
SUMMARY OF PhD THESIS

Morphological and imagistical study of the arterial system in Gallus domesticus Lohmann Brown Hybrid

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INTRODUCTION

Through this manuscript we have proposed realising an macroscopical anatomical study and an imagistical one of the arterial tree in the domestic hen, Lohmann Brown Hybrid, which to focus on the normal morphology of the arterial system in birds, following that the obtained data to bring an improvement of the present knowledge.

The reason why we have chosen this hybrid is because it has been very widespread in recent years in Romania, it is preferred in egg-producing farms, but also in households. This breed of domestic chickens is also very widespread in Europe due to the high production of eggs it has on an annual average.

In order to complete with the most up-to-date data on the hen's circulatory system, we have proposed to realise macroscopic investigations on the arterial system, particularly related to the origin, collaterals, trajectory and terminals.

Based on the consideration that in the specialized literature consulted by us we found little research regarding the description of the arterial system in birds in general, we proposed their anatomical and imaging investigation, as they are of a rather small caliber compared to the other species , in order to highlight them I used the studies described below.

The study sought to complete the data regarding the macroscopic description of the arterial system in birds as well as its topography, the relationship with the adjacent organs and the formations with which they are in topo-clinical contact.

Thanks to the most accurate investigation of the origin, collaterals and terminals of the aorta artery in the domestic chicken, we can provide anatomically accurate information, considered important and necessary for the clinician, to be able to use this species as an experimental model in the study of arteriopathies.

The present study aims to achieve the most accurate topography of the aorta artery, its collateral and terminal branches, using radiography and computer-tomography with contrast as an investigation method.

The purpose of this work is to achieve as accurate an exposure as possible of the arterial tree in the species *Gallus Domesticus*, Lohmann Brown hybrid, later it can be used as an experimental model in the study of experimentally induced arterial diseases.

THESIS STRUCTURE

The doctoral thesis entitled Morphological and imaging study on the arterial system in the species *Gallus domesticus* hybrid Lohamann Brown comprises 128 pages including a collection of original photographs taken during his own research. The thesis is developed according to the methodology of the Doctoral School in two parts:

The first part is represented by the bibliographic study and contains a number of 34 pages and is divided into 4 chapters.

The first chapter "Generalities about the species, breed and the arterial system" includes information on the taxonomic classification, the types of breeds, the appearance of the Lohmann Brown breed and its morphoproductive peculiarities.

The second chapter "Embryonic Development of the Arterial System in Birds" describes embryonic development from the zygote stage to the day-old chick with emphasis on the embryonic development of the heart and arterial system.

The third chapter "Histology of the Heart and Arterial System" contains information on the microscopic structure of the heart and arterial system.

The fourth chapter "Anatomy of the heart and arterial system" presents notions about the external conformation of the heart, its internal conformation, the origin and arterial distribution in the body.

The second part includes and is structured in 7 chapters in which the following are described: working hypothesis and objectives, materials and methods, anatomical research, imaging with contrast substance and Computer Tomography investigations.

THE OBJECTIVES OF THE THESIS

-the highlighting of possible new unidentified arteries, the establishment of the topography, the origin of the arteries, the collaterals and the terminals;

-the interpretation, analysis and description of the arterial tree in the species *Gallus domesticus* in a morphoclinical context.

-the interpretation, analysis and description of the arterial tree in the species *Gallus Domesticus* based on CT images and three-dimensional reconstructions.

MATERIALS AND METHODS

The biological material was represented by 10 adult hens, female, from the Lohamnn Brown breed, in which the injection of a colored substance at the level of the arterial system was performed, followed by anatomical dissection and imaging investigations by radiography with contrast substance and angio-CT.

RESULTS AND DISCUSSIONS

Chapter 6 "Anatomical study of the arterial system in the species *Gallus domesticus*-Hybrid Lohamnn Brown" was based on the above-mentioned objectives regarding anatomical investigations.

This chapter includes anatomical investigations carried out with the aim of capturing any particular aspects related to the arterial system, with reference to the origin of the collaterals and terminals of the arteries and their relationships with adjacent organs .

For this aim we have proposed the following objectives:

- Highlighting possible new anatomical peculiarities of the arterial system and their characterization.

- Description of the possible intraspecific topographical variations of the arteries in the Lohman Brown breed.

- Identification of possible new arterial branches and collaterals.

Following the anatomical investigations on the arterial system in the chicken, we reached the following conclusions:

Due to the small size of the studied species, as well as the size of the arterial vessels, we can claim that the introduction of a volume of colored substance at the level of the arterial bed is very useful for visualizing and identifying the arterial vasculature.

The first collaterals detached from the aortic arch are represented by the left and right brachiocephalic trunks, and in the cranially sense as terminals of the ascending aorta artery, the left and right common carotid arteries.

As a peculiarity of the domestic hen, the artery of the vagus nerve is described in the study, which accompanies it on its cervical path. The path of the two subclavicular arteries is short, having as its terminal distribution the arteries: sternoclavicular, axillary, thoracic. The sternoclavicular artery is a peculiarity of the species and so are the collaterals separated from it: the sternal artery, the clavicular artery and the acromialis artery.

Another peculiarity of the species found in the studied species is the external thoracic artery, which presents two terminal arteries: the dorsal external thoracic artery and the ventral external thoracic artery. Different from most species is the fact that at the level of the wings, the median artery is not present, 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 terminals the digital arteries.

The visceral collaterals detached from the aorta artery, abdominal segment are: the celiac arterial trunk, the caudal mesenteric trunk, the renal arteries, the gonadal arteries, the external iliac arteries, the sciatic arteries, the pudendal artery. Several visceral collaterals are emitted from the celiac artery trunk: Esophageal arteries, two dorsal and ventral proventricular arteries, four gastric arteries: dorsal, ventral, lateral and medial, hepatic artery, splenic artery. All the celiac arterial trunk serves almost entirely the large intestine and entirely the small intestine through the arteries:

duodenal, pancreatoduodenal, jejunal arteries, arranged in the shape of a fan, its branches being 4-5, the ileocecal arteries. The caudal mesenteric trunk serving the terminal portion of the large intestine.

A peculiarity found in this species is the irrigation of the pelvic limb through the arteries: external iliac and ischiatic.

Chapter VII entitled "Investigation of the arterial system in Gallus Domesticus Lohmann Brown hybrid by radiological exposure with contrast substance, " had the aim of achieving a topography as accurate as possible of the aorta artery, its collateral and terminal branches, using as an investigation method radiography with contrast substance.

The purpose of this chapter is to achieve the most accurate exposure of the arterial tree in the species Gallus Domesticus, later it can be used as an experimental model in the study of experimentally induced arterial diseases. To achieve the proposed goal, several objectives were established:

- Injection of the arterial tree with contrast substance and radiological exposure to capture the images

- Interpretation, analysis and description of the arterial tree in the species Gallus domesticus based on the X-ray images.

Following the imaging investigations, we reached the following conclusions:

Due to the small size of the studied species, as well as the size of the arterial vessels, we can claim that the introduction of a volume of colored substance at the level of the arterial bed is very useful for visualizing and identifying the arterial vasculature

The first collaterals detached from the aortic arch are represented by the left and right brachiocephalic trunks, and in the cranially sense as terminals of the ascending aorta artery, the left and right common carotid arteries.

As a peculiarity of the species, the artery of the vagus nerve is described in the study, which accompanies it on its cervical path.

The path of the two subclavicular arteries is short, having as its terminal distribution the arteries: sternoclavicular, axillary, thoracic.

The sternoclavicular artery is a peculiarity of the species and so are the collaterals separated from it: the sternal artery, the clavicular artery and the acromialis artery.

It is also observed in the radiological study with contrast material, as in the case of dissections, compared to most species, the fact that at the level of the wings, the median artery is not present, the terminal arteries of the brachial artery being the radial artery and the ulnar artery, the latter serving the wing to the digital level with its terminals the digital arteries.

By opacifying the arterial system with contrast material, the visceral collaterals separated from the aorta artery, abdominal segment can be easily identified: the celiac arterial trunk, the cranial mesenteric trunk, the renal arteries, the gonadal arteries, the external iliac arteries, the sciatic arteries, the caudal mesenteric artery.

The radiological images allow us to visualize the peculiarity encountered in this species, the irrigation of the pelvic limb through the arteries: external iliac and ischiatic, the latter having an impressive caliber.

The external iliac artery has as its terminal the femoral artery, which anastomoses with the sciatic artery caudal to the knee joint.

Chapter VIII entitled "Investigation of the arterial system in the species *Gallus Domesticus*, Lohmann Brown hybrid, by the angio-CT method with contrast substance" aimed to investigate the arterial tree, intravitaly, in the species *Gallus Domesticus*.

In order to achieve the goal, we proposed the following objectives:

- Injection of a contrast substance into the blood stream and carrying out computer tomographic investigations;

- Interpretation, analysis and description of the arterial tree in the species *Gallus Domesticus* based on CT images and three-dimensional reconstructions.

Following angio-CT investigations, the following conclusions were drawn:

By investigating the arterial tree using the angio-CT method, it is observed that the trajectory of the subclavicular arteries is short and is terminally divided into: the sternoclavicular artery, the axillary artery and the thoracic artery. The axillary artery gives off 2 branches along its trajectory: the subscapular artery, the coracoid artery and continues with the brachial artery.

The 3D reconstruction of the sections obtained at this level highlights the fact that the brachial artery serves the wing and gives off 3 branches: the deep brachial artery, the cranial humeral circumflex artery and the bicipital artery. Unlike most species, the median artery is absent, an aspect observed both morphologically in the dissections performed and by the method of investigation with the CT contrast substance, and the brachial artery divides into the radial and ulnar arteries, following which the ulnar artery divides into the digital arteries.

A characteristic feature of birds observed through the reconstruction of 3D images is that the hind limbs are irrigated by the external iliac artery and the sciatic artery. The external iliac artery divides into the femoral artery and the pubic artery. The popliteal artery gives off 3 branches: the median 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 Angio-CT image allows the accurate visualization of the fact that the aortic arch is located on the right side of the median plane.

The brachiocephalic trunks supply the wings, especially the flight, neck and head muscles.

The trajectory of the subclavian arteries is short and divides terminally into: the sternoclavicular artery, the axillary artery and the thoracic artery.

The Computed Tomographic investigation confirms that this study brings current data on the vascularization of the stomach, spleen, liver and intestine, observing how the celiac artery separates from the right lateral wall of the descending aorta artery in *gallus*

domesticus species, the Lohmann Brown hybrid, having multiple ramifications for said organs.

Chapter IX entitled "General conclusions" summarizes the aspects captured following the anatomical, radiological and computer-tomographic investigations, as follows:

The introduction of a volume of colored substance at the level of the arterial bed is very useful for visualizing and identifying the arterial vasculature.

As a peculiarity of the species, the artery of the vagus nerve, which accompanies it on its cervical trajectory.

The peculiarity of the species found in the studied species is the external thoracic artery, which presents two terminal arteries: the dorsal external thoracic artery and the ventral external thoracic artery.

Different from most species is the fact that at the level of the wings, the median artery is not present, 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 terminals the digital arteries.

The path of the two subclavicular arteries is short, having as its terminal distribution the arteries: sternoclavicular, axillary, thoracic.

The sternoclavicular artery is a peculiarity of the species and so are the collaterals separated from it: the sternal artery, the clavicular artery and the acromialis artery.

Another peculiarity of the species found in the studied species is the external thoracic artery, which presents two terminal arteries: the dorsal external thoracic artery and the ventral external thoracic artery.

The sternoclavicular artery is a peculiarity of the species and so are the collaterals separated from it: the sternal artery, the clavicular artery and the acromialis artery.

The visceral collaterals detached from the aorta artery, abdominal segment are: the celiac arterial trunk, the caudal mesenteric trunk, the renal arteries, the gonadal arteries, the external iliac arteries, the sciatic arteries, the pudendal artery.

Several visceral collaterals are emitted from the celiac artery trunk: Esophageal arteries, two dorsal and ventral proventricular arteries, four gastric arteries: dorsal, ventral, lateral and medial, hepatic artery, splenic artery.

All the celiac arterial trunk serves almost entirely the large intestine and entirely the small intestine through the arteries: duodenal, pancreatoduodenal.

The caudal mesenteric trunk serving the terminal portion of the large intestine. A peculiarity found in this species is the irrigation of the pelvic limb through the arteries: external iliac and ischiatic.

In the calf region of the chicken there are four tibial arteries: cranial, caudal, medial, lateral.

Angio-CT studies show that the trajectory of the subclavicular arteries is short and is terminally divided into: the sternoclavicular artery, the axillary artery and the thoracic artery.

The axillary artery gives off 2 branches along its trajectory: the subscapular artery, the coracoid artery and continues with the brachial artery.

The sciatic artery gives off 7 branches: caudal renal artery, caudal coxal artery, caudal circumflex artery, femoral artery, caudal femoral artery and sural artery.

The left branch of the celiac artery serves the left part of the glandular and triturating stomach, and the right branch of the celiac artery serves several organs of the digestive system, namely: liver, spleen, stomach, small intestine, pancreas.

ORIGINALITY AND INNOVATIVE CONTRIBUTION OF THE THESIS

The anatomical research realised brings more information to the scientific literature by pointing and verifying the following aspects:

The introduction of a volume of colored substance at the level of the arterial bed is very useful for visualizing and identifying the arterial vasculature.

As a peculiarity of the species, the artery of the vagus nerve, which accompanies it on its cervical trajectory.

The sternoclavicular artery, a peculiarity of the species, as well as the collaterals: the sternal artery, the clavicular artery and the acromialis artery.

The external thoracic artery which presents two terminal arteries: the dorsal external thoracic artery and the ventral external thoracic artery.

The radiographic studies with contrast material have highlighted:

Several visceral collaterals are emitted from the celiac artery trunk: Esophageal arteries, two dorsal and ventral proventricular arteries, four gastric arteries: dorsal, ventral, lateral and medial, hepatic artery, splenic artery.

The celiac arterial trunk serves the entire small intestine through the arteries: duodenal, pancreatoduodenal, jejunal arteries, arranged in a fan shape, ileocecal arteries.

The caudal mesenteric trunk serving the terminal portion of the large intestine.

A peculiarity found in this species is the irrigation of the pelvic limb through the arteries: external iliac and ischiatic.

The femoral artery, which caudal to the knee joint anastomoses with the sciatic artery, from there the four tibial arteries start: cranial, caudal, medial, lateral.

The Angio-CT research revealed:

The trajectory of the subclavicular arteries is short and divides terminally into: the sternoclavicular artery, the axillary artery and the thoracic artery.

The axillary artery gives off two branches along its trajectory: the subscapular artery, the coracoid artery and continues with the brachial artery.

The sciatic artery gives off seven branches: the caudal renal artery, the caudal coxal artery, the caudal circumflex artery, the femoral artery, the caudal femoral artery, and the sural artery.

The left branch of the celiac artery serves the left part of the glandular and triturating stomach, and the right branch of the celiac artery serves several organs of the digestive system, namely: liver, spleen, stomach, small intestine, pancreas.