



## SOME MACROSCOPIC AND MORPHOMETRICAL STUDY OF LOWER RESPIRATORY SYSTEM IN ADULT PIGEONS (*STREPTOPELIA DECAOCTO*)

Salim Salih Ali Al-khakani, Jafar Ghazi Abbas Al-Jebori and Kadam Abud Zaid Alzubaidi

Department of Anatomy and Histology, College of Veterinary Medicine, Al Qasim Green University, Babylon, Iraq  
Email : drsalimsailh2@gmail.com

### Abstract

Macroscopical and morphometric account of respiratory system in adult pigeons (*Streptopelia decaocto*), the number of pigeon which are used in this study ten healthy mature pigeon birds which are obtained from animals markets in Babylon province, all birds transferred to veterinary anatomy laboratory in Al-qasim green university, the healthy birds were anesthetized by intramuscular ketamine and diazepam at dose 25.5 mg/kg of body weight then the birds dissected to separate the whole lower respiratory structures (trachea, bronchi and lung) to record the morphoanatomical measurements. trachea in pigeon birds appears as cylindrical flexible long tube made of complete circular cartilages rings, the mean weight of birds and respiratory system ( $179.71 \pm 0.05$  gm,  $2.34 \pm 0.016$  gm) also length of the body and respiratory system was ( $30.5 \pm 0.09$  cm,  $10.8 \pm 0.15$  cm), the length, weight of trachea and number of its cartilage ring was ( $7.1 \pm 0.02$  cm,  $0.25 \pm 1.2$  gm,  $98.5 \pm 3.1$ ) respectively while, the length of both lungs right and left ( $1.6 \pm 0.05$ ;  $2.1 \pm 0.035$ ) in addition to, weight of both lungs (right and left) are ( $0.66 \pm 2.01$ ,  $0.85 \pm 1.2$  gram). Also observe diameter of cartilage approximately unequal where the average of diameter at above region is ( $0.45 \pm 1.1$  cm) while at the middle region ( $0.35 \pm 0.3$ ) and ( $0.3 \pm 0.1$  cm) in lower region. The number of ring cartilage that forming the right and left primary bronchi was ( $9.5 \pm 2.1$ ,  $8.3 \pm 1.2$ ) also the thickness of right and left lung ( $0.5 \pm 0.3$ ,  $0.6 \pm 0.6$  cm).

**Keywords:** Pigeon, respiratory system, birds, trachea

### Introduction

The bird's respiratory system mainly composed of two parts, the rigid gas exchanging bronchial, lungs and the non-vascularized ventilatory air sacs (Rastogi, 2007). The thermo-regulation occur mainly in birds by respiratory system also sense, smell and voice (Pesek, 2000).

In bee-eaters bird (*Merops orientalis*) trachea show as long cylindrical tube and the principle units consisting of overlapping circular ring cartilage which open at the medial side and this structures connect with each other by annular ligaments, also the mean length of the trachea ( $5.087 \pm 0.21$  cm) and the mean total number of tracheal cartilage ( $64.5 \pm 4.5$ ) as well as the diameter of trachea unequal its average near connection with larynx was ( $0.3 \pm 0.0$  cm) while in middle region and the connection between trachea and voice box was ( $0.25 \pm 0.0$  cm) (Al-Mamoori and Al-Ghagany, 2015).

In guinea fowl (*Numida meleagris galeata*) the mean weight of body female and male was ( $1.225 \pm 0.059$  kg) and ( $1.375 \pm 0.025$  kg) respectively and the mean weight of whole respiratory organs (trachea, primary bronchi and lung) ( $8.500 \pm 0.554$  gm) in female and ( $9.638 \pm 0.371$  gm) in male also the mean length of trachea and its diameter of guinea fowl was ( $26.413 \pm 0.725$  cm,  $0.813 \pm 0.035$  mm) in female and ( $26.363 \pm 383$  cm,  $0.875 \pm 0.031$  mm) in male (Ibe *et al.*, 2008). The trachea bifurcates after syrinx into two parts: left and right primary bronchi which enter lungs at proximal third through hilus, the primary bronchi are made of a chain of C-shape cartilaginous rings held collectively by annular ligaments where the dimensions of these rings are variable in concerning bird species (Bacha, 2000; Zwart, 2004; Reese *et al.*, 2006; Onuk *et al.*, 2009 and Al-Mussawy, 2011). The length of right and left primary bronchus of guinea fowl was ( $1.06 \pm 0.032$  cm,  $1.10 \pm 0.033$  cm) respectively in female and ( $1.10 \pm 0.032$  cm,  $1.10 \pm 0.033$  cm) respectively in male

while, the mean diameter of bronchi was ( $0.525 \pm 0.25$  mm) in female and ( $0.550 \pm 0.019$  mm) in male (Ibe *et al.*, 2008).

In male pigeon (*Columba domestica*) the mean length and number of cartilages in right primary bronchi was ( $0.76 \pm 0.04$ ,  $6.4 \pm 0.24$ ) cm respectively while, these dimensions in the left were ( $0.64 \pm 0.24$  cm and  $5.4 \pm 0.24$ ) respectively (AL-Mahmodi, 2012).

In yellow-vented Bulbul (*Pycnonotus goiavier*) the mean number of cartilaginous rings and mean length of left primary bronchi was ( $10.4 \pm 0.39$  cm,  $0.34 \pm 0.024$  cm) also this dimensions in right primary bronchi ( $10.6 \pm 0.39$  cm,  $0.36 \pm 0.024$  cm), the mean width, length and thickness of left lung was ( $0.82 \pm 0.037$  cm,  $1.16 \pm 0.067$  cm and  $0.26 \pm 0.026$  cm) and while, right lung about ( $0.82 \pm 0.041$  cm,  $1.1 \pm 0.062$  cm and  $0.26 \pm 0.024$  cm) respectively (Al-Ghakany, 2015).

The mean length of each lung in male pigeon about ( $3.1 \pm 0.66$  cm) while; width and thickness about ( $1.94 \pm 0.03$  cm,  $0.56 \pm 0.024$  cm) respectively (Al-Mahmodi, 2012).

The mean weight of lungs in female guinea fowl was ( $3.065 \pm 1.016$  gm) in right lung and ( $3.350 \pm 0.267$  gm) in left lung and ( $3.850 \pm 0.115$  gm) and ( $4.050 \pm 0.225$  gm) respectively in male (Ibe *et al.*, 2008).

Anatomically, in wood pigeon (*Columba palumbus*), the total length of right primary bronchi and lung was ( $0.65 \pm 0.05$  cm,  $2.8 \pm 0$  cm) and in left side was ( $0.7 \pm 0.1$  cm,  $2.75 \pm 0.05$  cm) respectively while; mean width of the right and left lung was ( $2.45 \pm 0.65$ ,  $2.7 \pm 0.7$  cm) (Alumeri *et al.*, 2013)

**The aim of study:** to provided morphoanatomical description and morphometric data information of lower respiratory system in pigeon (*Streptopelia decaocto*)

## Materials and Methods

The number of pigeon used in current study were ten healthy mature pigeon birds (*Streptopelia decaocto*), which are obtained from animals markets in Babylon province, then transferred directly into the Al-Qasim green university, veterinary college, anatomy laboratory. The birds were anesthetized and sacrificed by used intramuscular injection of a combination ketamine and diazepam at dose 25.5 mg/kg of body weight (Schindala, 1999). For anatomical study, the body weight of each bird was estimated by aspiring balance then the birds dissecting with surgical sections along the abdominal and thoracic region to obtain on lower respiratory organs and recording of morphological measuring, the instruments which used as vernier-caliper, ocular lens and stage micrometer, sensitive balance and digital camera and to obtain on the following parameters:

- 1- Body length measurement of pigeon birds.
- 2- Length of respiratory system from first tracheal cartilage ring cranially to the end of lung, length of the trachea from first tracheal cartilage edge frontally into the last tracheal cartilage ring and length of two lung as well as thickness.
- 3- Record weights of each birds, respiratory organs, trachea and lungs.
- 4- Record the diameter of the trachea from three regions, above tracheal region, middle and lower region.
- 5- Calculate the cartilage rings number in trachea and bronchi.

## Results

The anatomical properties of the trachea in pigeon birds (*Streptopelia decaocto*) as cylindrical flexible long tube and the tube consisting of overlapping complete circular cartilages rings strapped with each other by annular ligaments Fig. (1 & 2). The trachea positioning along the neck ventrally and see the esophagus behind the dorsal aspect of the trachea and extend from the caudal edge of larynx (rostrally) to the first tracheosyringeal cartilage (caudally) figure (1). The mean weight of birds and respiratory system (from trachea to the end of lung) ( $179.71 \pm 0.05$  gm,  $2.34 \pm 0.016$  gm ) table (1) also length of the body and respiratory system was ( $30.5 \pm 0.09$  cm,  $10.8 \pm 0.15$  cm) table (2). The length, weight of trachea and number of its cartilage rings was ( $7.1 \pm 0.02$  cm,  $0.25 \pm 1.2$  gm,  $98.5 \pm 3.1$ ) respectively table (1 & 2) while the length of right lung ( $1.6 \pm 0.05$  cm) and left ( $2.1 \pm 0.035$  cm) table (2), for the more, the weight of both lung (right and left) ( $0.66 \pm 2.01$  gm,  $0.85 \pm 1.2$  gm) table (1).

Observe diameter of cartilage approximately unequal where the average of diameter of trachea near connection with larynx (above region) is ( $0.45 \pm 1.1$  cm) while at the middle region ( $0.35 \pm 0.3$ ) and at the area connection between trachea and syrinx (Voice box, lower region) is ( $0.3 \pm 0.0$  cm) table (4).

After syrinx the trachea divided to form left and right primary bronchi as short tube which unite the lungs from the visceral surface through the hilus, the number of ring cartilage that forming the right and left primary bronchi was ( $9.5 \pm 2.1$ ,  $8.3 \pm 1.2$ ) table (3) also the thickness of right and left lung ( $0.5 \pm 0.3$ ,  $0.6 \pm 0.6$  cm) table (5).

**Table 1 :** The mean weight of birds, respiratory system, trachea and right and left lung (gram), (n=10, M $\pm$ S.E)

Anatomical parameters	Mean $\pm$ S.E
Weight of birds	179.71 $\pm$ 0.05
Weight of respiratory system	2.34 $\pm$ 0.016
Weight of trachea	0.25 $\pm$ 1.2
Weight of right lung	0.66 $\pm$ 2.01
Weight of left lung	0.85 $\pm$ 1.2

**Table 2 :** The mean length of body birds, respiratory system, trachea and right and left lung with cm, (n=10, M $\pm$ S.E)

Anatomical parameters	Mean $\pm$ S.E
Length of body	30.5 $\pm$ 0.09
Length of respiratory system	10.8 $\pm$ 0.15
Length of trachea	7.1 $\pm$ 0.02
Length of right lung	1.6 $\pm$ 0.05
Length of left lung	2.1 $\pm$ 0.035

**Table 3 :** The mean number of tracheal cartilage rings and right and left of primary bronchi cartilage (n=10, M $\pm$ S.E)

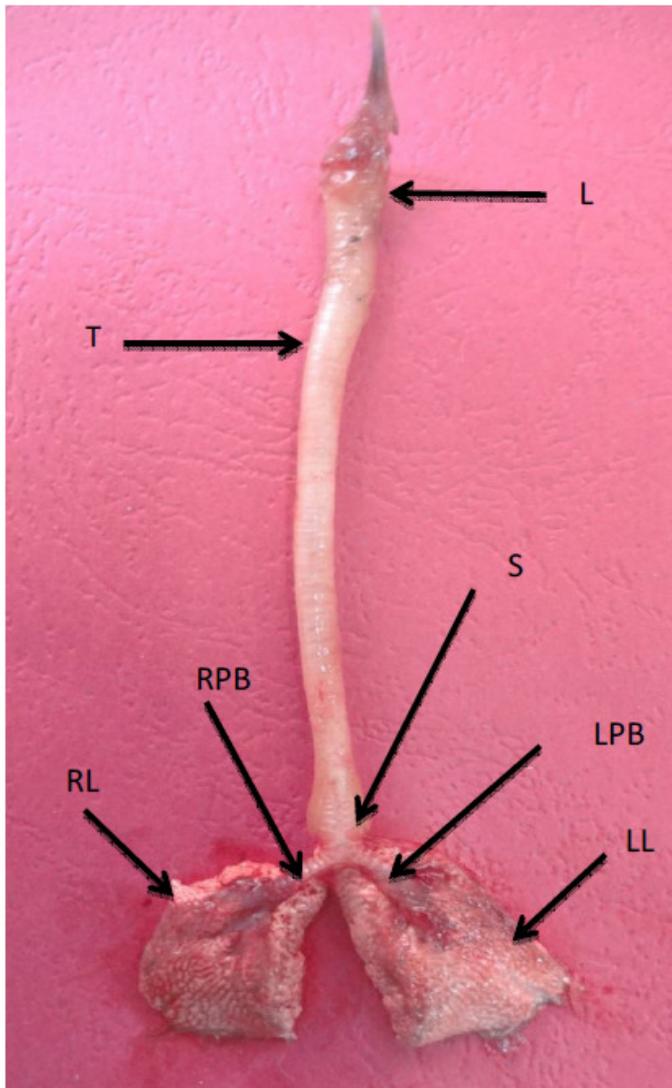
Anatomical parameters	Mean $\pm$ S.E
Number of tracheal cartilage rings	98.5 $\pm$ 3.1
Number cartilage of right primary bronchi	9.5 $\pm$ 2.1
Number cartilage of left primary bronchi	8.3 $\pm$ 1.2

**Table 4 :** The mean diameter of tracheal in above region, middle and lower region (n=10, M $\pm$ S.E)

Anatomical parameters	Mean $\pm$ S.E
Diameter of trachea in above region	0.45 $\pm$ 1.1
Diameter of trachea in middle region	0.35 $\pm$ 0.3
Diameter of trachea in lower region	0.3 $\pm$ 0.0

**Table 5 :** The mean thickness of right and left lung (n=10, M $\pm$ S.E)

Anatomical parameters	Mean $\pm$ S.E
Thickness of right lung	0.5 $\pm$ 0.3
Thickness of left lung	0.6 $\pm$ 0.6

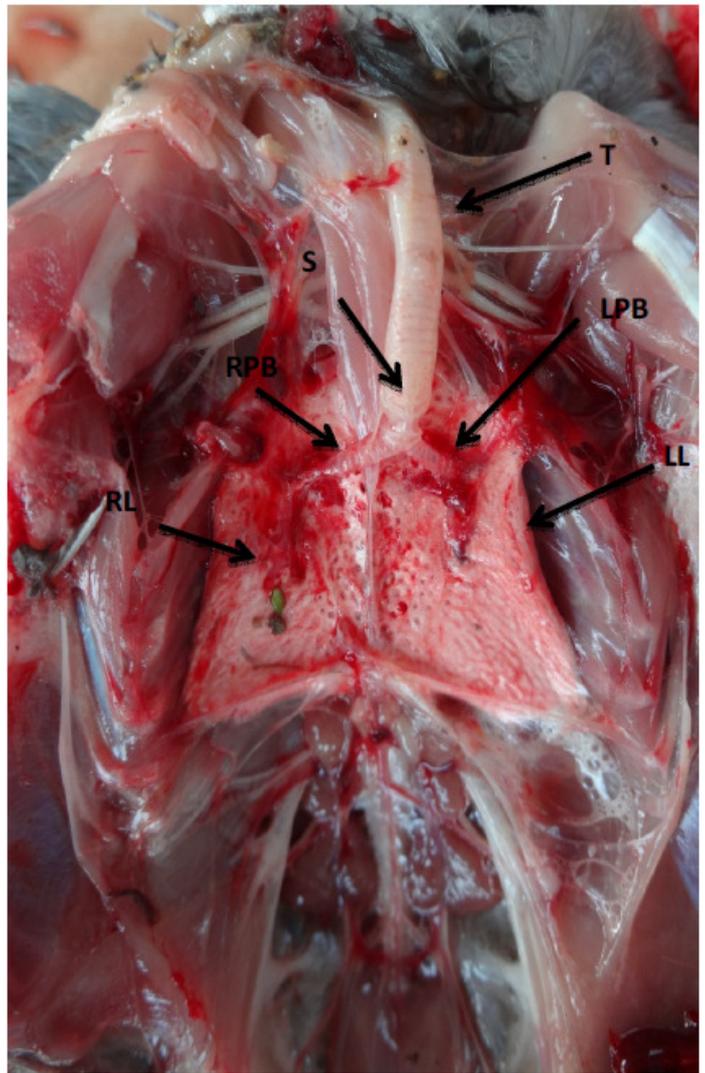


**Fig. 1 :** photograph illustrate L-larynx, T-trachea, S-syrinx, LPB-left primary bronchi, LL-left lung, RPB-right primary bronchi, RL-right lung

### Discussion

The trachea in pigeon birds (*Streptopelia decaocto*) as cylindrical flexible long tube consisting of overlapping complete circular cartilages rings which attached with each other by annular ligaments and extend along aspect of the neck ventrally also extend from the caudal end of larynx (rostrally) to first tracheosyringeal cartilage (caudally) our result was agreed with (Al-Mamorri; Al-Ghakany, 2015) in bee-eaters bird. The mean weight of pigeon birds and respiratory system ( $179.71 \pm 0.05$  gm,  $2.34 \pm 0.016$  gm) our results differ with (Ibe *et al.*, 2008) in Guinea fowl the mean weight of body and whole respiratory organs in female was ( $1.225 \pm 0.059$  kg,  $1.375 \pm 0.025$  kg) and in male ( $8.500 \pm 0.554$  gm,  $9.983 \pm 0.371$  gm) respectively because the weight of the respiratory system is directly proportional to body weight. The length of trachea and number of its cartilage rings was ( $7.1 \pm 0.02$  cm,  $98.5 \pm 3.1$ ). The result not concord with (Al-Mamorri; Al-Ghakany, 2015) in bee-eaters when he was noted the mean length of trachea and its number of cartilage are ( $5.087 \pm 0.21$  cm,  $64.5 \pm 4.5$ ) also our result again differ with (Ibe *et al.*, 2008) in female and male Guinea fowl the length of trachea ( $26.413 \pm 0.725$ ).

The length of two lungs in pigeon was ( $1.6 \pm 0.05$  cm) in right lung and ( $2.1 \pm 0.035$  cm) in left lung that's not similar with (Al-Ghakany, 2015) in yellow-vented bulbul the



**Fig. 2 :** Photograph illustrate T-trachea, S-syrinx, LPB-left primary bronchi, LL-left lung, RPB-right primary bronchi, RL-right lung

length of right lung in bulbul ( $1.1 \pm 0.062$  cm) and left lung ( $1.16 \pm 0.067$  cm).

The weight of right and left lung in pigeon ( $0.66 \pm 2.01$  gm,  $0.85 \pm 1.2$  gm), this results are not similar with (Ibe *et al.*, 2008) in Guinea fowl were in female the weight of right and left lung ( $3.065 \pm 1.016$  gm,  $3.350 \pm 0.267$  gm) and in male ( $3.850 \pm 0.115$  gm,  $4.050 \pm 0.225$  gm) respectively.

The our observations in diameter of tracheal cartilage in pigeon approximately unequal where the average of diameter near connection with larynx was ( $0.45 \pm 1.1$  cm) while at the middle region ( $0.35 \pm 0.3$ ) and at the area connection between trachea and syrinx (Voice box) was ( $0.3 \pm 0.0$  cm) this results agree with (Al-Mamorri and Al-Ghakany, 2015) when he also noted the diameter of trachea unequal in bee-eaters bird ( $0.3 \pm 0.0$  cm) near the connection with larynx and ( $0.25 \pm 0.0$  cm) in the middle and the connection between trachea and voice box.

At the end of syrinx the trachea of pigeon divided into two short tube termed left and right primary bronchi which enter lungs through hilus that's concord with (Ibe *et al.*, 2008) in Guinea fowl, (Al-Mahmodi, 2012) in male pigeon (*Columba domestica*) and (Al-Ghakany, 2015) in yellow-vented bulbul.

The number of ring cartilage that forming the right and left primary bronchi in pigeon was ( $9.5 \pm 2.1$ ,  $8.3 \pm 1.2$ ) the our result differ with (Al-Mahmodi, 2012) in male pigeon noted the number of right and left primary bronchi ( $6.4 \pm 0.24$ ,  $5.4 \pm 0.24$ ) and also differ with (Al-Ghakany, 2015) in yellow-vented bulbul the number of cartilaginous ring in right and left primary bronchi was ( $10.6 \pm 0.39$ ,  $10.4 \pm 0.39$ ).

The thickness of lung on right and left side in pigeon about ( $0.5 \pm 0.3$ ,  $0.6 \pm 0.6$  cm) which not concord with (Al-Ghakany, 2015) in yellow-bulbul which are the thickness of right and left lung was ( $0.26 \pm 0.024$ ,  $0.26 \pm 0.026$  cm) respectively.

### References

- Al-Ghakany, S.S. (2015). Anatomical Study of the Primary Bronchi and the Lung in Yellow-Vented Bulbul (*Pycnonotus goiavier*) International Journal of Advanced Research. 3(11): 818-822.
- Al-Mahmodi, A.M.M (2012). Macroscopic and Morphometric Studies of the Extrapulmonary Primary Bronchi and Lungs of the indigenous adult Male Pigeon (*Columba domestica*) Kufa Journal For Veterinary Medical Sciences. 3(1): 19-26.
- Al-Mamoori, N.A. and Al-Ghakany, S.S. (2015). Anatomical and Morphometric Study of the Trachea in Bee-eater Bird (*Merops orientalis*) ISOR Journal of Agriculture and Veterinary Science. 8(10): 1-4.
- Al-Mussawy, A.M.M. (2011). Anatomical and Histological Study of Major Respiratory Organs (Larynx, Trachea, Syrinx, Bronchi and Lungs) In Indigenous Male Turkey (*Meleagris gallopava*). M.S. Thesis. AL-Qadisiya Uni. Vet. Med. College.
- Alumeri, S.K.W.; Al-Mahmodi, A.M.M. and Al-Bishtue, A.A.H. (2013). Grossly and Microscopic Study of the Primary Bronchi and Lungs of Wood Pigeon (*Columba palumbus*) Kufa Journal for veterinary Medical Sciences, 4(2): 72-79.
- Bacha, W.J. and Bacha, L.M. (2000). Color Atlas of Veterinary Histology 2nd (ed.): Lippincott Williams & Wilkins. 175-190.
- Ibe, C.S.; Onyeausi, B.I.; Salami, S.O.; Umosen, A.D. and Maidawa, S.M. (2008). Study of the Major respiratory Pathways of the West African Guinea Fowl (*Numida meleagris galeata*) the Morphometric and Macroscopic Aspects. International Journal of poultry Science, 7(10): 997-1000.
- Onuk, B.; Hazirolu, R.M.; Kabak, M. (2009). Gross anatomy of the respiratory system in goose (*Anser anser domesticus*): Bronchi and sacci pneumatici. Ankara Univ. Vet. Fak. Derg., 56: 165-170.
- Pesek, L. (2000). The avian respiratory system. Winged Wisdom Pet Bird Magazine 1:1.
- Rastogi, S.C. (2007). Respiration. In: Essential of animal physiology. New Age Inter. (P) Ltd. PP. 263-285.
- Reese, S.; Dalamani, G. and Kaspers, B. (2006). The avian lung associated immune system. A Review. Vet. Res. 37: 311-324
- Schindala, M.K. (1999). Anesthetic effect of Ketamine with Diazepam in Chicken. Iraqi Vet. J. Sci., 12: 261-265.
- Zwart, P. (2004). Emphysema in the avian lung. Pathogenesis. Euro. Association of Zoo- and Wildlife Vet. (EAZWV) 5thNscientific meeting, Ebeltoft. Denmark. 81-82.