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Morpho-Immunohistological Analysis the Lower Respiratory System in Adults Rats

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Abstract: The goal of this research is to achieve a better understanding of the histomorphology of the lower respiratory system in Sprague-Dawley rats. The lower respiratory tract is made up of the trachea, bronchi, bronchioles, and terminal bronchi. Distinct tissues assist with oxygen supply, gas exchange, and immunological defense systems throughout the lower respiratory system. Airways continue to branch while reducing in diameter.

Twenty rats were divided into two groups of ten rats each. One group was used for morphometric measurements, which included tracheal and lung lengths and diameters. The mean values for the first group were 3.5±0.05e and 0.510±0.002e for the trachea, and 5.08±0.06e and 0.501±0.001e for the lung. The second group studied histometric and histochemical sections that had been fixed in 10% formaldehyde, embedded in paraffin wax, sectioned, and stained with Masson's Trichrome and routine stain (H&E). The tracheal wall was made up of mucosa, submucosa, hyaline cartilage, and adventitia. The mucosa was bordered by pseudostratified and ciliated respiratory epithelial cells. This epithelium consisted of basal cells, goblet cells, and ciliate cells. The open end and elastic connective tissues of the C-ring hyaline cartilage also house the smooth trachealis muscle. The thick fibroblastic tissue that surrounds the hyaline cartilage layer contains chondrocytes in the lacuna within an amorphous matrix. Collagen II penetrated the entire cartilage ring, significantly darkening the tracheal hyaline cartilage. The cartilage ring's perimeter contained collagen II.

Key word: Immunohistochemical, Morpho, Adult, Rat

Introduction

Rats' physiological similarity to humans makes them an excellent choice for many labs. Furthermore, compared to other complex animals, such as primates, rats are smaller and easier to feed, making them a more feasible choice for many researchers. Due to its availability and capacity for large-scale, high-throughput research, this device is reasonably priced (1).

The two components of the respiratory system—the conducting part, which regulates the movement of air inside and outside the body, starting with the nasal cavity and progressing to the nasopharynx, throat, and finally to bronchioles—vary in structure between and within species. Alongside the alveolar, the respiratory bronchiole is a component of the respiratory portion, which carries out gas exchange (2).

The lungs are the respiratory system's first and most crucial organ. In rats, the lung is divided into two lobes: the left lung and the right lung, which has four parts: the secondary, medial caudal, and cranial lobes. The three phases of the gas exchange process—cellular respiration, ventilation, and internal respiration—occur concurrently (3).

The lower respiratory tract consists of the trachea, bronchi, bronchioles, and terminal bronchioles. Each component of the lower respiratory system is made up of distinct tissue that aids in immunological function, gas exchange, and oxygen delivery. The diameter of the airways decreases as they continue to branch (4,5).

Several C-shaped cartilages that encircle the trachea and are open in the dorsal region are connected by the tracheal muscle. The trachea is a flexible tube with cartilaginous rings joined by a fibromuscular membrane and mucosa lining the inside (4). The trachea and extrapulmonary bronchi are lined with goblet cells and pseudostratified columnar ciliated epithelium. Sero-mucous glands are scattered beneath the mucosa in the submucosa. The luminal surface is lined by ciliated and Clara cells. (6-8)

Adventitia, hyaline cartilage, submucosa, and mucosa are the four layers of cartilaginous tubes that make up the tracheas of most domesticated animals (9). Longitudinal folds are present in the dorsal membrane section of the mucosa, but the mucosa itself is not folded. Its pseudostratified ciliated columnar epithelium is composed of goblet, ciliated, and basal cells. The majority of the cell population consists of ciliated columnar and basal cells. (10-12).

The bigger chondrocytes in lacunae located in the anterior of the hyaline cartilage are surrounded by the robust connective tissue perichondrium, which works in conjunction with the submucosa and adventtitia to regulate the tracheal lumen. Hyaline cartilage fragments in the shape of Cs or incomplete rings were being interfered with by this connective tissue (13).

Material and method

Animals: - Twenty healthy rats were acquired from the College of Veterinary Medicine's Animal House. After that, they were kept in separate cages, fed, and given water before to their dissection and killing process. Ten rats of each age were included in the first section, which concentrated on the morphological aspect of the rats. The second one concentrated on the histometrical and histochemical sections portion that included ten rats of each age.

Specimen preparation: - included measuring the rats using a digital balance before administering an intramuscular injection of 15 mg of ketamine per kilogram of body weight to put them to sleep (14) The trachea and lung, along with its complete morphology, were carefully dissected after an abdominal laparotomy and cranial displacement of the sternum. They were then cleaned with a standard saline solution to get rid of any blood or other sticking material. A digital camera was used to locate and take pictures of the lung and trachea. then cleaned to get rid of any blood or other sticky residue using a regular saline solution. The trachea was located and photographed in its native habitat using a digital camera. Following a full day of fixing in 10% formaldehyde, the tissue samples were washed with xylol, dehydrated in graded alcohol, and then embedded in paraffin wax. Hematoxyline and eosin (H and E) staining was carried out after each paraffin block was cut into six micrometer-thick sections. Collagen fibers and smooth muscle can be seen with Masson's Trichrome.

Results and Discussion

According to the study it shown the lower respiratory system, Trachea histologically revealed in **Figures (1,2and 3)** that The tracheal wall consisted of mucosa and submucosa with hyaline adventitia and cartilage as well. The cross section showed that the mucosa was bordered by mucous and ciliated columnar epithelium that is pseudostratified. What's Large, elongated nuclei were found in cells resting on the basement under the lamina propria. There was a smooth trachealis muscle , within the C-ring hyaline cartilage's open end, with the material flexible connective tissue. The tracheal hyaline cartilage was markedly discolored by collagen II.penetrated the entire ring of cartilage. The discovery of Collagen II on that ,the edge of the cartilage ring **(Figure 1, 2)** The rat's trachea is composed of a number of organized cartilaginous rings that are joined by annular ligaments and are incomplete dorsally. The perichondrium is connected to the trachealis muscle. Similar to what (15). Furthermore, there was a unique staining pattern within the body of the bronchi **(Figure 4,5)** . This was observed throughout the entire tracheal cartilage. The main measurement of the lower respiratory system of rat was be measured that’s show length and diameter of trachea (3.5±0.05e, 0.510±0.002e) and the length and diameter of lung (5.08±0.06e ,0.501±0.001e) **(table -1)** Due to the heart's skewed position, the right lung is slightly larger than the left (14). The statistical analysis of the results (16) revealed significant variations (P>0.05) in the trachea's length and diameter as well as the lung's weight and length at various dates. According to the trachea's histological analysis, the wall is made up of mucosa,

submucosa, hyaline cartilage, and adventitia, which is similar to goats and neonates (17). Most domestic animals have cartilaginous, non-collapsible tracheas with walls composed of four layers: adventitia, muscularis, submucosa, and mucosa (18). **Figure (3,4)** Furthermore, the open end of the C-ring hyaline cartilage and elastic connective tissues include the smooth trachealis muscle. According to results from (Elizabeth et al., 2010), chondrocytes in the lacuna within an amorphous matrix are discovered in the dense fibroblastic tissue between the cartilaginous rings and the perichondrium that surrounds the hyaline cartilage layer. The adventitia in cats was made up of a lot of elastic fibers in connective tissue. Figure **(1,2 and 3)** .The whole cartilage ring was penetrated by Collagen II, which markedly darkened the tracheal hyaline cartilage. The margin of the cartilage ring contained collagen II **Figure (1, 2)**. Inside the bronchi body, there was also a unique staining pattern. This was observed throughout the entire tracheal cartilage that's agree with (19).

Table (1) The Measurements of Trachea, Lung of Adult Rat

Length trachea	Diameter trachea	Length lung cm	Diameter lung mg
3.5±0.05e	0.510±0.002e	5.08±0.06e	0.501±0.001e

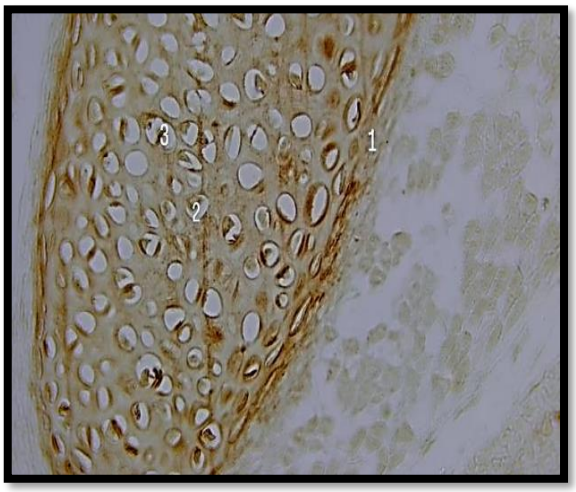

Figure 1. Cross section of trachea hyaline cartilage of adult rat show Perichondrium (1), chondrocyte (2) ,isogenous group (interstitial growth) (3) stained with collagen type II (COL2A1 stain 100X)

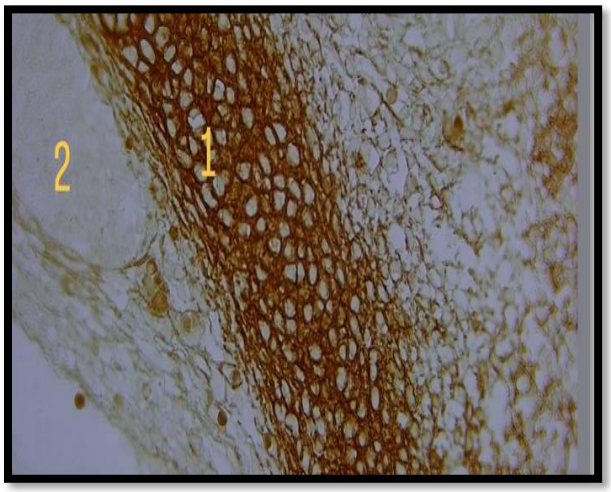

Figure 2. Cross section of trachea cartilage with collagen II with numerous chondrocyte are present within clear lacunae (1), large blood vessels (2) (COL2A1stain 100X)

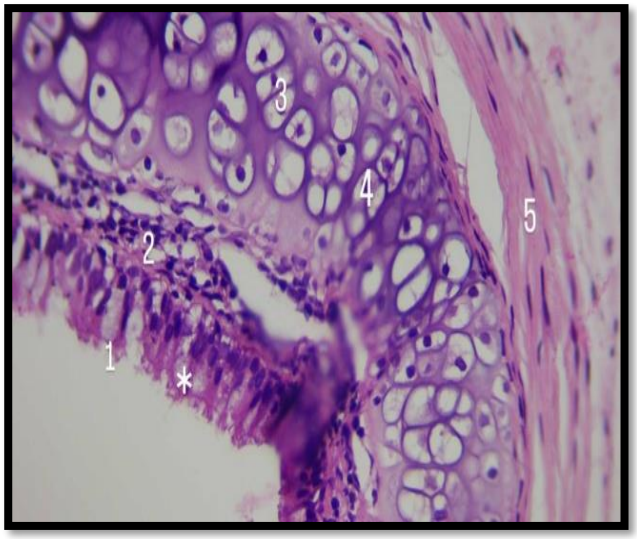

Figure 3. Cross section that's show trachea in adult rat with Masson's trichrome stain (1) ciliated cell with respiratory epithelium (2) sub mucosa (3) glands (4)tracheal hyaline cartilage (5) adventitia (*) goblet cell 400X

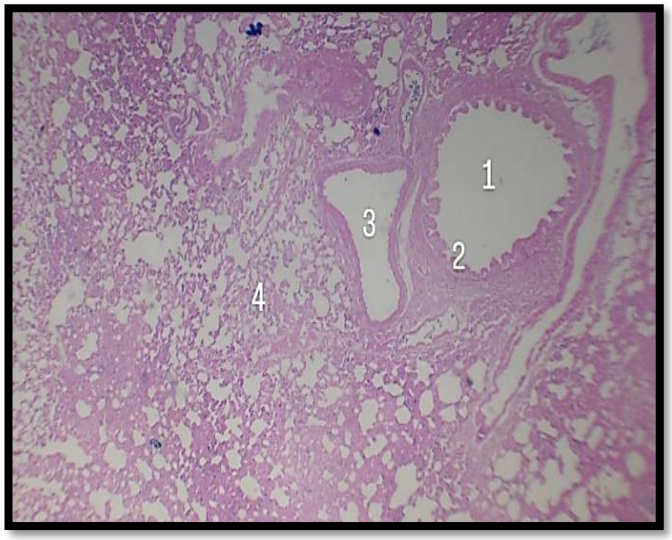

Figure 4. Cross section that's show bronchus , Bronchus (1) ,cartilage (2) , Blood vessels (3), smooth muscle (4) ,(star) terminal bronchiole (stained by H&E 100x)

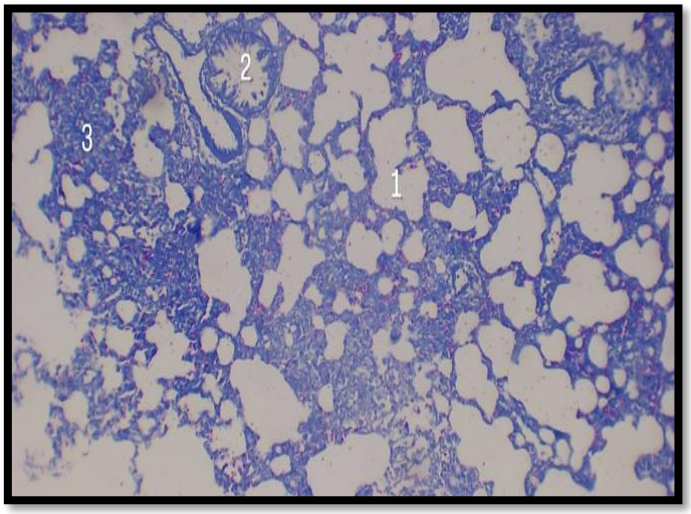

Figure 5 . Cross section that's show lung of adult rat ,alveoli (1) ,terminal bronchiole lined by simple cuboidal epithelium (2) , smooth muscle (3) (Masson's trichrome stain 100x)

References

1. K. Coughlin, "The advantages of rat models," Genetargeting, Oct. 25, 2022. [Online]. Available: https://www.genetargeting.com/crispr/the-advantages-of-rat-models.
2. M. S. Legaspi, "Comparative safety respiratory pharmacology: Validation of a head-out plethysmograph–pneumotachometer testing device in male Sprague–Dawley rats, Beagle dogs and Cynomolgus monkeys."
3. P. J. Chai et al., "Soluble complement receptor-1 protects heart, lung, and cardiac myofilament function from cardiopulmonary bypass damage," Circulation, vol. 101, no. 5, pp. 541-546, Feb. 2000.
4. I. Dabanoğlu, M. K. Öcal, and M. E. Kara, "A quantitative study on the trachea of the dog," Anatomia, Histologia, Embryologia, vol. 30, no. 1, pp. 57-59, Feb. 2001.
5. D. Cui and B. J. Moxham, "A core syllabus for histology within the medical curriculum—the cell and basic tissues," Clinical Anatomy, vol. 34, no. 3, pp. 483-495, Apr. 2021.
6. A. McEwen and C. Henson, "Quantitative whole-body autoradiography: past, present and future," Bioanalysis, vol. 7, no. 5, pp. 557-568, Mar. 2015.
7. E. Aughey and F. L. Frye, Comparative Veterinary Histology with Clinical Correlates, CRC Press, Feb. 15, 2001.
8. F. N. Ghadially, "Invited review: The technique and scope of electron-probe X-ray analysis in pathology," Pathology, vol. 11, no. 1, pp. 95-110, Jan. 1979.
9. V. Khyalia, B. Meshram, and N. Jakhar, "Gross and histomorphological studies on the respiratory and conducting portions of respiratory system in goats (Capra hircus)," Indian Journal of Veterinary Anatomy, vol. 31, no. 2, pp. 97-98, Dec. 2019.
10. J. M. Icardo et al., "The lungs of Polypterus senegalus and Erpetoichthys calabaricus: Insights into the structure and functional distribution of the pulmonary epithelial cells," Journal of Morphology, vol. 278, no. 10, pp. 1321-1332, Oct. 2017.
11. Yang B, Yu S, Cui Y, He J, Jin X, Wang R. Histochemical and ultrastructural observations of respiratory epithelium and gland in yak (Bos grunniens). The Anatomical Record: Advances in Integrative Anatomy and Evolutionary Biology. 2010 Jul;293(7):1259-69.
12. N. A. Al-Mamoori and A. M. Al, "Anatomical and morphometric study of the trachea, primary bronchi and lung in laughing dove (Streptopelia senegalensis)," Kufa Journal for Veterinary Medical Sciences, vol. 7, no. 2, pp. 111-119, Dec. 31, 2016.
13. N. E. Everds, "Evaluation of clinical pathology data: correlating changes with other study data," Toxicologic Pathology, vol. 43, no. 1, pp. 90-97, Jan. 2015.
14. Y. J. Mousa and M. H. Al-Zubaidy, "Anesthetic efficacy of ketamine, ketamine-tramadol and ketamine-ketorolac in chicks," Iranian Journal of Veterinary Research, vol. 20, no. 1, pp. 33, 2019.
15. A. Koçyiğit et al., "Morphometry of the thorax and three-dimensional modelling of the lower respiratory tracts with computed tomography in Van cats," Acta Veterinaria Brno, vol. 93, no. 3, pp. 313-319, Oct. 3, 2024.
16. V. Pathak, "Gross anatomical studies on the trachea and bronchi of Gaddi sheep," Indian Journal of Veterinary Anatomy, vol. 30, no. 1, Sep. 2018. [Online]. Available: https://epubs.icar.org.in/index.php/IJVA/article/view/83428
17. J. N. Maina and C. O. Igbokwe, "Comparative morphometric analysis of lungs of the semifossorial giant pouched rat (Cricetomys gambianus) and the subterranean Nigerian mole rat (Cryptomys foxi)," Scientific Reports, vol. 10, no. 1, pp. 5244, Mar. 23, 2020.

18. N. H. Yousif and M. S. Dawood, "Morphometric comparative anatomical study of lower respiratory tract between sheep (Ovis aries) and goat (Capra hircus) in Baghdad province," Kufa Journal for Veterinary Medical Sciences, vol. 10, no. 2, Jul. 1, 2019.

19. J. A. Eurell and B. L. Frappier, Eds., Dellmann's Textbook of Veterinary Histology, John Wiley Sons, Mar. 19, 2013.