



ANATOMICAL STUDIES ON THE TRACHEA IN JAPANESE QUAIL (*Coturnix coturnix japonica*)

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Abstract

The trachea was made up of 110-116 complete hyaline cartilaginous rings, which extended from cranial larynx to syrinx. The craniocaudal width of the rings progressively increased along the cranial third of the trachea and then decreased caudally. Histologically it was lined by a pseudostratified ciliated columnar epithelium. Lamina propria was made up of loose connective tissue and contained alveolar mucous glands. The submucosa was continuous with the perichondrium of the cartilaginous rings and presented elastic fibres. The overlapping cartilaginous rings were flattened triangular in longitudinal section. Externally, there was a thin tunica adventitia. Trachealis muscle was absent. Sternotrachealis muscle was of striated type.

Key words: *Histomorphology, Japanese quail, trachea*

Respiratory organs of birds differ from those of mammals in many features, which are associated partly with the requirements of flight and partly with the voice production. Tracheal cartilages formed complete rings in birds, which overlapped and interlocked with adjacent rings (Dellmann and Eurell, 1998). Literature available on gross anatomical and histological studies on the trachea in Japanese quail is limited. To bridge this deficiency, the present study was undertaken.

Materials and Methods

The trachea was collected from 20 apparently healthy adult Japanese quails from University Poultry Farm, Mannuthy and studied for their gross and histological details. The trachea was cut across into small pieces and was processed conventionally. Paraffin sections of 4 to 5 μ m thickness were taken and stained using Haematoxylin and Eosin, Mallory's phosphotungstic acid haematoxylin for striated muscle fibres, Van Gieson's method for collagen fibres, Verhoeff's haematoxylin for elastic fibres and Gomori's one step trichrome method for connective tissue and muscle fibres (Luna, 1968). Micrometrical parameters like height of the lining epithelium and width of the lamina propria, cartilaginous rings and tunica adventitia were recorded using ocular micrometer.

Results and Discussion

Trachea extended from the cranial larynx to the syrinx or caudal larynx. The anterior end of the trachea was placed in the midline ventral to the oesophagus. It was attached to the oesophagus by connective tissue. The average length of the trachea was 4.05 ± 0.08 cm. In chicken, the length ranged from 17.0 to 18.0 cm in males and 15.5 to 16.5 cm in females (Mc Lelland, 1975). Distal to a length of 1.5 to 2 cm, the trachea was directed slightly towards the right of the median plane with the oesophagus on its left side. The

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trachea was related to the cervical vertebrae dorsally and to the skin of the cervical region ventrally. It entered the thoracic cavity between the two rami of the furcula. At the thoracic inlet, it was related to the crop on the right side. On either side of the trachea was the sternotrachealis muscle. In chicken, King and Molony (1971) reported that sternotrachealis muscle was responsible for the oscillation of the trachea and syrinx rostrocaudally in and out of the thoracic inlet.

The trachea had a skeleton of complete cartilaginous rings. Number of rings ranged from 110 to 116. Nickel *et al.* (1977) reported the presence of 100 to 130 rings in the trachea of fowl. These rings were of different sizes in the present study. The larger rings almost touched each other and the smaller rings were inside halfway between the openings of the larger rings forming a double tube. Similar observations were made in domestic birds by Mennega (1962). In White Pekin ducks, Mennega (1962) found that the tracheal rings were complete and bony with four notches, two on each side, which allowed

them to interlock so that one half of each ring lay on the outside, while the other half was inside. This also formed a double tube, which provided good protection to the air passages. Mathey (1965) reported that the ossification of tracheal rings occurred earlier in the goose and duck than in the chicken and turkey. The tracheal rings were connected with each other by narrow annular ligaments.

The last few tracheal rings preceded the tympanum of the syrinx. The maximum mean width recorded in the cranial third of the trachea was 4.01 ± 0.05 mm. In the caudal third, the mean diameter was 1.95 ± 0.08 mm. The corresponding values in the trachea of chicken were reported to be 6.0 to 7.0 mm and 2.0 to 3.0 mm, respectively (Hodges, 1974). The tracheal rings were oval in cross section. In fowl, King and Molony (1971) reported that the rings of the cranial third of the trachea were oval transversely and the rest were circular in cross section.

Histological section through the cartilaginous ring of the trachea showed the following layers from inner to the outer surface:

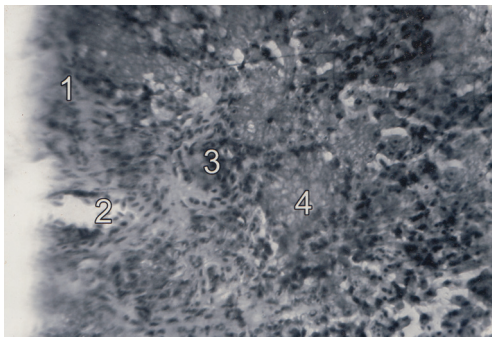


Fig. 1. Longitudinal Section of the trachea showing mucosa

1) Mucosa 2) Blood vessel 3) Lamina propria 4) Mucous gland

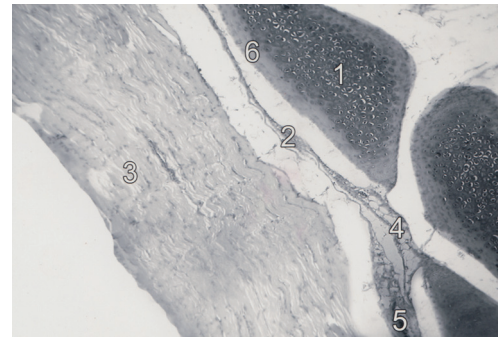


Fig. 2. Longitudinal Section of the trachea showing the overlapping cartilages

1) Tracheal cartilage 2) Tunica adventitia 3) Sternotrachealis 4) Adipose tissue 5) Blood vessel 6) Perichondrium

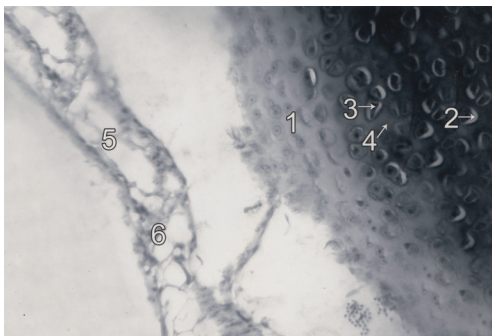


Fig. 3. Longitudinal Section of the tracheal cartilage

1) Perichondrium 2) Lacunae 3) Chondrocyte 4) Intercellular Matrix 5) Tunica adventitia 6) Adipocyte

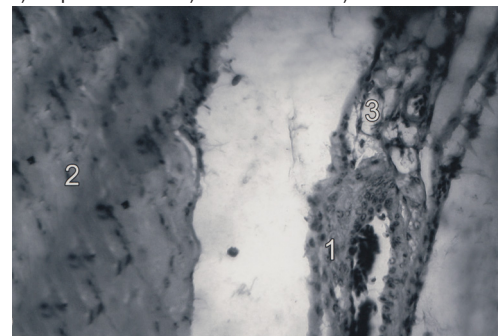


Fig. 4. Tunica adventitia showing large blood vessel

1) Blood vessel 2) Sternotrachealis 3) Adipose tissue

the mucosa, submucosa with cartilage rings and adventitia. The mucosa was lined by pseudo stratified ciliated columnar epithelium. Similar observations were also reported in mammals by Rizzo (2006). The mean height of the epithelial cells ranged from 9.38 to 15.00 μm . The basal cells were smaller and had round nuclei, while the ciliated columnar cells showed oval nuclei. The lamina propria was 234 to 325 μm wide and showed loose connective tissue with mucous glands, which were lined with pyramidal cells (Fig.1). The nucleus was oval and placed towards the base of the cell. The apical portion showed foamy cytoplasm. Lamina propria contained collagen and elastic fibres, blood vessels and nerve fibres. Similar observations were made in chicken by Hodges (1974) and Aughey and Fyre (2001). Diffuse lymphocytes were also noticed in the lamina propria.

The cartilaginous rings were flattened triangular in longitudinal section with a mean width of 143 μm in the centre and 57 μm towards the ends (Fig.2). It was made up of hyaline cartilage (Fig. 3) as reported by Dellmann and Eurell (1998) in chicken. The adjacent cartilaginous rings overlapped in this stage. The smaller and larger rings were arranged alternatively. Externally there was a very thin adventitia of 9.38 to 22.5 μm width. It was made up of connective tissue, which showed numerous blood vessels and some adipocytes (Fig.4). The longitudinal section of sternotrachealis muscle is shown in fig. 2. It was made up of striated muscle fibres. The presence of this muscle has also been reported by Hodges (1974) in fowl. Banks (1993) reported that in chicken longitudinally oriented striated muscle was located at the periphery of the trachea in a lateral position. Trachealis muscle seen in the case of animals was absent as reported by Dellmann and Eurell (1998).

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