

## Histological Study of Lower Respiratory System on Cats (*Felis Catus Domesticus. L*)

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The present study was designated to demonstrate the histological features of Lower Respiratory System in Cats. The histological specimens of the trachea, bronchi and lungs were stained with haematoxyline and eosin, alcian blue at a pH (2.5), Periodic Acid-Schiff (PAS), Van Gisons and Masson Trichrom stains. The microscopic results of the trachea demonstrated incomplete hyaline cartilaginous ring like c-shape and it had four types of cells were identified in cross section of mucosa (pseudostratified columnar ciliated with goblet cells), then the sub mucosal glands which separated from the underlying hyaline cartilage. The ends of hyaline cartilage were attached by smooth muscle called tracheal muscle, the sub mucosal glands located internally to the trachealis muscle, the sub mucosa present tubulo-acinar shape and composed of mixed secretory cells (serous and few mucus), they were greater in the ventral aspect and less in the dorsal aspect of the trachea. The lung was surrounded by a thin layer of flattened cuboidal mesothelium cell called pleura, the bronchus divided to primary and secondary bronchus which lead to the tertiary bronchus continuously reach to the terminal bronchioles which opening into the respiratory bronchioles, and finally connected to the alveolar duct and then alveolar sac compose of the alveoli which consist of the three types of cells: type I was the predominate cell: squamous cell, responsible for gaseous exchange, while type II cell was the source of pulmonary surfactant and macrophage or dust cell.

**Key Words:** Microscopic feature of lower respiratory system, Trachea, Lung, Cat, (*Felis Catus Domesticus. L*).

### Introduction

The feline respiratory system serves a dual purpose it is not only a system of replacing carbon dioxide in the body with oxygen, but also the singular cooling system that the animal has unlike humans, cats have sweat gland in their feet and cannot sweat to maintain body temperatures. In order to reduce the body temperature, cats must breathe harder for a faster exchange of warm air with the cooler air out side. The respiratory system of cats is almost similar to human inhaled air enters the body through the nostrils and the mouth, and moves through a complex setup of cavities and tubes (1). The respiratory organs also play an important function like phonation, flection, body temperature regulation, Production and removal of many substance like histamine and etc. (2,3)

### Materials and Methods

This study was carried out in a total number of twenty four healthy adult of Iraqi local breed of cats of both sexes (male and female), were collected from Diyala Governorate weighting range between (2600-5000)g aging (10- 50 months) determined by their dental formula were anaesthetized with intra muscular doses of xylazine doses 10mg/kg B.W. with Ketamin 15 mg/kg. B.W. and opened the common carotid artery, to bleed until death, then removal of the trachea and lung from the thoracic cavity immediately. The samples were taken after death from all lobes of each lung and trachea. These samples were collected and fixed in 10% neutral buffered formalin and left for 72 hours.

### Results and Discussions

The microscopic results of the current work indicated that the trachea of cat as the wall of the hollow organs composed of four tunica: (fig. 1)

1- Tunica Mucosa: which composed of three layers: a- Epithelium b- Lamina propria c- Muscularis Mucosa

2- tunica Submucosa:

3- Tunica Muscularis:

4- Tunica Adventitia, these results were in agreement with (3,4,5) in sheep and hamster.

**The epithelium** of the trachea in cats was pseudo stratified ciliated columnar epithelia with goblet cells lied on basement membrane (fig. 1) which composed of four types of cells. The major secretory cells was mucous cell. All these cells rested on the basement membrane. The nuclei of these cells however were disposed at different levels. The description of the morphology and distribution of the four distinct cell types are differ as following:

1- Goblet cell: The cell is flask shape mucous cell, the height was varied, with flattened compressed nucleus occupied a portion of cytoplasm, (fig 1) which contain the granules of secretory mucigen. The goblet cell was positive alcian blue at PH 2.5 (fig.2) stained strongly acid mucopolysacchorides (carboxylate + sulphate type). This result in cat same as the result reported in Yak. (6)

2- Ciliated cells were specialized to transport secretions in the airway. This cells were more common in lower respiratory (trachea, bronchus).

3- Basal cells were small, triangular to rectangular cells with small nucleus surrounded by a margin of very dense cytoplasm lie on basement membrane.

4- Intermediate cells were ciliated, small amount from goblet cell with spherical nucleus (fig. 1). This result of epithelium in cat support research in sheep reported by(4).

**The muscularis mucosa:** This layer composed from very few smooth muscle bundles (fig 1).

**Tunica Sub Mucosa:** which contain the glands which located between the muscle and the epithelium were tubulo-acinar composed of serous secretory cell and few mucus glands (fig. 3). This result in the cats was the same as the result in yak ,In angora goat; (In the goat supports a similar observation in sheep (6,7,8)

The trachea of the cat contained few or no glands internally of the centers of the cartilaginous rings, but they were abundant between rings. The glands greater in the ventral aspect and less in the dorsal aspect of the trachea (fig4). The acini were found predominately between muscle and epithelium (fig 3). This result same as the result reported in most mammal (8) and different from in rabbit the trachea there is no gland.(9)

**The tracheal muscles** attached on the external side of the cartilaginous ring. This result similar the result stated in mammals.(8)

**Tunica Adventitia:** The sub mucosa merges with perichondrium of the underlying Hyaline cartilage ring as here, with the dense fibro elastic between the cartilage ring. Hyaline cartilage shown in( fig. 3) two zones are evident on Inner zone narrow, pale stained peripheral zone which merges with adjacent support by a large mass of cartilage matrix while the cells of each cluster are separated by only a thin layer of matrix (fig. 4). This result of the cat similar most species (3) , in hamster (5), in angora goat.(7)

**Bronchus:** Divided two or more bronchus include primary ,secondary ,and tertiary bronchus ,

**The primary and secondary bronchus:** Was similar to that at the trachea but differs in several details as follows:

a- The epithelium of primary bronchi were pseudo stratified columnar ciliated epithelium which were folded, less tall and contain fewer goblet cells. stained by (Van Gison) stain (fig 6).

b- Lamina propria was more dense with large quantity of elastin in its more superficial layer it was separated from the sub mucosa by a layer of smooth muscle which become progressively more prominent in smaller air way (fig 6). This air way's smooth muscles varied and become shorten in case .

**Tertiary (segmental) bronchus:** The present study of the tertiary bronchus in cat elucidate that its structure was progressively change to resemble more closely to that of large bronchioles. The mucosa was folded, is now tall columnar with little pseudo stratified epithelium with goblet cell and ciliated cell very little non ciliated cell (fig. 7). These results were agree with Mariassy and Plopper) in sheep,(4) in Syrian golden (5). The lamina propria was thin elastic and completely enclosed by smooth muscle. This

arrangement of smooth muscle permits contraction of the bronchi in both length and diameter during expiration, mucosa glands were rarely seen in Bronchiole.

**The bronchioles of cat:** It had less cartilaginous support, and have no cartilage support and sub mucosal glands (fig.7). Thus mucosa highly folded simple columnar ciliated epithelium in type. Generally, the bronchioles epithelium in cat consists of:

a - Ciliated cells: were tall cuboidal contain the nuclei occupied large placed of cytoplasm which stain in Masson Trichrome dya.

b- Clara cells (non -ciliated cell): tall-dome-shaped, tall columnar, had a light-staining cytoplasm, large centrally nucleus (fig.7)

Lamina propira composed of elastic fibers and the smooth muscle forms a complete ring and there was no adventitia. The smooth which composed of bundles a arranged in various orientation which effectively to controls resistance to air flow within the lung (fig.7).

**The bronchioles including the following results**

**The terminal bronchioles:** The terminal bronchioles which subdivided in two or more respiratory bronchioles linkage ring between. The conducting airways and respiratory airways and these enclosed with the pulmonary arterioles (fig 8) during its passage in lung parenchyma. The mucosa of terminal bronchioles was folded satellite lumen and lined by simple low columnar epithelium with no goblet cells and two types cells ciliated and non-ciliated cells. The lamina propria and smooth muscle continuous with sub mucosa.

The sub mucosa: thin layer of smooth muscles cells and fibers . The mucosal glands and cartilage were lacking. The terminal bronchioles in the cats appear to be similar to that seen in most mammalian species including Angora goat (7), adult goat (10) Macaque monkey (11), but the terminal bronchioles in laboratory animals (mice, rat, gerbil, hamster and rabbit) were short and open directly into several alveolar ductless in guinea pig (12) and in laboratory animals (mice, rat, gerbil, hamster and rabbit)(13).

**Respiratory bronchioles and lung parenchyma:**

The first portions of respiratory airway the end of terminal bronchioles divided into two or more respiratory bronchioles (fig 9) which lined by simple cuboidal epithelium. This type of cells had no cilia in cells (Clara cells). Thin layer of smooth muscle cells and in addition to collagen fibers can be see (fig. 3,6). The respiratory bronchioles in cats terminated into several alveolar ducts. The alveolar ducts lead into alveolar sac, each comprising several alveoli. This result in cat the same as the most mammalian species such as show on most animals (3), in goat (7).

The respiratory bronchioles of cats different from results in guinea pig (12) and the common laboratory mammals (13), the respiratory bronchioles were

rudimentary or absent in laboratory rat. Surface epithelium: this epithelium lining to each alveolar and consisted of two types of cells, most of the alveolar surface area was covered by large squamous cells called type I pneumocytes, these cells characterized by flattened irregular shape cells with high density stained nuclei which characterized by these cells very similar in cytoplasm constituents thin sheets of peripheral cytoplasm extending a way from the nucleus like ( ) (fig. 9). Pulmonary alveolar type I cells were a part of thin tissue bounding that limited of the alveoli in the lung and separated in haled air

from blood in the capillaries. These results in cats were the same as the result reported by research (Davis *et al* (12) Guinea pig (14) ; In adult rat (15) and in caprin Lung (16).

Type II pneumocyte: a second epithelial cell type known as the type II pneumocytes, these cells were rounded in shape and thus they were less than type I pneumocyte. Type II pneumocytes secrete a surface active material called surfactant which reduce the surface tension within the alveoli, prevent alveolar collapse during expiration. fig (10).

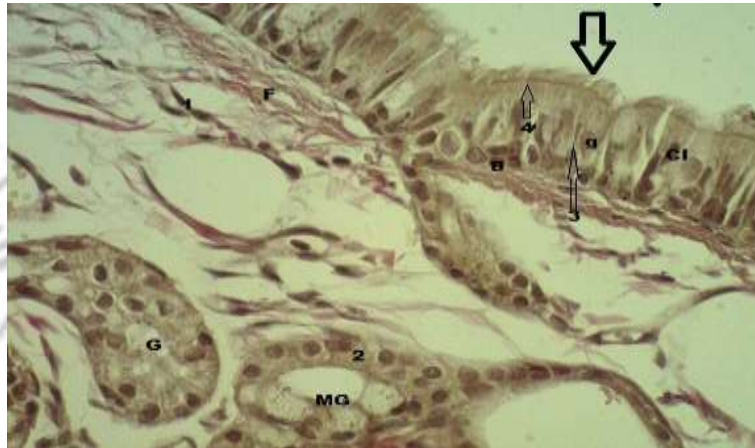


Fig.(1): Histological section illustrates the tracheal epithelium, lamina propria, submucosa in cats 1-arrow cilia g=goblet cells. Ci=ciliated cells. B=basal cells. F=collagen fibers. MG=mucous glands. 1-fibroblast 2-demilunes 3=intermediate cells 3-basal bodies. G= gland. (van Gieson stain x100)

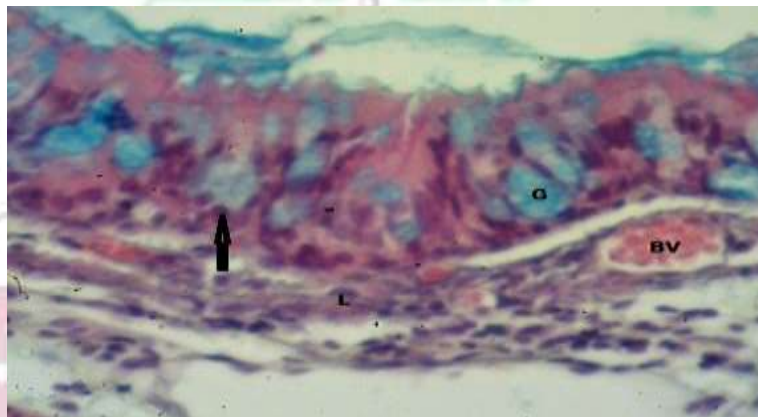


Fig.(2): Histological section illustrates the tracheal epithelium, G= goblet cells (acid reaction) blue, the arrow goblet cells its flask shape , BV=blood vessels , L=lamina propria. See the lymphatic cell (Alcian blue stain at PH 2.5 x400).



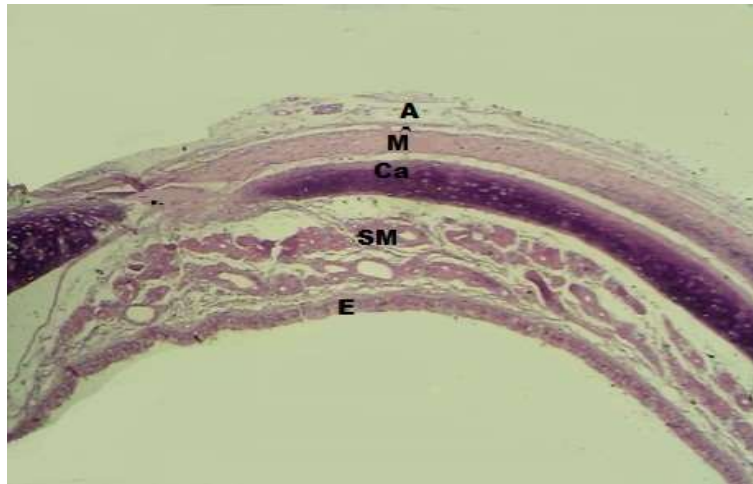


Fig.(3): Histological section illustrates the tracheal gland of cats highly density in ventral wall. E=pseudo stratified columnar ciliated epithelium with goblet cells. SM= Sub mucosa=submucosa glands Ca= hyaline cartilage. M= trachealis muscle (externally) A=adeditia. (H&E stain x200).



Fig.(4): Histological section illustrates the tracheal glands of cats are lower density in dorsal wall. E=epithelium. Ca=cartilage. G=gland. (E&H stain x200)

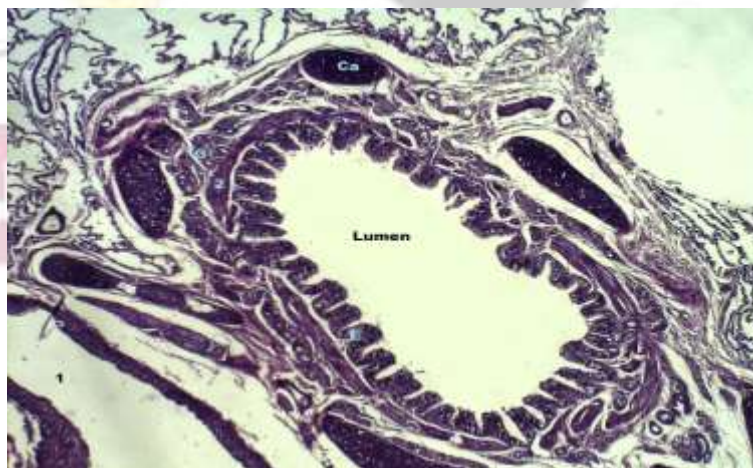


Fig.(5): Histological section illustrates the primary bronchi within lung. The positive reaction with Lumen of bronchi. E=epithelium (PAS stain x200).



Fig.(6): Histological section illustrates the primary bronchi within lung. E= pseudo stratified columnar ciliated epithelium. G= goblet cells. LP= lamina propria. Ci= cilia. (Van Gison stain x1000).

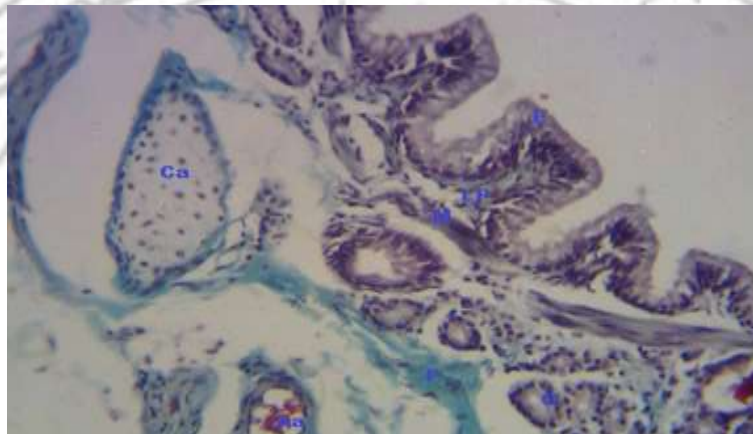


Fig.(7): Histological section of the tertiary bronchi illustrates the mucosa, sub mucosa, Muscularis Mucosa E=pseudo stratified low columnar ciliated. Lamina propria= collagen +elastic fibers. (masson trichrom stain x400).

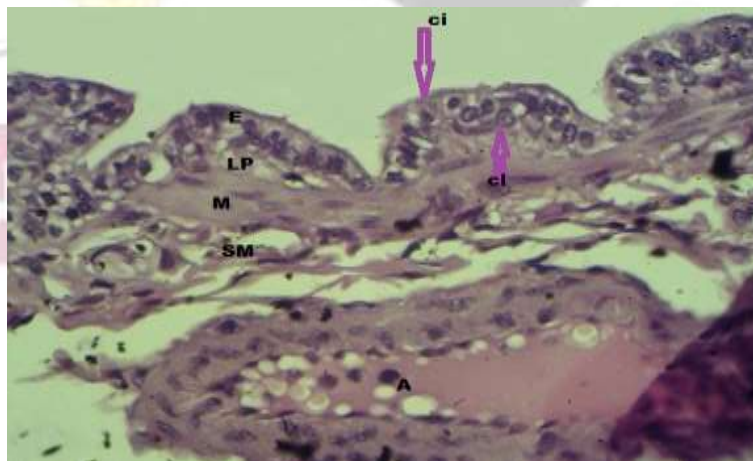


Fig.(8): Histological section of parenchyma illustrates the terminal bronchiole, respiratory A= arteriole, M =muscularis mucosa cl= clara cell . (H&E stain x400).



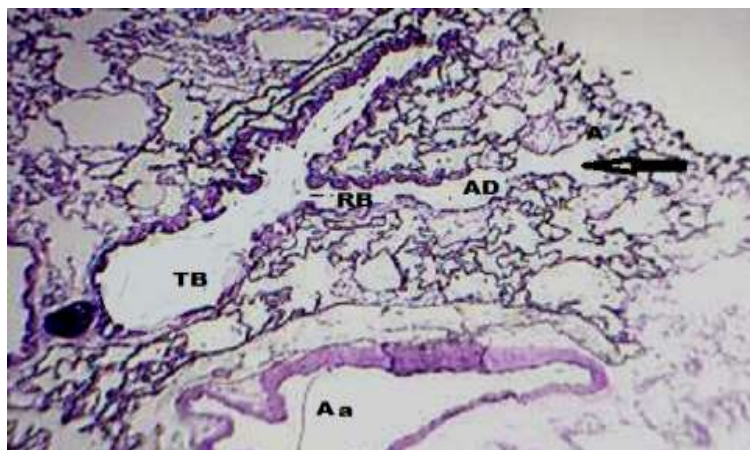


Fig.(9): Histological section illustrates the TB=Terminal bronchiole. RB=respiratory bronchiole. AD=alveolar duct. (arrow) AS=alveolar sac opening in alveolar. Aa=arteriole (PAS stain x200).

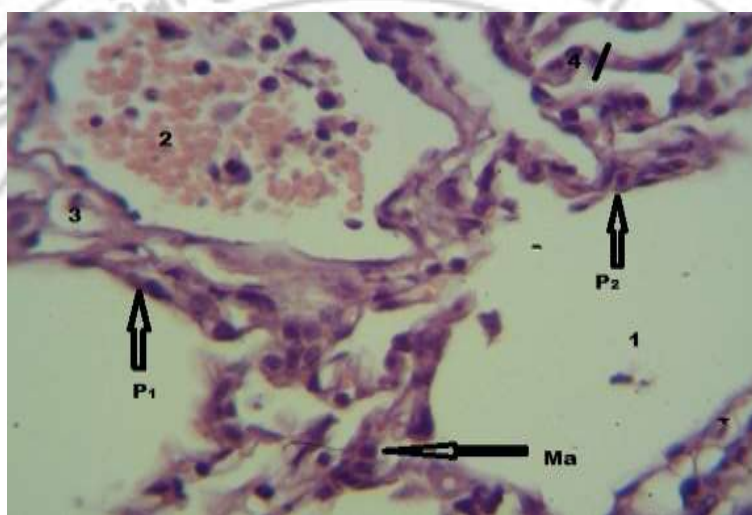


Figure (10): photomicroscope of the cat (*Felis catus*) pulmonary alveolar (E&H stain x400) illustrates: P1=type I cell (squamous cell). P2=type II cell. Ma=dust cell (macrophage). 1= alveolar sac. 2=alveolar septum. 3=pulmonary arterioles.

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## دراسة نسيجية للجهاز التنفسي السفلي في القطط

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### الملخص

خصصت الدراسة الحالية لإظهار الصفات النسيجية المميزة للجهاز التنفسي السفلي في القطط. العينات النسيجية من القصبة الهوائية و الرغامى والقصبات الهوائية والرئتين تم معاملتها باستخدام صبغات الهيماتوكسيلين، فان كيزن، شيف فوق الأيودين و ثلاثية الكروم. أظهرت النتائج المجهرية المأخوذة من المقطع العرضي للرغامى ان خلايا ظهارة الرغامى تشمل (الخلايا الكاسية، والخلايا العمودية المهيدة، والخلايا القاعدية) ثم الطبقة تحت المخاطية التي تتفصل عن الطبقة التي تحتها وهي الغضروف الزجاجي كذلك ان نهايات الغضروف الزجاجي تتصل ببعضلات ملساء تدعى العضلات الرغامية التي تربط حافتي الغضروف الخارجية للغضروف مع بعضها ، وملاحظة الغدد الرغامية التي تقع إلى الجهة الداخلية للعضلة الرغامية في المنطقة تحت المخاطية وهي من نوع الغدد البسيطة النيببية العنقية ذات الإفراز المختلط (مصلي ومخاطي) وتتركز بكثافة عالية في الجهة البطنية لرغامى، بينما كانت أقل منها في الجهة الظهرية. أما الرئتين فإنها تحاط بطبقة رقيقة من الخلايا الميزنكيمية تسمى غشاء الجنب. أما القصبة الهوائية فهي تنقسم إلى قصبية هوائية أولية وثانوية إلى أن تنتهي بالقصبية النهائية التي تؤدي إلى القصبية التنفسية وأخيراً بالحوصلات الرئوية حيث تتشكل الوحدة التنفسية التي يحدث فيها التبادل الغازي. والحوصلة الهوائية تتألف نسيجياً من ثلاث أنواع من الخلايا ألتنفسية النوع السائد نوع I خلايا حرشفية مسؤولة عن التبادل ونوع الخلايا II فهي خلايا إفرازية تفرز مادة السيرفاكتن الذي يمنع وهط الرئة. والنوع الثالث الخلايا الغيارية (الملتهمة).

**الكلمات المفتاحية:** الصفات المجهرية للجهاز التنفسي السفلي ، الرغامى ، الرئة ، القطط

المؤتمر العلمي الثالث