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A comparative histomorphological and histochemical study for trachea in postnatal and adult rats Rattus

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Abstract

This study's objective was to describe development structure of trachea, comparison the grossly, histological and histochemical features of trachea between rat (one day) postnatal and adult . Two sets of seven rats each—seven adults and seven newborns—were created from a total of fourteen healthy rats. Gross study; describe the development of trachea, measurement length and diameter of trachea in different ages of rat. For histological and histochemical studies; the specimens were taken from the different regions of trachea and fixed in 10% formaldehyde to histological technique after that embedded in paraffin wax, then sectioned, stained with routine stain, AB, Masson's Trichrome. The length and diameter of the trachea in one day age was (0.405±0.012; 0.09±0.008 cm) respectively, while in adult age was (3.7±0.07; 0.507±0.006 cm) respectively. The results statistical analysis show that there were significant differences (P> 0.05) in the length and diameter of the trachea also length and weight of lung with different times in the postnatal stage .

The findings showed that the trachea of (one day) postnatal lined with pseudostratifed columnar non ciliated epithelial with development mucous glands, lamina propria, consists of loose connective tissue and sub mucosa contained loose connective tissue in one day age. while in adult rat lined with ciliated pseudostratifed columnar epithelial with seromucous glands, in adult the lamina propria was consists of dense connective tissue. The hyaline cartilage consists chondrocytes, within the lacunae, the adventitia was made up of loose connective tissue, with many elastic fibers.

Key words: Rats, Trachea, Development, Histological

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I. INTRODUCTION

Rats are a great choice for many labs since they are smaller and easier to handle than other complicated animals, making them a more practical choice for researchers (Kristen, 2018). The breathing and exhale of oxygen and carbon dioxide by living organisms is facilitated by the respiratory system, a complicated biological system made up of numerous organs. The lungs control respiration in all air-breathing animals, although they are hardly the only parts of the respiratory system (Murtadha and Al-alwany, 2022).

The lungs, bronchi, bronchioles, and trachea make up the lower respiratory system. A flexible tube known as the trachea is made up of cartilaginous rings joined by a fibromuscular membrane and inside lined with mucosa. It is made up of multiple C-shaped tracheal cartilages from several species that are open dorsally, and tracheal muscle spans the space between them (Hussein and Zahra, 2016). There are differences in the respiratory tract's architecture both within and across species (Legaspi, 2010; Gazi,2017). The respiratory epithelium of the trachea in most mammals is enclosed by a submucosa, has a well-developed subtending adventitia, and has incomplete cartilaginous rings(Auda,2007;Samuelson,2013;Majeed,*etal*.,2009). Chondrocytes are found in the lacuna of the hyaline cartilage and the cartilage surround by perichondrium (Ahmed and Sadoon, 2020**;** Ali,*et al*., 2015). Few references on ,development of trachea of rat, so that this study to descrpie the development, structure of trachea in Rattus rattus.

II. MATERIALS AND METHODS

Seven (one day) postnatal and seven (adult) healthy Rattus rats from fields in Tikrit Governorate ,were kept in cages at the Veterinary Medicine College/University of Basrah. They were fed during the course of the study on supplies as specified by (Al-Ali, 2004). They were then given an intramuscular dose of ketamine to put them to sleep. By abdominal laparotomy and cranial displacement of the sternum, the trachea was seen and collected. It was then carefully dissected, preserving its entire morphology, and washed with normal saline solution to remove any blood or other adhering debris. Using a digital camera, the trachea was located and captured in its natural environment. The tissue samples were dehydrated in a graded alcohol, cleaned in xylol, and embedded in paraffin wax after being fixed in 10% formaldehyde for 24 hours. Each paraffin block was divided into six-micrometer-thick sections, which were then stained with Hematoxylin and Eosin (H and E) to show the organ's histological components, Alcian blue (AB) to show the weak acidic polysaccharides, and Masson's trichrome to show the collagen fibers and smooth muscle (Suvarna, *et al.*, 2013).

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III. RESULTS AND DISCUSSION

The results of the statistical analysis reveal that the trachea's length and diameter varied significantly (P> 0.05) over the course of the postnatal period (Table 1, figure 1,2). The trachea's diameter in this study at various periods in the postnatal stage of the rat substantially varied with age; this shift in diameter may be caused by the growing pups' increased need for oxygen. The diameter of a mouse's trachea increases with age, going from 1 mm to 2.5 mm (Widdicombe, *et al.,* 2001). African giant pouched rat fetus rostral tracheal diameter 5.22 mm measured by (Ibe *et al.*, 2011).

According to the results of the histological analysis, the mucosa lining the trachea of rats one day after birth was largely cuboidal to low columnar nonciliated. These outcomes are comparable to those seen in the majority of mammalian species by (Smolich, *et al.,* 1976; Yang, *et al.,* 2010). The lamina propria was a loose connective tissue that was dotted with lymphatic, blood, and collagen fibers. These characteristics resemble the histological characteristics of cats and goats (William, 1990). With rat age, the tracheal mucous submucosal glands also develop. The interstitial material appears in a light blue tint, with chondrocytes inside a lacuna, and the tracheal cartilage has double nuclei that are purple in color along with the matrix. The adventitia consisted of collagen fibers with numerous elastic fibers Figure (3, 4 A, B), these agree with (Eurell and Frappier, 2013).Figure (5-8) shows the adult rat trachea wall, which is lined with pseudostratified ciliated columnar epithelium and has a number of goblet cells lining the mucosa. These findings are similar to those reported by (Yang *et al.,* 2010) for the majority of mammalian species. The lamina propria was a flexible connective tissue that included ser-mucous glands in the submucosa, lymphatic, blood, and collagen fibers. These characteristics are similar to those described in (William, 1990; Nassar, 2013) for the trachea of cats, sheep, and goats. The mucosa appeared somewhat folded and had a thin muscle layer and thin plates of hyaline cartilage (5). These findings concur with those from mouse studies by (Al-Anbaki, 2013; Zhang, 2011).

Additionally, the smooth trachealis muscle is found inside the open end of the elastic connective tissues of the C-ring cartilage. Figure (7 A, B) shows that chondrocytes are present in the lacuna inside an amorphous matrix in the dense fibroblastic tissue that surrounds the hyaline cartilage layer and is situated between the cartilaginous rings and the perichondrium (Elizabeth, et al., 2010). In cats, the adventitia is composed of loose connective tissue with many elastic fibers consisting of collagen fibers (William, 1990).

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Table (1) the measurements of trachea of rat in different ages (cm)

Age rat	length Tr	Diameter Tr
One day	0.405±0.012a	0.09±0.008 a
Adult	3.7±0.07 e	0.507±0.006 e

The different small letters refer to a significant deference (P ≤ 0.05). between the groups in vertical row\Trachea (TR)

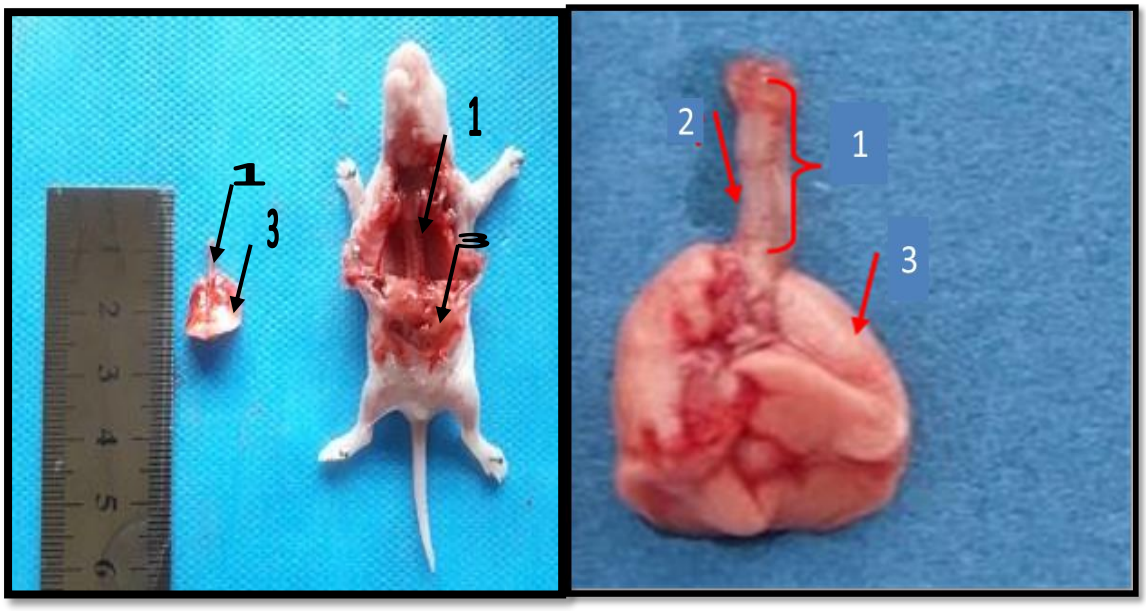

Figure 1: Gross appearance of the respiratory system of rat, show; trachea (1), esophagus (2), lung (3).

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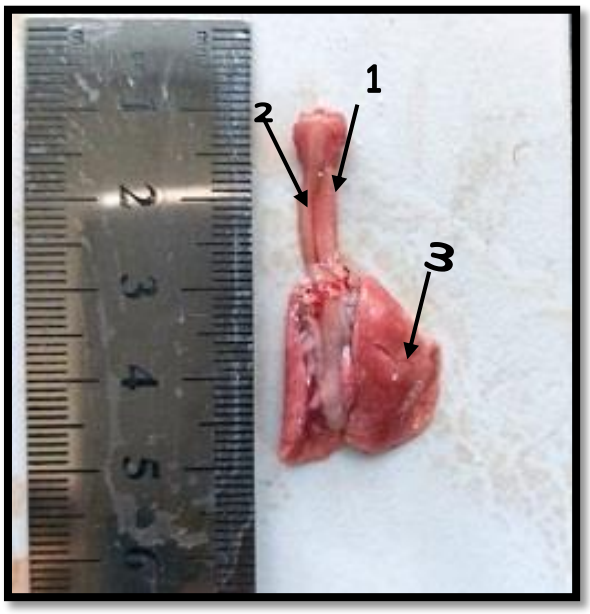

Figure 2: Gross appearance of the respiratory system of rat, show; increase in length of trachea (1) , esophagus (2), lung (3).

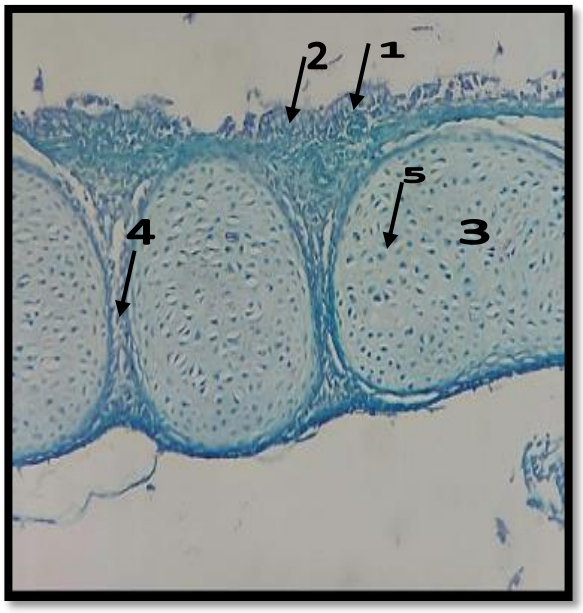

Figure 3: Cross section of the adult rat trachea; epithelium (1), goblet cell (2), cartilage (3), smooth muscle (4), chondrocytes (5), (AB, stain ,200X).

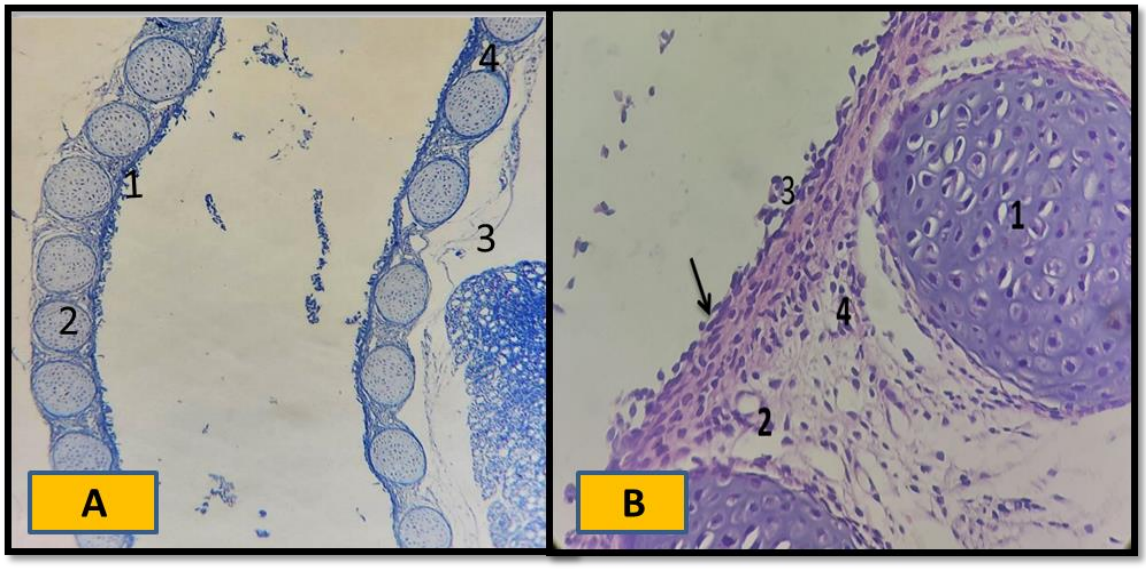

Figure 4: Cross section of trachea in 1 day postnatal rat, A-The lumen lined by respiratory epithelium, non-ciliated (1). The tracheal cartilage in blue color (2), Adventitia (3), (Masson trichrome stain 40X) B-The lumen lined by respiratory cuboidal epithelium (arrow) the tracheal cartilage has profuse deeply basophilic matrix (1), Blood vessels (2). Nonciliated (3), submucosal glands (4),) (H & E stain 400X)

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Figure5: Cross section of postnatal rat trachea, epithelium(1) Mucosa (2) , sub mucosa(3), adventitia(4), cartilage (5), muscle(6) (H&E stain 40X)

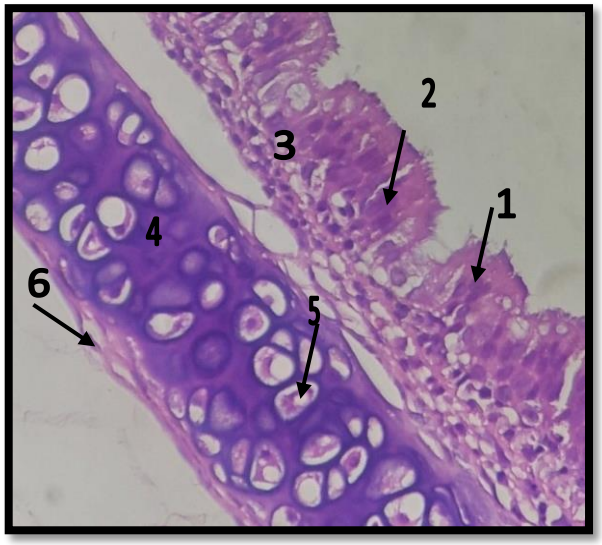

Figure 6: Cross section of adult rat trachea, epithelium (1), goblet cell (2), sub mucosa(3), cartilage (4), chondrocyte (5), adventitia (6), (H&E stain 100X)

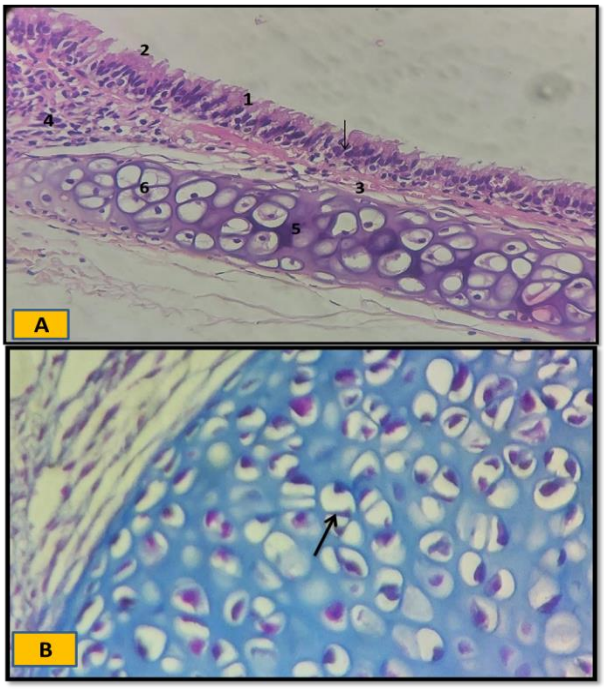

Figure7: Cross section of adult rat trachea, A- Respiratory epithelium (1), ciliated cells (2), sub mucosa. (3), glands (4), cartilage (5), lacuna (6), goblet cells (H&E 400X)

B- cartilage, chondrocyte , matrix (Masson trichrome 400X)

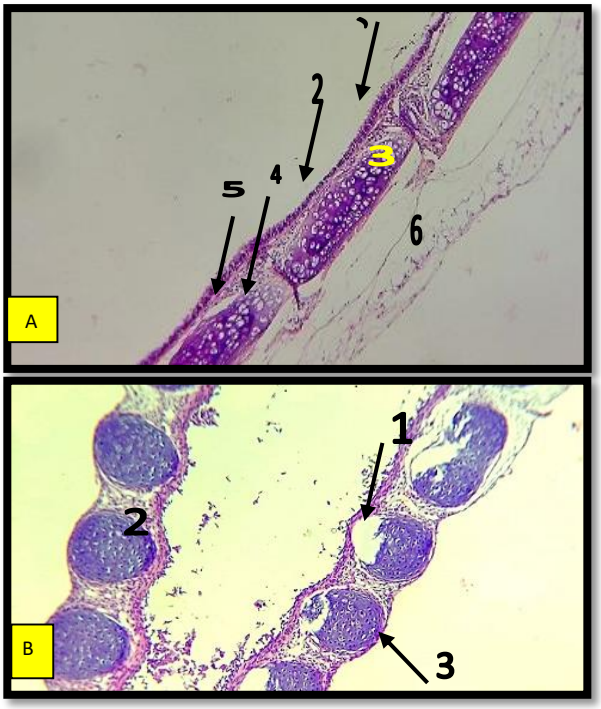

Figure 8: Cross section of one day age rat trachea, A- epithelium (1), goblet cells (2), cartilage (3), lacuna (4), chondrocyte (5), adventitia (6), (H&E 200X)

B- cartilage, epithelium (1), cartilage (2) , adventitia (3), (H&E 400X)

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