



The Anatomical Study of Trachea in The Common Palm Civet (*Paradoxurus hermaphroditus*)

Martina Marina¹, Audrey Tabitha Gracia¹, Woro Danur Wendo²,
Arvendi Rachma Jadi^{2*}

¹Undergraduate Student, Faculty of Veterinary Medicine, Universitas Gadjah Mada

²Department of Anatomy, Faculty of Veterinary Medicine, Universitas Gadjah Mada

*Corresponding author: arvendi@ugm.ac.id

Abstract

*The common palm civet (*Paradoxurus hermaphroditus*) is one of the wild animals that can be found across Java, Sumatra, Kalimantan, Sabah, Sarawak, India, and Sri Lanka. Civet is considered as a nocturnal and arboreal animal. This study aims to determine the anatomical morphology of the civet's trachea, which information is still limited. The trachea of three adult civets of different sexes obtained from Yogyakarta and Lampung were used in this study. Samples were collected, diffused, examined macroscopically, and microscopically processed to produce paraffin blocks. Paraffin blocks were sliced of thickness 4 μ m using a microtome. Samples were stained with hematoxylin-eosin. The staining results were then described to determine the tracheal profile of the civet's trachea. Histologically, trachea has several layers successively from the inside out are the mucosa, submucosa, hyaline cartilage layer, and tunica adventitia. The mucosal layer consists of the epithelium, lamina propria, and the invisible muscularis mucosa. The epithelium portion of the trachea is a ciliated stratified pseudo columnar containing goblet and basal cells. Column cells are oval with a dark cell nucleus at the basal area. The lamina propria part of the civet's trachea consists of connective tissue consisting of collagen, elastin, and reticular fibers. There are seromucous glands between the lamina propria and submucosa. The tracheal musculus is located on the external side of the hyaline cartilage.*

Keywords: Common Palm Civet, Hematoxylin Eosin, Histology, Morphology, Trachea

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Introduction

The Common palm civet, also known as Asian palm civet or toddy cat is classified in the family of Viverridae alongside the other civet species, genet, linsang, and the other carnivore species (Laura et al., 2014). Civet fur color varied from brown to dark grey especially around the body part which has darker fur color, more specifically on the legs, tail, and face. Some species of civet have a distinctive longitudinal line on the dorsal side of the body (Grzimek, 2004). Previous studies have been carried out about the anatomy of the common palm civet, including the brain (Amalo, et al., 2019) and osteology of cranial extremities (Jadi, et al., 2019). The respiratory system generally consists of nasal cavities, larynx, trachea, and lungs. Researches on this topic especially in mongoose, dog, donkey, and other mammals have been carried out around the world (Dyce, 2010; Shil, et al, 2012, and Rajathi, 2020). Until now, there is limited

information regarding the respiratory system of the common palm civet. The study aims to investigate the macro and micro-morphological characteristics of the common palm civet trachea.

Materials and Methods

The material used in this study was the trachea of three adult civets of different sexes with a mean bodyweight of 2.13 ± 0.15 kg obtained from Yogyakarta and Lampung. The sample had been collected in advance for previous research. This research has obtained a Certificate of Ethical Clearance from the Ethical Clearance Commission of FKH Universitas Gadjah Mada No.0016 / EC-FKH / Int. / 2018 and identification of civets by the Animal Systematics Laboratory of the Faculty of Biology Universitas Gadjah Mada No: BI / SH / 36 / V / 2018. Tracheal organs were collected as samples which were processed to obtain paraffin blocks which were then cut to a thickness of $4\mu\text{m}$ using a microtome. The slides were stained with eosin hematoxylin by doing deparaffinization first and continued until rehydration and purification. The results of the staining were seen under a microscope and then interpreted.

Results and Discussions

The anatomical morphology of the civet's respiratory tract, which helps the passage of breathing through the nasal cavity, into the larynx, trachea, and finally enters the lungs, as in the Indian grey mongoose (Shil, et al., 2012) and dogs (Rajathi, 2020).



Figure 1. The Respiratory Tract of The Common Palm Civet

The trachea is a long tubular organ that is located in the neck and thoracic cavity along with the oesophagus (Rajathi, 2020). In civet, the sample of trachea (Figure 1) has a mean length from the tip of the first ring to the tracheal bifurcation of about 11.01 ± 1.1 cm with a diameter of 8.26 ± 0.80 mm.

Table 1. Average Diameter and length of Civet's Trachea

Sample	Measurement (DS: Deviation Standard)			
	Average (mm)		Average (cm)	
	Diameter	DS	Length	DS
Civet 1	8,37	0,06	12,12	0,28
Civet 2	7,41	0,23	9,92	0,22
Civet 3	8,99	0,10	10,99	0,23
Average	8,26	0,80	11,01	1,10

The tracheal rings in civet consist of C-shaped cartilages that are not completely closed and meet at the dorsal point, as in other carnivores such as mongoose and dogs (Shil et al., 2012 and Rajathi, 2020). The civet trachea has several layers in a row from the inside out, namely the mucosa, submucosa, hyaline cartilage layer, and tunica adventitia as in dogs and several other mammals (Figure 2)(Dyce, 2010 and Rajathi, 2020). The mucosal layer consists of the epithelium, lamina propria, and mucous mucosa which are not visible (Rajathi, 2020).

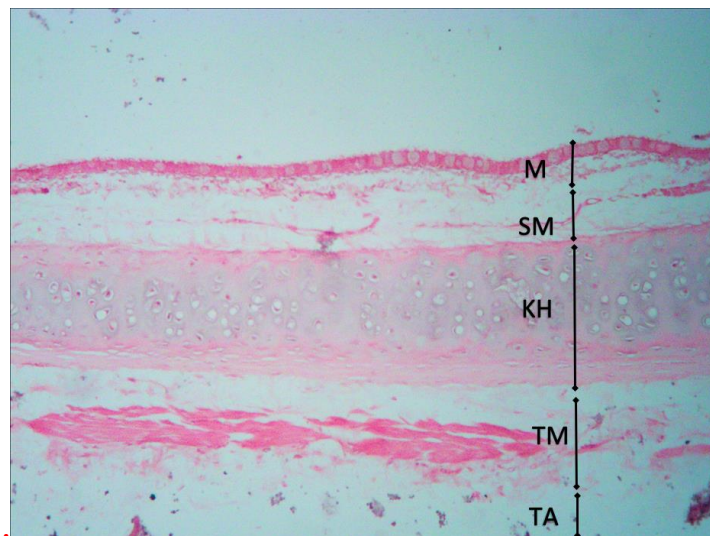


Figure 2. Histology of The Common Palm Civet Trachea with HE Staining and 100X of Magnification (M = Mucosa, SM = Submucosa, KH = Hyaline Cartilage, TM= Tunica Muscularis, and TA = Tunica Adventitia)

The epithelium portion of the trachea is a ciliated stratified pseudo columnar containing goblet and basal cells (Figure 3). Based on these observations, the same thing can also be found in several species such as dogs, mongoose, donkeys, and camels (Dyce, 2010; Shil, et al., 2012, and Rajathi, 2020). The columnar cells are oval with a dark cell nucleus at the basement with goblet cells scattered along the lining. This section is the mucus-producing part which has the function as protective agents in the respiratory tract against dirt and infective agents (Antunes and Cohen, 2007). The loss of cilia in the column sample cells obtained may be due to rupture or damage during sample

preparation. Basal cells are angular in shape with a round to spherical cell nuclei as a barrier and protect when the column layer is lost (Erjefat, et al., 1997).

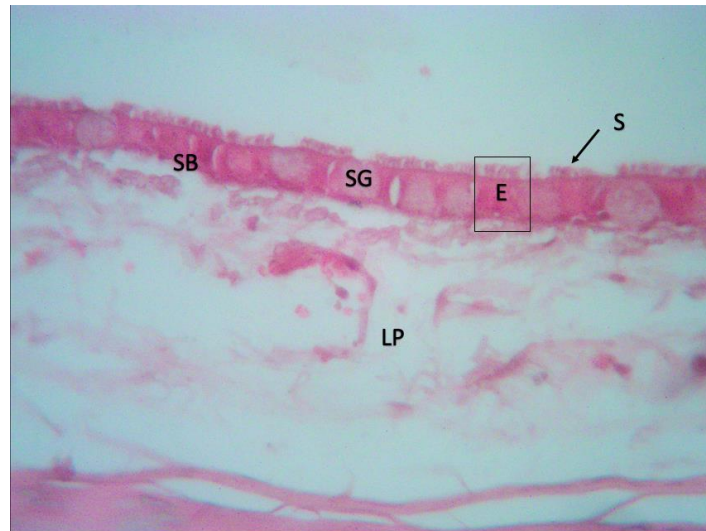


Figure 3. The Common Palm Civet Tracheal Epithelium with HE Staining and 400X of Magnification (S = Cilia, E = stratified Pseudo columnar Epithelium, SG = Goblet Cells, SB = Basal Cells, LP = Lamina Propria)

The lamina propria part of the civet trachea consists of connective tissue consisting of collagen, elastin, and reticular fibers, as found in cats and goats (Mirish and Nassar, 2013). There are seromucous glands in the submucosal layer (Figure 4). Tracheal musculus in ferrets as in dogs and other carnivores are present in the external part of the hyaline cartilage (Rajanthi, 2020) which is a contrast when compared to donkeys (Bello, et al., 2017) and camels (Abdel-Salam, et al., 2015). Tunica adventitia layer consists of connective tissue, which in domestic animals and birds are also the same. In this section, there are also nerve fibers, lymphatic tissue, and blood vessels (Dyce, 2010 and Rajathi, 2020).

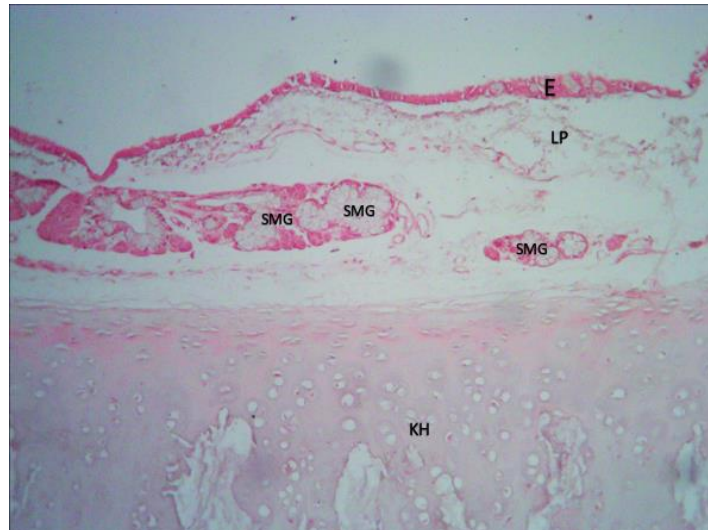


Figure 4. The Common Palm Civet Tracheal Seromucous Glands with HE Staining and 100X of Magnification (E = Ciliated Pseudo Columnar Epithelium, LP = Lamina Propria, SMG = Seromucous Gland, KH = Hyaline Cartilage)

Conclusion

Tracheal morphology in civet consists of a tracheal ring that is C-shaped as in some carnivores with a mucosal layer, submucosa layer, hyaline cartilage, and tunica adventitia with its muscular part on the external side of the hyaline cartilage.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the research, authorship, and publication of this paper.

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