

Histological and Histochemical Study of the Trachea of Billy-Goat *Capra Hircus* During Different Ages

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Article Information

Received: April 23, 2023

Accepted: May 26, 2023

Published: July 27, 2023

Keywords

Trachea, Development,
Goat, Histochemical

ABSTRACT

The study's goal to define the trachea's characteristics in goats, was carried out on (5) as suckling kids and (5) as young kids. The trachea's wall is made up of muscle, adventitia, cartilage, submucosa, and mucosa, mucosa was lined by ciliated pseudostratified columnar epithelium contained (columnar, goblet and basal) cells, goblet cells were more than in thoracic trachea than that in cervical trachea, and young ages had higher percentage of goblet cells than suckling ages. Alveolar mucous glands and blood vessels made up the lamina propria-submucosa; there are several mucous simple alveolar glands in the cervical epithelium, mucous glands in the thoracic epithelium replaced by goblet cells. The cartilaginous rings were flattened, and perichondrium-enclosed. Dense fibroelastic tissue and smooth muscle joined the posterior ends of the cartilages, the ground substance and chondrocytes make up the cartilage that covered by adventitia, muscle was made of smooth fibers and elastic fibers. The goblet cells had a mildly positive reactivity to Alcian blue with periodic acid, negative to Alcian blue, and positive to periodic acid Schiff.

INTRODUCTION

The goat's trachea is a tube-like structure that found from a cricoids cartilage to where it divides into bronchi. It has 38–43 rings of hyaline cartilage that form an incomplete ring to the dorsal of the structure. The tracheal membrane connects each ring-shaped cartilage dorsally while the trachealis attaches to the cartilage externally (1,2). According to position, the trachea is separated into the cervical and thoracic parts in most mammals (3). Histologically; Mucosa, submucosa, muscularis, and adventitia make up the trachea. The respiratory epithelium, submucosa, and well-developed adventitia make up the lining, which has an incomplete cartilaginous ring (4,5). The tracheal epithelium composed of columnar ciliated, smaller basal and goblet cells in *Bos grunniens* (6), in camel including four different cell types: basal cells,

ciliated cells, goblet cells, intermediate cells sitting on the basement membrane (7).

The ciliated cells are entirely present in the trachea and just marginally so in the bronchi of newborn dogs and cattle, but they are absent from the airways of calves and pups' distal respiratory bronchioles (8). (5) discovered that ovine and porcine epithelial cells with cilia are designed to the secretions in the airway. The movement of ion and water across epithelia is carried out by these ciliated cells. The trachea of a newborn dog contains dense cilia covering its dorsal and ventral surfaces, as well as longitudinally oriented folds on its dorsal walls (9). In Camels, the respiratory epithelium lines the mucosal fold of the tracheal mucosa, which is made up of the loose connective tissue called lamina propria (10,11). The goal of the current study was to shed light on the characteristics of the goat trachea using histological and histochemical methods. This knowledge was crucial for providing baseline data for investigative researches and aids in understanding physiology, pathology, and other sciences. There aren't many articles on trachea developmental study of the goat in Iraq.

Materials and method

The investigation was conducted utilizing Ten healthy local breeds of Billy-goats (*Capra hircus*), five of which were sucklings at forty days old and five of which were young at ninety days old, were collected from the AL-Muthanaa abattoir between January and May 2022. Samples were taken from various regions of the trachea (the cervical and thoracic parts), and five specimens from each region were fixed in formalin 10% for 24 hours then being subjected to histological technique, the stains that used; Harris hematoxylin and Eosin (H&E) stain; For demonstrating the general histological components, Periodic acid/Schiff (PAS) stain; To the carbohydrate, mucoprotein, glycoprotein, mucopolysaccharides, and basement membrane, accompanied the Periodic acid /Schiff (PAS-AB) with alcian blue to neutral mucopolysaccharides and Masson's trichrome stain; To the smooth muscles and collagen (12). The thickness each of mucosa, submucosa, and adventitia tunicae of each tracheal segment was measured use an ocular micrometer in five sections at each age. The cells in 10 fields (per microscopic field (X200) from each region of the trachea were counted using a goblet technique. For each measurement, the mean (\bar{x}) and standard error (S. E) are computed for thirty slides of each section (13).

Results

The four layers of the trachea's wall were adventitia tunicae, submucosa, muscularis, and mucosa. The lamina propria-submucosa, which was composed of loose connective tissue and contains lymphocytes, longitudinal arrangements of elastic fibers and blood vessels, and well-developed adventitia which cover incomplete cartilaginous rings, encircles the respiratory epithelium and goblet cells that make up the mucosal lining (Fig.1-3). The columnar ciliated, goblet cell, and basal cells made up a sizable percentage of the tracheal epithelium in young kids (Fig.2,4). The ciliated cells were completely in young age trachea, while was not found in some part of thoracic portion of trachea of suckling kids (Fig.1,5).

The goblet cells, which produce mucus and were dispersed erratically among the columnar cells that lined the trachea's length, were sandwiched among the other cells by wedge-shaped basal cells (Fig. 6), and all trachea portions' epithelium is thicker, has a higher cell density, and rests on a thicker membrane than that stated for the trachea of sucking ages when they are young kids (Fig.7,8). Tracheal glands are more numerous in the ventral than dorsal portions of the trachea (Fig.1,3),

The tracheal epithelium's cervical region contains many simple alveolar mucous glands, whereas the thoracic portion contains fewer mucous glands and most of its regions were home to "intraepithelial glands," which have taken the place of mucous glands in the cervical tracheal epithelium and were less developed in the cervical trachea than the thoracic trachea in both ages (Fig.1,8), In the direction of the thoracic portion of the trachea, the thickness each of mucosa and submucosa tunicae was steadily reduced (Table 1). The tracheal glands in sucking and young kids were mixed glands and showed a positive response to PAS and to PAS-AB (Fig. 1,2), the chondrocytes found in clusters in the matrix, the cartilage matrix reacted strongly with PAS; chondrocytes, on the other hand, reacted weakly, and the perichondrium reacted strongly with PAS (Fig. 1,3,5,6), While with PAS-AB stain the matrix of cartilage, perichondrium and chondrocytes were reacted moderately (Fig.2).

The trachealis muscle, found on the posterior membrane region of the trachea, connects the cartilaginous ends by bundles of the smooth fibers. The tiny bands of smooth muscles that make up the posterior trachea wall, which is devoid of cartilage, keep it in place (Fig.7). The trachea's seromucous coiled tubuloacinar branched glands were internal to the trachealis muscle, that was linked to the cartilaginous rings' outer surface (Fig. 5,6), the mean of number of goblet cells in cervical and thoracic parts of trachea in suckling kids was (35 ± 2 , 30 ± 1), while in young kids was (42 ± 1 , 36 ± 2) and their number in cervical part of trachea more than that in thoracic part, thickness of mucosa in cervical trachea in suckling kids was ($86.5 \pm 1.1 \mu\text{m}$), while in young kids was ($100.7 \pm 1.2 \mu\text{m}$), and it thickness in thoracic trachea in suckling kids was ($81.6 \pm 1.4 \mu\text{m}$), while in young kids was ($92.4 \pm 1.2 \mu\text{m}$), and thickness of mucosa in the cervical trachea was thicker than that in the thoracic trachea of each study animals (Table 1). Thickness of submucosa which consist of dense connective tissue and gland, in cervical and thoracic parts of the trachea in suckling kids was (301.1 ± 2.2 , $284.2 \pm 2.1 \mu\text{m}$) respectively, while in young kids trachea was (351.2 ± 1.2 , $297.1 \pm 0.1 \mu\text{m}$) respectively. Thickness of adventitia which consists of loose connective tissue in cervical and thoracic parts of trachea in suckling kids was (61.3 ± 0.2 , $64.1 \pm 0.3 \mu\text{m}$) respectively, while in young kids trachea was (68.2 ± 0.3 , $71.4 \pm 0.1 \mu\text{m}$) respectively (Table 1).

Table(2) :Measurement of thickness of the wall layers and number of goblet cells (Per microscopic field (X200)) in trachea of Billy-goat (μm) ($\bar{X} \pm \text{S.E}$)

Part Measure	Tunica mucosa	Tunica submucosa	Tunica adventitia	Number of goblet cells
Cervical part in suckling kids	86.5 ± 1.1	301.1 ± 2.2	61.3 ± 0.2	35 ± 2
In young kids	100.7 ± 1.2	351.2 ± 1.2	68.2 ± 0.3	42 ± 1
Thoracic part in suckling kids	81.6 ± 1.4	284.2 ± 2.1	64.1 ± 0.3	30 ± 1
In young kids				

	92.4 ±1.2	297.1±0.1	71.4±0.1	36±2
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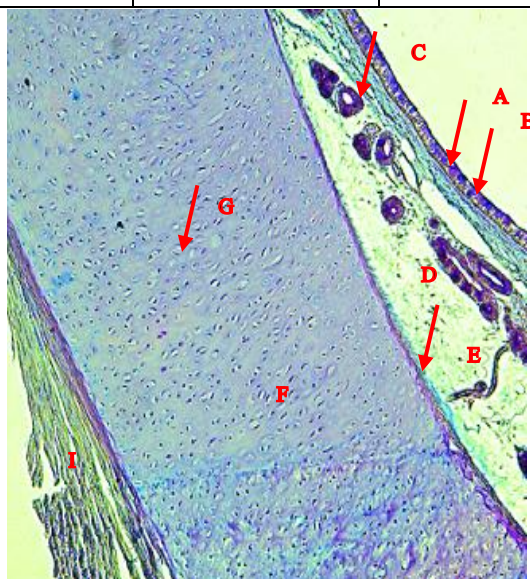


Fig.(1): Cross section of the cervical trachea of suckling kids; epithelium (A), goblet cell (B), gland (C), submucosa (D), perichondrium (E), cartilage (F), chondrocyte (G), smooth muscle (I), PAS, 200X

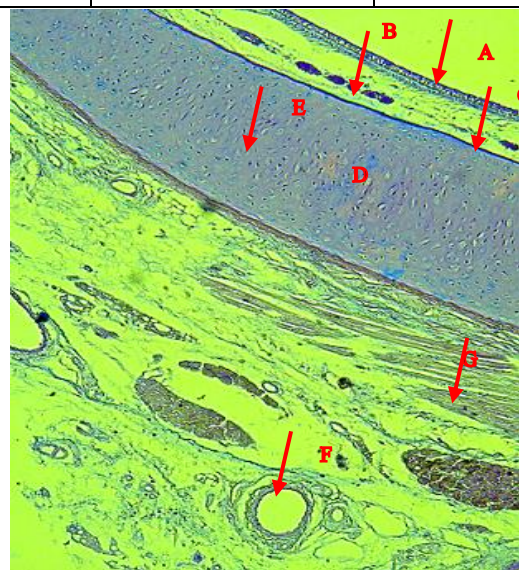


Fig.(2): Cross section of the cervical trachea of young kids; respiratory epithelium (A), gland (B), perichondrium (C), cartilage (D), chondrocyte (E), blood vessels (F), muscles (G), PAS-AB 100X.

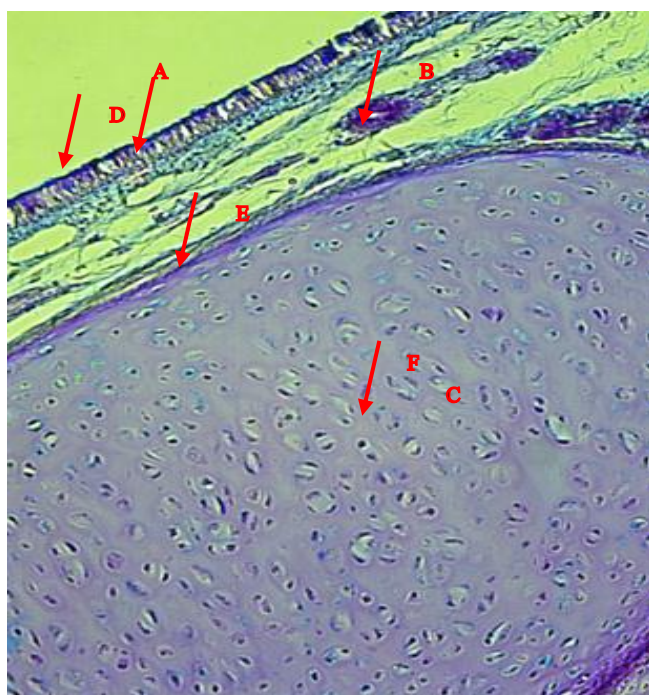


Fig.(3): Cross section of the thoracic trachea of suckling kids; mucosa (A), glands in submucosa (B), cartilage (C), goblet cells (D), perichondrium (E), chondrocyte (F), PAS stain, 200X

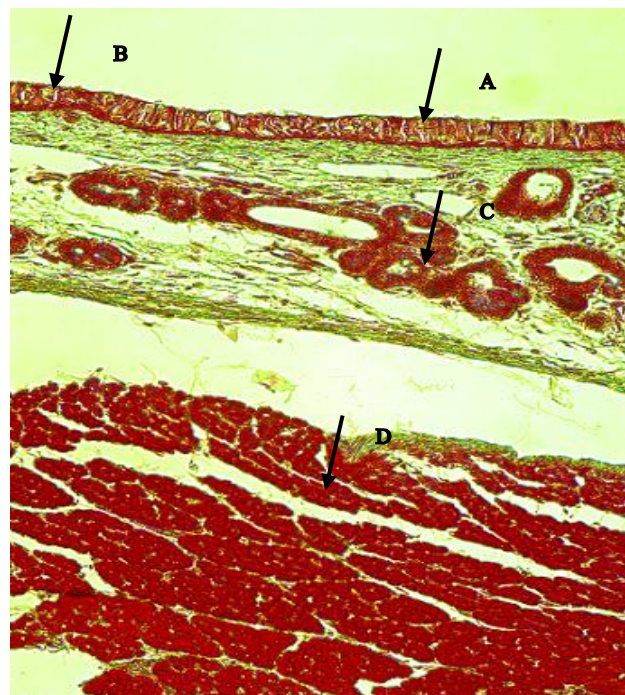


Fig.(4): Longitudinal section of the thoracic trachea of young kids; mucosa (A), goblet cell (B), mucous glands in submucosa (C), smooth muscle (D), Masson stain, 200X

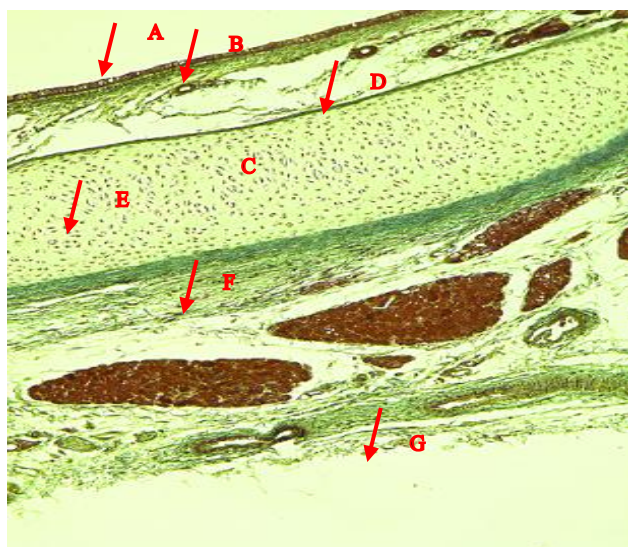


Fig.(5): Cross section of the cervical trachea of suckling kids; epithelium (A), glands in submucosa (B), cartilage (C), perichondrium (D), chondrocyte (E), smooth muscle (F), adventitia (G), Masson stain, 100X



Fig.(6): Cross section of the cervical trachea of young kids; epithelium (A), glands in submucosa (B), cartilage (C), perichondrium (D), chondrocyte (E), blood vessels (F), Masson stain, 100X

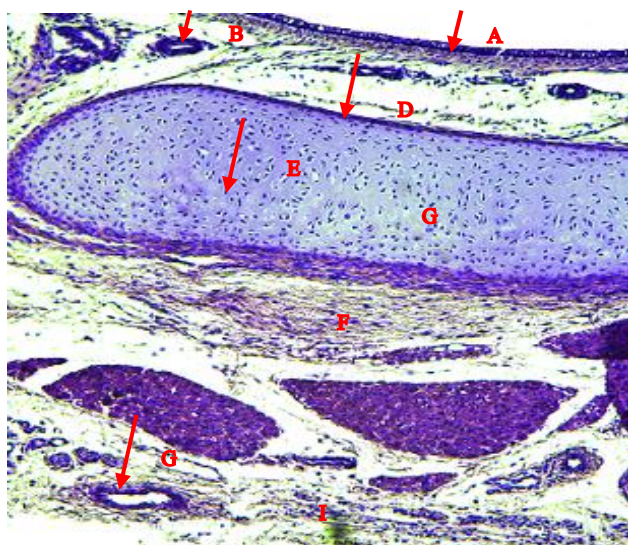


Fig.(7): Cross section of the cervical trachea of suckling kids; epithelium (A), glands (B), cartilage (C), perichondrium (D), chondrocyte (E), smooth muscle (F), blood vessels (G), adventitia (I), PAS stain, 200X

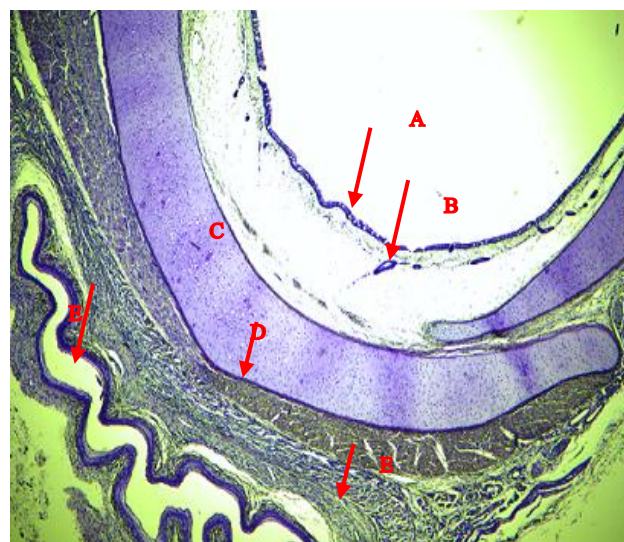


Fig.(8): Cross section of the cervical trachea of young kids; mucosa (A), glands in submucosa (B), cartilage (C), perichondrium (D), smooth muscle (E), lumen of esophagus (F), PAS stain, 100X

Discussion

Goat trachea mucosa is made up of many goblet cells and pseudostratified ciliated tall epithelium that rest on a basement membrane, (14) presented a comparable description of domestic animals, and the cells and respiratory epithelium are similar to those described by (11) in camel, (6) in Iraqi sheep and goat, and (15) in rabbit. The respiratory epithelium of camel tracheal mucosa, which is short and lined by ciliated, goblet intermediate, and basal cells sitting on the basement membrane (12). The trachea in a newborn dog features creases in the dorsal wall that are covered by dense cilia (17). (20) who reported; the trachea of a goat is lined by a respiratory epithelium with goblet and basal cells that lie on the basement membrane, unlike the airways of rodents, which lack ciliated cells, All of the trachea of nursing animals have ciliated cells, while all of the trachea of newborn animals have non-ciliated columnar epithelium (6).

(1) it should be emphasized that ovine and porcine tracheal ciliated cells are designed to convey secretion in the airway. The movement of ion also water across epithelia is carried out by these ciliated cells. (3) Notably, serous cells, non-ciliated bronchiolar epithelial (Clara) cells, and secretory mucous cells are hypothesized to make up the tracheal epithelium in mammals. The ciliated cells are cover in mucus which produced by goblet cells and spreads by the weather mean. Mucus from the respiratory tract adhering to ciliated epithelial cells (1,2). As in domestic mammals, goblet cells are distributed in the trachea and are involved in the generation of mucus, were squeezed between the other cells by basal cells (17).

The tracheal glands are mucous in suckling kids and branched seromucous coiled in young kids, The number of goblet cells in this study is difer between tracheal parts and between ages, same results in the cat, sheep and monkey trachea (1). According to our findings, the trachea contain significant amounts of acidic and neutral polysaccharides. The number of goblet cells with both acidic and neutral mucins rose during the sucking stage. These findings agre with those made by (19) in goat and sheep (2) and by (19) in ox. In this study, there are more goblet cells for protection. (3) who reported the greatest number of species in which the gland, the surface of cartilaginous ring, and trachealis muscle are external to the muscle. The glands were internal to the muscle in all species where the muscle is link to the outside surface of cartilaginous rings. The ventral rather than the dorsal portion of the trachea contains glands in dog, goat, ox, and sheep. The specialized tracheobronchial glands extended into the submucosa from the airway surface epithelium (1).

The (22) noted there are two different types of secretory cells in the tracheal gland of giraffes: serous and mucous. In camels, there are less mucous and more serous submucosal glands (21). In the guinea pig, rabbit, and mouse, tracheal glands are lacking (1). The muscle fibers are joined directly for the perichondrium, which in some species (such as, dogs, cats and rabbits) connects to the exterior of the trachea ring's crescent. Certain animals, as guinea pigs, hedgehogs, have crescents that are directly joined on tip and on both sides in rats (2). The chondrocytes had a mild reactivity, same to that of most mammals, but the cartilage matrix showed a high reaction to PAS (1). Early on, the proportion of goblet cells with neutral mucins increased. This study's enhanced goblet cells serve as protective. **In conclusion**, Different ages of goat trachea revealed variations in the histological layer thickness, as well as the amount and type of the goblet cells.

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