

The arterial vasculature of the wing in domestic fowl (*Gallus gallus domesticus*)

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Abstract

The arterial blood supply of the wing in domestic fowl was studied to investigate the course and distribution of the subclavian artery as a trial to extend our knowledge on the vascular anatomy of poultry which had received a little attention in the field of veterinary comparative anatomy. The present work was carried out on eight adult, apparently healthy chickens of both sexes. The birds were slaughtered and the subclavian artery of five chickens was cannulated and flushed with warm normal saline (0.9%), then injected with red gum milk latex. The specimens were subjected to fine dissection to demonstrate the origin, course, relations and distribution of the subclavian artery. The other three chickens injected with Urograffin for x-ray purposes. The arterial supply of the thoracic limb of the fowl was formed mainly by the pectoral trunk and axillary artery. The obtained results were photographed, described and discussed with their corresponding features of authors who performed earlier studies in other avian breeds.

Key words: Chicken; Arterial supply; Wing; Axillary artery; brachial artery.

Introduction

The domestic fowl is superfamily phasianoidae of the family phasianoidae, genus gallus and species gallus and subspecies domesticus.

Cage birds tend to be of increasing veterinary significance economically. However, by far the most important of all domesticated birds are those which domesticated for meat and eggs. The domesticated birds are of special value because of their efficiency of converting vegetable into animal protein with high biological value for people all over the world.

Despite numerous studies on the functional morphology of the avian wing, most based on gross anatomical dissection. Few data exists on the activity patterns of the forelimb muscles responsible for powering and controlling the wing (Dial, 1992).

The available literature on the axillary artery and its distribution doesn't provide complete detailed information about the scope of the work. So, the present study aimed to declare this confusion about the course and distribution of the external thoracic (pectoral trunk) and axillary arteries in the domestic fowl.

Materials and Methods

The current study was conducted on eight adult, apparently healthy chickens obtained from the chicken farms around Cairo. They were of different sex, weighing about 2-2.5kg, aging between 7-9 months and. Five birds were

slaughtered and the left and right subclavian arteries were cannulated and flushed with normal saline. The birds were injected with 60% gum milk latex colored red with **Rotring®** ink. (Tompsett and Wakelly, 1965). The animals were left in a mixture of 10% formalin, 2% phenol and 1% glycerin for only two days before the routine dissection to keep the flexibility of the wing.

The other three chickens injected with urograffin® for x-ray purposes. The exposure factors were 100 cm. FFD, with 15 mAs and 55 KV.

The obtained results were photographed using **Sony®** digital camera 12.1 mp, 4x.

The nomenclature used was that recommended by the *Nomina Anatomica Avium* (Baumel et. al., 1993).

Results

The arterial blood supply of the thoracic limb of domestic fowl is mainly achieved by two branches from the subclavian artery; the pectoral trunk and the axillary artery. The latter considered the continuation of the subclavian artery in the thoracic limb.

A. subclavia

The subclavian artery (fig. 1, 2 & 3/1); the parent artery which arises from the brachiocephalic trunk, as one of its terminal branches. It gives off sternoclavicular artery, internal thoracic artery, pectoral trunk and continues along the thoracic limb as the axillary artery (fig. 1, 2 & 3/2).

A. sternoclavicularis

The sternoclavicular artery (fig. 2 & 3/3); springs from the subclavian artery opposite to the origin of the axillary artery, it is distributed in the supracoracoideus and the sternum. **Truncus pectoralis**

The pectoral trunk (fig. 2 & 3/4); detaches from the subclavian artery and accompanies the pectoral vein and nerve. These vessels enter mainly to ramify in the pectoral muscles. It trifurcates into the cranial pectoral (fig. 1 & 3/5) and caudal pectoral (fig. 1, 2 & 3/6) arteries, which distributed to the pectoralis and supracoracoideus, and the cutaneous thoracoabdominal artery in between (fig. 1, 2 & 3/7). The latter branch is distributed in the cutaneous costohumeralis and a wide area of skin on the lateral thoracic wall.

A. axillaris

The axillary artery (fig. 1, 2, 3, 4 & 8/8); is considered as the direct continuation of the subclavian artery in the thoracic limb. It passes craniodorsally with the axillary vein and crosses the brachial plexus, then gives off the supracoracoid artery (fig. 1, 2 & 3/9) to the supracoracoideus. During its course it detaches 2-4 branches to the medial head of the subscapularis and the subcoracoideus. The second branch is the subscapular artery (fig. 1, 2 & 3/10) to the deep serratus and lateral head of the subscapularis. In three examined cases the supracoracoid and subscapular branches of the axillary artery originate by a common trunk.

Then the axillary artery passes laterally, leaving the thoracoabdominal cavity to enter the axilla. It passes along the scapulohumeralis between the medioulnar and radial nerve trunk; the axillary artery gives off the deep brachial artery (fig. 2, 4 & 8/11) and continued as the brachial artery (fig. 2, 4, 6 & 8/12).

A. profunda brachii

The deep brachial artery (fig. 2, 4 & 8/11); is derived from the axillary artery at the proximal end of the arm region and descends in company with the radial nerve. It gives off the dorsal circumflex humeral artery (fig. 4 & 5/13) then bifurcated into collateral ulnar (fig. 4/14) and collateral radial branches (fig. 4 & 5/15). The collateral ulnar artery mainly distributes to the muscles of the ventral wall and elbow joint while the collateral radial artery ramifies in the dorsal wall and skin.

A. circumflexa dorsalis humeri

The dorsal circumflex humeral artery (fig. 4 & 5/13); gives off three branches to supply the proximal muscles of the arm (deltoideus major, deltoideus minor, scapulotriceps and humerotriceps), and shoulder joint. It also releases a branch to the skin of the lateral wall of the arm region and propatagialis.

A. collateralis ulnaris

The collateral ulnar artery (fig. 4/14); arises from the deep brachial artery between the scapulotriceps and humerotriceps. It passes caudally and distally to appear at the ventral aspect of the arm region. It gives off about 5-6 branches to supply the before mentioned muscles and the elbow region. The collateral ulnar artery communicates with the recurrent ulnar artery at the elbow joint.

A. collateralis radialis

The collateral radial artery (fig. 4 & 5/15) is considered as the direct continuation of the deep brachial artery. It passes dorsally between the scapulotriceps and deltoideus major with the radial nerve, and then proceeds to the dorsal aspect of the arm region. It supplies the extensor carpi radialis, and also it gives off cutaneous branches (fig. 5/15a) to the skin of the forearm region and articular branches (fig. 5/15b) to the elbow joint.

A. brachialis

The brachial artery (fig. 2, 4, 6 & 8/12) is the continuation of the axillary artery along the arm region. It passes distally to the ventral aspect of the arm region, between the biceps and triceps muscles. It gives off a prominent muscular branch (bicipital artery) (fig. 4/16) to the biceps brachii and several cutaneous branches to the skin of the arm. The brachial artery is terminated, under the second half of the biceps brachii, into ulnar and radial arteries.

A. ulnaris

The ulnar artery (fig. 4, 6 & 8/17); arises from the brachial artery with the radial artery on the deep face of the biceps brachii. It sends two branches to the cubital fossa and it gives off a recurrent ulnar artery (fig. 4, 6 & 8/19) which supplies the flexor carpi ulnaris and unites with a branch from the collateral ulnar artery. The ulnar artery continues distally between flexor carpi ulnaris and ectepicondylo-ulnaris along the ventral aspect of the forearm region, to enter the carpal region between the ulnar and radial carpal bones, it gives off artery of the pollex (fig. 6/20) and ventral metacarpal artery (fig. 6/21), the latter passes between the proximal extremity of the III and IV carpometacarpal bones and gives off superficial branch (fig. 6/22) and proceeds in the carpometacarpal space between the shafts of carpometacarpal bones III and IV. The superficial branch passes along the third carpometacarpal bone and at the level of digit III, forms an arch (fig. 6/23) which unites with the main stem of the ventral metacarpal artery. The latter arch supplies the arteriae pennarum to the feather follicles attached to the digits (fig. 6/24).

A. radialis

The radial artery (fig. 4, 6 & 8/18); detaches from the brachial artery and gives off superficial radial artery (fig. 4 & 6/25) along the ventral border of the extensor carpi radialis. It continues in the forearm as the deep radial artery. The

deep radial artery (fig. 6/26) sends a dorsal interosseous artery (fig. 7/27) to the space between radius and ulna. The dorsal interosseous artery, at the level of the elbow joint, gives off the recurrent radial artery (fig. 7/28). The latter artery unites with the branch of the deep brachial artery. It gives off the dorsal metacarpal artery (fig. 7/29) at the carpal joint. The deep radial artery sends smaller branches to the extensor muscles, skin of the forearm region and to the follicles of flight feathers attached to the ulna.

Table (1): Showing the arteries supplying the wing of the fowl and their branches:

Main Artery	Branches	Suppling
I-Subclavian artery	1- Sternoclavicular artery	Supracoracoides muscle and the sternum.
	2- Internal thoracic artery	Internal thoracic wall muscles
	3- Pectoral trunk	Pectoral muscles
	4- Axillary artery	Thoracic limb muscles.
II-Pectoral trunk	1- Cranial pectoral artery	Cranial part of pectoralis.
	2- Caudal pectoral artery	Pectoralis and supracoracoideus muscles.
	3- Cutaneous thoracoabdominal artery	Cutaneous costohumeralis muscle and a large area of skin of the lateral wall of thorax.
III- Axillary artery	1- Supracoracoid artery	Supracoracoideus, subscapularis and the subcoracoideus muscles.
	2- Subscapular artery	Deep serratus and lateral head of the subscapularis muscles.
	3- Deep brachial artery	Arm region
	4- Brachial artery	Arm region
IV- Deep brachial artery	1- Dorsal circumflex humeral artery	<ul style="list-style-type: none"> ▪ Deltoideus major, deltoideus minor, scapulotriceps and humerotriceps muscles. ▪ Shoulder joint. ▪ Skin of the lateral wall of the arm region and propatagial M.

	2- Collateral ulnar artery	Scapulotriceps , humerotriceps muscles and elbow region.
	3- Collateral radial artery	Extensor carpi radialis and the skin of the fore arm region
V- Brachial artery	1- Bicipital artery	Biceps brachii muscle and skin of the arm
	2- Radial artery	Forearm and wrist region.
	3- Ulnar artery	Forearm and wrist regions.
VI- Ulnar artery	1- Recurrent ulnar artery	Superficial flexor muscles, skin of the ventral forearm region and the follicles of flight feathers attached to the digits.
	2- Artery of the pollex	
	3- Ventral metacarpal artery	
VII- Radial artery	1- Superficial radial artery	Extensor carpi radialis and skin of the forearm region
	2- Deep radial artery ▪ Dorsal interosseous artery ▪ Recurrent radial artery ▪ Dorsal metacarpal artery	extensor muscles, skin of the forearm region and the follicles of flight feathers attached to the ulna

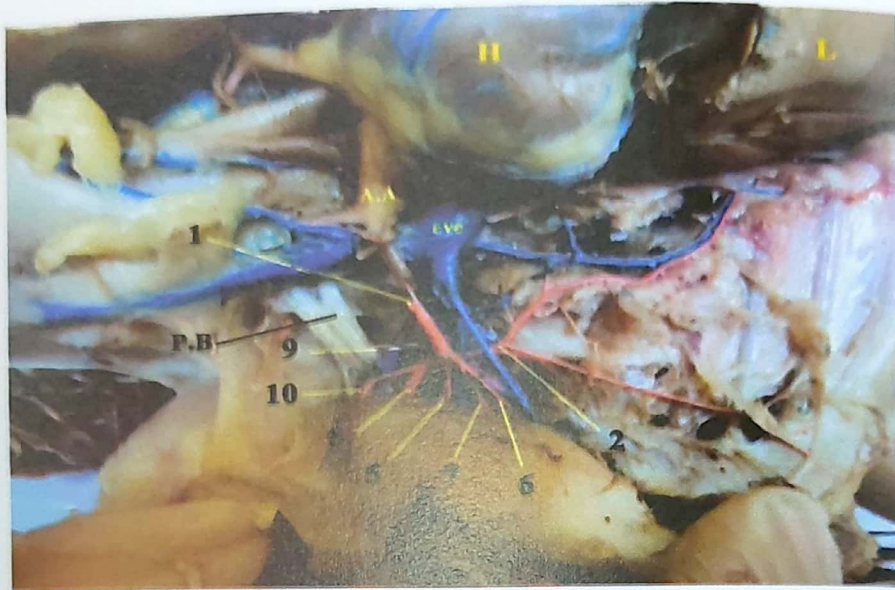


Fig. 1: A photograph showing the origin of the subclavian artery from the brachiocephalic trunk in the right thoracic limb (medial view).

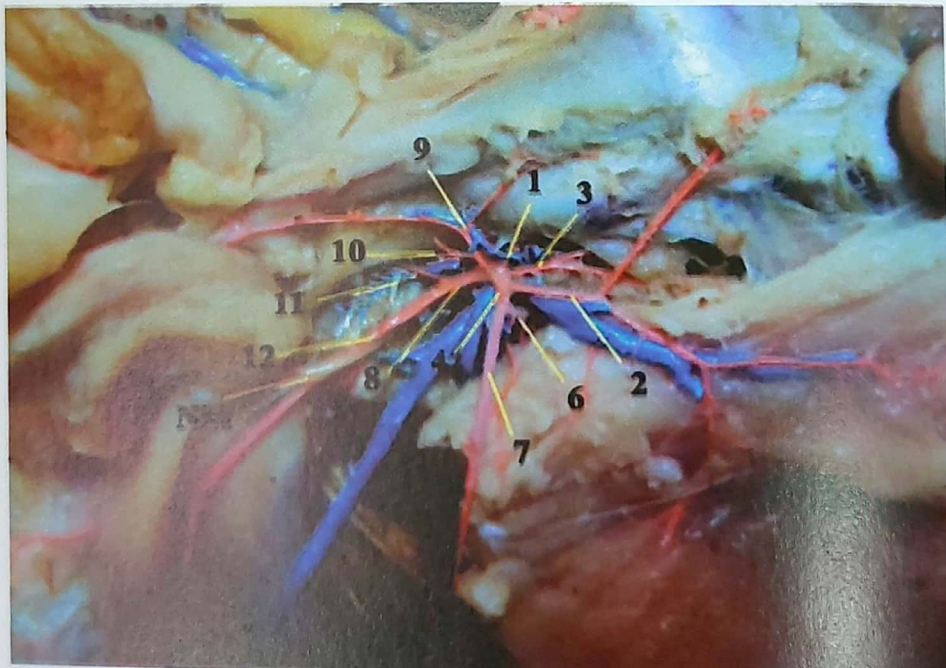


Fig. 2: A photograph showing the branches of the subclavian artery in the right thoracic limb (lateral view).

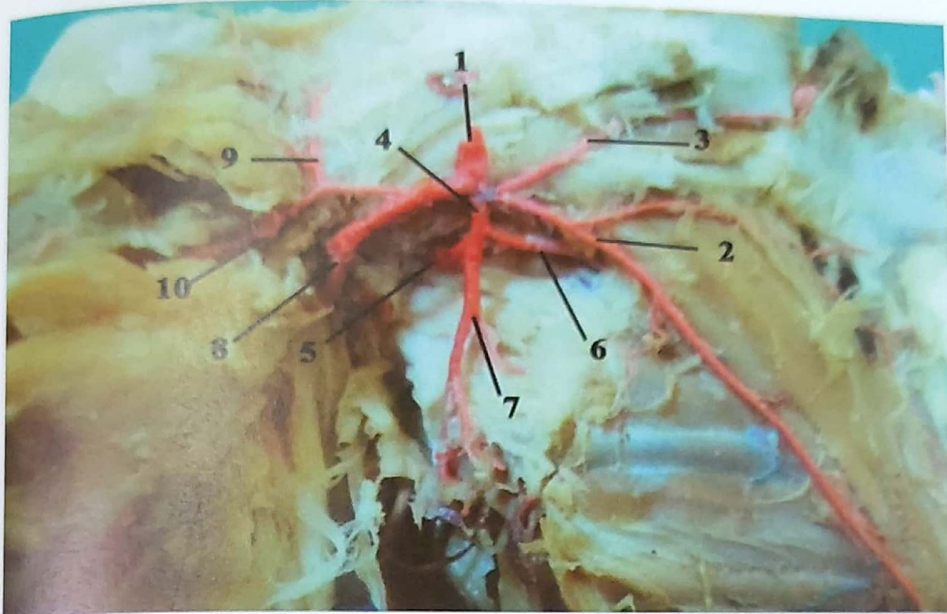


Fig. 3: A photograph showing the branches of the subclavian artery in the right thoracic limb (lateral view).

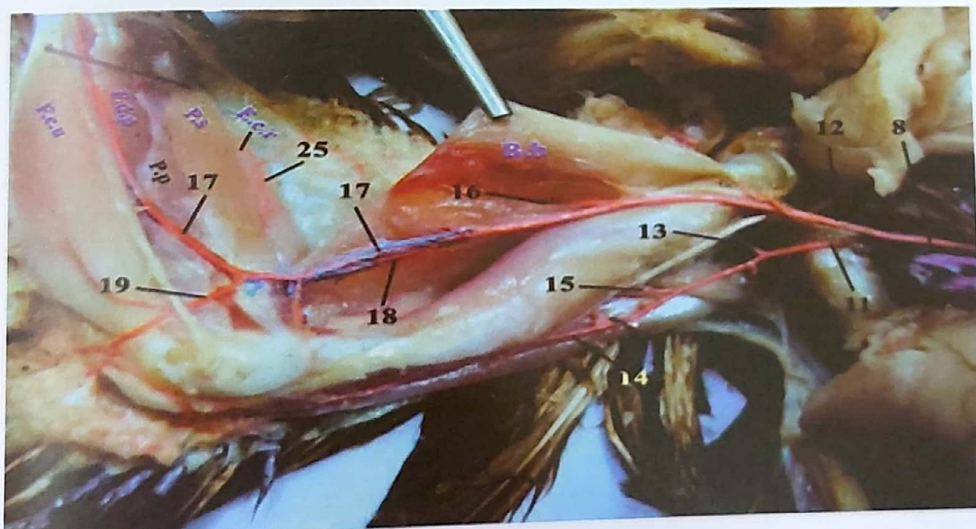


Fig. 4: A photograph showing the branches of the axillary artery in arm & forearm of the right wing (ventral view).

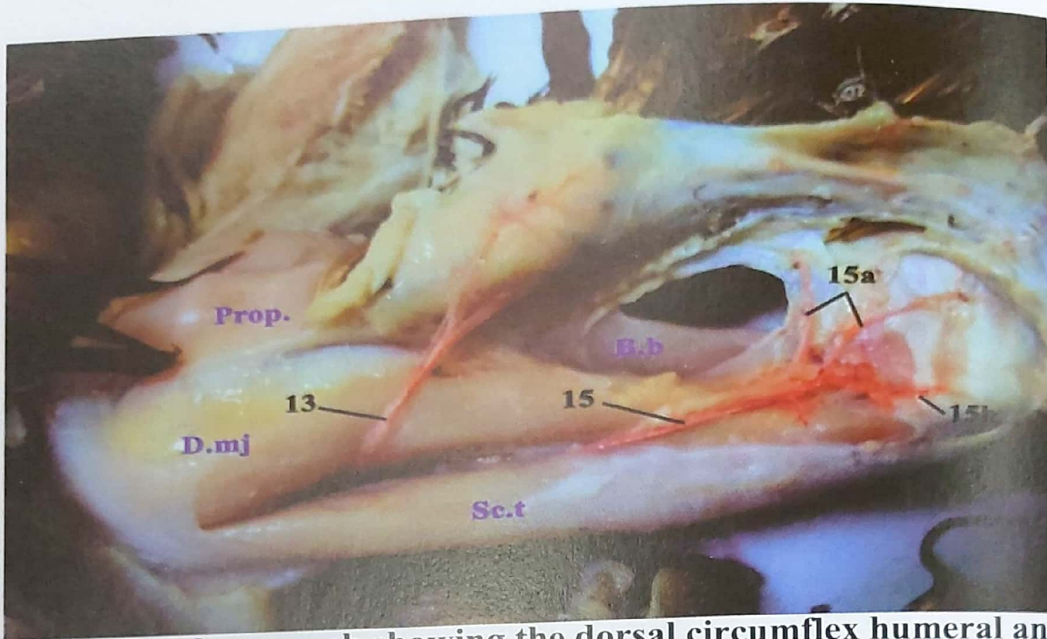
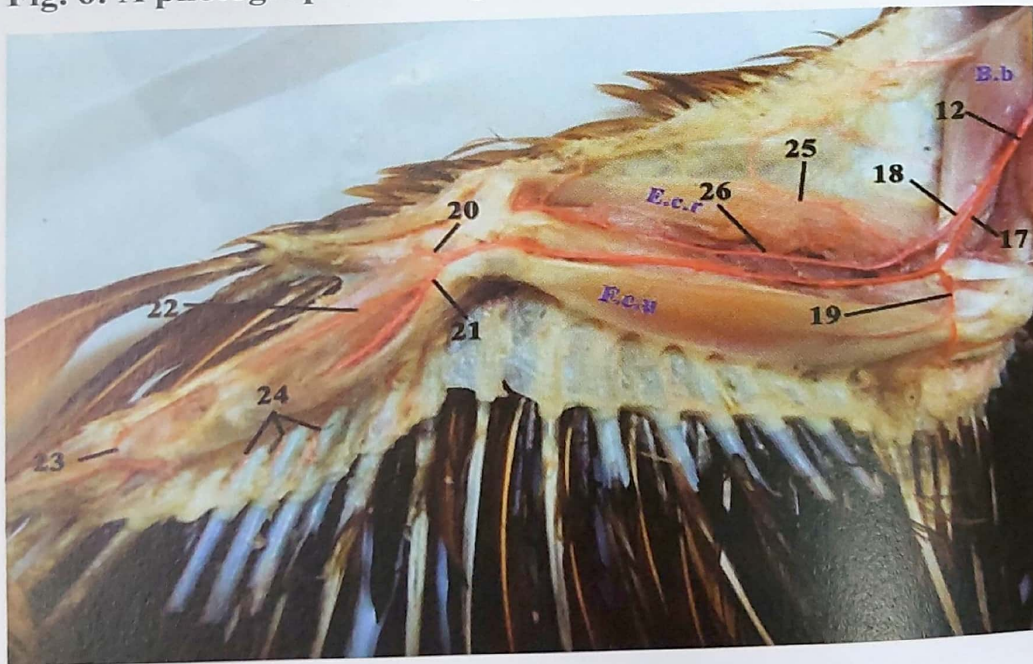


Fig. 5: A photograph showing the dorsal circumflex humeral and collateral radial artery in arm of the left wing (dorsal view).
Fig. 6: A photograph showing the branches of the brachial artery in



forearm and Manus of the right wing (ventral view).



Fig. 7: A photograph showing the branches of the radial artery in forearm of the left wing (dorsal view).



Fig. 8: A radiograph showing the arteries of the right wing.

Legend of figures (1-8):

1- A. subclavia	15b-Articular rami	L- Liver
2- A. thoracica interna	16- A. bicipitalis	A.A- Aorta ascendens
3- A. sternoclavicularis	17- A. ulnaris	B.b- Biceps brachii
4- Truncus pectoralis	18- A. radialis	P. B - Plexus brachialis
5- A. pectoralis cranialis	19- A. recurrens ulnaris	CVC- Cranial vena cava
6- A. pectoralis caudalis	20- Artery of the pollex	D.mj- Deltoideus major
7- A. cutanea thoracoabdominalis	21- A. metacarpalis ventralis	Ect.u- Ectepicondylo-ulnaris
8- A. axillaris	22- Rami superficialis	E.d.c- Extensor digitorum communis
9- A. supracoracoidea	23- Arch	F.d.p- Flexor digitorum profundus
10- A. subscapularis	24- Arteriae pennarum	E.c.r- Extensor carpi radialis
11- A. profunda brachii	25- A. radialis superficialis	E. c.u- Extensor carpi ulnaris
12- A. brachialis	26- A. radialis profundes	F.c.u- Flexor carpi ulnaris
13- A. circumflexa dorsalis humeri	27- Aa. interossee dorsales	F.d.p- Flexor digitorum profundus
14- A. collateralis ulnaris	28- A. recurrens radialis	NM- Nervi medianus
15- A. collateralis radialis	29- R. metacarpalis dorsalis	P.p.- Pronator profundus
15a- Cutaneous rami	H- Heart	P.s- Pronator superficialis
		Prop.- Propatigalis
		Sc.t.-Scapulotriceps

Discussion

The present investigation revealed that, the subclavian artery arises from the brachiocephalic trunk, this finding was supported by Dyce et al., (2010), Baumel et al., (1993), Mclelland (1990) and Ghetei (1976) in birds and Cralley (1965) in starling. It gives off sternoclavicular, internal thoracic, pectoral trunk and the axillary artery. This result was in accordance with Petneházy et al., (2005) in the pigeon, Baumel et al., (1993) and Nickel et al., (1977) in birds. Nickel et al., (1977) in domestic birds, added that the subclavian artery continued as the thoracic artery and gave off the acromial artery to the shoulder joint, coracobrachial and long head of triceps brachii.

In agreement with Petneházy et, al., (2005) in the pigeon, Baumel et al., (1975), Ghetei (1976) and Nickel et al., (1977) in birds, the sternoclavicular artery derived from the subclavian artery and supplying branches to the supracoracoid muscle and the sternum. Baumel et al., (1993) and Nickel et al., (1977) in domestic birds, added that the sternoclavicular artery divided into sternal and clavicular arteries. Also, Ghetei (1976) in birds described the acromial artery as another branch from the sternoclavicular artery.

The present results were similar to that recorded by Petneházy et al., (2005) in the pigeon, Glenny (1947) in Ruffed grouse, Baumel et al., (1993) and Dyce et al., (1977) in birds, the pectoral trunk arose from the subclavian artery

accompanied the pectoral vein and nerve, these vessels enters mainly the pectoralis muscles. The pectoral trunk trifurcated into the cranial pectoral artery, the caudal pectoral artery and the cutaneous thoracoabdominal artery in between. The first two branches distributed to the pectoralis and supracoracoideus muscles.

Nickel et al., (1977) in domestic birds, Glenny (1947) in wild turkey, reported that, the axillary artery was considered a branch from the subclavian artery. In contrary, in this work and reports of Baumel et al., (1993), Orosz (1989) and Ghetei (1976) in birds and Cralley (1965) in starling, the axillary artery considered the direct continuation of the subclavian artery and gave off the supracoracoid artery to the supracoracoideus and the subscapular artery the deep serratus and lateral head of the subscularis.

In agreement with Ghetei (1976) in birds the deep brachial artery derived from the axillary artery at the proximal end of the arm region, accompanied by the radial nerve. This result denied by Baumel et al.,(1993) and Nickel et al., (1977) in domestic birds. They recorded that, the deep brachial artery was a branch from the brachial artery.

According to current investigation and studies of Baumel et al., (1993) and Nickel et al., (1977) in birds, the deep brachial artery gives off the dorsal circumflex humeral artery, and then bifurcated into collateral ulnar and collateral radial branches. The collateral ulnar artery mainly distributed to the muscles of the ventral wall and elbow joint while the collateral radial artery distributed to the dorsal wall and skin.

The latter two branches were not recorded in the results of Ghetei (1976) in birds.

The dorsal circumflex humeral artery gave off three branches to supply the proximal muscles of the arm, in agreement with Nickel et al., (1977) and Ghetei (1976) in birds. However, Ghetei (1976) in birds stated that the circumflex humeral artery is a branch from the axillary artery.

Similar to that recorded by Baumel et al., (1993) and Nickel et al., (1977) in birds, the collateral ulnar artery arose from the deep brachial artery between the scapulothoriceps and humerotriceps, it passed caudally and distally, appeared at the ventral aspect of the arm region and gave off many branches to supply the previous muscles and the elbow region. The present study added that the collateral ulnar artery anastomized with the recurrent ulnar artery at the elbow joint.

Baumel et al., (1993) and Nickel et al., (1977) in birds reported that, the collateral radial artery was considered as the direct continuation of the deep brachial artery; it passed dorsally between the scapulothoriceps and deltoideus major with the radial nerve. Distally at the dorsal aspect of the arm region, it supplies the extensor carpi radialis and the skin of the fore arm region. This was in line with the present study.

Baumel et al., (1993) and Ghetei (1976) in birds, Cralley (1965) in starling agreed with our study in considering the brachial artery the continuation of the axillary artery along the arm region. It passed distally, from the ventral aspect of the arm region, between the biceps and triceps muscles.

Similar to that recorded by Baumel et al., (1993), the brachial A. gives off a prominent muscular branch (bicipital artery) to the biceps brachii and several cutaneous branches to the skin of the arm.

The brachial artery bifurcated under the second half of the biceps brachii into ulnar and radial arteries. The results were in agreement with Petneházy et al., (2005) in the pigeon, Baumel et al., (1993) and Nickel et al., (1977) in birds.

Petneházy et al., (2005) in the pigeon, Baumel et al., (1993) and Nickel et al., (1977) in birds reported that, the ulnar artery arose from the brachial artery with the radial artery, it supplied the flexor muscles and vascularize the distal part of the wing. This was in line with the present study.

Our results were the same as reported by Baumel et al., (1993) and Nickel et al., (1977) in birds, the ulnar artery at the biceps brachii detached two branches to the cubital fossa and gave off a recurrent ulnar artery which supplied the flexor carpi ulnaris and anastomosed with a branch from the collateral ulnar artery.

In accordance with the results of Petneházy et al., (2005) in the pigeon, Baumel et al., (1993) and Nickel et al., (1977) in birds, the radial artery arose from the brachial artery. It gave off superficial radial artery along the ventral border of the extensor metacarpi radialis and continued in the forearm region as the deep radial artery.

In the present work, the deep radial artery gave off the dorsal interosseous artery to the space between radius and ulna, and then the dorsal interosseous artery at the level of the elbow

joint detached the recurrent radial artery that anastomosed with the branch of deep brachial artery. It also gave off the dorsal metacarpal artery at the carpal joint. The same results were stated by Baumel et al., (1993) in birds.

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الجملة الوعائية الشريانية للجناح في الدجاج

سماح البابلي- حمدي رزق
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أجري البحث علي عدد ثمانية من القوائم الصدرية للدجاج البالغ، وقد تم تخدير الحيوانات وحقنها من الشريان تحت الترقوي بمحلول ملح طبيعي 0.9% لتنظيفها من بقايا الدم، تلي ذلك حقنها بكتلة المطاط السائل الملون بمادة حبر الروترنج.

وقد بينت الدراسة أن المدد الشرياني للجناح في الدجاج المستأنس يعتمد علي الشريان الصدري الخارجي والشريان الإبطي، وقد تبين أن الشريان الصدري الخارجي ينقسم الي ثلاثة شرايين تقوم بتغذية العضلات الصدرية الامامية والخلفية والجلد في منطقة الصدر والبطن. بينما يقوم الشريان الأبطي بتغذية القائمة الامامية حيث يعطي الشريان العضدي الغائر في منطقة العضد ثم يتحول الي الشريان العضدي والذي ينقسم بدوره في منطقة الساعد الي الشريان الكعبري المسئول عن تغذية العضلات الباسطة لأصابع الجناح والشريان الزندي المسئول عن تغذية العضلات القابضة لأصابع الجناح.

تتغذي منطقة اليد علي الشريان المشطي البطني والشريان المشطي الثاني الناتجان من إنقسام الشريان الزندي.