

RESEARCH CONCERNING METHODS OF STUDY OF LYMPHATIC VESSELS IN DIFFERENT SPECIES OF DOMESTIC FOWLS

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Summary

Researches were carried out on two domestic gallinaceae species – the domestic hen (*Gallus domesticus*) and the Japanese quail (*Coturnix coturnix japonica*). All fowls were adult. The lymphatic vessels that drain the lymph at the thoracoabdominal cavity viscera level and the thoracic duct may be highlighted by administration of lymphagogue substances (vegetal and animal fats) administered in fodder. The limb lymphatic vessels may be highlighted by methods as used in human medicine – that is injection of coloured substances and / or radiopaque substances. By subcutaneous injection of trypan blue or China ink the lymphatic vessels on the cadavers were highlighted. Using the injection technique with radiologic contrast substances under the shape of buttons in the interdigital zones and the pulvinus metatarsalis for the pelvic limb and on the metacarpal level and of the tela interdigitalis for the thoracic limb and the serial radiographing on 5 minutes series, the lymphatic vessels were highlighted on the live animal. The period between two radiographies was that short because the contrast substance was hydrosoluble and, consequently, it was rapidly eliminated from the organism.

Materials and methods

In the research there were used 10 fowls of various sex, breeds and breeding standards from intensive breeding industrial units and from private breeders. Only conventional fowls were used – that were subject to the current prophylaxis program (only fowls from intensive breeding industrial units)

Researches were carried out on fresh fowl cadavers injected intrabulbarly with 4 per cent solution of Xiline (with no blood emission, so that the normal aspect of the lymphatic vessels could be preserved). Three hens were tranquilized with Ketamin (an i.m. dose of 10-30 mg/kg), so that the hens could be used for the radiological study of the lymphatic vessels.

The study, description and homologation of the formations were in accordance to *Nomina Anatomica Avium – 1979* and *Nomina Anatomica Veterinaria, Nomina Histologica* and *Nomina Embryologica – 1994*.

The dissection was the most used method in this research.

Thus, the animal was positioned on the dissection table either in lateral decubitus, or in dorsal decubitus – according to the area to be studied. The dissection was executed bilaterally and on successive sections up to the visibility limit using the stereo-microscope type SMZ-2T NIKON located in the Laboratory of

Domestic Animal Anatomy, the Faculty of Veterinary Medicine, Bucharest, Romania. The stereomicroscope is provided with a photo system to take macroscopic images.

In order to highlight the superficial lymphatic vessels in the head, neck and limbs, coloured injections were performed with lymphatic tropism – that is 1.5 per cent water solution of trypan blue and China ink water solution. The animals were subcutaneously injected in various body areas – particularly at the free extremities of the thoracal limbs and also at the tela interdigitalis (so that lymphatic vessels on regional areas could be visualized) and also at the level of the interdigital membrane and of the pulvinus metatarsalis (for the lymphatic vessels of the pelvic limb). The injection was performed twice per day with 0.2 – 0.5 – 1 ml, according to the region, two days running; then the animals were slaughtered. During the dissection the skin was attentively removed and in the subcutaneous tissue the lymphatic vessels could be noticed, photographed and sketched.

For the observation of the lymphatic vessels in the thoracal and abdominal cavity, two individuals of each species were studied.

The fowls were fed with fodder containing animal fat (lard); orally they were given 10 ml of edible oil (three times a day, two days running). In the third day, the animals were slaughtered.

For the photographic visualization of the lymphatic vessels there were used a water soluble iodate substance – that is *Omnipaque solution* 350 mg/ml, which contains Iohexol in a concentration of 350 mg/ml (755 mg equivalent of 350 mg I). This substance has the osmolarity of 0.78 Osm/kg H₂O, a viscosity of 23.3 at a temperature of 20 °C and of 10.6 at a temperature of 37 °C; it is also isotonic with the blood and with the interstitial liquid.

There were examined 3 hens (two hens were treated with *Omnipaque* solution and one hen – *Omnipaque* solution (1/1) and trypan blue solution 1.5 per cent). The place was similar with the place for the administration of coloured substances; in several points there was administrated 1 ml at each shot.

The radiological analysis was performed during the Semiology and Image Diagnosis Course at the Faculty of Veterinary Medicine, Bucharest, Romania. The x-ray images were taken in serial shots, right after injection, then after 5, 10 and 15 minutes after injection.

By this lymphographic method it was tested and successfully performed the lymphatic vessel x-ray examination of fowls too. Yet, due to their more accelerated metabolism the contrast substance used in radiology was rapidly eliminated out of their bodies; for this reason the radiographies should be performed in between periods of time limited at max. 5 minutes.

Results and discussions

There are more lymphatic vessels in fowls than mammals – but the lymphatic vessels are thinner. The lymphatic vessels have a parallel traject as to

the blood vessels and accompany the veins in head, neck and limbs, whereas in the thoracic and abdominal cavity they accompany the arteries.

The lymphatic vessels of the thoracic limb are originated in the skin and in the musculature; they are mainly superficially positioned.

At the thoracic limb extremity level (digit 1 and 2) there is a lymphatic net that structures the regional lymphatic vessels (2 -3 vessels) which are the roots to be of the lymphatic vessels located in the forearm.

One of the vessels is formed by the join of several branches originated in digit 2 and accompanies the artery and the radial vein; close to the antebrachial and brachial joint it joins the lymphatic vessels of the tela interdigitalis level. This vessel continues up to the arm.

Another antebrachial vessel – a companion of the ulnar artery and vein, is originated in the lymphatic net of the meta-carpal joint and of the antebrachial carpal joint and it continues up to the arm.

The third vessel – the longest and the most important is structured from the superficial volar lymphatic net of the forearm distal extremity and accompanies the vena transversa cubiti along the forearm ventral edge; further at the ulnar radio-humeral joint, it intersects the radius proximal extremity in a medial plane and it continues up to the arm. All along its trajectory it receives numerous lymphatic branches from the skin and from the musculature.

The arm lymphatic vessels, originated in the three antebrachial vessels, all along the humerus, show many anastomoses. The vessels accompany the brachial vein and the vena transversa cubiti; in the scapular joint area they unite in one single vessel which accompanies the subclavicular vein and join the jugular vein close to the joining point of the jugular and subclavicular veins (see figures 1).

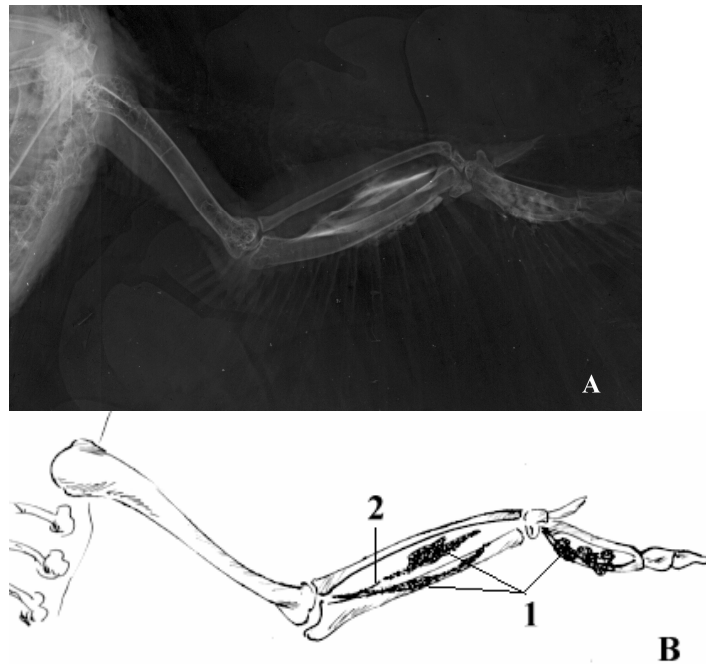
Fig. 1. The hen antebrachial (1) and brachial (2) lymphatic vessels after having been injected with trypan blue 1.5 per cent solution (original)



The brachial lymphatic vessels receive along the traject several collateral lymphatic vessels from the following points: the thorax lateral wall, the ulnar radio-humeral joint and branches from: the pectoral musculature and the brachial biceps muscle. Also, lymph is received by many branches from the arm lateral skin and from the deltoid muscle.

The lymphatic vessels at the thoracal limb could be radiologically visualised by injection of contrast substances (fig. 2).

Fig.2. X-ray image (A) and sktech (B). Note the injection button of the contrast substance (1); the occurance of the antebrachial lymphatic vessels (2) (original).



The thorax duct performs the main lymph drain in the thoracoabdominal cavity. In most animals the thoracal duct is even: the right thoracal duct and the left thoracal duct and it accompanies the aorta. The two thoracal ducts show many anastomoses. Either thoracal duct joins the cranial vein cava on ther same side. The two ducts are the largest lymphatic vessels of the fowls.

Along the traject, either thoracal duct receives parietal and visceral lymphatic affluents:

- from the stomach, duodenum, jejunum, ileum – by vessels which go in parallel with the celiac artery (fig. 3).

- from the terminal digestive segment (ceca, colon, rectum), from ureters from deferent ducts or oviducts – by vessels which go in parallel with the iliac artery.

- From the lumbar-sacral zone, kidneys, suprarenals and from ureters – by many short vessels which accompanies the caudal mesenteric artery;

- from the testicles, epididymal, ovaries and from the oviduct cranial area – by vessels that accompany the cranial mesenteric artery;

- From the pelvic limbs – by the lymphatic vessel that accompanies the external iliac artery;

- From the skin and abdominal musculature – by numerous vessels which flow directly into the thoracal duct.

The lymphatic vessels which accompany the intern thoracal vein drain the lymph from the pulmons and from the heart and directly join the cranial vena cava.

The lymphatic vessels in the thoracoabdominal cavity may be very well visualised if vegetal and animal fats are used when feeding the fowls.

On the dorsal and plantar side of the digits, there are lymphatic nets which stand for the lymphatic vessel origin of the pelvic limb.

On the axial and abaxial side of each digit there is one lymphatic vessel which accompanies the vein and artery structures (the proper digit veins and arteries), whereas on the dorsal side of the main metatarsus distal extremity they join again and become origin of three lymphatic trunks wich receive the lymphatic vessel affluence from the pulvinus metatarsalis.

One of this lymphatic vessels is located on the dorsal side of the metatarsus and it accompanies the leg dorsal artery (the common dorsal metatarsal artery) and also the lateral and medial metatarsal veins; then it goes through the tibial bone duct and it continues on the tibial dorsal side, up to the upper third of the leg. (see fig. 4)

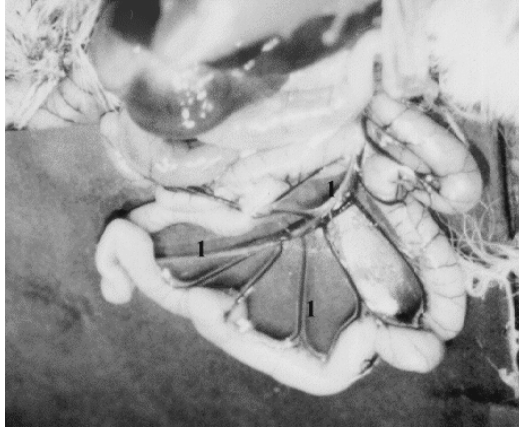


Fig. 3. Japanese quail jejunal lymphatic vessels (1) after having been fed with oil.

Another lymphatic vessel is located medially and it accompanies both the medial metatarsal vein and artery; then it continues on the medial side of the metatarsal tarso-tibial joint and in the tibia proximal third it joins back the vessel situated on the tibia dorsal side.

The third vessel is located on the metatarsal lateral side and it accompanies both the lateral plantar metatarsal vein and artery and then it goes on the lateral side of the metatarsal tarso-tibial joint and it continues in the leg area.

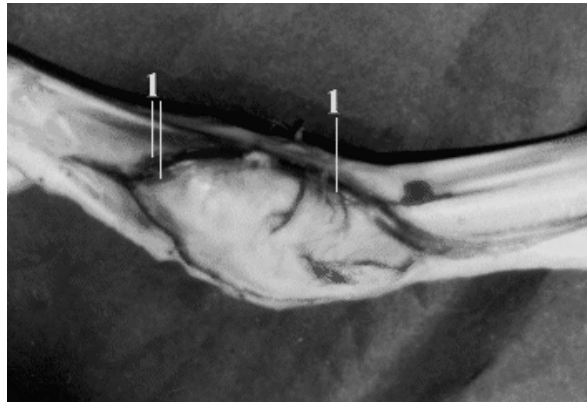


Fig. 4. Hen metatarsal tarso-tibial lymphatic vessels (1) after having been injected with trypan blue 1.5 per cent solution

The first two lymphatic vessels (the dorsal one and the medial one) join together in the upper third of the femur, then go towards the medial side of the patellar tibio-femoral joint and continue on the femoral medial side, accompanying the femoral vein with which they get into the thoracoabdominal cavity. The lymphatic vessel on the lateral leg side goes up to the tibial proximal extremity, it accompanies the anterior tibial vein and it drains either in the dorsal or in the medial gamba lymphatic vessel.

In the leg region, the lymphatic vessels receive collaterals from the cranial and caudal musculature of the gamba and from the local skin.

In the femur, branches from the patellar tibio-femoral joint and from the femoral caudal and cranial musculature are lymphatic vessel affluents.

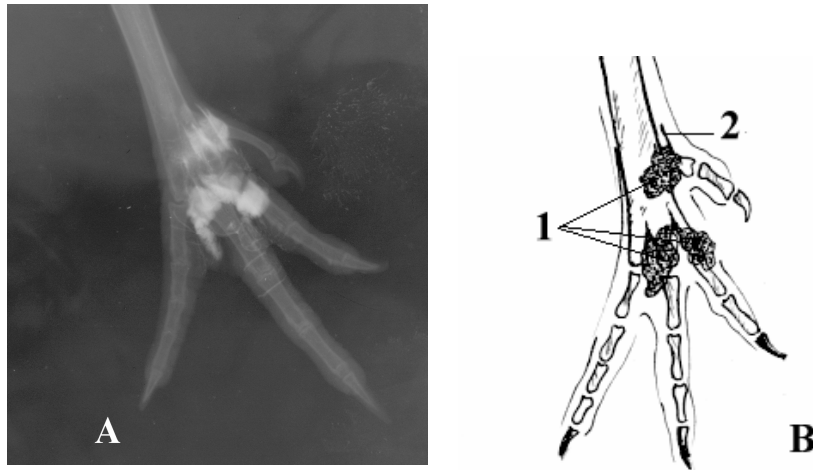


Figure 5. X-ray image (A) and sketch (B). Note the injection button of the contrast substance (1); the metatarsal lymphatic vessels (2).

The lymphatic vessel that accompanies the femoral vein and artery in the thoracoabdominal cavity goes towards the external iliac artery and becomes radix to the thoracic duct.

The lymphatic vessels of the pelvic limb could be radiologically visualised by injecting contrast substances into the interdigital membrane and in the pulvinus metatarsalis. (see figures 5).

Conclusions

On the basis of the proper research results performed on 10 domestic fowl (the domestic hen, the Japanese quail) the following conclusions may be drawn with regards on the lymphoid formation morphotopography:

1. The lymphatic vessels are numerous and they have a parallel trajet with the blood vessels accompanying the veins in head, neck and limbs and arteries in the thoracoabdominal cavity.

2. From the thoracal limb the lymph is drained through the lymphatic net of the free extremity through 3 antebrachial lymphatic vessels which continue at the arm level and close to the scapular joint they join back into one single vessel which drains the jugular vein.

3. The thoracal duct, generally double, takes over the lymph from the pelvic limbs and from the thoracoabdominal viscera and it opens in the cranial vena cava. The lymphatic vessels which drain the lymph from the thoracoabdominal viscera and the thoracal duct can be highlighted by administrating lymphotrope substances (animal and vegetal fats) in the fooder.

4. From the axial and abaxial lymphatic vessels of each digit and from the pulvinus metatarsalis originate three metatarsal lymphatic vessels which continue also in the gamba and femural regions. In the femural upper third the three lymphatic vessels join back together into one single vessel which accompanies the femural artery towards the thoracoabdominal cavity and then it accompanies the external iliac artery up to the sublumbar area and here it becomes radix to the thoracal duct.

5. The limb lymphatic vessels can be highlighted by methods used also in human medicine – that is injection of contrast and / or radiopaque substances. Subcutaneous injection of trypan blue or China inks made it possible visualisation of lymphatic vessels on cadavers. Using buttons as radiological contrast substance injection technique in the interdigital zones and in the pulvinus metatarsalis for the pelvic limb and at the metacarpal level and tela interdigitalis for the thoracal limb and also using serial x-ray imaging in 5 minutes' series the lymphatic vessels were visualised in the live animal. The period between two radiographies was that short because the contrast substance was hydrosoluble and, consequently, it was rapidly eliminated from the organism.

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