanicus* weasel with different ages and weights ranging from 288-565 g obtained from Najaf province and the hunting process was carried out using special nets, the samples of the study was anatomized and removed the trachea and lungs and put them in the normal saline solution 9% and then put in the fixative solution until the completion of other work procedures.

2.1. Morphological study using methylene blue stains

The samples were placed in methylene blue for 1.5 minutes. Left until the lungs lobes are clear and the possibility of counting them accurately. Then transferred to ethyl alcohol 70% for 2 minutes until the samples are clear for study.

2.2. Bronchial tree study

This study was carried out on the bronchial tree by the process of resin cast and then exposing the sample to erosion according to [9]. In this study, five samples of both sexes were obtained and the samples of the trachea and lung were obtained in the same anatomy manner referred to in above with the note taking parts of the neighboring organs to avoid rupture of the tissues that may lead to the ejection of resin during injection and the samples are kept freezing until use. In this study was selected for the proper resin, which is characterized by its viscosity at room temperature and at the same time possesses solidification to give the required results after the process of maceration.

2.3. Injection technique

The injection was performed as follows: Prepare the resin by dissolving 1 g of resin powder in 12 ml of liquid resin 12 min before the injection. The samples were removed from the freezer and melted before the injection. A 4 mm plastic feeding tube was inserted through the larynx and fixated by a surgical suture wire to prevent resin from being ejected during injection. The injection was done by hand using a 20 ml plastic syringe. The first sample was injected with 6 ml, the second sample was injected with 8 ml and the third injected by 12 ml and the fourth sample by 15 ml and the fifth sample injected by 20 ml and then closed the trachea opening by a thick thread, and the sample was left all night at room temperature 30-25 °C to complete the hardening of the resin. The maceration was performed by placing the samples in a suitable plastic tank containing 500 ml of potassium hydroxide

KOH at a concentration of 40% for 5-4 days. After the maceration process is completed, the samples were washed thoroughly and carefully with water running for at least an hour. The samples were then dried using hot air so that the sample would be ready for examination. The samples were examined with the naked eye or using an anatomy microscope and then the samples were photographed using a digital camera.

3. Results

The results of the macroscopic examination of the weasel *Herpestes javanicus* lungs showed that it is possess a pair of lungs similar to clover leaf pattern and each lung looks in the form of a bright pink sponge organ and occupy most of the thoracic cavity similar to the shape of the thoracic cavity, and extends from the third rib to the twelfth rib. While anatomically, the results of the current study showed that each lung in the weasel has an apex and three surfaces represented by the costal surface which is convex, and the middle surface and characterized by its narrow and diaphragmatic surface and is identical to the diagram (Figure 1). The results showed that the right lung is larger than left lung and the right lung is composed of four lobes represented by cranial or apical lobe, middle or intermediate lobe, caudal or basal lobe and accessory lobe (Figure 2, 4). While the left lung consists of three lobes represented by the cranial or apical lobe, intermediate lobe, caudal or basal lobe (Figure 3, 4).

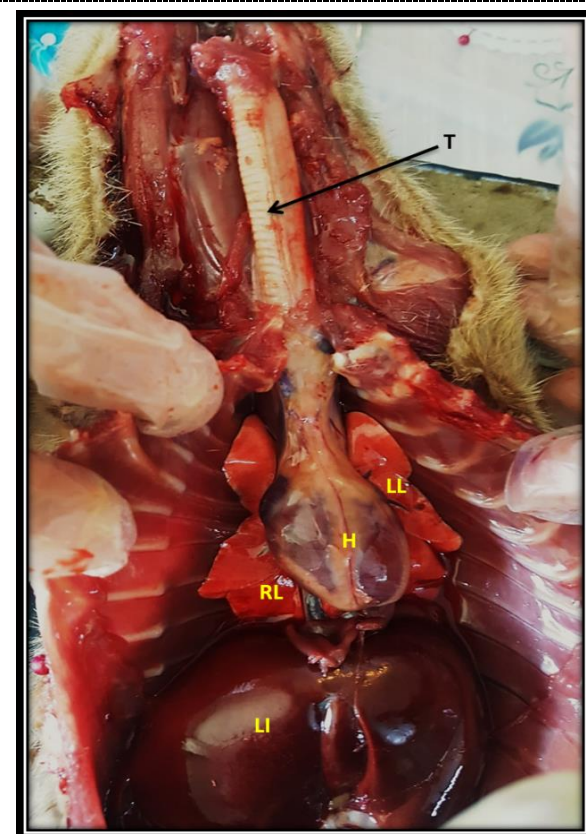


Figure 1. The internal anatomy of weasel *Herpestes javanicus* shows the location of the trachea (T) in general and the location of the lung (L), the heart (H), the liver (Li).

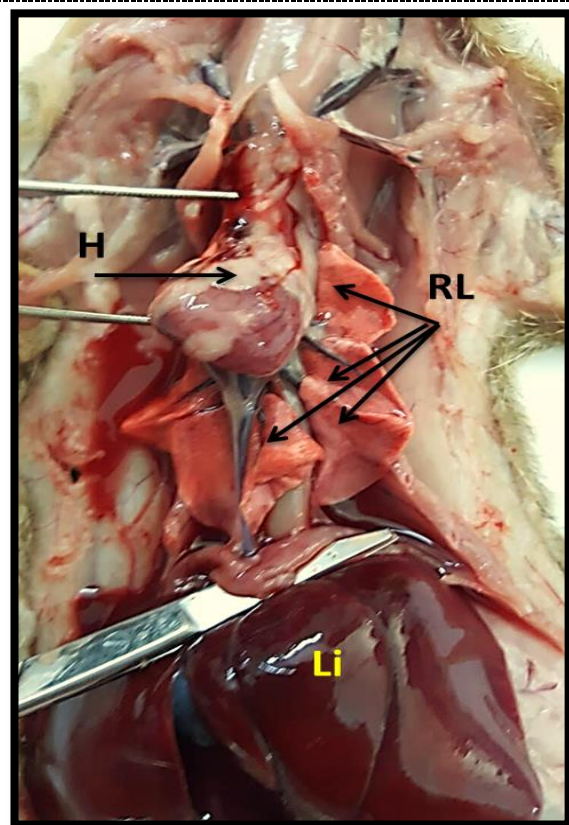


Figure 2. Figure 2: The internal anatomy of weasel *Herpestes javanicus* shows the lobes of right lung (RL), Trachea (T), the heart (H), the liver (Li).

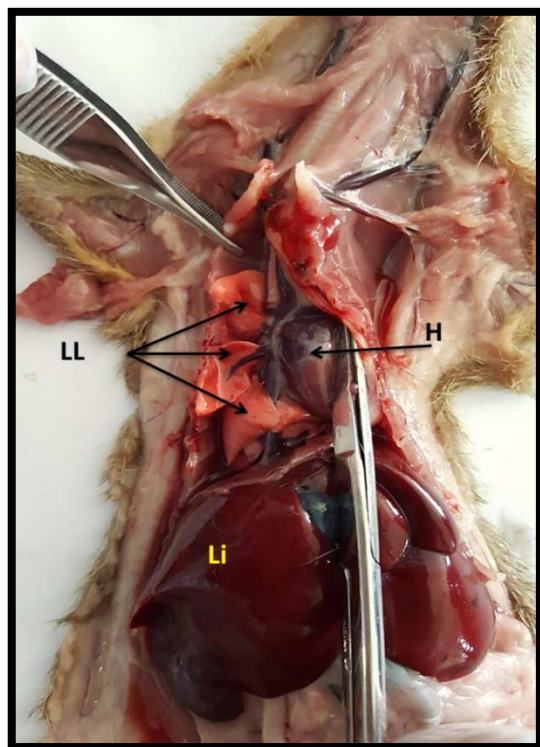


Figure 3. The internal anatomy of weasel *Herpestes javanicus* shows the lobes of left lung (LL), Trachea (T), the heart (H), the liver (Li).

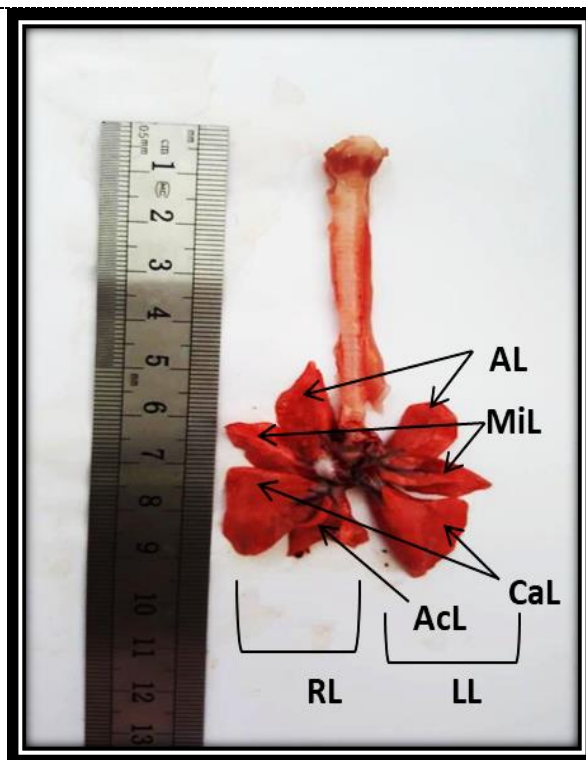


Figure 4. Shows the shape of the lungs in the weasel and its lobes, the apical lobe (AL), middle lobe (MiL), caudal lobe (CaL), accessory lobe (ACL), right lung (RL), left lung (LL).

The results also showed that the right lung top is small and semi-sharp compared to the left lung, which shows its top round and blind (Figure 4, 5). The mean length of the right lung is 4.9 cm and the mean length of the left lung is 4.4 cm, and the results showed that the total lung width was 5.9 cm (Table 1). The results of the morphological study using resin cast technology showed that the trachea in the weasel appears as a long tube branching into two main branches represented by the right primary bronchus and the left primary bronchus. It was noted that the right primary branched into two secondary branches; secondary or lobular (Lobar) bronchi after entering the right lung represented by a superior branch that enters the cranial or apical lobe, which in turn branches into two secondary branches representing the first branch tertiary bronchi, the latter also branched into a number of bronchioles, which as a result end with alveoli, while the second branch (inferior branch) of the right primary bronchus is divided into three branches: superior enters the middle lobe, and the medial enters the caudal lobe, while the third branch in turn is divided into two secondary branches entering each of its branches into the accessory lobes. The results of the current study showed that the primary left bronchus branched into three secondary or lobar before entering the left lung, as the first branch enters the apical lobe while the second branch enters the middle branch while the third branch enters the caudal lobe (Figure 6).

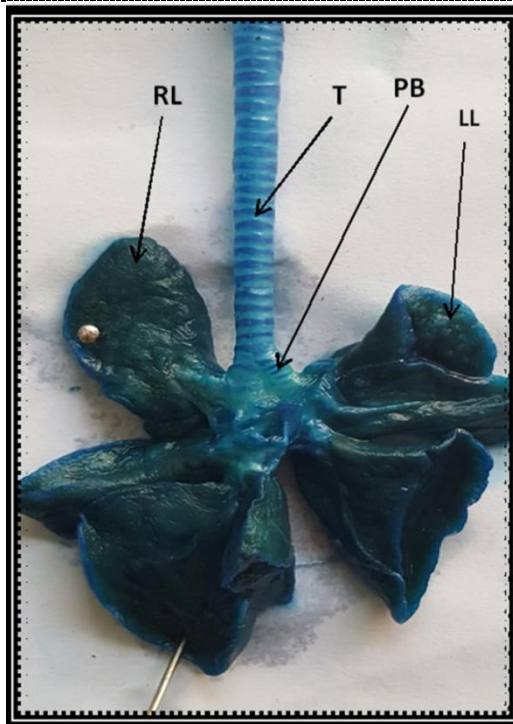


Figure 5. : Shows the branching of the trachea (T) into two branches of the primary bronchi (PB), the entry of a branch to the right lung (RL) and a branch to the left lung (LL), (Methylene blue stain).

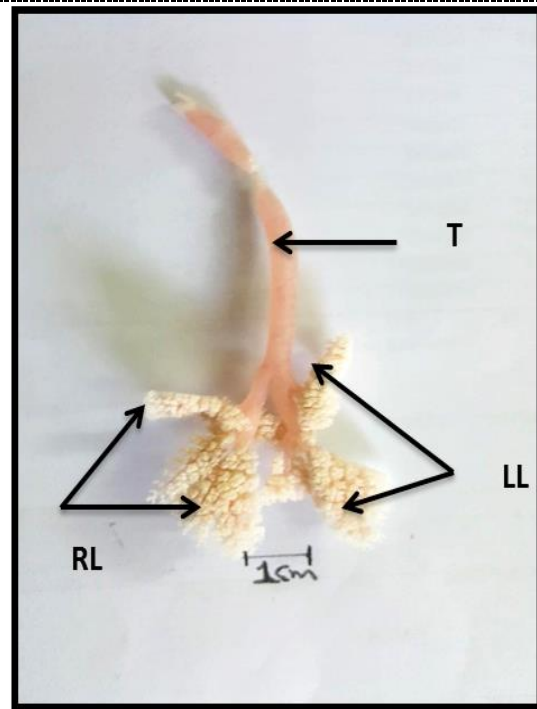


Figure 6. Whole preparation of the lung using resin casting technique shows the branches of the bronchi, trachea (T), right lung (RL), left lung (LL).

Table 1: Shows the rate of length and weight of lung for study samples.

Sample number	Real length/ cm	standard length/ cm	animal weight/ g	Length of left lung/ cm	Length of right lung/ cm	Total width of lung. cm
1	56	28	341.26	4.5	5	5.5
2	60	30	435.81	4.5	5	5.5
3	61	32	564.14	4.5	5	6
4	60	32	396.32	4.5	4.5	6
5	54	26	288.17	4	5.2	6.5
Mean	58.2	29.6	405.14	4.4	4.94	5.9

4. Discussion

The macroscopic examination showed that weasel *Herpestes javanicus* has a pair of bright pink sponge lungs that surround the heart and occupy most of thoracic cavity and shows its shape identical to the thoracic cavity it occupies and these results are fully consistent with references for the study about domestic animals [10, 11]. The results of the current study showed that the lungs of the weasel are in the form of clover leaf pattern and this result of appearance is contrary to the lungs of naked-bellied tomb bat [12] whose appearance is pyramidal in shape because the structural of the lung fits with the thoracic cavity that contains it. The lung is smooth-surface and each lung has a cranial apex that resembles the apical lobe and caudal base, which similar to the diaphragmatic surface of the caudal lobe, and each lung has three borders: dorsal and ventral abdominal, caudal (Basel) borders. The results of the anatomical study of weasel's lungs were consistent with the results of [13, 14] in

Canis lupus and [15] in ruminants, as it was found that the top of the right lung looks small and semi-sharp while the top of the left lung is round and blind. The results are contrary to what was shown by the results of [16] about the local rabbits *Oryctolagus cuniculus*, as mentioned study explained that the top of the left lung is sharp and small, while the top of the right lung is large, rounded and blind, these results are partly consistent with same study in the cats *Felis catus*, this study showed that the right lung top is sharp as it is contrary to the lung of the naked-bellied tomb bat [12] because the top of the right lung is sharp but folded down, while [17] study on *Felis catus* showed that the right lung was contained on a pointed top, which is not consistent with the results of the weasel study because the right lung contains a semi-pointed top. The left lung of the weasel in the current study showed smaller than the right lung and consists of three lobes represented by the cranial lobe, the middle lobe and the caudal lobe, while the right lung is larger than the left lung and consists of four lobes, a cranial, middle, caudal, accessory lobes. This result is consistent with the results of the study of the guinea pig *Cavia porcellus*, which showed that the right lung contains four lobes and the left lung contains three lobes [18]. The results of the current study were also contrary to the results of [16] on the local rabbit *Oryctolagus cuniculus*, as the anatomical results showed that both lungs have two lobes; one of which is apical lobe and the other is caudal lobe, and the left lung is divided into two lobes unequal in shape and the apical lobe is smaller than the caudal lobe. In addition, it disagreement with [19] study in *Cryptotis parva*, as it has a right lung containing four lobes represented by a cranial, middle, caudal and accessory lobes, while its left lung has one caudal large lobe, which is fully integrated with the small cranial lobe so that no clear dividing line between the lobes appears.

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