Anatomical Studies on the Arterial Blood Supply of the Pelvic Limb of Geese

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Abstract | The present study was conducted on 25 adults, healthy Egyptian native breed of geese. The arteries of the pelvic limb were demonstrated by injection of colored gum milk latex and treated by the ordinary method of preservation. The arterial vascularization of the pelvic limb was mainly obtained from the external iliac and ischiatic arteries. The external iliac artery supplies the pelvic limb to the level of the knee joint, while the ischiatic artery is responsible for supplying the entire limb, changing its name according to the region of the limb it supplies. The ischiatic artery terminates after giving off the sural artery and continues in the leg region as the popliteal artery. The branches of the popliteal artery supply the knee and leg regions; whereas the cranial tibial artery, the continuation of the popliteal artery, supplies the foot with its own branches. The presence of extensive arterio-venous anastomosis (rete tibio tarsale) was shown to clarify means of thermoregulation in limbs. The aim of the present work is to highlight the accurate angi-architecture of the pelvic limb which is pivotal for surgical interference in cases of joints, limb and foot affections in water birds.

Keywords | Pelvic limb, Geese, External iliac, Ischiatic, Arterial supply.

INTRODUCTION

Poultry meat production is a worldwide business that progressively has become the standard form of mass production of protein (Jordan and Pattison, 1996). Despite this, geese have never been exploited commercially as much as chickens or even ducks have been (Chelmonska, 1995). Domestic geese were widely farmed to provide a source of meat, livers, eggs, and feathers. Historical records point to the use of geese, e.g., the fattening of goose for the table, and force-feeding has been known since ancient Egyptian times (Johanna et al., 2018). Bird’s foot was exposed to injuries, wounds, bumble foot, fibrosis, and swelling of the metatarsal pad, where the most common and needed surgical interference is done (Heidenreich, 1997, Routh, 2000; Cooper, 2002). The importance of the poultry among our native livestock has initiated an increasing interest to establish accurate and detailed anatomical facts about the arterial vascularization of the pelvic limb of the geese (Swielim et al., 2012).

MATERIAL AND METHODS

The present work was carried out on 25 adult healthy Egyptian native breed of geese of both sex. Their average body weight was (2.8-3.5) kg with ages about 120-140 days. They were obtained from local markets and transported to the laboratory of Anatomy and Embryology Department, Faculty of Veterinary Medicine, Cairo University.
**THE ARTERIAL-ARCHITECTURAL STUDY**

Before exsanguination, the birds were anaesthetized by intramuscular injection of 0.5 ml of xylazine 2% (xylazine hydrochloride, Dutch Farm veterinary pharmaceuticals) then injected by heparin (Cal heparin, 5000 I.U) in wing vein for 30 minutes. Each specimen was slaughtered according to the Islamic method of slaughtering through the common carotid arteries and the jugular veins and then left to bleed for 15 minutes, the arteries of injection were cannulated and thoroughly washed by warm normal saline solution NaCl 0.9% containing amount of heparin (heparin calcium 5000 I.U) to prevent blood clotting and blood remaining in the vessels.

**LATEX NEOPRENE INJECTION TECHNIQUE**

Immediately following euthanasia, the ribs and the sternum were carefully removed to expose the heart. The ventricular apex of the heart was removed and a Nelaton catheter of size 6F to 8F (MA MEDICAL company) was introduced into the left ventricle of the heart to the aorta for injection of the pelvic limb. The injected material was 60% latex neoprene colored with red Rottring ink (Tompsett and Wakelly, 1965). The specimens were then preserved in a container of 10% formalin solution, 2% phenol, and 1% glycerin for 3-5 days at room temperature (25°C) to allow solidification of the latex. The specimens were dissected for exposing the arterial distribution patterns.

**RESULTS**

The chief arterial supply of the pelvic limb comprises the external iliac and ischiatic arteries.

**A. ILIACA EXTERNA**

The external iliac artery (Figs.1,2/3&3, 4, 5, 6/2); a short trunk, arises from the lateral side of the descending aorta, about 1cm cranial to the hip joint. It proceeds caudal to the cranial renal artery and passes cranio-laterally within the division between cranial and middle lobes of the kidney. The external iliac arterygivesoff the pubic artery then continues outside the pelvis as the femoral artery through the pre-acetabular notch.

**A. PUBICA**

The pubic artery (Figs.1/7& 2/8 &3/3 &4, 5, 6, 9/4) is long slender branch, detached from the lateral aspect of the external iliac artery, 1cm caudal to the origin of the latter artery. It is considered the longest branch of the external iliac artery and proceeds caudo-ventrally with the same curvature of the pubic bone, incinerates itself between the vicinity of the internal obturator and abdominal muscles. During its course, it gives off fine branches that penetrate the cranial part of incisura pubo-ischiadica to supply theM. obturatorius lateralis. The pubic artery continues its course on the ventral border of the pubis to be distributed in the Mm. obturatorius medialis and pubo–ischio-femoralis.

**A. FEMORALIS**

The femoral artery (Figs. 1,2/10 & 3/4 &4, 5, 6/5); represents the direct continuation of the external iliac artery, descends ventro-medially to reach the level of the head of the femur where it detaches dorsally small vessel; the cranial coxal artery, then it bifurcates into the cranial and medial femoral arteries.

**A. Cranialis Coxae:** The cranial coxal artery (Figs.1/9 &2/7 &4, 5, 6/6); arises from the dorsal aspect of the femoral

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**Figure 1:** Arteries of the pelvis, thigh and leg regions, ventral view; diagrammatic.

**Figure 2:** Arteries of the left pelvic limb of goose, medial view; diagrammatic.
artery. It releases several branches to supply Mm. *ambiens*, *ilio-tibialis cranialis*, *ilio-trochantricus cranialis*, *ilio-femoralis externus*, *ilio-tibialis lateralis*, *femoro-tibialis externus* as well as the capsule of the hip joint.

**Figure 3:** A photograph showing the termination of the descending aorta and the main arteries of the pelvis, (Ventral view).

- A. *M.obliquus externus abdominis*
- B. *M.obliquus internus abdominis*
- C. Divisio renalis cranialis
- D. Divisio renalis media
- E. Divisio renalis caudalis
- F. *Cloaca*
- G. *Aorta descendens*
- H. *A.iliaca externa*
- I. *A.iliaca interna*
- J. *A.iliaca media*
- K. *A.femoraliscranialis*
- L. *A.femoralis medi alis*
- M. *A. femoralis cranialis*
- N. *A. femoralis caudalis*
- O. *A. ischiadica*
- P. *A.pubica*
- Q. *A. nutricia proximalis femoralis*
- R. *Ureter*
- S. *A. rena lis cranialis*
- T. *A. renalis media*
- U. *A.mesentrica cranialis*
- V. *A. renalis caudalis*
- W. *A. renalis medialis*
- X. *A. re nalis cranialis*
- Y. *A. mediana caudae*
- Z. *A. pubica*

**Figure 4:** A photograph showing the arteries of pelvic and thigh regions; (ventro-medial view); left side.

- A. *M. obturatorius medialis*
- B. *M. iliotibialis cranialis*
- C. *M. femorotibialis medialis*
- D. *M. ischiofemoralis medialis*
- E. *M. flexor cranialis medialis*
- F. *M. pubeo-femoralis caudalis*
- G. *M. gastrocnemius pars lateralis*
- H. *M. flexor perforatus digitii III*
- I. *Aorta ascendens*
- J. *A. iliaca externa*
- K. *A. iliaca interna*
- L. *A. pubica*
- M. *A. femoralis*
- N. *A. cranialis coxae*
- O. *A. cranialis caudalis*
- P. *A. femoralis cranialis*
- Q. *A. femoralis medialis*
- R. *A. femoralis cranialis*
- S. *A. femoralis caudalis*
- T. *A. ischiadica*
- U. *A. ischiadica*
- V. *A. pubica*
- W. *A. nutricia proximalis femoralis*
- X. *A. urealis*
- Y. *A. poplitea*
- Z. *A. tibialis cranialis*
- A. *A. tibialis caudalis*
- B. *A. cranialis coxae*
- C. *A. cranialis caudalis*
- D. *A. femoralis cranialis*
- E. *A. femoralis medialis*
- F. *A. femoralis cranialis*
- G. *A. femoralis caudalis*
- H. *A. ischiadica*
- I. *A. ischiadica*
- J. *A. pubica*
- K. *A. nutricia proximalis femoralis*
- L. *A. urealis*
- M. *A. poplitea*
- N. *A. tibialis cranialis*
- O. *A. tibialis caudalis*
- P. *A. cranialis coxae*
- Q. *A. cranialis caudalis*
- R. *A. femoralis cranialis*
- S. *A. femoralis medialis*
- T. *A. femoralis cranialis*
- U. *A. femoralis caudalis*
- V. *A. ischiadica*
- W. *A. ischiadica*
- X. *A. pubica*
- Y. *A. nutricia proximalis femoralis*
- Z. *A. urealis*
- A. *A. poplitea*
- B. *A. tibialis cranialis*
- C. *A. tibialis caudalis*
- D. *A. cranialis coxae*
- E. *A. cranialis caudalis*
- F. *A. femoralis cranialis*
- G. *A. femoralis medialis*
- H. *A. femoralis cranialis*
- I. *A. femoralis caudalis*
- J. *A. ischiadica*
- K. *A. ischiadica*
- L. *A. pubica*
- M. *A. nutricia proximalis femoralis*
- N. *A. urealis*
- O. *A. poplitea*
- P. *A. tibialis cranialis*
- Q. *A. tibialis caudalis*
- R. *A. cranialis coxae*
- S. *A. cranialis caudalis*
- T. *A. femoralis cranialis*
- U. *A. femoralis medialis*
- V. *A. femoralis cranialis*
- W. *A. femoralis caudalis*
- X. *A. ischiadica*
- Y. *A. ischiadica*
- Z. *A. pubica*

**A. FEMORALIS CRANIALIS**

The cranial femoral artery (Figs. 1, 2/11 & 4, 5, 6/7, 9/7); emanates from the parent trunk at the level of the hip joint and passes cranio-laterally in the thigh region between the Mm. *ilio-tibialis cranialis* and *femoro-tibialis cranialis*. It gives off fine collateral branches to supply the preceding muscles as well as the Mm. *pectinus* and *ambiens*.

**A. FEMORALIS MEDIALIS**

The medial femoral artery (Figs. 1, 2/12 & 4, 5, 6/7, 8); long distal branch of the femoral artery, directed caudo-ventrally to the head of the femur where it passes between the neck of the femur and tendon of the M. *ilio-femoralis internus* in the medial aspect of the thigh. The medial femoral artery proceeds between the Mm. *ischiofemoralis* and *femoro-tibialis medialis* at the caudal surface of the femur till reach the stifle joint. During its course, it gives off a muscular branch to supply Mm. *ilio-femoralis internus*, *ilio-trochantricus cranialis*, *ilio-trochantricus caudalis*, *femoro-tibialis medialis* and adductor muscle. It joins the medial tibial artery on the medial aspect of the stifle joint.

**A. ISCHIADICA**

The ischiatic artery (Figs. 1, 2 & 4 & 5 & 4, 5, 6, 7, 9/10); the main source of the arterial blood supply of the pelvic limb. It originates from lateral aspect of the abdominal aorta, caudal to the origin of the external iliac artery by about 1.5 cm at the level of 4th - 5th sacral segment of synsacrum. The ischiatic artery dips in the renal fossawhere it gives off its intra-pelvic branches; the middle renal (Figs. 1, 2/14 & 3/6 & 4, 5, 6/11), caudal renal (Figs. 1, 2/15, 3/7 &
4, 5, 6/12), obturator (Fig.2/18) and ilioischiatic (Fig.2/16) arteries, then leaves the pelvis via the cranial end of ilioischiatic foramen. The extra-pelvic part of the ischiatic artery proceeds ventro-laterally to the thigh region and becomes incinerated between the vicinity of the M.ilio-fibularis laterally and M. ischio-femoris medially. It continues distally between M.ilio-tibialis lateralis and M.caudo-iliofemoralis till reaches the caudal aspect of the stifle joint. Along its extra-pelvic course, the ischiatic artery detaches; the caudal coxal, caudal femoral, proximal nutrient femoral, caudal

**Figure 6: A photograph showing the arteries of pelvic and thigh regions. (Ventral-medial view)**

- A. M.obturatorius medialis
- B. M.iliofibularis cranialis
- C. M.femorotibialis medialis
- D. M.ischiofibularis medialis
- E. M.flexor cruralis medialis
- F. Aorta descendens
- G. A.iliaca externa
- H. A.pubica
- I. A.femoralis
- J. A.cruralis coxae
- K. A.femoralis cranialis
- L. A.femoralis medialis
- M. A. renalis media
- N. A. renalis caudalis
- O. A. iliaca interna
- P. A. ischiadica
- Q. A. renalis cranialis
- R. A. mesentrica cranialis
- S. A. renalis cranialis
- T. A. mesentrica media
- U. A. mesentrica caudalis
- V. A. pubica
- W. A. genicularis media
- X. A. genicularis cranialis
- Y. A. tibialis cranialis
- Z. A. tibialis medialis

A. femoralis caudalis
The caudal femoral artery (Figs.1/17 &2/19&4/13&7/13); detached from the caudal aspect of the ischiatic artery. It courses caudo-ventrally to the thigh region to supply M.ilio-fibularis and the flexor muscles of the thigh.

**Figure 7: A photograph showing the arteries of the thigh and leg regions. (Caudo-medial view).**

- B. M.iliofibularis cranialis
- C. M.femorotibialis medialis
- D. M.ischiofibularis medialis
- E. M.flexor cruralis medialis
- F. M.gastrocnemius pars lateralis
- G. M.femoris nutritiae proximales
- H. M.flexor perforatus digiti III
- I. A.unicus proximales femoris
- J. A. cruralis.
- K. A. rectus femoris
- L. A. tibialis medialis
- M. A. tibialis cranialis
- N. A. peroneus tertius
- O. A. poplitea
- P. A. tibialis cranialis

**A. femoralis cranialis**
The proximal nutrient femoral artery (Figs.1/18 &2/21&4,7/14); emanates from cranio-lateral wall of the ischiatic artery. It proceeds cranially to provide the M. pubo-ischio-femoralis, and then pierces the proximal nutrient foramen of the femur to supply its medullary cavity.

**A. cutanea femoralis caudalis**
The caudal femoral cutaneous artery (Fig. 2/20); springs from the lateral aspect of the ischiatic artery cranial to the stifle joint. It proceeds caudolaterally till reach to the integument of the lateral aspect of the thigh region, knee joint and ramifications into 2-3 fine arteries.

**A. suralis:**
The sural artery (Figs.1/19 & 2/22&4,7/15); long strong vessel, emitted from the caudal aspect of the ischiatic artery at the level of the stifle joint. The sural artery descends caudo-ventrally to the caudal surface of the leg region. During its course, it detaches the caudal cutaneous crural artery and terminates by dividing into medial and lateral
sural arteries at the level of the hock joint.

**A. Cutanea Cruralis Caudalis:** The caudal cutaneous crural artery (Fig.2/24) is long fine vessel erupted from the caudal aspect of the sural artery. It passes ventro-laterally to ramify in the skin of the caudal aspect of the crus.

**Aa. Surales Lateralis Et Medialis:** The lateral and medial sural arteries (Figs. 1/20,21 &2/25,26); the terminal branches of the parent trunk, pass caudo-ventrally to the muscles of the caudal aspect of the shank on the lateral and medial sides respectively. During their courses, they supply the Mm. ilio-fibularis, gastrocnemius as well as the Mm. flexor perforans et perforatus digiti III, IV by about 3–4 muscular branches.

**A. poplitea**
The popliteal artery (Figs.1/22 & 2/27&4, 7/16); the direct continuation of the ischiatic artery in the leg region beyond the origin of the sural artery. It runs caudo-ventrally to the stifle joint, then passes between caudal head of M. flexor perforans digiti III and the pars intermedia of M. gastrocnemius till reaches the interosseous space between tibia and fibula. Along its course, it detaches the proximal geniculate, medial tibial and caudal tibial arteries, then continues as the cranial tibial artery.

**A. geniculatis proximalis**
The proximal geniculate artery (Fig.1/23); detaches from cranial aspect of the parent trunk and proceeds cranio-laterally to the stifle joint capsule between pars intermedia of Mm. gastrocnemius, flexor cruris lateralis and flexor perforates digiti III. It gives off 3–4 fine collateral branch esto supply the preceding muscles and detaches A. nutricia distalis femoralis to enter in the distal nutrient foramen of the femur.

**A. tibialis medialis**
The medial tibial artery (Figs.1/24 &2/28 &4,7/17), emanates from the craniolateral wall of the popliteal artery. It passes caudoventrally to the crural region where it gives off the medial geniculate artery.

**A. geniculatis medialis**
The medial geniculate artery (Figs.1, 2/13&4, 6, 7/9); erupts from the caudal aspect of the medial tibial artery. It descends on the medial aspect of the leg region to supply the pars medialis of M. gastrocnemius and continues as medial crural cutaneous artery to provide the integument of the leg region.

**A. tibialis caudalis**
The caudal tibial artery (Figs. 1/25 & 2/29 &4,7, 9/18); is emitted from the caudal aspect of the popliteal artery and passes caudoventrally to supply the flexor muscles of
the leg; the *pars medialis, intermedia* of Mm.gastrocnemis, popliteus, flexor hallucis longus, flexor digiti longus and *flexor perforates digiti III*. It runs parallel to shaft of the tibia till reaches the caudal aspect of the hock joint where it ramifies into 3-4 fine branches.

**A. TIBIALIS CRANIALIS**
The cranial tibial artery (Figs.1/26 &2/34 & 4, 7,8, 9, 10/19); the direct continuation of the popliteal artery, passes caudo-ventrally to the lateral surface of the tibia between the *M.popliteus* and the proximal part of shaft of tibia. It descends into the caudal interosseous groove for about 0.3 cm to supply the Mm. *flexor perforates digiti III* and *flexor digiti longus*. It penetrates the interosseous membrane between tibia and fibula and transverses it to the cranial surface of tibia to supply Mm. *tibialis cranialis* and *fibularis longus*. The cranial tibial artery continues till reaches the hock joint and ramifies into 2-3 fine twigs. During its course, it detaches; the *fibular* and lateral tibial arteries and continues at the proximal end of the tarsometatarsus as common dorsal metatarsal artery.

The arterial blood supply of goose’s foot is supplied by two sets; the dorsal and planter.

**The dorsal set:**
The dorsal set involves of the *Rete tibiotarsale* and *A. metatarsalis dorsalis communis*

**RETE TIBIOTARSALE**
The *rete tibio-tarsale* (Figs. 2/35, 36 &10/45) is a network of multiple arteries and veins which is located on the distal third of the tibiotarsus and proximal part of tarsometatarsus. It comprises the collateral branches of the cranial tibial, deep fibular, superficial fibular and lateral sural arteries then continues distally to the dorsal aspect of tarso-metatarsus as common dorsal metatarsal artery.

**A. METATARSALIS DORSALIS COMMUNIS**
The common dorsal metatarsal artery (Figs. 2/39 &9,10,11/26); is the direct continuation of the cranial tibial artery at the flexor surface of tarsus and descends to dorsal surface of tarsometatarsus. Along its course; it gives off a perforating branch traverses the proximal vascular foramen to reach the plantar aspect forming the plantar set then continues on the dorsal surface of tarsometatarsus to be divided into medial and lateral dorsal metatarsal arteries.
A metatarsalis dorsalis medialis
The medial dorsal metatarsal artery (Figs. 2/43 & 9, 11/27); courses dorso-medially till reach the distal third of the tar-sometatarsus where it gives off the medial digital I and medial digital II arteries. During its course, it detaches 2-3 fine arteries to supply Mm. extensor digitorum communis, extensor proprius digitii II and extensor hallucis longus.

A. metatarsalis dorsalis lateralis
The lateral dorsal metatarsal artery (Figs. 2/42 & 11/28); descends on the tarso-metatarsus till reach the distal vas-cular foramen, through which it traverses to the planter side and participate in the formation of the planter arch. Along its course, it gives off fine branches to supply the tendon of the Mm. extensor digitorum communis, extensor proprius digitii II, extensor breves digitii III and IV.

II. The planter set:
The planter set of arteries is composed of the Aa. inter–metatarsales plantares and the planter arch.

1. Aa. Intermetatarsales Plantares Lateralis Et Medialis
The lateral and medial planter inter-metatarsal arteries (Fig. 11/48); originate from the common dorsal metatarsal artery on the planter aspect of tarsus after its emergence from the proximal vascular foramen of tarso-metatarsus. Each bifurcates into an ascending and descending branches. The former one is denominated as the planter tarsal artery while the descending branch forms the planter metatarsal artery.

Figure 11: A photograph showing the distribution of the digital arteries, dorsal view.
33. A. digitalis III lateralis 36. A. digitalis I medialis
34. A. digitalis II medialis 37. A. digitalis I lateralis
35. A. metatarsalis plantaris medialis 38. A. metatarsalis plantaris medialis

Aa. Tarsales Plantares
The plantar tarsal arteries (Figs. 2/37, 38 & 12/42), originated as short thin vessels from ascending branch of the planter inter-metatarsal artery. They ascend proximally on the planter sides of tarsus where they ramify on the tarsus and skin around the latter joint. Along their course; they joined the lateral sural arteries to supply the corresponding region.

Aa. Metatarsales Plantares Lateralis Et Medialis
The lateral and medial planter metatarsal arteries (Figs. 2/40, 41 & 11, 12/35 & 12/41); the distal continuation of the descending branches of the planter inter-metatarsal artery. They proceed on the either sides of the planter aspect of tarso-metatarsus and nourish several muscles; Mm. flexor hallucis longus, flexor digitorum longus, tendon of M. flexor digitorum profundus and M. flexor digitorum superfi-cialis by fine twigs. Finally, the planter metatarsal arteries unite with the lateral dorsal metatarsal artery to form the planter arch.

Figure 12: A photograph showing the distribution of the plantar arch, plantar view.
32. A. digitalis III medialis 38. Arcus plantaris
33. A. digitalis III lateralis 39. R. pulvinaris
40. A. digitalis IV lateralis 41. A. metatarsalis plantaris lateralis
42. A. tarsalis plantaris 45. A. metatarsalis plantaris medialis
M.P. metatarsal pad 37. A. digitalis I medialis
31. A. metatarsalis plantaris medialis
The plantar arch (Figs. 2/44 &12/38) comprises the union of the medial, the lateral plantar metatarsal arteries by 1-2 fine transverse branches and the lateral dorsal metatarsal artery which pierces the distal vascular foramen of the tarsometatarsus. It is situated at the deep face of the common digital flexor tendon and runs distally til reaches the proximal extremity of the fetlock joint where it is divided into pulvina branch and digital arteries.

**DISCUSSION**

The chief arterial supply of the pelvic limb comprises the external iliac and ischiatic arteries, which is consistent with previous studies by (Havenga et al., 2020) in raptor, (El-Gammal, 2012) in chicken, (Can et al., 2010) in Japanese quail, (El-Nahla et al., 2010) in ostrich and (Dyce et al., 2002, Kuru, 1996, Baumel et al., 1993, King et al., 1984, Baumel, 1975) in domestic fowl. (Havenga et al., 2020) in raptor observed that the external iliac artery gave off the femoral circumflex, gluteal and pelvic arteries. However, (Jianzhong et al., 2010) in chickens decided that the external iliac artery detached two branches; the femoral and circumflex femoral arteries that were distributed into the hind limb. On the other hand, (Nickel et al., 1977) had the opinion that the external iliac artery left the pelvic cavity where it divided into the pelvic and the femoral arteries in domestic fowl while (Can et al., 2010) in Japanese quail and (Fitzgerald, 1969) in the European quail mentioned that the external iliac artery emitted the umbilical (pubic) and the cranial gluteal arteries as well as the muscular branches that supplied the sartorius and the quadriceps femoris muscles. Moreover, (Baumel, 1975; Baumel et al., 1993) in domestic fowl stated that the umbilical artery was a large branch of the pubic artery which courses in the ventral extra-peritoneal fat to the umbilical scar of the abdominal wall.

The femoral artery represented the direct continuation of the external iliac artery and gave off the cranial coxal, the cranial femoral, and the medial femoral arteries. This statement was in accordance with (El-Gammal, 2012) in chicken, (El-Nahla et al., 2010) in ostrich (Jianzhong et al., 2010) in chicken, (Dyce et al., 2002) in the avian species, (Kuru 1996, Baumel et al., 1993; King and Mcleland 1984, Nickel et al., 1977; Baumel, 1975, Mcleod et al.,1964; Nishida,1963) in domestic fowl. In contrast to (Bentley and Poople, 2009) in the Quail in the same respect, the main artery of the hind limb was the ischiatic artery which was released from the dorsal aorta.

The ischiatic artery was the main source of the blood supply of the pelvic limb of goose, such statement was similar
to that asserted in chicken (El-Gammal, 2012), Japanese quail (Can et al., 2010), ostrich (El-Nahla et al., 2010), rooster, drake and pigeon (Kurtul and Haziroglu 2002), and domestic fowls (Kuru 1996, Baumel et al., 1993; King et al., 1984). The ischiatic artery originated from ventro-lateral aspect of the abdominal aorta, caudal to the origin of the external iliac artery, in contrast with that by (Havenga et al., 2020) in raptor. The ischiatic artery emerged from descending aorta at the middle axis of the division renalis media (Havenga et al., 2020), while in chicken (El-Gammal, 2012), Japanese quail (Can et al., 2010), and domestic fowls (Baumel et al., 1993; Baumel 1975) the ischiatic artery arose from lateral aspect of the aorta caudal to the origin of the femoral artery. On the other hand, the ischiatic artery detached from the aorta at the junction of the middle and caudal renal divisions, caudal to the origin of the external iliac artery in ostrich (El-Nahla et al., 2010) while in domestic fowl showed that the ischiatic artery sprang from the aorta at the level of the hip joint (Nickel et al., 1977).

The extra pelvic distribution of the ischiatic artery, the current work demonstrated that it gave off the caudal coxal artery after leaving the pelvis through ilioischial foramen. These findings denied that had been mentioned by (El-Gammal, 2012) in chicken, (Baumel et al., 1993, Nickel et al., 1977; Baumel 1975) in domestic fowl.

The popliteal artery was the direct continuation of the ischiatic artery in the leg region. The same result was mentioned by (El-Gammal, 2012) in chicken, (Can et al., 2010) in Japanese quail, (El-Nahla et al., 2010) in ostrich, (Nickel et al., 1977, Baumel et al., 1993, Baumel 1975, Fitzgerald 1969; Mcleod et al., 1964) in domestic fowl. The popliteal artery in goose gave off; the proximal geniculate, medial tibial and caudal tibial arteries; similar information was given by (El-Gammal, 2012) in chicken. On the other hand, (El-Nahla et al., 2010) in ostrich, (Baumel et al., 1993, Baumel 1975, Fitzgerald, 1969; Mcleod et al., 1964) in domestic fowl stated that the popliteal artery gave off the caudal tibial artery. (Can et al., 2010) explained that the popliteal artery divided into cranial tibial and caudal tibial arteries in the caudo-medial aspect of the knee joint in Japanese quail.

The popliteal artery continued as the cranial tibial artery. This result was confirmed previously in chicken (El-Gammal, 2012), in ostrich (El-Nahla et al., 2010), in domestic fowl (Baumel et al., 1993, Baumel 1975, Fitzgerald, 1969; Mcleod et al., 1964), while it was contrary to that reported in domestic fowl as the popliteal artery terminated into cranial and lateral tibial arteries (Nickel et al., 1977).

The cranial tibial artery was considered the direct continuation of the popliteal artery. This statement was in accord-
In contrast, the descending branches of the medial and lateral planter tarsal artery were connected inside the metatarsal pad with the lateral and medial dorsal metatarsal arteries to form the *Arcus plantaris* which was responsible for detaching the digital arteries in the sole of the foot in chicken (El-Gammal, 2012). The pulvinar branch arose from the planter arch in the majority of the cases while in few specimens was emanated from a common stem with the lateral digital III, medial digital IV arteries (Tolba and Daghash, 2014) in goose and (Farag, 2013) in duck. Moreover, the pulvinar arteries arose from the common dorsal metatarsal artery at the level of the meta–tarsophalangeal joint (El-Nahla et al., 2010) in ostrich, (Baumel et al., 1993, Nickel et al., 1977; Baumel, 1975) in domestic fowl.

In contrast to the present study, the dorsal metatarsal artery gave off the digital arteries in goose (Waxman et al., 2015), while all digital arteries erupted from the plantar arch (Tolba and Daghash, 2014) in goose and (Farag, 2013) in ducks. (Tolba and Daghash, 2014) added that the lateral digital II artery and lateral digital IV originated from the medial dorsal metatarsal artery and lateral planter metatarsal artery respectively, while the arteries of the 2nd digit and lateral IV digital artery erupted from medial dorsal metatarsal artery and lateral planter metatarsal artery, respectively (Farag, 2013). However, the digital arteries of the 1st digit, medial II digital artery, medial III digital artery and lateral IV digital artery originated from the planter arterial arch (El-Gammal, 2012) in chicken and the lateral III digital artery and medial IV digital artery arose from lateral dorsal metatarsal artery (Can et al., 2010) in Japanese quail.

**CONCLUSION**

Arterial blood supply of the pelvic limb of the geese was mainly obtained through the external iliac and ischiatic arteries. The external iliac artery only supplies the pelvic limb of the geese to the level of the stifle region, while the ischiatic artery is responsible for supplying the entire limb, changing its name according to the region of the limb it supplies. The ischiatic artery terminates after giving off the sural artery and continues in the leg region as popliteal artery. The popliteal artery supplies the knee and leg regions, whereas the cranial tibial artery, the continuation of the popliteal artery, is responsible for supplying the foot with its own branches. The Rete tibiotarsale is playing a role in thermoregulation of the leg temperature through heat conservation or dissipation due to the presence of extensive arteriovenous anastomosis.

**AUTHOR CONTRIBUTIONS**

All authors contributed to the experimental design, sampling, and reviewing the scientific content. Gamal A. Swielim, Khaled Abo-EL-Soud and Samar M. El-Gammal performed the scientific and grammatical revisions to the manuscript. Meray N. Ramsis performed the experiments, data collection and writing the paper.

**CONFLICT OF INTEREST**

The authors have declared no conflict of interest.

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