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SUMMARY OF THE PhD THESIS

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MORPHOLOGICAL AND IMAGING EVALUATION REGARDING ADAPTIVE ASPECTS OF ASCENDING AORTA AND PULMONARY TRUNK IN PIGS

(SUMMARY OF THE PhD THESIS)

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Introduction

Previous studies performed in human regarding the segment of ascending aorta and pulmonary trunk identified several intraspecific differences that referred to the presence and number of aortic collaterals in this region. Due to the numerous similitudes of the cardiovascular system between humans and swine, we choose this specie to study the interspecific variations regarding the aortic and pulmonary trunk branches.

1. Research Structure

The thesis contains a total of 161 pages and is structured in accordance with current legal provisions. A total of 1 table and 108 figures (images, graphs, diagrams) are inserted in its content. In Part I, we present the most important and conclusive data from the state of the art regarding aspects. In Part II of the research we present our own researches, which are aimed at shaping the macro- and microscopic features of pulmonary trunk and ascending aorta in pigs by performing anatomical investigations - using the dissection and latex substances injection technique, histological investigations - using microscopic techniques, and imaging - using angiographic and angiocardiography technique.

The bibliography contains a total of 143 titles of scientific papers from national and foreign literature.

2. Research Goals
This thesis was designed as a detailed study of the swine aorta in its ascending segment and the pulmonary trunk, highlighting its systematization and describing the branches/collaterals and their number in order to draw some comparative relevant conclusions similar to the situation encountered in humans.

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

To realize anatomical dissections in both fresh bodies and the bodies to which the dissection was preceded by red latex injection, at the arterial level to highlight the origin of the studied arteries and their path.

To perform a histological examination to determine the exact structure of the mentioned arteries, knowing that not always bibliographic aspects are consistent with the existing reality in each species. Thus, was intended to evaluate the structure of the blood vessel knowing their function and the direct relationship between them.

To determine precisely the topography of the heart, the origin, path and distribution of both, the pulmonary trunk and the ascending aorta and its collateral by radiological examination with contrast substance.

This research, through its objectives, can make important contributions to the current state of art by highlighting several new elements and individual peculiarities, knowing that the cardiovascular system in both swine and human presents a wide variety. Aspects of novelty are also found through the conclusive results regarding the heart and cardiovascular system segment mentioned above. These results can serve as experimental models in various investigations and medical experiments, both in humans and in pigs and other species here by reference to anatomical dissection techniques, histological examination and medical imaging.

3. Results and Discussions

Chapter 5, entitled Anatomical investigations on pulmonary arterial trunk and the ascending aorta in pigs was based on identifying several particular situations in human for aortic branches / collaterals in both its ascending segment and the aortic arch. This hypothesis leaded us to evaluate whether in swine can be founds such particular
situations and their incidence. In this regard, we have taken into account the existence of several similarities of the cardiovascular system of swine compared to human.

Therefore we proposed to achieve a detailed study of the pig aorta in its ascending segment and the aortic arch, highlighting its systematization, description and number of branches/collaterals, in order to draw some comparison conclusions with the situation encountered in humans.

Using stratigraphic dissection and plastic injection into adult pig corpses we observed the pulmonary trunk (Trunchus pulmonalis) and aorta (Arteria aorta), from its origin in the heart, including aortic arch (Crossa aortae) up to their collaterals: coronary arteries, brachiocephalic arterial trunk and left subclavian artery. In the latter two arteries - brachiocephalic trunk and left subclavian artery we also studied their main collateral. Thus the objective of this paper was to realize a comprehensive study of the swine aorta, in its initial part, namely the aortic arch, to highlight its systematization and to describe its branches and their count. To highlight the potential particularities found in the initial part of aorta we initially dissected the arteries and then injected them with latex mixed with red pigment to obtain a better view of the blood vessels. The process of latex injection was made by two ways: through the left ventricle and through the abdominal aorta. Through dissection we observed several specie peculiarities in our subjects.

The aortic bulb, the first segment of aorta is reduced in size, without presenting difference is calibre compared to the aortic arch. Brachiocephalic trunk was issued in all subjects, immediate after the aorta emergences from pericardium. In the specimens examined by us we have not noticed differences in arterial calibre of the vessel when passing from one segment to another, with no clear separation between the two areas. Also, we did not find the ascending aorta segment which is common throughout the other species, or coronary artery position variability in any of the subjects. At the end of the left subclavian artery, we noted very well developed collateral called the muscular branch. In all individuals the artery branches dorsal collateral - costocervical trunk, deep cervical artery and vertebral artery. A particular aspect was noted in deep cervical artery branch as collateral of the omocervical trunk.

In Chapter 6, entitled **Histological investigations regarding pulmonary trunk and ascending aorta in pigs**, we determined the precisely studied vessel wall
components using histological slides obtained from adult pigs. In this study we performed a histological examination to determine the exact structure of the mentioned arteries, knowing that not always bibliographic aspects are consistent with the existing reality in each species. Thus, was intended to evaluate the structure of the blood vessel knowing their function and the direct relationship between them.

The investigation highlight some specific aspects related to large artery structure, classified as elastic arteries, which emphasize with the tight relationship between structure and function. The studied arteries show comparable structural aspects, but also particular aspects in all layers. Intima appears discreetly folded in pulmonary trunk, aortic bulb, ascending aorta, aortic arch, brachiocephalic trunk and left subclavian artery, whereas in bicarotid trunk it shows a medium folding and in right subclavian artery and the two common carotid - right and left it presents an obviously folding. The difference is given by the appearance of the elastic component from the immediate vicinity of the media. In arteries with an obvious average folding there is a thick internal elastic membrane. Elastic component prevail in aorta (aortic bulb, ascending aorta and aortic arch), where we consider the elastic component is approximately 70% of the media layer. In common carotid arteries, the elastic component is not dominant, but ranks second after the muscular layer, which is why we believe that for these vessels the correct name would be muscular elastic arteries. The differences between studied arteries are represented by both the percentage of the elastic component and its arrangement. The concentric and orderly layout of elastic component is comparable from a certain point of view to the majority of studied vessels, but their thickness and especially the distance between them is different. Left subclavian artery, right common carotid and left carotid artery presents a very particular adventitia, which shows a well-represented elastic tissue. Special structural aspects of the vessel were found to be adaptations to the external and internal stresses to which is subject each vessel, depending on the anatomic region in which it is located.

Chapter 7, entitled Imaging investigations on ascending aorta and pulmonary trunk in pigs, aimed at implementation anatomy from virtual stage to real state, without the need for euthanasia of piglets to view anatomical formations found within the body. Therewith, non-ionic contrast substances used to visualise the cardiovascular system in
pigs, offers argument to consider this species as an experimental model in comparative medicine as imaging technique did not result in loss of any subject in the study. In this chapter, we performed a radiological investigation of the heart and main arteries. Specifically, the obtained radiographic images focused on heart, ascending aorta, aortic arch, brachiocephalic trunk, left subclavian artery, thoracic aorta and abdominal aorta.

The results indicate that the intracardiac injection of the contrast agent yielded more conclusive results, compared to the injection of the contrast medium in the external jugular vein. Due to both methods of angiocardiography we were able to visualize the heart and main vessels with their origin, path and distribution. Both radiological exposures lateral-lateral decubitus of subjects with the lateral-lateral exposure and ventral-dorsal decubitus of subjects with dorsal-ventral exposure helped to obtain a good image in terms of heart topography in pigs. In all subjects, angiographic images performed during injection of Iomeron 350 in pigs positioned in the lateral-lateral decubitus and lateral-lateral exposure revealed a good view of the topography of the aorta and its branches and the pulmonary trunk. The best results regarding heart and arteries opacification were obtained by performing radiologic exposure during the injection and after one minute. The angiocardiography with contrast medium technique proved to be a useful imaging technique in pigs when observing heart and main arteries topography and their relation with the other organs.

4. General conclusions

The investigation of food models in relation with the cardiovascular risks allowed us to elaborate partial and general conclusions throughout this thesis, within which we will mention the most relevant.

- Diet is a complex variable that requires multiple approaches to examine the relationship between dietary habits and cardiovascular risk; analyzing dietary habits represents one of these approaches.
- Frequent consumption of at least five types of dangerous foods was observed in respondents with cardiovascular disease and is associated with reduced quality of life.
• The consumption of food supplements based on omega-3 fatty acids causes positive changes in HDL cholesterol and triglycerides, but the effects on serum LDL cholesterol fraction is still uncertain.

• In the prevention of atherosclerotic cardiovascular disease is desirable to use a combination therapy involving the use of HMG-CoA reductase inhibitors (statins), as well as lipid-lowering supplements (esters of omega-3 fatty acids).

• Prevention of atherosclerosis can be achieved by modulating strictly the diet in the initial stage, and in the second phase by pharmacological modulation as a lack of response from the diet.

• The improvement of serum lipid profile through diet is an effective and inexpensive alternative to the drug therapy which may have adverse effects.

• Analysis of food model is useful in demonstrating correlations between diet and cardiovascular disease, as it takes into account all the effects of diet, not just of food nutritional compounds

5. Recommendations

➢ We recommend conducting a larger study, involving the national population level in order to certify and validate the ranking of risk factors with implications for cardiovascular disease.

➢ We recommend the possibility of extending the studies on other sources of unsaturated fatty acids to compare the implications of each class of acids in reducing cardiovascular risk.

➢ Finally, we recommend the adoption of a dietary model based on a low fat and carbohydrate intake; the dietary habits are to be accompanied by lifestyle changes.