



## Review on the Morphological Structures and Histological Features of the Respiratory System in Birds

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### Abstract

The goal of these reviews was to identify the morphological structures and histological features of the bird's respiratory system. The respiratory system of the birds consists of the nasal openings, nasal passage, larynx, trachea, syrinx, bronchi, lungs and air sacs. The beak's base holds the nostrils. The nasal and oral parts there are division of pharynx and has a single cavity; oropharynx because the soft palate not present, the upper, middle and lower conchae were found, the rings of trachea were complete, the syrinx situated at the division of the trachea, the lungs were not lobulated and were fixed in the position, causing them unable to contract and expand in the respiration, absence of the diaphragm, the air sacs extended to the bones and these were have the ability to contract and expand with the respiration. The epithelia which lined the air ways, nasal cavity, larynx, trachea, syrinx and primary bronchi were ciliated pseudostratified columnar epithelium, but simple cuboidal in the smallest airways. Lamina propria contain loose connective tissues, associated with lymphoid tissues, muscularis mucosa consists of the smooth muscle tissues. There are five types of the epithelial cells can be found that are columnar cells which considered the most abundant type, goblet cells, brush cells that were regarded as a receptor cells, and basal cells as a small rounded, can be differentiated into the other mentioned cell types. Small granule cells have numerous granules; constitute a population of cells of the diffuse neuroendocrine system. The submucosa consists of loose connective tissues accompanied with serous and mucous glands which are absent in the tertiary bronchi. Tunica muscularis contains the outer longitudinal smooth muscles fibers and circular layer internally. Tunica adventitia is a light coat constructed from loose connective tissues filled with blood vessels.

**Keywords:** Birds; Respiratory System; Glands; Mucosa; Muscularis

### Introduction

The respiratory system includes the series of air passages that link the sites of the gas exchange with the external environment and the respiratory muscles, in addition to controlling the body temperature [1]. There are many differences between the respiratory system of the birds and mammalian one. In fact, the birds lack soft palate, epiglottis, vocal cord, pleural cavity and diaphragm and their lungs are relatively small. They have air sacs and syrinx instead of the vocal cord, and these are considered modified structures for the flight, voice production and thermoregulation mechanism [2] base of the bird's beak holds the nostrils and the nares

are visible in most of the birds [3]. The air will pass from it into the nasal cavity is branched by the nasal septum into right with left sides. The cartilage and bone they are parts of nasal septum [4]. The nasal conchae project from the lateral side of the nasal cavity. Their conchae classified into upper, middle and lower conchae in each of the domestic chicken, Japanese quail and Kuttanad ducks [5] but differently not found the caudal concha in Brown Eared Bulbul [6]. Also absence of the rostral nasal concha in the Quail [7], while The second nasal conchae is disappear in Phalacrocoracids which mentioned by [8] and caudal nasal conchae hide in Collocalia [7].

## Literature Review

In birds the respiratory compartment include the nasal cavity, larynx, trachea, syrinx, bronchi, lungs and air sacs [2]. The nasal septum divided the nasal cavity into two channels and it is extended from the nostrils rostrally to the choanae caudally. The conchae have the meatuses and usually three in numbers that are rostral, middle and caudal. The cartilages, muscles and ligaments are the parts of larynx. At the floor of the oropharynx situated behind the base of the tongue [9,28]. The trachea is cylindrical, flexible tube located in the midline and tends to shift to the right side of the neck (ventrolateral of cervical vertebrae) and down to the esophagus. From laryngeal cricoids cartilage it extend to the syringeal tympanum and composed of a series of complete cartilaginous rings and it is separated into right and left primary bronchi at the syrinx [10,22,23]. The syrinx; inverted Y-shape structure lies between trachea and primary bronchi at the tracheal bifurcation, on the level of heart base, ventrally to the esophagus. it is the main organ that produces voice in the birds. The cartilage and a wedge-shaped cartilaginous or bony pessulus are supported the tympanic membranes (internal and external) [11,24,25].

The lungs in birds are proportionally compact and lack the ability to be expanded and contract. It is paired not lobulated as in the mammals and located at the craniodorsal part of the body, against dorsal wall of the thorax [12]. The primary bronchus branched to smaller narrow tubes in diameters within the lungs till it communicates with the abdominal air sacs. The bronchus is subdivided into the secondary bronchi and each of them subsequently branched into approximately 400 to 500 tertiary bronchi [2,9]. Morphologically the parabronchial lungs contradict from the mammalian bronchio-alveolar lungs, In mammalian lung the arrangement of the bronchial airway system displays iterating, commonly dichotomous bifurcation that terminate in blind ended air conduits. The birds lung, highly intricate anastomotic system exists. In complete contrast to the tidally ventilate mammalian respiratory system, where entering air is mixed with residual stale air in the respiratory airway. The lung of avian is considered a flow through system [13]. The system of the air conduits, each of the first bronchus, secondary bronchi and tertiary bronchi, the birds which aerate air sacs specifically the lung persist and unidirectional like a pair of bellows, In the parabronchial tissues occur. gas exchange, that the necessary role in the lung of birds [14].

At the first bronchus join the lungs on the edge of the cranial and medial third of the ventral surfaces of the lungs and reaches to the caudal edges, where it go into each of the abdominal air sacs, medioventral, lateroventral, mediadorsal and laterodorsal secondary bronchi derive from the initial bronchus [15]. The number of the air sacs differs within the different avian species [16]. Most of the birds have seven air sacs, four of these are paired, cranial thoracic, caudal thoracic and abdominal air sacs, but the single air sacs are the interclavicular and cervical [17].

Histologically, the larynx is coated partially by the stratified squamous epithelium and a ciliated pseudostratified columnar epithelium with a great many elastic fibers present in the lamina propria [18]. The serous, mucous or mixed glands may be present in the submucosa [19]. The trachea and primary bronchi are lined by the ciliated pseudostratified columnar epithelium composed of numbers of the simple alveolar glands, and subsequently in the last segment of the trachea the glands are replaced by the goblet cells [10].

Five types of the epithelial cells can be encountered in the avian respiratory system. First: Ciliated columnar cells which are the well available, on its apical surface. Second: Mucous goblet cells which have mucous droplets on their apical portion. Third: Brush cells that are considered receptor cells. Fourth: Basal cells that are small and rounded shape lies on the basal lamina; they can be differentiated into the other above cell types. Fifth: Small granule cells which have numerous granules and these cells are considered cellular population of the diffuse neuroendocrine system [19]. The lamina propria and submucosa are enriched with elastic fibers, contains loose connective tissues invested well with the blood vessels and nerves. In the lamina propria-submucosa, there are numerous of the elastic fibers organized in the middle of the hyaline cartilage longitudinally.

The outermost layer formed of loose connective tissue accompanied by adipose cells, nerve and small vessels which called tunica adventitia [10]. Syrinx is lined by stratified squamous and in some regions a columnar epithelium. The lamina propria have mucous gland and lymphatic nodules [20]. The main bronchi are marked by ciliated pseudostratified columnar epithelium escorted by goblet cells. Extra-pulmonary primary bronchi form cartilaginous circular strapes c shaped like, but the partitions of the intrapulmonary primary bronchi contains instead the cartilaginous plates here are

bands of the circular smooth muscles arranged at the lamina propria, with a great many elastic fibers in the bronchial connective tissues. The secondary bronchi are covered by ciliated columnar epithelium with goblet cells. It is characterized with well-developed lamina propria. The tertiary bronchus is lined by the cuboidal epithelium rested on a thin underneath layer of connective tissues.

Actually, the most important function of the tracheal and bronchial epithelium is the mucociliary clearance of the inhaled harmful particles. This important pulmonary protective function depend on both the availability and the subsequent efficiency of the mucosal glands and the active ciliary motility [26].

The lungs in birds lung is comprised of the primary, secondary, tertiary bronchi, atria and air capillaries [19].

Extra-pulmonary primary bronchi are continued as intrapulmonary primary bronchi terminates when they go into abdominal air sacs subsequently. The epithelium of the trachea resemble to that in chief bronchi coated by a ciliated columnar epithelium.

The cartilages of bronchi are changed into incomplete at proximal portion medially and become spot like distally in structures. The obstacle of the air sacs is contained of a delicate slim sheet of squamous or cuboidal epithelial cells based on fluffy layer of connective tissues [27]. The barrier of the main bronchi and the beginning of the secondary bronchi are lined by a mucosa, which is ciliated, longitudinal folds. The air sacs poorly vascularized which consists of squamous and cuboidal cells in the epithelium of slim walled, In addition a few ciliated columnar and non-ciliated columnar cells [29,21].

## Conclusion

The nasal cavity is seperated into two regions and the nostril forms long narrow slit, containing the operculum. The two division of nasal cavity separated by nasal septum, that are rostral, middle and caudal nasal conchae. The larynx appeared as a triangular-shaped mound, consists of single cricoids and procricoid cartilage, in addition to paired arytenoids cartilages. The trachea described as long tube consists of the complete cartilaginous rings. The syrinx located at tracheobronchial junction. The pulmonary primary bronchi consist of the incomplete C shape cartilages. The lungs situated at the cranio-dorsal part of the thorax. There were nine air sacs. The conducting airways of the respiratory tract are padded by the respiratory epithelium the ciliated pseudostratified colum-

nar epithelium. The epithelia were lined the larynx are many types, para keratinized stratified squamous epithelium, that continuous as pseudostratified ciliated columnar epithelium with glands of intra epithelial and goblet cells. In the lining of the tertiary bronchi not found mucous cells and glands, the great wedge of parabronchial wall consist of smooth muscles.

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