

**ARTERIAL SUPPLY OF THE LIMBS
IN LOHMANN BROWN HYBRID CHICKEN (*HYBRID PULLUM BRUNNEIS LOHMANN*)
VASCULARIZAȚIA ARTERIALĂ A MEMBRELOR
LA HIBRIDUL DE GĂINĂ LOHMANN BROWN (*HYBRID PULLUM BRUNNEIS LOHMANN*)**

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ABSTRACT | REZUMAT

In the specialised literature consulted, there are few studies related to the description of the arterial system in birds, in general and in particular to the study of the arterial tree at the level of the wing and the limbs. There are notable differences highlighted in birds compared to mammals in terms of the origin, path, collaterals, and terminals of the arteries at the level of the limbs. The materials and method used were: injection with red resin for a good highlighting of the arterial system, chicken corpses were taken from the pathological anatomy discipline. The highlighted results and conclusions were the following: the path of the two subclavian arteries is short, having as its terminal distribution the arteries: sternoclavicular, axillary, thoracic; different from most species is the fact that the median artery is not present in the wings, the terminal arteries of the brachial artery being the radial artery and the ulnar artery, the latter serving the wing up to the digital level with its terminal digital arteries, a peculiarity found in this species is the irrigation of the pelvic limb through the arteries: external iliac and sciatic, the external iliac artery has as its terminal the femoral artery, which anastomoses with the sciatic artery caudal to the knee joint, from there the four tibial arteries start: cranial, caudal, medial, lateral.

Keywords: arterial, byrds, circulatory system

În literatura de specialitate consultată există puține studii legate de descrierea sistemului arterial la păsări, în general și în special de studiul arborelui arterial la nivelul aripii și al membrelor. Există diferențe notabile evidențiate la păsări față de mamifere în ceea ce privește originea, calea, colateralele și terminalele arterelor la nivelul membrelor. Materialele și metoda folosite au fost: injectarea cu rasina rosie pentru o bună evidențiere a sistemului arterial, s-au prelevat cadavre de pui de la disciplina anatomie patologică. Rezultatele și concluziile evidențiate au fost următoarele: traseul celor două artere subclaviere este scurt, având ca distribuție terminală arterele: sternoclaviculare, axilare, toracice; diferit de majoritatea speciilor este faptul ca artera mediana nu este prezenta in aripi, arterele terminale ale arterei brahiale fiind artera radială și artera ulnară, aceasta din urmă deservind aripa până la nivelul digital cu arterele sale digitale terminale, o particularitate întâlnită la această specie este irigația membrului pelvin prin artere: iliacă externă și sciatică, artera iliacă externă are ca terminal artera femurală, care se anastomozează cu artera sciatică caudal până la articulația genunchiului, de acolo cele patru pornesc arterele tibiale: cranian, caudal, medial, lateral.

Cuvinte cheie: arterial, păsări, sistem circulator

Studying the literature, in regards to the anatomical aspects of the arterial tree distribution, it was observed that existing findings generally follow the description and distribution of the aorta (8, 10) and the main visceral trunks (4, Neira et al. 2016). The bird's cardiovascular system is often addressed for the study of atherosclerosis, an area in which the coronary arteries and the aorta are studied in particular (4). The literature also has data on the embryonic development

of the cardiovascular system of several species of birds (12). From the bibliographic studies carried out, the variety of species studied was observed. Thus, the cardiovascular system was studied in species such as *Ramphastostoco* (10), *Amazona aestiva* (Gonçalves et al. 2011), *Struthio camelus Linnaeus* (Neira et al. 2016), *Corvus cornix* (Noor, 2017), *Phoenicopterus roseus* (2), and *Botaurus stellaris* (8).

Regarding the studied species, the literature has shown a variety of topographic, origin and distribution differences of the arterial supply compared to mammals, although they are not fully identified (1).

The aim of this article is to describe the arterial supply of the wings and limbs of *Gallus domesticus*-Lohmann brown hybrid, with the purpose of providing a-

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accurate data in regards to the arterial supply of these segments to researchers and clinicians.

MATERIALS AND METHODS

The biological material was represented by 10 adult chicken bodies, Lohmann brown hybrid chicken with an average weight of 2 kg, females, from the Parasitology Clinic of the Faculty of Veterinary Medicine, Cluj-Napoca. After procurement of the biological material, the feathers, skin, muscles, and sternum were removed for easy access to the heart. After left ventricular cannulation, epoxy resin mixed with red dye was injected. A ligature of the aorta was performed in order to avoid the return of the substance to the ventricular cavity. The body was immersed in 5% formaldehyde for 24 hours. The stratigraphic dissection was performed to highlight the arterial vessels in order to photograph and describe them.

RESULTS AND DISCUSSIONS

Following stratigraphic dissection, the ascending aorta (*Arteria aortes ascendens*) was first examined, with the origin in the left ventricle. After a short trajectory, the aorta continues with the aortic arch (*Arcus aortae*). From the cranial margin of the aortic arch, two brachiocephalic trunks emerge. Their origin is found ventrally to the syrinx and caudally to the primary bronchi. First, the left brachiocephalic trunk (*Truncus brachiocephalicus sinister*) emerges, followed by the right brachiocephalic trunk (*Truncus brachiocephalicus dexter*). Following a short dorso-cranial trajectory, each brachiocephalic trunk divides into a common carotid artery and a subclavian artery. Thus, the left brachiocephalic trunk divides into the left subclavian artery (*Arteria subclavicularis sinister*) and the left common carotid artery (*Arteria carotis comunis sinister*), while the right brachiocephalic trunk divides into the right subclavian artery (*Arteria subclavicularis dexter*) and the right common carotid artery (*Arteria carotis comunis dexter*).

Each subclavian artery gives rise to the sternoclavicular (*Arteria sternoclavicularis*), an internal thoracic artery, intercostal arteries, and an axillary artery. The axillary artery is the first arterial branch of the wing (Fig. 1).

The axillary artery (*Arteria axilaris*) is the direct continuation of the subclavian artery, with its origin on the cranial margin of the first rib. The artery is located medially to the glenohumeral joint, passes it caudally and divides ventrally to the humeral head. The axillary artery has two smaller branches, the coracoid artery, and the subscapular artery. The continuation of the axillary artery is the brachial artery.

The coracoid artery (*Arteria coracoidea*) is the

first branch of the axillary artery. It has a cranial trajectory, and it follows the position of the coracoid bone and divides to the ascending pectoral region.

The subscapular artery (*Arteria subscapularis*) is the second branch of the axillary artery and it is oriented dorso-caudally to the proximal extremities of the clavicle.



Fig. 1. Branches of the subclavian artery: 1. Left subclavian artery; 2. Ascending aorta; 3. Sternal artery; 4. Clavicular artery; 5. Left common carotid artery; 6. Right common carotid artery; 7. Brachiocephalic arterial trunk; 8. Acromial artery; 9. Origin of the left common carotid artery; 10. Axillary artery; 11. External thoracic artery; 12. Internal thoracic artery

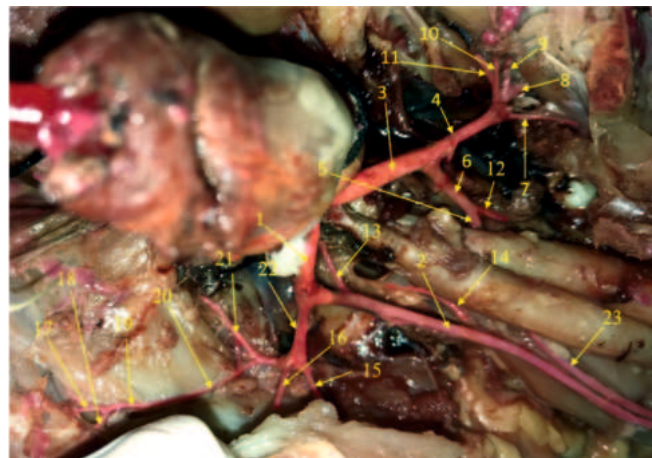


Fig. 2. 1. Right brachiocephalic arterial trunk; 2. Right common carotid artery; 3. Left brachiocephalic arterial trunk; 4. Left subclavian artery; 5,6. Left common carotid artery; 7. Left sternoclavicular artery; 8,9 Left axillary artery; 10. Left external thoracic joint; 11. Left external thoracic artery; 12,14. Vagus nerve artery; 13. Acromial artery; 15. Right sternoclavicular artery; 16. Right axillary artery; 17,18,19,20. External thoracic artery; 21. Right internal thoracic artery; 22. Right subclavian artery

The brachial artery (*Arteria brachialis*) represents the continuation of the axillary artery; it has a straight course medially to the humerus, where it intersects ventro-cranially at an acute angle, then passes cranio-medially to the elbow joint. Ventrally to the elbow, it divides into the radial and ulnar arteries. Emerging from the brachial artery, there is the deep artery of the arm, the cranial circumflex humeral artery and the bicipital artery (Fig. 2).

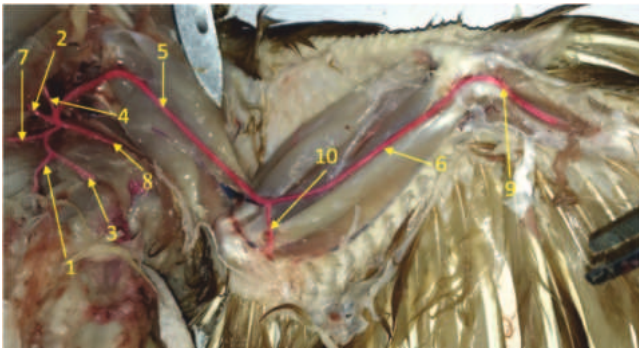


Fig. 3. The wing arteries: 1. Deep brachial artery, descending branch; 2. Axillary artery; 3. Deep brachial artery, ascending branch; 4. Cranial circumflex humeral artery 5. Brachial artery; 6. Ulnar artery, 7. Cranial circumflex humeral artery 8. Caudal circumflex humeral artery; 9. Digital artery; 10. Articular branches

The deep artery of the arm (*Arteria profunda brachii*) emerges caudally, at a right angle, under the humeral insertion of the teres major et infraspinatus muscle. It is a large calibre artery; it divides through ascending and descending branches to the triceps brachii muscle and continues with the caudal circumflex humeral artery (Fig. 3).

The bicipital artery (*Arteria bicipitalis*) divides and supplies the distal third of the biceps muscle.

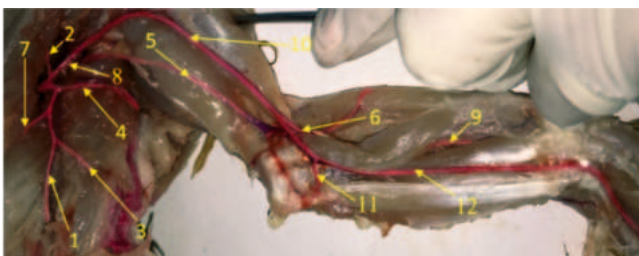


Fig. 4. Distribution of arteries in the region of the arm and forearm in the chicken: 1. Deep brachial artery, descending branch; 3. Deep brachial artery, descending branch; 4. and 5. Muscular branches, 6. Radial artery; 7. Cranial circumflex humeral artery; 10. Brachial artery 9. Muscular branches; 11. Articular branches; 12. Ulnar artery

The radial artery (*Arteria radialis*) in Lohmann brown hybrid chicken, is the continuation of the bra-

chial artery; it emerges from the brachial artery under the flexor carpi radialis muscle's tendon. Cranially, it gives rise to a small number of muscular branches and divides terminally, and supplies the proximal extremity of the metacarpal bone (Fig. 4).

The ulnar artery (*Arteria ulnaris*) is a branch of the brachial artery, and it has a longer course than the radial artery. It divides terminally to supliate the distal region of metacarpal bones. From its origin, the artery has a straight trajectory medially to the radius bone (Fig. 5).

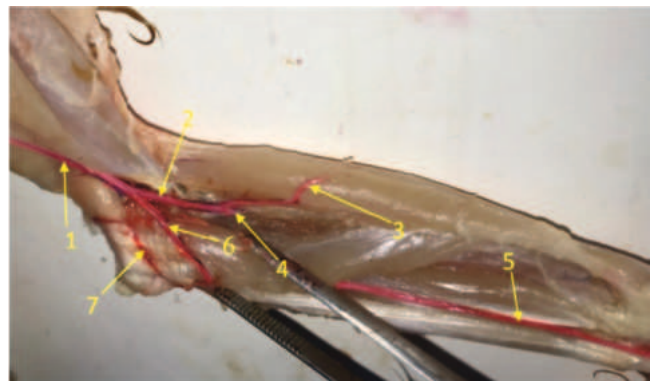


Fig. 5. Terminals of the brachial artery: 1. Brachial artery; 2. Radial artery; 3, 4. Muscle branches; 5. Ulnar artery; 6, 7. Articular branches.

Two arteries branch off from the descending aorta that serve the irrigation of the pelvic limb: the external iliac artery and the ischiadic artery.

The external iliac artery (*Arteria iliaca externa*) rises up from the descending aorta, situated near the cranial opening of the pelvis. It has a smaller calibre than the ischiadic artery, passes cranially to the acetabulum, and supplies the thigh. Along its course, it emits a branch of the pubic artery (Fig. 6).

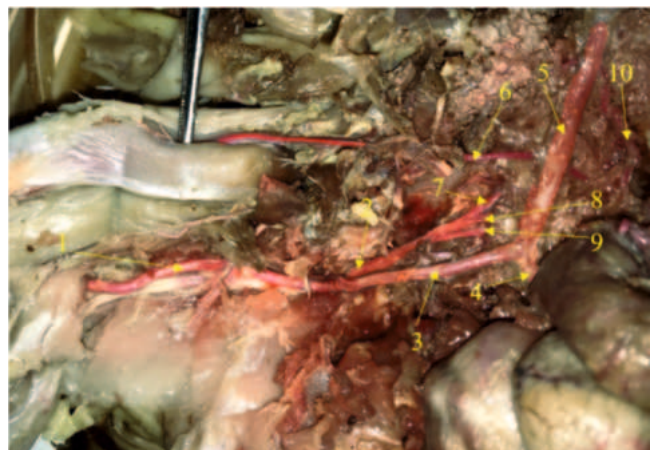


Fig. 6. External iliac artery: 1,3, and 4. Sciatic artery; 2,7,8, and 9. Sciatic nerve; 5. Descending aorta artery; 6. External iliac artery; 10. Gonadal arteries

The femoral artery (*Arteria femoralis*) is a direct

continuation of the external iliac artery, it passes straight in a ventro-medial direction to the hind limb and supplies the caudal abdominal muscles and the cranial and medial muscles of the thigh. The branches arising from the femoral artery are the cranial femoral artery and the cranial coxal artery.

The pubic artery (*Arteria pubica*) arises from the external iliac artery and supplies the organs located in the pelvic cavity. Along its course, following the internal surface of the sacrospinous ligament, on the dorsal margin of the internal obturator muscle, it emits branches that distribute to the pelvic cavity.

The ischiatic artery (*Arteria ischiadica*) rises up from the descending aorta, it passes under the lumbosacral joint and the sacroiliac joint to the caudal margin of the ilium. After its origin, the artery passes through the ilio-ischiatic foramen and divides caudo-laterally to the femur. At this point, the artery's course is parallel to the ischiadic nerve. It emits branches: the medial renal artery, the caudal renal artery, the caudal coxal artery, the caudal circumflex artery, the distal caudal femoral artery, the proximal caudal femoral artery, and the sural artery. The continuation of the ischiadic artery is the popliteal artery (Fig. 7).

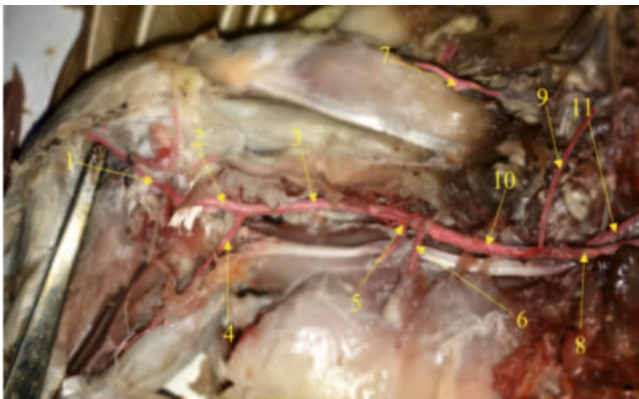


Fig. 7. Ischiatic artery. 1,2 Cranial tibial arteries; 3. Sciatic artery; 4. Caudal tibial artery; 5,6. Muscular branches

The middle renal artery (*Arteria renalis media*) is the first branch of the ischiadic artery, oriented cranially and supplies the middle third of the renal parenchyma.

The circumflex femoral artery (*Arteria circumflexa femoris*) is the second branch of the ischiadic artery, oriented cranially from the upper third of the ischiadic artery, and supplies the quadriceps femoris muscle.

The caudal renal artery (*Arteria renalis caudalis*) is the first caudally oriented branch of the ischiadic artery and supplies the renal parenchyma.

The proximal caudal femoral artery (*Arteria femoralis proximocaudalis*) arises from the ischiadic artery, it is oriented caudally, and it supplies the semi-

membranosus muscle.

The distal caudal femoral artery (*Arteria femoralis distocaudalis*) arises from the ischiadic artery, it is oriented caudally, and it supplies the gracilis muscle.

The sural artery (*Arteria suralis*) is the last caudally oriented branch of the ischiadic artery, it arises caudally to the femurotibial joint and divides through various branches to the gastrocnemius muscles.

The popliteal artery (*Arteria poplitea*) is the continuation of the ischiadic artery; it arises caudo-medially to the femurotibial joint. It emits branches: the medial genicular artery, the lateral genicular artery, and the fibular artery. Near the proximal third of the tibia, it divides into a cranial tibial artery, and a caudal tibial artery.

The medial genicular artery (*Arteria genicularis medialis*) divides laterally to the femurotibial joint.

The lateral genicular artery (*Arteria genicularis lateralis*) divides laterally to the tibio-tarsal joint.

The fibular artery (*Arteria fibularis*) is a small calibre branch for the fibular muscle.

The caudal tibial artery (*Arteria tibialis caudalis*) is found in the caudal subregion of the zeugopodium, and supplies the muscles of this region. The artery passes under the flexor hallucis longus muscle (Fig. 8).

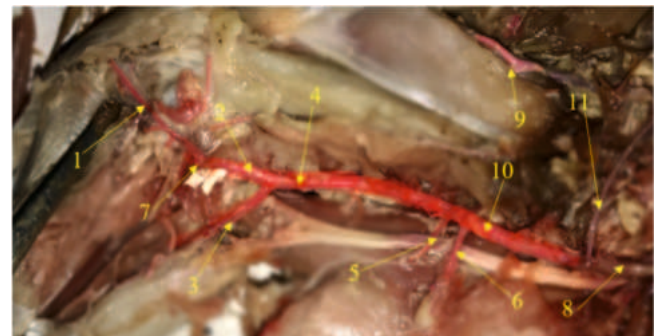


Fig. 8. The sciatic artery and its collaterals. 1. Cranial tibial artery; 2, 4, 10, 8. Sciatic artery; 3. Caudal tibial artery; 7. Medial tibial artery; 5, 6. Muscular branches; 9. Femoral artery

The cranial tibial artery (*Arteria tibialis cranialis*) is found on the cranial surface of the tibia, under the cranial tibial muscle, supplying the cranial muscles of the zeugopodium, and continuing with the common dorsal metatarsal artery.

The common dorsal metatarsal artery (*Arteria metatarsalis dorsalis comunis*) is found on the cranial surface of the tarsometatarsus, it supplies the long extensor to the toe muscle and the extensor digitorum muscle. It divides terminally near the phalanges.

For the studied species, the continuation of the axillary artery is the brachial artery. The brachial artery is situated on the medial surface of the wing. The axillary artery emits 2 branches: the coracoid artery and the

subscapular artery. The brachial artery emits 4 branches: the brachial artery, the cranial circumflex humeral artery, the caudal circumflex humeral artery, and the bicipital artery and divides terminally into the radial and ulnar arteries. The ulnar artery divides into the digital arteries. Unlike the studied species, in equids and bovines, the axillary artery emits 4 branches: the subscapular artery, the caudal circumflex humeral artery, the thoracodorsal artery, and the scapular circumflex artery (20).

The branches emitted by the brachial artery in equine and bovine species are: the cranial humeral circumflex artery, the bicipital artery, the deep brachial artery, the ulnar collateral artery, and the transverse elbow artery. In avian species, the brachial artery divides into the radial and ulnar arteries.

Near the lumbar vertebrae, the descending aorta divides to supply the hind limbs, through the external iliac artery, situated cranially, and the ischiadic artery, situated caudally; these are particular of the studied species (16). The continuation of the external iliac artery is the femoral artery, which emits 2 branches: cranially, the femoral circumflex artery and caudally, the pelvic artery.

In birds, the ischiadic artery arises from the descending aorta, passes through the sciatic foramen and divides medio-caudally to the hind limb.

The hind limb's arteries are: the external iliac artery and the ischiadic (sciatic) artery. The ischiadic artery's continuation is the popliteal artery, as described by König, in chickens, and by Can in the Japanese quail. The popliteal artery divides into lateral genicular artery, the medial genicular artery, the fibular artery, the cranial tibial artery and the caudal tibial artery. Can describes that the popliteal artery divides into the cranial and caudal tibial arteries (16).

CONCLUSIONS

The subclavian arteries' trajectory is short and divides terminally into: the sternoclavicular artery, the axillary artery, and the thoracic artery. The axillary artery emits 2 branches along its trajectory: the subscapular artery, the coracoid artery, and continues with the brachial artery. The brachial artery supplies the wing and emits 3 branches: the deep artery of the arm, the cranial humeral circumflex artery, and the bicipital artery. Unlike most species, the median artery is absent in birds' wings, the brachial artery divides into the radial and ulnar arteries, and the ulnar artery goes on to divide into the digital arteries and supply the wing. A characteristic feature of birds is that the hind limbs are supplied by the external iliac artery and the ischiadic artery. The external iliac artery divides into the femoral artery and the pubic artery. The ischiadic artery emits 7 branches: the medial renal ar-

tery, the caudal renal artery, the caudal coxal artery, the caudal circumflex artery, the dorso-caudal femoral artery, the proximal caudal femoral artery, and the sural artery. The popliteal artery arises from the sciatic artery. The popliteal artery emits 3 branches: the medial genicular artery, the lateral genicular artery, and the fibular artery. From the proximal third of the tibia, the popliteal artery divides into a caudal tibial artery, and a cranial tibial artery, the latter of which continues with a dorsal metatarsal artery.

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