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| RESEARCH ARTICLE

Histological Investigation of the Lung in Adult Male Guinea Pig

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| ABSTRACT
The study was done on six adult guinea pigs weighing 300-400g and 180 days old. These healthy adult male pigs (Cavia porcellus) were obtained from the Drug Control Center in Baghdad, Iraq. Then, the animals were euthanized by using chloroform anesthesia to examine the histological features of the lungs in adult guinea pigs. The animals were prepared for anatomy by opening the chest with a scalpel after the animal was anesthetized. From the chest cavity, the lung was removed, and four lobes of the right lung, three lobes of the left lung, and two lungs in the chest cavity were revealed, around the middle body and heart. Histological analysis in the current study showed that the lung parenchyma contained alveoli, air sacs, and air ducts, in addition to the presence of bronchioles that were devoid of cartilage and replaced by smooth muscle fibers. The wall of the lung's alveoli was found lined with alveolar (squamous) cells Type I, which are involved in blood-blood gas exchange, and alveolar (squamous) cells Type II, which are involved in the secretion of a lipid-binding substance to prevent collapse. The interstitial tissue between the alveoli is composed of collagen and elastic fibers and contains macrophages, white blood cells, and blood vessels. The collagen fibers are essential for supporting the framework of the lung, while the elastic fibers assist in the elasticity of the lung during breathing.

| KEYWORDS

Guinea Pigs, Lung, Histology, Alveoli.

| ARTICLE INFORMATION

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1. Introduction

The guinea pig (Cavia porcellus), also called the Cavy, is a type of rodent which they belonging to the family Caviidae and the genus Cavia. Despite its common name, these animals are not pigs, nor are they related to the guinea subspecies. They originated in the Andes Mountains (Barbara, 1974).

The lung is described as a pair of organs responsible for breathing. It is located in the chest cavity on both sides of the mediastinum and is covered by a serous membrane named pleura, which consists of an internal membrane adjacent to the lung, which is called the visceral membrane, and another parietal membrane close to the ribs. Between the two membranes is the pleural sac, which contains limited serous fluid (Cara, 2024).

The respiratory system in guinea pigs like other mammals consists of an air-conducting part and a respiratory part. The air-conducting part consists primarily of the larynx, trachea, bronchi, and bronchioles (Carolina, 2021). While, the respiratory part is located in lung tissue and consists of the respiratory bronchioles, the alveoli, which are composed of alveolar sacs, alveolar ducts, and alveoli (Ahookhosh, 2020). The alveoli are considered the final stage where gas exchange occurs with the capillaries adjacent to the alveolar walls. Stuki (2024) who reported declare that the numbers of alveoli at an adult human lung is approximate 300 million, equivalent to 80 m2.

The respiratory system at small animals has some variation in structure comparative with other animals. The lung in rats was described as composed of three lobes on the left side: the posterior, anterior and posterior, while the right side contains a single conical lobe. In contrast, in hamsters and rabbits, the respiratory system is made up of two lobes on the left and three lobes on the right side. All of these lobes are found on either side of the mediastinum and heart (Cara, 2024). Thus, the current study aimed to analyze the histologically features of the guinea pig lung in order to understand the structure and respiratory function of the lung in this organism, which can be used as an experimentally model in many medical studies.

2. Materials and Methods

This study used six adult male guinea pigs (Cavia porcellus). The study was conducted in the animal house of the College of Veterinary Medicine, Tikrit University. The averages weight of pigs between 300 to 400g and aged were 180 days. They were kept in the steel cages (6 animals/cage). These animals were allow to acclimatize to the new environment with a 12:12 light-dark cycle, a temperature of 30-20°C, and a relative humidity of 50-60% (Paintal, 2005).

The anesthetic animals by used chloroform, the once the animals stopped breathing, they were placed on a table in a closed glass box. The lungs were then removed, washed with water for ten minutes, and fixed in a 10% formalin solution for 12 hours. Histological techniques were then performed to obtain tissue slices, which were then examined under a light microscope. After fixation, the samples were passed through increasing concentrations of alcohol (50%, 70%, 90%, and finally in a 100% absolute solution) for one hour. They were then placed in a xylene solution for two hours, followed by a wax oven at 62°C for 24 hours, where they were then cast, encased in wax, and molded. The samples were then cut with a microtome at a thickness of 6 µm, and then stained with hematoxylin and eosin for general description. The samples were then examined under a light microscope, and the histological samples were photographed with a digital camera. The histological technique was performed according to (Luna, 1968).

3. Results and Discussion

Histological investigation showed that the lung tissue was composed of regular alveoli. Some alveoli were shaped like alveoli sacs, while others were like alveolar ducts. The alveolus was lined with cuboidal and squamous alveolar cells. The interstitial tissue between the alveoli was found to have loose connective tissue fibers, blood capillaries, some blood cells, as well as, some inflammatory white blood cells (Fig. 1). The squamous cells act as a barrier alveolar barrier and a part of the blood-pulmonary, while cuboidal alveolar cells have a role in preventing the collapse of the alveoli and the lung by secreting a phospholipid substance. This is agreed with many previous studies that described the structure of the lung in many mammalian species (Cohen,1991). Small single alveoli were noticed within the lung tissue that was surrounded by a thick interstitial tissue composed of bundles of dense collagen fiber with a large infiltration of white blood cells and macrophages (Fig. 2). This also does not conflict with (Florine, 2015) in rabbits (Samuelson, 2017) and in rats (Samuelson, 2007). In addition, the lung tissue contained clear bronchioles lined with simple columnar cells and the existence of epithelial cells in the lumen of these bronchioles that were surrounded by white blood cells. These cells were also found around the walls of the alveoli (Fig. 3). This is consistent with (Cohen, 1991; Stuki, 2024) and). The bronchi were found lined with simple columnar cells that become visible in the form of small folds. The basement membrane was present around the epithelium, and collagen fibers were found surrounding the lumen of the bronchi in a circular shape. Also, around these collagen fibers, the hyaline cartilage contained cartilage cells surrounded by the ground substance (Fig. 4). This is also mentioned recently by (David et al, 2018)

Within the lung, the trachea was found to contain several mucosal folds that lined with simple columnar cells and colloidal connective tissue around the epithelium, in addition to the hyaline cartilage containing chondrocytes ground substance of the cartilage (Fig. 5). This description is agreed with other researchers (Ahookhosh, 2020, Carolina, 2021).

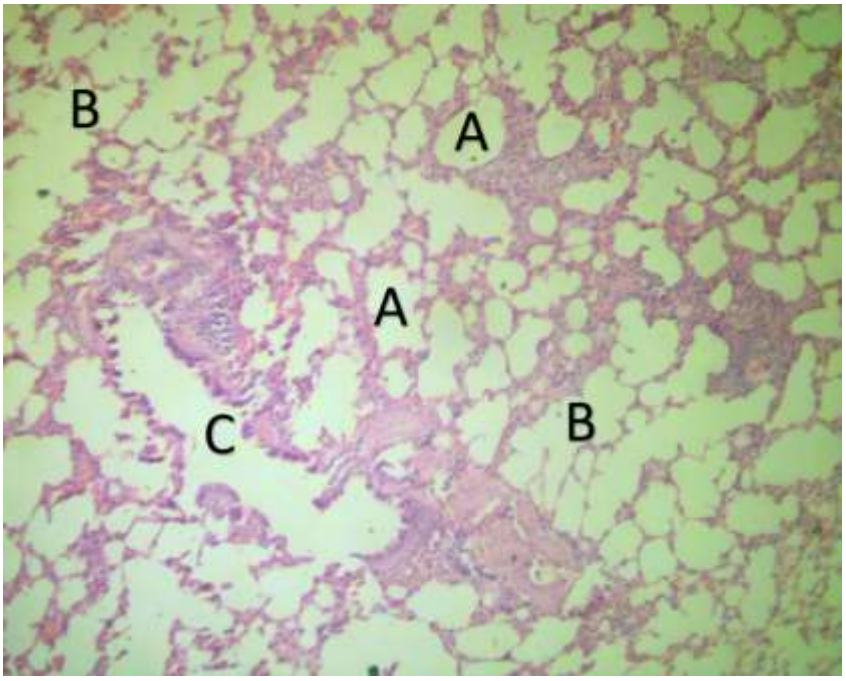

Figure 1 Showing tissue in the lung of a male guinea pig includes the pulmonary alveoli (A) the alveolar sacs (B), and the respiratory bronchi (C), (H&E x 40)

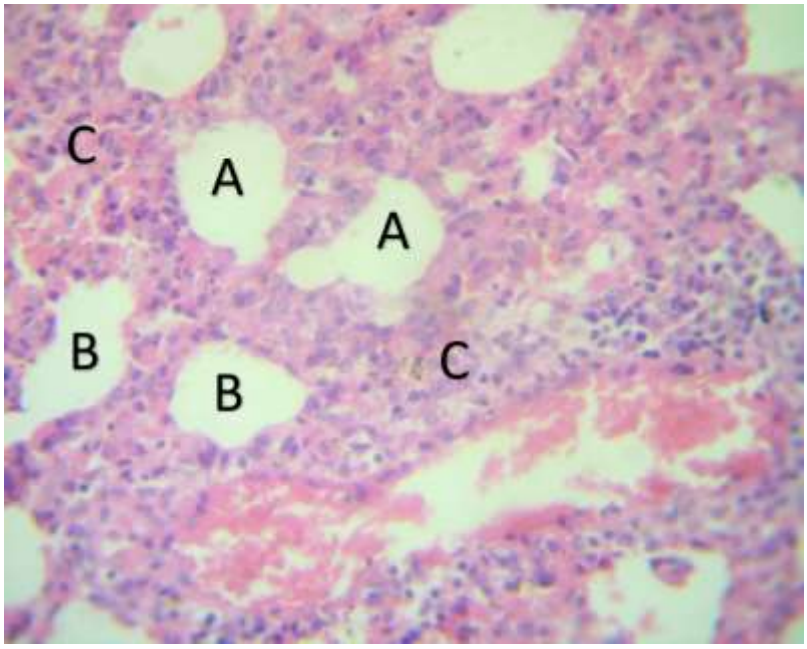

Figure 2 Showing a small pulmonary alveolus (A), Cells lining the alveoli (B), infiltration of white blood cells (C), Congested blood vessel (D), (H&E x 40)

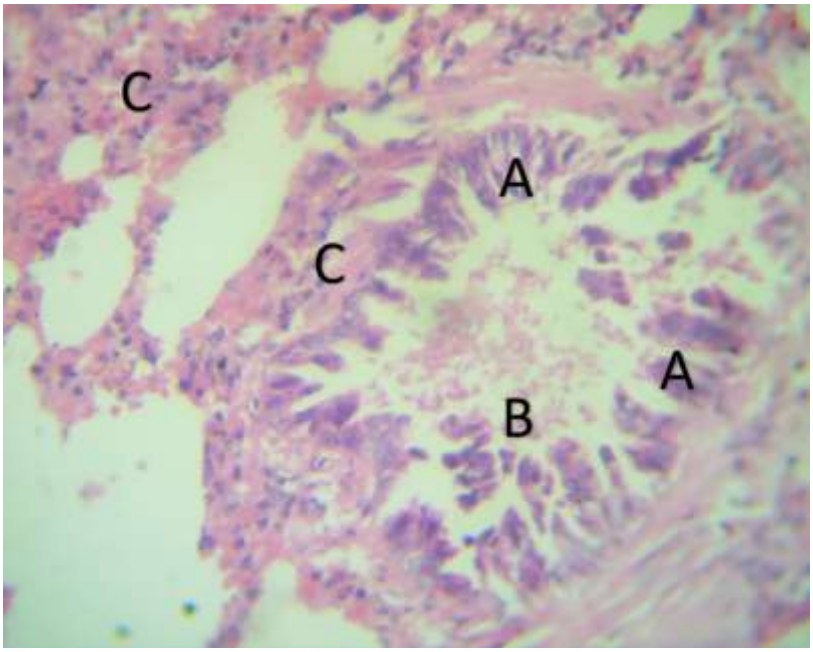

Figure 3 Showing bronchioles contain mucus lining (A), Simple columnar epithelium (B) Sloughed-off epithelium inside the bronchus (B) Infiltration of small blood cells around the bronchus and alveoli (C), (H&E x 40)

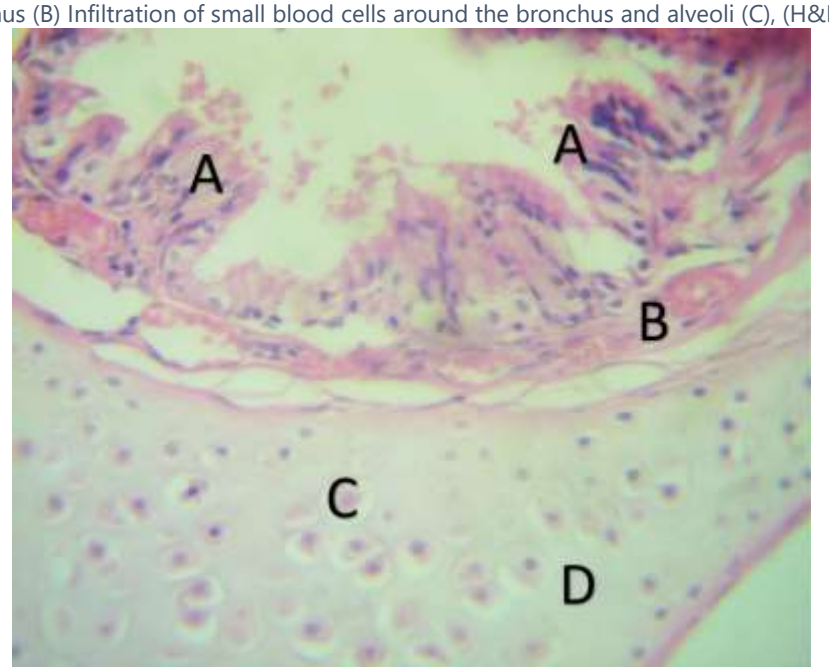

Figure 4 Showing trachea lined with mucous membranes, (A) Collagen connective tissue around the epithelium (B), Hyaline cartilage and chondrocytes (C), Ground substance of the cartilage (D), (H&E x 40)

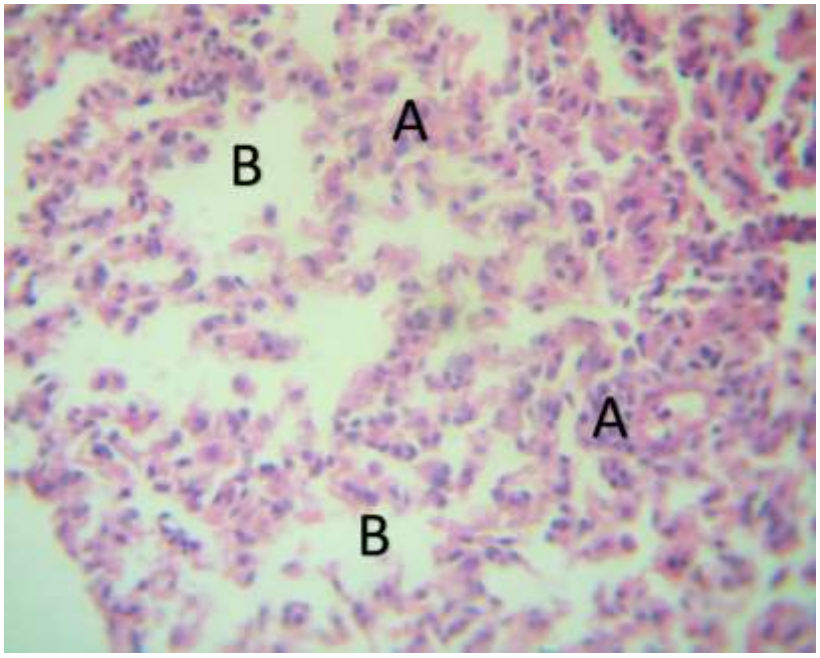

Figure 5 Slowing lung tissue with massive infiltration of white blood cells and sputum (A), Alveolar cavity (B), (H&E x 40)

4. Conclusion

The current study was conducted on male guinea pigs to investigate the histological features to understand their structure and compare the lungs with other laboratory animals such as rabbits, hamsters, and mice. This seems to be important and can be used as an experimental model in many medical researches. The lung tissue of guinea pigs contains alveoli, air sacs, and bronchioles, replaced by smooth muscle fibers. The alveolar wall was lined by type I alveolar (squamous) cells, important in blood gas exchange, and type II alveolar (squamous) cells, that essential in the secretion of a lipid-binding substance to prevent collapse.

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