SUMMARY OF PhD THESIS

Studies on the macro and microscopic morphology of the thoracic and abdominal cavity vascular system in pigs

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INTRODUCTION

Studies on the etiology and mechanisms of disease evolution in humans are fundamental in order to approach an effective therapeutic approach. Certain impediments, and in particular ethical ones, often prevent direct research of diseases on human patients and, therefore, certain animal models are crucial for obtaining "in vivo" data on their etiology and pathogenesis. Over time, mice and other small species, known as laboratory animals, have been essential experimental models for fundamental research and have made a major contribution to the understanding of numerous pathogenic mechanisms in human medicine. However, rodent species and especially lower vertebrates (amphibians and even birds) have limited use. Some impediments such as the different metabolic rate, influenced by the size of the body and this size itself, make certain surgeries difficult, including the use of their organs. Major differences also occur in the mechanisms that govern the activity of the immune system, metabolism and responses to stress conditions (ZAGRAI et al., 2024). For example, there are major differences in age-associated blood glucose levels between mice and monkeys/humans (PALLYAGURU et al., 2021). A proof of the lack of effectiveness is that the potential therapies that have demonstrated their efficacy and safety in studies in mice, in more than 80% do not yield in humans (PERRIN, 2014).

To overcome these shortcomings, researchers have tried to find mammals as experimental models that are close in terms of morphological characters and physiological constants to the human species (LUNNEY, 2007). They concluded that pigs are very similar to humans in terms of the size and structure of anatomical formations, immunology, genetically and physiologically. Therefore, they have replaced rodent models in basic and clinical research (SANCHEZ, I. et al., 2011; SWINDLE, M. et al. 2007; GERDTS et al., 2015; GUTIERREZ et al., 2015; PERLEBERG, C. et al. 2018).

In the case of the circulatory system, pigs show similarities with humans in terms of the anatomical appearance of the heart, its physiology, similarities in the conformation and structure of the atria of the ventricles and the coronary circulation pattern. Due to this, animals have been used in improving heart reperfusion and cardiac catheterization techniques (CAMACHO et al., 2016). Also, from porcine cardiac tissues, valves for the human heart have been developed and vascular segments have been used for transplantation (SUZUKY et al., 2011; LOSSI et al., 2016; REICHART et al., 2020).

The listed aspects support the importance of detailed knowledge of the morphological aspects of the vascular substrate in pigs.

We have described numerous similarities of the two species, which are advantages in using the pig as an experimental model. In the second part of this brief introduction we wanted to remind you that there are also morphological differences, which, due to the fact that they have not yet been clarified, should not constitute impediments to the use

of the animal in research, but on the contrary focus the research on clarifying the less understood things.

We exemplify the statements of a relatively recent macroscopic comparative study (VON TRHOTA et al., 2015), which showed that the blood flow of the digestive tract in humans differs considerably from that of pigs. The mesenteric vascularization in humans presented typical formations in the form of arches. In contrast, that of the pig was represented by multifilamentary structures detached from the main mesenteric branch, then directed towards the intestinal wall without any branching, and finally terminated through the straight vessels. The arterial vascularization mentioned in pigs did not show ramifications or anastomosis, which is frequently observed in humans. This type of arterial feeding of the intestine in pigs had first been published in the anatomical literature in the 1980`s (SPALDING and HEATH, 1987), but received little attention in the field of surgical literature. Anatomists Hugh Spalding and Trevor Heath (SPALDING and HEATH, 1986) reported this important peculiarity observed when studying the vascularization of jejunal lymph nodes. They observed that the vascularization of the pig intestine is not only fundamentally distinct from that of humans, but is also different from that of other mammals in which the vessels branch out and form arches. Although, other authors in about the same period have described these aspects (SOMMEROVA, 1980; CHIBA and BOLES, 1984; SEMERARO and DAVIES, 1986; SCHUMMER, 1981), however, the unique vascular architecture of the pig remained insufficiently understood.

Taking into account the above, we approached this study, with the hope that the results obtained can be useful to all those who want to deepen their knowledge of the circulatory system in the species *Sus scrofa domesticus*.

STRUCTURE OF THE DOCTORAL THESIS

The doctoral thesis " **Studies on the macro and microscopic morphology of the thoracic and abdominal cavity vascular system in pigs**", totals 158 pages and contains 10 chapters, 1 table, 68 figures and 155 bibliographic resources, being structured in two parts:

- Current state of knowledge – 32 pages
- Personal contribution – 105 pages

The first part (The Current State of Knowledge) presents general aspects regarding:

1. Systematics and evolution of the domestic pig (*Sus scrofa domesticus*)

2. Embryological aspects of the formation of the vessels of the thoracic and abdominal cavities

3. Known anatomical aspects regarding the vascularization of the thoracic and abdominal cavity in pigs

The second part of the thesis (Personal contribution) is structured in 6 chapters that present the objectives, research methods, results and discussions, conclusions and recommendations, originality and innovative contributions of the research.

4. Objectives

In order to achieve the proposed goal, the following objectives were established:

- identification in detail of the morphology of the walls of the thoracic and abdominal cavities in pigs;
- identifying in detail the macro- and mycoscopic morphology of the organs in the thoracic cavity, pointing out their relationships with vascular and nervous formations;
- establishing the exact morphology and topography of the cavity arteries and veins, by classical dissection, using the method of injection with contrast agents and by using imaging examinations;
- establishing the exact morphology and topography of cavity lymph nodes, by classical dissection, using the method of injection with contrast agents and by using imaging examinations;
- establishing the degree of efficiency of the use of classical and imaging methods in the identification of cavity vascular formations in pigs;
- implementation of the results obtained in the clinical examination of animals, both in the field of medical-veterinary practice and in the field of experimental medicine.

5. Study 1. Topography of the viscera and large vascular trunks in the thoracic and abdominal cavities

5.1.1. Introduction

The study is directed at the topography of the viscera and the large vascular trunks in the thoracic and abdominal cavities.

Bearing in mind that topographical anatomy is the component of greatest importance in the scope of clinical interest, it was felt that such a study fully deserved its place within the thesis. Moreover, it could be observed that in the specialized literature, this species has been little investigated in terms of the topographical relationships between the different components of the body's apparatus and systems

The study is directed at the topography of the viscera and large vascular trunks in the thoracic, abdominal and pelvic cavities. Taking into account the fact that topographic anatomy is the most important component in the clinic's sphere of interest,

it was considered that such a study fully deserves its place in the thesis. Moreover, it could be observed that in the specialized literature, this species has been the least investigated in terms of the topographical relationships between the different components of the organism's apparatus and systems.

5.1.2. Materials and methods

The method used was simple, but extremely effective. Taking into account the fact that the viscera of the thoracic and abdominal cavities are structures with a high degree of mobility whose topography changes rapidly when the cavitary walls are opened, in order to be able to assess the correct position, the corpses were first frozen, and the subsequent study was carried out by stratified dissection, by progressive thawing or by making cross-sections according to certain landmarks.

5.1.3. Results and discussions

The results obtained by this method are much more conclusive than those obtained by using the cadaver formalization method because formaldehyde having "astringent" properties has an effect of "compressing" tissues, significantly modifying the dimensions of some structures and implicitly their ratios.

As for the organs of the thoracic cavity, there are clear landmarks for identifying the atrio-ventricular orifices and the pulmonary trunk. The anatomical relationships between the origins of the two large arterial trunks are also presented: the aorta and the pulmonary trunk. The aortic arch in pigs is defined and described in detail, and then the route and in each sector of the caudal mediastinum of the descending aortic artery. In the abdominal cavity, the ratios of the very complex vessels are somewhat influenced by the large length of the small intestine, the large volume of the large intestine, but also by the different way in which the mesoa fix these structures from other species.

5.1.4. Conclusions

The method of studying the topography of the organs and large vessels in the abdominal cavity on cross-sections, performed on parts frozen at -18^{0}C, in the cold room is much more efficient than the one performed on parts injected into the circulatory system with formaldehyde (classical method), since the "astringent" effect of formaldehyde modifies quite significantly the topography of the studied structures.

The study of the topography of structures on such pieces is extremely useful in interpreting the results of most imaging examinations for vascular formations with a caliber exceeding 3-4 mm and for lymphnodular formations with a similar diameter, but it is relatively difficult to identify structures with a lower caliber without the use of a contrast agent (e.g. colored two-component latex for vascular formations).

6. Study 2. Macroscopic aspects regarding the morphology and topography of the thoracic and abdominal cavities arteries

6.2.1. Introduction

Currently, in order to understand the topography and distribution of the main cavity arteries in pigs, those interested generally turn to the descriptions in anatomy treatises of established authors such as Barone, König, Sisson or Dyce. However, they do not always provide the necessary details and we have found, as well as other authors, that in the recent literature there are not enough morphometric studies of the thoracic and abdominal cavities, nor even of the root of the thoraco-abdominal aorta in pigs of different weight categories. For this reason, problems arise especially in experimental surgery, in the case of using devices (probes, implants) incorrectly calibrated to the dimensions of the animal used. In order to determine morphometric details, the authors used both paraclinical methods, such as high-frequency ultrasonography (UHFUS) or radiological examinations with contrast agents, but also classic dissection methods with the use of contrast agents injected into the arterial bed.

Even if the research of the vascular system in pigs is not a "territory" that has not been explored, we believe that any comparative study on its anatomical and functional characteristics can provide new information, which will be of great importance for specialists involved in the therapy of cardiovascular diseases, which is why the present study was approached.

6.2.2. Materials and methods

The study was carried out on 20 animals weighing 25-30 kg, aged about 3.5 months, of both sexes. The macro- and microscopic anatomical studies as well as the ultasonographic investigations were performed at the Faculty of Veterinary Medicine in Bucharest. For the classical dissection, a two-component silicone latex "Aditie shore A 15 olimpiQ" was used as a contrast agent for injection. The advantages of this method were obvious: - excellent flexibility after curing, the vessels being resistant to extension and breakage and low toxicity, being a substance also used in the food industry. For the histological examinations after the euthanasia stage, tissue fragments were taken (thoracic aortic segment, pulmonary trunk, caudal vena cava, mesenteric vessels at the level of the jejunal insertion, mesenteric lymph node, tracheobronchial lymph node, superficial inghinal lymph node, thymus, artery and caudal mesenteric vein). The staining method used Hematoxylin-Eosin as dye. The ultrasound examinations were performed with the help of the Esaote Mylab 60 and Esaote Mylab X8 devices, respectively, using 5-9 MHz microconvex probes and 1-12 MHz linear probes, after prior

preparation of the patient (trimming, application of ultrasound gel) and standard positioning – depending on the investigative objective.

6.2.3. Results and discussions

The thoracic cavity is dominated in the anterior mediastinum by the origin of the collaterals of the subclavicular arteries. Even if there is no symmetry of the two subclavicular arteries, the collaterals of each have the same distribution territory. Regarding the differences, the most important is the common origin on the right side of the three dorsal collaterals in a single trunk.

Different aspects of the distribution of the intercostal arteries originating from the supreme intercostal artery were also observed, these being presented in detail both topographically and morphometrically.

Regarding the arteries of the abdominal cavity, one of the most important observations was made on the entanglement of the jejunal arteries with the venous networks developed on the small curvature of the jejunum.

6.2.4. Conclusions

Synthetically, we present the most significant conclusions from this study:

The left subclavicular artery, direct collateral of the aortic arch, emits four dorsal and two ventral collaterals. The dorsal collaterals are represented by the costocervical trunk, the deep cervical artery, the vertebral artery and the superficial cervical artery. All of these have been found to have independent origins. The ventral collaterals are represented by the external thoracic artery and the internal thoracic artery.

The right subclavicular artery detaches from the brachiocephalic trunk. The superficial cervical artery is slightly ventrally oriented and represents the ventral collateral. The other three dorsal collaterals form a trunk of common origin on the right.

In correlation with the data in the literature, the left gastric artery showed morphological differences, being unique in 50 % of the cases, represented by two vessels in 40 % and three in 10 %.

To the left of the origin of the gastro-duodenal artery, collateral of the hepatic artery, we have identified a branch that distributes to the square lobe, although in the literature, including in the Nomina Anatomica Veterinaria, it is not described as collateral of the hepatic artery. Also, two pyloric branches were identified, detached from the gastro-duodenal artery and the quadrate lobe artery, which were not found in the bibliographic records.

7. Study 3. Macroscopic aspects regarding the morphology and topography of cavitary veins

7.3.1. Introduction

According to the literature, the interest of anatomists in the study of the venous system in pigs has been stimulated by the use of this species not only as an experimental model, especially in research carried out on the cardiovascular system, but also due to the increasing number of owners who associate the pig as a pet. Presenting animals as pets at primary care facilities presents a challenge for veterinarians and technical staff to develop knowledge of pig morphology and skills in the various intervention procedures.

Current descriptions of anatomical formations and intervention techniques are often limited, possibly with few details. This is also the case with decrements on the venous system. However, many procedures involve puncture and venous catheterization. For this reason, we considered that a detailed description of the vascular component of the venous system accompanied by the presentation of a visual material taken by phorography from the worked pieces, can provide clinicians with the theoretical "resources" necessary for successful interventions.

7.3.2. Materials and methods

The materials and methods used in this study are identical to those used in the study of the arterial system, except that the contrast dye was replaced and a blue pigment was introduced into the veins.

7.3.3. Results and discussions

In pigs, the cranial vena cava is formed by the union of two short brachiocephalic veins, each supplied by double subclavicular veins in all cases. Brachiocephalic veins have no tributaries. However, on the left side, a caudal thyroid vein can sometimes be identified. The cranial vena cava itself has a small number of tributaries. Apart from some thin thymic veins there are two pairs of tributaries: the internal thoracic veins and the costocervical veins. In our cases we did not identify a right zygose vein.

The portal vein directs to the liver all the blood volume that comes from the abdominal digestive viscera and the spleen. It is a voluminous vessel that drains the entire volume of blood that reaches the viscera through the celiac, cranial mesenteric and caudal mesenteric arteries, blood that has no direct way back to the caudal vena cava. While each mesenteric artery has a homologous vein, the celiac artery is not

accompanied by a satellite vein. In this case, the homologous is the portal vein itself, which accompanies the hepatic artery at the entrance to the liver, after it has received the splenic and gastroduodenal veins.

From the entrance to the liver, the portal vein divides into two strongly divergent branches, the angle of their separation being qualified as the "portal vein sinus". The right branch, the smallest, branches into the right lateral lobe and caudate process (through a branch emitted at the origin). The left branch directly extends the portal vein to the left lobe. It integrates two successive portions, which are called the transverse portion and the umbilical portion. The latter, which is directed into the fissure of the round ligament, is so called because in the fetus it directly prolongs the umbilical vein, whose extrahepatic portion, closed after birth, becomes the round ligament of the liver. The delimitation between the two portions of the left branch is marked by the fibrous vestige of the venous duct, which joins the umbilical vein with the caudal vena cava in the fetus.

The last divisions of the portal vein supply the interlobular veins of the hepatic parenchyma. They are terminal type, without anastomoses. The interlobular veins emit sinusoid capillaries, which join the centro-lobular vein, the initial roots of the hepatic veins.

7.3.4. Conclusions

In pigs, the portal vein has only two roots: the cranial mesenteric vein and the caudal mesenteric vein.

In the case of the cranial mesenteric vein, we found that the jejunal veins form a series of overlapping arches, in which fine venous branches intertwine with arteries of the same caliber. Since no detailed descriptions of these formations have been found in the literature, we believe that further investigation of these formations may provide new insights into their physiological role.

Odd and satellite of the homonymous artery, the caudal mesenteric vein exchanges anastomoses on the lateral sides of the rectum with the middle and caudal rectal veins, apparently tributary to the caudal vena cava. This arrangement seems to have an important consequence: rectally administered substances are almost entirely absorbed through the veins of the systemic circulation, with only a small amount passing through the portal vein of the liver.

8. Study 4. Aspects regarding the morphology and topography of cavity lymph nodes

8.4.1. Introduction

Since the middle of the last century, anatomists who have been studying the lymphatic system in mammals have found an interesting thing, namely that in pigs they are structurally different from those in other domestic animals. Most authors believe that this species could be used as a model of a large animal for the research of the lymphatic system due to the anatomical structure of the lymphosomes and the considerable caliber of the lymphatic vessels. Since we found on the one hand, that in the literature there are some small inconsistencies related to the topography of the abdominal lymph nodes in this species and on the other hand, that we did not find any source in which these structures are examined by the ultrasound method in this species, we tried to approach in this study a detailed description of the morphology and topography of these lymph nodes as well as the possibility of identifying the clusters by the ultrasound method.

8.4.2. Materials and methods

For macroscopic and topographic analysis, lymph nodes in both the thoracic and abdominal cavities were examined "in situ". They were identified, from a terminological point of view, measured with the stool and photographed.

For the ultrasound examination, the animal was examined in the supine position. The jejunal lymph nodes were followed in the jejunal meso, at the origin of the straight parallel branches of the jejunal arteries. Although the colic lymph node chain in animals weighing 25-30 kg is approximately the same size, they are more difficult to identify by this workmanship, due to their deep topography in the colic meso, intimately surrounded by the loops of the ascending colon. The lymph nodes belonging to the ileosacral lymphocenter were analyzed with the animal in lateral decubitus, near the origin of the iliac arteries.

For examination under the light microscope, samples were washed with distilled water, fixed with 11 % neutral formaldehyde solution, then dehydrated with a progressively increased concentration ethanol solution (70%–100%), clarified in xylene and incorporated into Paraplast. 6 mm sections were then made and stained with Hematoxylin - Eosin then analyzed as the preparations made through arteries and veins.

8.4.3. Results and discussions

Reduced thoraco-aortic lymph nodes are located along the azygos vein and on

the right side of the aorta.

Caudal mediastinal lymph nodes are always fewer in number (between one and three). They are associated with the esophagus, immediately behind the tracheobronchial and ventral lymph nodes of the aorta. The afferents originate from the pericardium, the caudal part of the mediastinum and the corresponding part of the esophagus. The efferents connect to the tracheobronchial lymph nodes or can also approach some thoraco-aortic lymph nodes.

The tracheobronchial lymphocenter is formed in the same way as ruminants, it also includes the eparterial lymph nodes. Pulmonary lymph nodes are missing.

The lumbo-aortic lymph nodes are located on the lateral surfaces of the aorta, starting from the diaphragmatic orifice to the origin of the deep iliac circumflex artery. The iliac lymphocenters are represented by large lymph nodes that form a bundle at the origin of the celiac artery. Colic lymph nodes are located along the path of the right colonic artery.

Splenic lymph nodes are placed on the path of the homonymous vessels. Their topography is between the aorta and the hilum of the spleen. In this sector there may be 2-4 lymph nodes, but there are others (2-5) located along the upper quarter of the spleen. They receive the efferent vessels from the spleen, from the great epiplon, from the left portions of the stomach and pancreas.

The jejunal lymph nodes form a double chain in the middle of the jejuno-ileum meso, about 30 cm long. The two portions of this chain, each in contact with the peritoneum of one side of the meso, are separated by a layer of adipose tissue, crossed by the jejunal vessels. In the area corresponding to the ileum, the jejunal lymph nodes are more dispersed.

The caudal mesenteric lymph nodes are reduced, located dorsally by the descending colon on the path of the caudal mesenteric artery.

8.4.4. Conclusions

Although variable in number, the thoraco-aortic lymph nodes are constant regarding the presence, but no intercostal lymph nodes were identified in any situation. Similarly, the cranial sternal lymphocenter is represented by constant cranial lymph nodes and the caudal ones are absent.

In the case of mediastinal lymph nodes, the anterior ones are present, but their topography differs significantly from individual to individual. Caudal mediastinal lymph nodes are reduced and we consider their value in the anatomo-pathological examination to be insignificant.

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lymph nodes are reduced and we consider their value insignificant in the anatomical-pathological examination.

The most important groups of visceral lymph nodes are jejunal and colic. It can be mentioned that the jejunal ones can be examined relatively easily by the ultrasound method. On the other hand, the colic ones are masked in the thickness of the mesocolon root and surrounded de spirele colonului ascendent motiv pentru care sunt dificil de reperat ecografic.

The most important groups of visceral lymph nodes are the jejunal and colic. It can be mentioned that the jejunal ones can be examined relatively easily by the ultrasonographic method. Instead, the colic ones are masked in the thickness of the root of the mesocolon and surrounded by the spirals of the ascending colon, which is why they are difficult to detect sonographically.

The most important parietal lymphocenter is the ileosacral one; In it, we were able to describe for the first time some individual variants, namely: lateral iliac lymph nodes dominant in volume compared to the medial ones, the absence in some cases (10%) of anorectal lymph nodes in some specimens, in which, however, a compensation was observed by the development of a chain of small units on the path of the median sacral artery.

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9. General conclusions and recommendations

1. The results obtained from the topographic study of the large vessels, carried out by dissection on successive planes and by cross-sections, on pieces frozen at -18^{0}C, are much more representative than those obtained from the classical study of parts injected with formaldehyde, due to the astringent effect of this substance which significantly modifies the topography of the studied formations.

2. The identification of the anatomical formations of interest on the sections is of great importance for the clinician because it gives him the opportunity to recognize these structures on the images obtained with the help of ultrasound, CT or MRI.

3. Following ultrasound investigations, we found that this method can be used as a current method in establishing the diagnosis of various pathological processes in pigs, being a non-invasive method with great clinical relevance.

4. The anatomical structures at the level of the abdominal cavity, through their characteristic ultrasound appearance and topography, constitute true echoes for the identification of the lymph nodal tissue of the parenchymal and cavitary organs.

5. In connection with the cavitary vascular substrate, it was observed that the left subclavicular artery, which is a direct branch of the aortic arch, emits four dorsal branches and two ventral branches. The dorsal branches include the costocervical trunk, the deep cervical artery, the vertebral artery and the superficial cervical artery. All of these have separate origins. The ventral branches are represented by the external thoracic artery and the internal thoracic artery.

6. The right subclavicular artery detaches from the brachiocephalic trunk. In this case, the three dorsal collaterals form a common trunk on the right side. The ventral collaterals of the right subclavian artery are represented by the superficial cervical artery and the internal thoracic artery. The external thoracic artery detaches anteriorly from the first rib, as a branch of the axillary artery.

7. With the exception of their origin, the distribution of the collaterals of the subclavicular arteries is generally symmetrical.

8. As far as the celiac artery is concerned, it has been observed that in adults the splenic and hepatic arteries have a relatively equal caliber, although in some works it is described that at this age the hepatic artery is much more voluminous.

9. The other branches of the splenic artery retained the intraspecific topography, respecting the "common" norm.

10. The dorsal thoracic lymphocenter is represented only by the group of thoraco-aortic lymph nodes, which vary in number, and the thoracic lymphocenter only by the cranial sternal lymph nodes.

11. In pigs, jejunal and colic lymph nodes form compact chains in the mesoa that support the two components of the digestive tract.

12. In pigs, the portal vein has only two roots: the cranial mesenteric vein and the caudal mesenteric vein.

13. Odd and satellite of the homonymous artery, the caudal mesenteric vein is anastomosed on the lateral sides of the rectum with the middle and caudal rectal veins, apparently tributary to the caudal vena cava. This arrangement seems to have an important consequence: rectally administered substances are almost entirely absorbed through the veins of the systemic circulation, with only a small amount passing through the portal vein of the liver.

9.1 Recommendation

1. As far as the ultrasound examination is concerned, we recommend using it in the clinical evaluation of the animal, the knowledge of the topography being necessary in assessing the integrity of the morphology and topography of the evaluated structures.

2. In the case of topographic examination of vascular formations on cross-sections, we recommend when possible the injection of vessels with contrast substance,

since those with a caliber of less than 3 mm are difficult to identify or cannot be identified.

3. Since no detailed descriptions of the overlapping arches formed by jejunal arteries and veins have been found in the literature, we recommend further investigation of these formations in order to establish their physiological role.

10. Originality and contributions innovative aspects of the thesis

The studies carried out within this doctoral thesis have a clear character of originality and innovation. As a whole, the innovative contributions of the thesis are given by the results obtained regarding the possibility of using descriptive morphology data as reference elements in imaging diagnosis.

1. It is the first study to identify how the left subclavicular artery, a direct collateral artery of the aortic arch, emits four collateral, two dorsal and two ventral. The dorsal collaterals are represented by the costocervical trunk, the deep cervical artery, the vertebral artery and the superficial cervical artery, all of which have independent origins. The ventral collaterals are represented by the external thoracic artery and the internal thoracic artery.

2. An element of originality is defined by the identification of a branch detached from the gastro-duodenal artery, collateral of the hepatic artery, which is distributed to the quadrate lobe, although in the literature, including in Nomina Anatomica Veterinaria, it is not described as a collateral artery of the hepatic artery. Also, two pyloric branches have been identified, detached from the gastro-duodenal artery and the quadrate lobe artery, which are not described in the literature.

3. Another element of originality is given by the topography of the cranial mesenteric vein, which highlights the fact that the jejunal veins form a series of overlapping arches, in which fine venous branches are anastomosed with arteries of the same caliber.

4. In correlation with the data in the literature, the left gastric artery showed morphological differences, being unique in 50% of cases, in 40% it was represented by two vessels, and in 10% of cases it was represented by three vessels.

5. It is the first morphology study that used the substance called Aditie shore A 15 olimpiQ for dissection, which although it has a different destination, being used for mold casting, due to its physical characteristics it has allowed to obtain very good results in the injection process such as elasticity and tear resistance.

We have identified in the literature several substances based on natural rubber that could be used in injections, but we have used for the first time the substance called Aditie shore A 15 olimpi Q, which although it has a different destination (mold casting),

due to its physical characteristics has allowed to obtain very good results in injection such as elasticity and tear resistance.

Taking into account all these elements, we consider that this work stands out for a high level of originality, and our research is relevant and has scientific importance.

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