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Histology of the Trachea in Dogs

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Abstract

The trachea was collected from apparently normal six adult dogs of spitz breed aged between 2-4 years of age from the post-mortem of the Veterinary Pathology department. The aim of the study was to observe the histological details of the trachea in the spitz breed of dogs. The tracheal wall consisted of the mucosa, submucosa, hyaline cartilage, and adventitia. Tracheal mucosa was lined by a pseudostratified ciliated columnar epithelium with mucous secreting goblet cell and basal cells. Lamina propria was made up of loose connective tissue and contained some alveolar mucous glands. Muscularis mucosa was a thin layer with smooth muscle fibers arranged in a dispersed manner. The submucosa contained loose connective tissue with numerous mucous secreting tubule – acinar submucosal gland and was found related to the perichondrium of cartilaginous rings. The dense fibroelastic tissue was found between the cartilaginous rings. The cartilaginous rings were flattened in cross-section. Thin tunica adventitia of loose connective tissue and covered the cartilaginous rings. Trachealis muscle was found.

Keywords: Histology, Trachea, Veteinary Science and Dog

The function of the respiratory system is the oxygen and carbon dioxide gaseous exchange, homeostasis of body temperature. The inspired air during inspiration passes from the nasal cavity to the larynx, trachea, and reaches the lung. The trachea is a long tubular organ found in the neck region and thoracic region about the esophagus. The trachea in domestic animals was lined with a layer of classical respiratory epithelium. The epithelium contained goblets cells that secrete mucously and are glandular simple modified columnar cells. The mucous of goblet cells along with the cilia of the lining epithelium of trachea function in the trapping of inhaled foreign particles. The mechanism of elimination of foreign materials with mucous and cilia is called mucociliary clearance (Antunes and Cohen, 2007). The literature available on the histological features of the trachea in dogs is scarce. To fulfill this space, the present study was undertaken.

Materials and Methods

The trachea was collected from six healthy dogs of spitz breed aged between 2-4 years (irrespective of sex) and studied for their histological details. The trachea from different regions, namely proximal, middle, and distal part was cut across into small pieces and was processed conventionally. Paraffin sections of 4 to 5 µm thickness were taken and stained using Haematoxylin and Eosin (Luna, 1968). Micrometrical parameters like the height of the lining epithelium, lamina propria, submucosa, cartilaginous layer, and adventitia layer. Images were recorded using the image size recording system and digiscope imaging system.

Results and Discussion

The present study showed that the wall of the trachea consisted of the following layer from the lumen to the exterior viz. Mucosa, submucosa, hyaline cartilage layer, and tunica adventitia/serosa (Fig. 1). Similar observations were recorded in all domestic animals by Dyce, (1996).

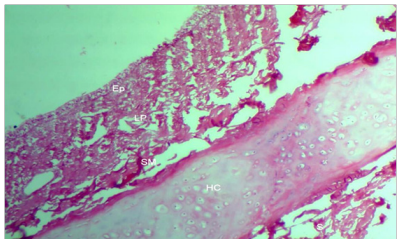

Figure 1 showing the epithelium (Ep), lamina proper (LP), submucosa (SM), hyaline cartilage layer (HC) and serosa (S) in the cross-section of the trachea of dog H & E x 100

The mucosa consisted of lining epithelium, lamina propria and muscularis mucosa (Fig. 3). The lining epithelium of trachea was pseudo stratified ciliated columnar epithelium. The lining epithelium also contained goblet cells and basal cells (Fig. 2). Similar observation was also found in the donkey by Bello et al., (2017) and Japanese Quail by Rajathi et al (2009), in Myna by Rajathi et al. (2018) and in camel by Abdel-Rahman, 1999. The columnar cells were tall in shape with oval dark nucleus located basally. The basal cells were angular in shape with round to spherical shaped nucleus. Erjefalt et al. (1997) mentioned that the basal cells played an important role in airway defense as a barrier structure, where they rapidly flattened out to cover the basement membrane at loss of neighbour columnar cells. The goblet cells were found as modified glandular columnar epithelial cells and were few in number in the present study (Fig. 2). It was an oval shaped cell with round to elongated nucleus located basally. The mucous secreted by goblet cell act as a protective barrier for the tracheal epithelium by lubricating, insulating and providing an appropriate condition for mucociliary clearance (Antunes and Cohen, 2007). The epithelium of trachea did not show the presence of brush cells or clara cells but these cells were found in the trachea of rat (Rhodin and Dalhamn, 1956 and of man (Rhodin, 1966). The mean height of the respiratory epithelium in the present study ranged from 9.58 to 12.54 µm.

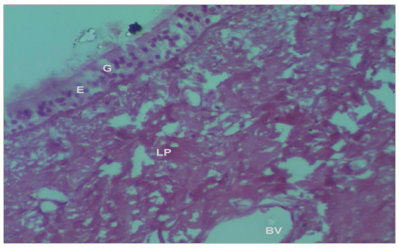

Figure 2 Cross section of trachea of dog showing pesudostratified ciliated columnar epithelium (E) with Goblet cell (G). Lamina propria (LP) containing blood vessels (BV) H & E x 400

The lamina propria was of loose connective tissue with collagen, elastic and reticular fibres. It also contained blood vessels, lymphatics and nerve fibres (Fig. 2). Similar results were found in cats and goats (Mirish and Nassar, 2013).Alveolar mucous gland was found in the present study (Fig. 3). This confirmed with the findings of Abdel-Salam et al (2015) in camel and Bello et al. (2017) in donkey. The width of the lamina propria was 125 to 136 µm. Small mucous glands were found in this layer. Similar glands were also found in the trachea of pigeon (Rajathi et al., 2018). The muscularis mucosa layer in the present study was thin with few smooth muscle fibres (Fig. 3) and similar results were observed in donkey (Bello et al., 2017) and in camel (Abdel-Salam et al., 2015).

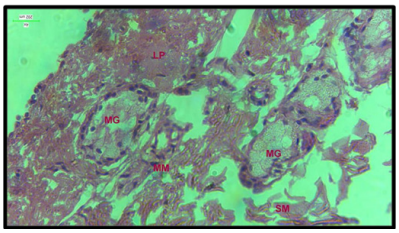

Figure 3: Cross section of trachea of dog showing mucous glands (MG) in the lamina propria (LP) and Submucosa (SM). Muscularis mucosa (MM) was found as thin layer between the lamina propria and submucosa. H & E x 400

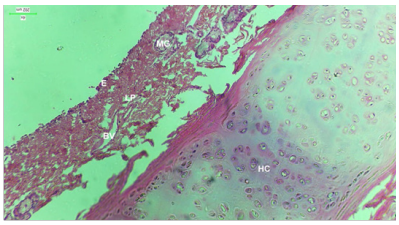

Figure 4: Cross section of trachea of dog showing epithelium (E), Lamina propria (LP), Mucous gland (MG), Blood Vessels (BV) and Hyaline cartilage (HC) H & E x 100

The submucosa was formed by loose connective tissue with blood vessels, nerve fibres and lymphatics (Fig. 3). It contained collagen, elastic and reticular fibres and connective tissue cells like fibroblast, macrophages and plasma cells. It also contained few submucosal mucous glands (Fig. 3) and was lined by pyramidal cells with-wide basal part and slightly narrowed apical part. The nucleus of the mucous glands was oval and placed towards the basal part of the cells. The apical part showed foamy-cytoplasm. The mucous glands were tubuloalveolar in type. Similar observations were found in the trachea of donkey (Bello et al, 2017). The width of the submucosa ranged from 225 to 326 µm.

The cartilaginous layer showed flattened hyaline cartilage of U shaped (Fig. 4). In contrast to this, the donkey trachea had horse shoe shaped cartilage (Bello et al, 2017) and in pigeon, overlapping of cartilaginous rings was found (Rajathiet al., 2018) which was not found in the present study. But in some areas, overlapping of tracheal cartilages was found (Fig. 5). The width of the cartilaginous layer ranged from 20 to 295 µm. The tracheal hyaline cartilage had dark staining perichondrium with flattened nuclei. Centrally it showed lacunae containing chondrocyte and smooth intercellular matrix. The chondrocytes were oval in shape with round nucleus (Fig. 4).

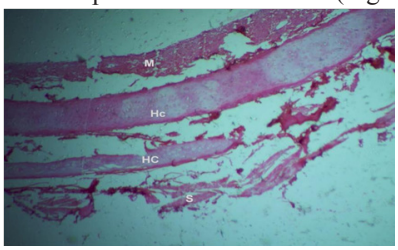

Figure 5: Cross section of trachea of dog showing tunica mucosa (M), overlapping of hyaline cartilage (Hc) and tunica Serosa (S). H & E x 40

The trachealis muscle was smooth and was found lying external to the open end of the cartilage. Similar results were found in carnivores (Dyce, 1996). In contrast to this, the trachealis muscle was found internal to the cartilage in donkey (Bello et al., 2017) and camel (Abdel-Salam et al, 2015).

The tunica adventitia layer was thin and was of loose connective tissue (Fig. 5). Similar observation wasfound in all domestic animals and birds. It consisted of connective fibres, blood vessles, lymphatics, nerve fibres and adipocytes (Dyce, 1996). The width of tunica adventitia was 3.21 to 3.54 µm.

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