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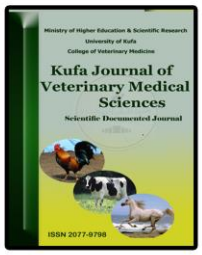

Anatomical and Morphometric Study of the Trachea in Pied Kingfisher Birds *(Ceryle rudis).*

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Abstract

The present study include eleven of the Pied Kingfisher *(Ceryle rudis)* birds from both sex, the weight and length of body were (98 ± 6.901gm), (32 ± 0.524 cm) respectively. The trachea characterized by a long flexible tube (6.34 ± 0.26 cm) in length and this refer to (49.403%) from the ratio length of respiratory system. It was mostly extend along the right side of the neck ventral to the esophagus and then enter the coelomic cavity. The trachea extend rostrally from the caudal end of the cricoid cartilage of the larynx into the connection between the trachea and syrinx (First tracheosyringeal cartilage) caudally.

The weight of trachea was (0.152 ± 0.018 gm) and this refer to (9.331%) from the weight of respiratory system. The cartilage rings which forming the trachea was oval in shaped and form the basic unit structure of the trachea. The total number of tracheal cartilage rings was (64.2 ± 1.2) and the diameter of the cartilage rings unequal and show a gradual decrease of its connection of the larynx into the syrinx and the mean of perimeter of the trachea connection with larynx was (43.252 ± 1.911 mm), while the connection with syrinx was (22.915 ± 1.152 mm). It can be see two skeletal muscles connected with trachea were trachiolateralis and sternotrachealis muscles.

Key words: Pied Kingfisher *(Ceryle rudis)*, trachea, anatomy, respiratory system.

دراسة تشريحية وقياسات مظهرية لرغامي طائر صياد السمك الابقع (*Ceryle rudis*) .

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الخلاصة

شملت الدراسة الحالية احد عشر عينة من طائر صياد السمك الابقع *(Ceryle rudis)* ومن كلا الجنسين, حيث كان وزن وطول جسم الطائر98±6.901 غم و 32±0.524 سم على التوالي. يمتاز الرغامي كونه انبوب طويل مرن يبلغ طولة 6.34 ± 0.26 سم وهذا يشكل نسبة 49.403 % من طول الجهاز التنفسي. غالبا ما يمتد الرغامي على الجانب الايمن من العنق و بطنيا للمريء وبعدها يدخل الرغامي الى التجويف الصدري. يمتد

الرغامي اماميا من النهاية الخلفية للغضروف الحلقي للحنجرة الى الارتباط بين الرغامي وعضو التغريد خلفيا (الغضروف الرغامي المصفاري الاول).

كان وزن الرغامي 0.018 ± 0.152 غم وهذا يمثل 9.331% من وزن الجهاز التنفسي. ان الحلقات الغضروفية المكونة للرغامي لها شكل بيضوي وتمثل الوحدة البنائية الاساسية له, حيث بلغ عددها الكلي 64.2±1.2, وكان قطر الحلقات الغضروفية المكونة للرغامي غير متساوية وتلاحظ بان القطر يقل تدريجيان كلما اتجهنا خلفيا باتجاه عضو التغريد وبلغ متوسط المحيط الداخلي للرغامي في منطقة ارتباطه مع الحنجرة 43.252± 1.911 ملم, بينما كان متوسط محيط الرغامي عند اتصاله مع عضو التغريد 22.915±1.152 ملم. ونلاحظ وجود عضلتين هيكليتين مرتبطتا مع الرغامي وهي العضلة الرغامية الوحشية والعضلة القصية الرغامية.

Introduction:

The Pied Kingfisher *(Ceryle rudis)* a widely distributed across Africa and Asia. It was one of the three most common types in the world. In ancient times believed this type descended from an ancestral American green kingfisher which crossed the Atlantic Ocean about 1 million years ago (1) but the more recent suggestion was that the American green kingfishers and Pied Kingfisher are derived from an Old World species (2). The Pied Kingfisher *(Ceryle rudis)* characterized by maculata plumage consisting of the black and the white color. It was non-migratory birds, can be seen near lakes and rivers, and the feeds mainly on fish. Its characterized by ability to fly for a long time in the same place and eating small fish during the flight without resorting to homes (nests), and this activities need to good body structure and strong circulatory and respiratory systems. The respiratory system of birds differ from mammalian in more specialty features, which relationship with the flight and the voice production such as air sac and syrinx organ (3). The respiratory system in bird consist of nasal cavity, larynx, trachea, syrinx, bronchi, lungs and air sacs (3; 4 and 5), while in mammals it was consist of nostrils, nasal cavity, larynx, trachea, bronchi, lungs (6). The trachea in bird bifurcation at the syrinx into the left and right primary bronchi, both primary bronchi enter the target lungs during the hilus at septal surface (7; 8; and 9).

Materials and Methods:

The experimental animals of the present study include eleven specimens adult Pied kingfisher (*Ceryle rudis*) weighed (98 ± 6.901gm) of both sex collected near the lakes fish farming and streams of Al-Diwanyia province in Al-Daghra city, catching the bird by using the fishing machine from January to March, 2014. After that fixing the birds on the table on the dorsal recumbency and make incision from the neck region up to the level of the pelvic region to show and photographs the respiratory system (Trachea) and record the relationship with the neighboring organs. Separate the trachea and remove the adipose and connective tissues to record morphological measuring, and then fixed the trachea in 10 % formalin for 48 hours, after that left the trachea in 70% alcohol for 2 hours and then the trachea was placed in 1% Eosin solution for 15 minute, finally the specimen were placed at 50% and 70% of alcohol for 1 hour to getting rid of excess stain. The purpose of using stain to obtain good vision to the

cartilaginous rings. In the morphometric study used some instruments such as (Vernier, Ocular and stage micrometer, electrical balance, digital camera Sony ericsson and lens (X6 and X12)) to recorded the following:

1- Measured the body length of the kingfisher (it measured from beak into tail) , length the respiratory system (it measured from the cranial end of the larynx into caudal border the lung) and length of the trachea (it measured from cranial border of the first tracheal cartilage ring into the caudal border of last tracheal cartilage ring which connect with syrinx).

2- Measured the body weight of bird, weight of respiratory system and weight of trachea.

3- Measured the radius and perimeter of the trachea after fixation by using the formalin and 70% alcohol (alcohol used to dehydration of the trachea and easily disconnection of cartilage rings to calculate). Record the radius and perimeter of the trachea from three regions:-

A-The connection between the trachea and the larynx (First tracheal cartilage ring).

B- The middle part of the trachea.

C-The connection between the trachea and syrinx (Last tracheal cartilage ring).

4- Calculated the number of the tracheal cartilage rings.

Results:

In the present study the anatomical features of the trachea in adult pied kingfisher (*Ceryle rudis*) showed as a long flexible tube. It was mostly extend along the right side of the neck ventral to the esophagus and then enter the thoracic cavity. The boundary of the trachea extend rostrally from the caudal end of the cricoid cartilage of the larynx into the connection between the trachea and syrinx (First tracheosyringeal cartilage) caudally (Fig:1 and 2). The trachea involved with primary bronchi to formation the syrinx. The mean length of the trachea was (6.34 ± 0.26 cm) and this form highly percentage about (49.403 %) from the total length of the respiratory system while the length of all another organs (larynx, syrinx, primary bronchi and lungs) form approximately (50.597%)(Table: 2), while the weight of the trachea was (0.152 ± 0.018) and this form low percentage from the weight of the respiratory system reaches into (9.331 %) (Table: 1). The tracheal cartilages was complete rings, oval (Ellipse **0**) in shaped and refer to the basic unit structure of the trachea. it consist of two parts were broad and narrow parts (Fig: 2, 3 and 4). The narrow part of one cartilage ring overlaps the broad part of the two adjacent rings. The mean total number of tracheal cartilage (64.2 ± 1.2). Showed the perimeter of the tracheal cartilage rings approximately unequal which begins with a gradual decrease of its connection to the larynx into the syrinx and the mean of perimeter of the trachea connection with larynx was (43.252 ± 1.911 mm) , and the middle region was (27.176 ± 0.476 mm), while the connection with syrinx was (22.915 ± 1.152 mm) (Table: 3), (Fig: 4). It can be seen two skeletal muscles on the lateral side of the trachea:

1-Trachiolateralis muscle:- it was thin paired skeletal muscles when compare with the sternotrachealis muscle, it was cylindrical shape extend along the lateral border of trachea. it was origin from the distal end of lateral border of trachea near from connection between the trachea and syrinx and insertion at the lateral aspect of the cricoid cartilage of the larynx (Fig.3).

2-Sternotrachealis muscle:- it was thick and broad paired skeletal muscles. It was cylindrical shape, origin from the craniolateral process of the sternum, and insertion at the proximal end of the cartilage of the syrinx (Fig.1 and 2).

Table (1): Body weight, respiratory weight and trachea weight of the kingfisher birds.

Parameters	Mean ± SEM	% Body weight	% Respiratory weight
Body weight.	98 ± 6.901gm	100	-------
Weight of respiratory system.	1.628 ± 0.427gm	1.661	100
Weight of larynx, syrinx, primary bronchi and lung	1.476 ± 0.409 gm	1.506	90.663
Weight of trachea.	0.152 ± 0.018 gm	0.155	9.331

Table (2): Length of body, respiratory system and trachea of kingfisher birds.

Parameters	Mean ± SEM	% Body length	% Respiratory length
Length of body*.	32 ± 0.524 cm	100	-------
Length of respiratory system**	12.833 ± 0.166 cm	40.103	100
Length of larynx, syrinx, primary bronchi and lung.	6.493 ± 0.09 cm	20.290	50.596
Length of trachea.	6.34 ± 0.26 cm	19.812	49.403

* Length of body from beck into the tail of bird.

** Length of respiratory system include:(larynx, trachea, primary bronchia, syrinx and lung)

Table(3): Parameters of radius and perimeter of some regions of the trachea kingfisher bird.

Parameters	Radius big of tracheal cartilage.	Radius small of tracheal cartilage.	Perimeter of tracheal cartilage.
Connection trachea with larynx.	9.09 ± 0.332 mm	3.575 ± 0.325 mm	43.252 ± 1.911 mm
Middle area of trachea.	5.8 ± 0.093 mm	1.93 ± 0.127 mm	27.176 ± 0.476 mm
Connection trachea with syrinx.	3.79 ± 0.146 mm	3.49 ± 0.246 mm	22.915 ± 1.152 mm

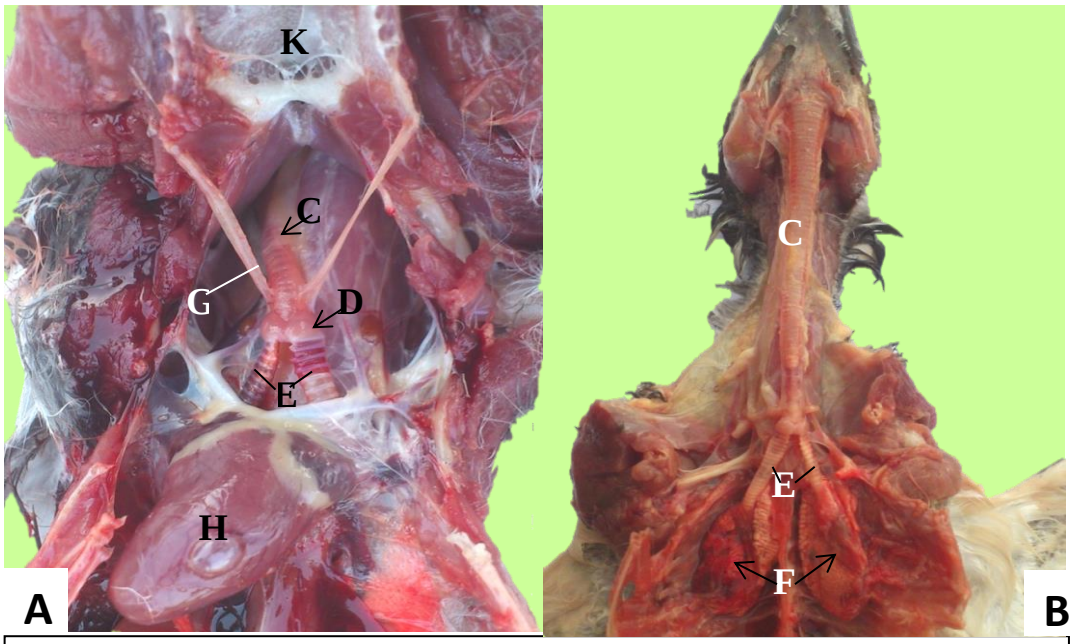

Figure 1 (A, B): Ventral view of respiratory system in Kingfisher bird.

C- Trachea. D- Syrinx. E- Primary bronchi. F-Lungs. G- Sternotrachealis muscle. H- Heart. K- Sternum.

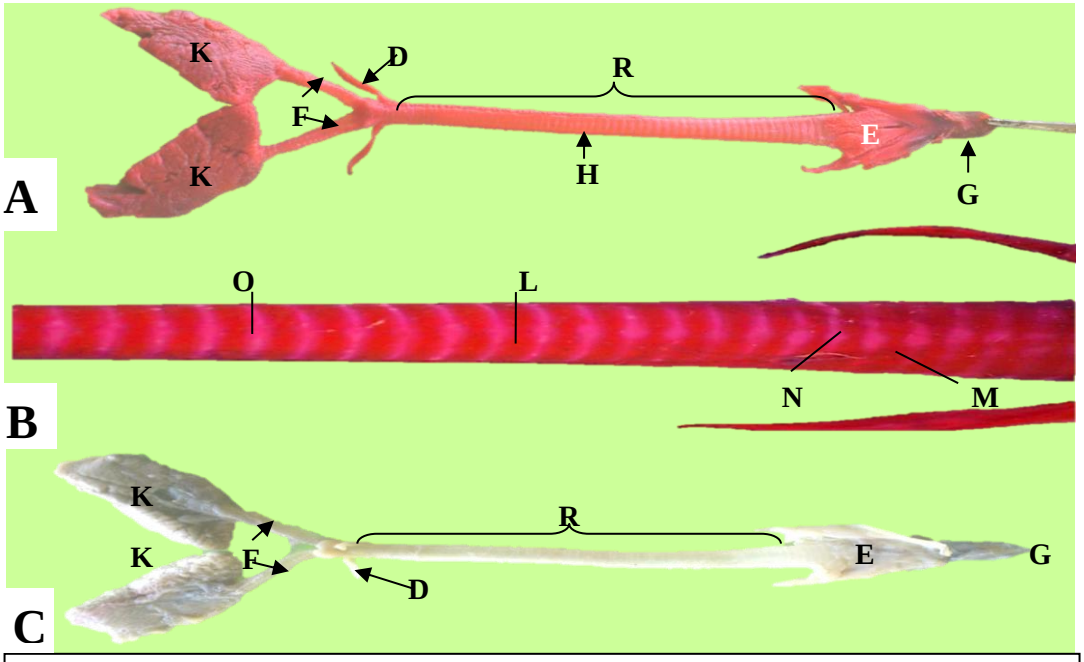

Figure (2): Trachea in king fisher birds (A, B Dorsal view of trachea staining with Eosin stain); (C, Ventral view of trachea) :

R- Trachea. D- Sternotrachealis muscle. E- Larynx. F- Right and left primary bronchi. G- Tongue. H- Trachiolateralis muscle. K- Right and left lungs. L- Cartilage ring. M- Broad part of cartilage. N- Narrow part of cartilage. O- Intramembrane cartilage.

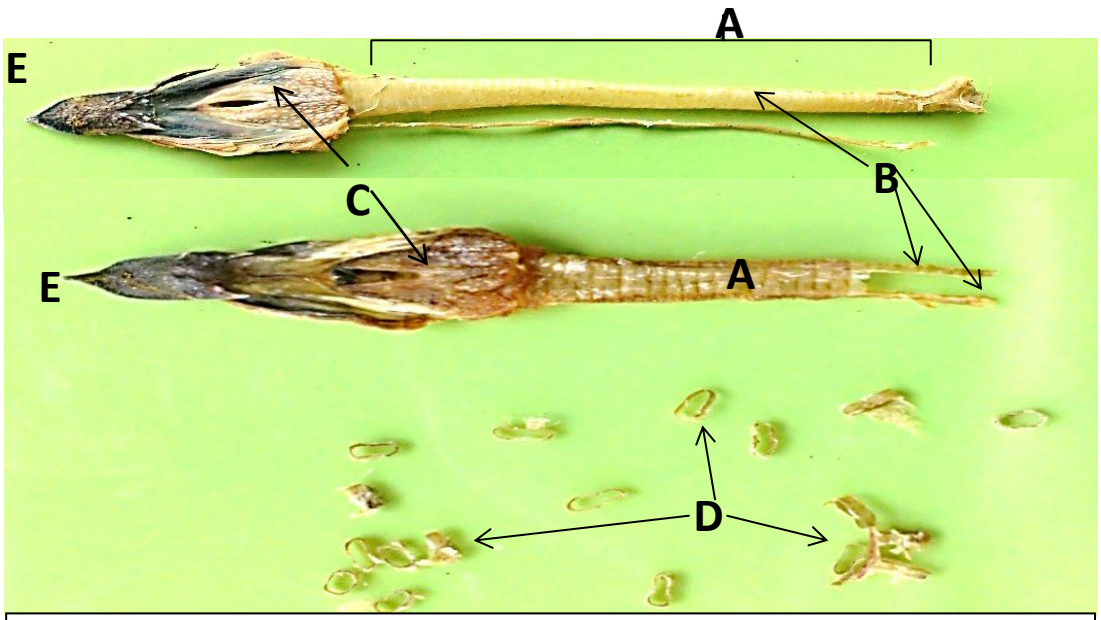

Figure (3): Dorsal view of the trachea in kingfisher birds.

A- Trachea. B- Trachiolateralis muscle. C- Larynx. D- tracheal cartilage rings.

E- Tongue.

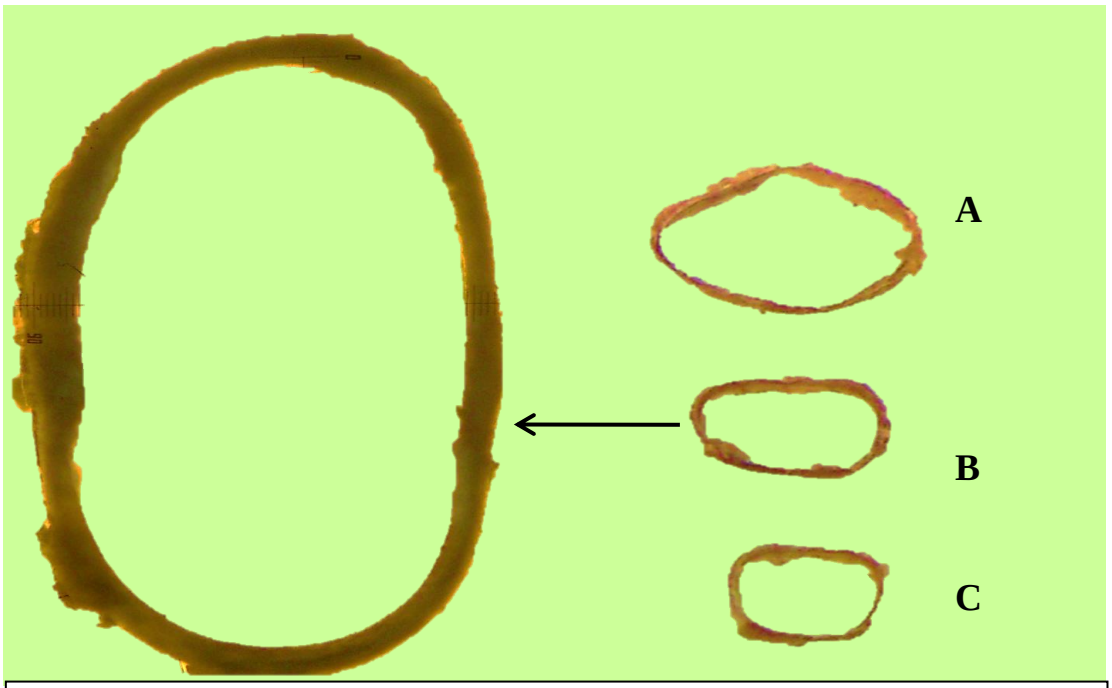

Figure (4) : Tracheal cartilage rings.

A- First tracheal cartilage ring (Connection between the trachea and larynx) .

B- Middle tracheal cartilage ring. (Middle region)

C- Last tracheal cartilage (Connection between trachea and syrinx). 40X under microscope.

Discussion:

The current study was focus on anatomical feature of the trachea in the Pied Kingfisher *(Ceryle rudis)* bird. The trachea was similar to almost anatomical description such as shape, unity structural and position with (5 and 10) in the chicken and male turkeys.

The mean length of the trachea in the Pied Kingfisher was (6.34 ± 0.26 cm) this result disaccord with (11, 12 and 13) show the length of trachea in turkeys (26 ± 1.23 cm) ; in West african guinea fowl (26.363 ± 0.383 cm) and in scaup (*Aythya marila)* was (15.8 ± 0.53 cm) this difference due to species and body volume of birds.

The distal part of the trachea after forming syrinx is bifurcates into two short tubes were the left and right primary bronchi which enter the proximal third of the visceral surface of the lungs through the hilus, agreement with (11;12;13;14;15 and 16). The reason for this similarity that most of the birds were similar in anatomy of the respiratory system.

When comparing the ratio of the weight of the body to the weight of the respiratory system (1.661%) note a significant decrease is due to the nature of the anatomy that made up the respiratory system and of compositions hollow structure (the larynx and tracheal, syrinx, bronchi and air sacs), and also compositions spongy structure (lungs), and this system designed in this form for the purpose of accommodating the air inside.

The weight of the trachea was (0.152 ± 0.018 gm) and this form a low percentage (9.331%) from the respiratory system due to the anatomical structure of the trachea, which consists of a hollow tube working on the transfer of air into the lower parts of the respiratory tract and disagreement with (13) the weight of trachea in scaup (*Aythya marila)* was (3.66 ± 0.66 gm). While the length of the trachea was (6.34 ± 0.26 cm) and this form a high percentage (49.403%), this because the anatomical structure of the trachea was a long tube, runs along the neck and enters the thoracic cavity and this course gives the highly ratio of the trachea length when compared to the respiratory tract, in addition to the physiological function to control and serves to warm the inspired air and also prevent enter the trap dust particles present in inhaled air and last but not least the length of the tracheal affect of process of sound production in birds (17) .

The tracheal cartilage was complete rings (0) shape and this disagreement with (9;11;12; 18 and 19) which explain the trachea composed of series (C) shape cartilage rings, while agree with (20 and 21) in Japanese Quail *(Coturnix coturnix japonica)* and in the domestic fowl the tracheal cartilage was complete rings. The total number of cartilage rings in trachea was (64.2 ± 1.2) and this disaccord with (12; 13; 20; 21; 22 and 23) West african guinea fowl (*Numida meleagris galeata)* (119 – 159); in scaup (*Aythya marila)* (97 ± 7.6); in Japanese Quail (110 – 116); in the domestic fowl (107- 138); in goose *(Anser anser domesticus)* (137 – 140) and in the long-legged buzzard *(Buteo rufinus)* (89 – 96) this difference due to species and body volume of birds.

When measuring the perimeter tracheal observed a gradual reduction was the contact between the larynx and trachea (43.252 ± 1.911 mm), while the contact between the trachea and syrinx was (22.915 ± 1.152 mm) and this decline leads to increased air flow in the trachea towards syrinx and lungs as the inverse relationship between the

diameter and pressure, this result agree with (12 and 22) which explain the diameter of the tracheal cartilage rings was unequal, this difference due to species of birds.

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