"OVIDIUS" UNIVERSITY OF CONSTANTA

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THORACIC AORTA MORPHOLOGY

SUMMARY OF THE PhD THESIS

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CONTENT

INTRODUCTION

"Cardiovascular diseases represent a major cause of death in the developed countries, as well as in several developing countries, as has been reported by the Working group of the European Society of Cardiology, and confirmed by the European statistics on cardiovascular mortality and morbidity, 60% of the registered deaths being caused by cardiovascular diseases" [Vilacosta]. The mortality rates due to cardiovascular diseases vary depending on the age, sex, the socio-economic background, ethnicity and geographic region, they increase with age and are higher with the male sex. A key factor for the timely diagnosis of cardiovascular diseases is early diagnosis, which requires complex and costly equipment, aside from a competent staff. Among these diseases, the coronary disease ranks highest in terms of the number of cardiovascular deaths, "coronary disease being one of the most widespread diseases with the highest mortality and morbidity. The incidence of the disease varies between 15 and 200/ 100,000 persons, the prevalence being 2.5% of the general population, being higher with men between 50 and 70 years old, of up to 15%. In Romania, mortality based on cardiovascular diseases ranks the highest, accounting for more than 50% of the total deaths. The aetiology is mainly the atherosclerosis process of coronary arteries. In a limited number of cases, other aetiologies may also be encountered: coronary embolisms, local compressions or inflammations, immune or infectious vasculitis" [Ispas]. The surgical revascularization of the myocardium represents one of the most successful operations in the history of medicine, which benefits patients suffering from the atherosclerotic coronary disease. The survival after the surgery depend on the state of the coronaries at the moment of the intervention and on the possibilities of revascularization. Over 90% of the surgeries survive more than 5 years.

Among cardiovascular diseases are included the diseases of the thoracic aorta, its anomalies (aneurism, dissection, coarctation, congenital aortic dilatation), which are less frequent than coronary diseases, but which have a high degree of mortality.

Among them, aortic aneurysm presents in the general population a prevalence of 2-3%, and in the higher risk population, such as men over

65 years old, smokers, prevalence reaches 6-12% (Tinica). According to Vega, 50% of the aneurysms of the thoracic aorta affect the ascending aorta, 40% the descending aorta and 10% the aortic arch; Isselbacher establishes that at the level of the root of the aorta and of the ascending aorta aneurysms are in a proportion of 60%, while Tinica states that most often the aneurysm of the thoracic aorta regards the coronary sinus, in approximately 70% of the cases. In the case of the rupture of the aneurysm, mortality id over 90%, more than half of the patients dying before reaching the hospital. Miller believes that the risk of rupture of the aneurysm of the aorta seems connected to the diameter of the aorta, while Clouse finds that the rupture of the aneurysm happens in 16% of the cases in which the aneurysm has 4 – 5.9 cm, and when it has 6 cm, the rupture happens in 31% of the cases.

The classical branching of the aortic arch is met in 84% of the cases by Young Shin and in 85.2% of the cases by Ergun. From the above data, the drawn observation is that both the pathology and the variants of the thoracic aorta happen frequently, which requires the thorough knowledge of its normal anatomy, which has a major importance in the early diagnosis of the various aortic syndromes and anomalies, which continue to have a high mortality, which confirms that the management of this pathology remains a problem.

According to Benachebou, "the management of the lesions at the level of the thoracic aorta (aneurysm, dissection, trauma) is based on anatomic research, the diameter and length of the endoprosthesis being chosen to match the normal measurements, while the extremity of the prosthesis is placed in aortic segments which are supposed to be healthy".

For Bernardi, "the anatomical and morphologic variants of the thoracic aorta and of its branches are significant for the diagnosis and surgical treatment procedures at the level of the thorax and throat".

Brevière emphasizes that "very frequently this aortic pathology is asymptomatic, for which reason its diagnosis is often fortuitous, on the occasion of the presentation of the patient for completely different reasons".

Thus, results the importance of the development in the past years of the imaging and therapeutic fields, which has had a major contribution in this field.

New imaging methods (transoesophageal echocardiography, nuclear magnetic resonance imaging, spiral computed tomography, electron beam tomography) have been introduced in practice lately and such new techniques lead to a more correct and precocious diagnosis of aortic diseases, even under emergency conditions. They have modified the therapeutic approach of the patients in the past years, leading to a diagnosis and to faster decision-making [Vilacosta, Miller, Wooley, Coady].

In the PhD thesis I have used anatomical names in accordance with "Terminologia Anatomica. International Anatomical Terminology", which appeared in 1988 at Thieme, Stuttgart-New York.

WORK MATERIAL AND METHODS

My study was undertaken on a characteristic number of cases for each studied anatomical item, for it was not possible to study all of the intended aspects on only one concoction. As study methods, I have used dissection, the injection of plastic mass followed by dissection or corrosion, as well as the study of the CT angiographies. I used the injection of plastic mass followed by corrosion for the study of the ascending aorta and of the aortic arch, as well as for the study of coronary arteries. For injection, I used as plastic mass Technovit 7143, of German production, and the corrosion was only produced with sodium hydroxide. The AngioCT which I had the chance to examine come from the Pozimed diagnosis centre in Constanta, being executed on a computer tomography LightSpeed VCT64 Slice Ct and from the Medimar Exploration Centre within Spitalul Clinic de Ungenta "Sfantul Andrei" of Constanta, being executed on a CT scanner GE LightSpeed 16 Slice CT. I only studied the angiographies which had no pathological signs.

CONCLUSIONS

The overall shape of the thoracic aorta depends on the position in which the imaging examination is made (from the front or from the side), on the sex, on the morphological type of the individual and on his/her sizes. I found that most frequently the thoracic aorta has the shape of a question mark, with different characteristics of its segments, the shape of the loop of the question mark depending on the dimensions of the ascending artery and on the shape and dimensions of the aortic arch. The loop of the question mark may be wider and less tall, between the ascending and the descending aorta being a larger distance, and the convexity of the aortic arch being less tall, being close to horizontal, the descending branch being initially vertical up to the level of the vertebrae T8-T8, after which it takes an oblique, inferomedial trajectory to the right, toward the anterolateral side of the vertebral column, the descending arm being overall straight or slightly curled. Sometimes, the three components of the loop of the question mark (the ascending aorta, the aortic arch and the upper side of the descending aorta) have the aspect of the reversed "U" letter. Sometimes the loop of the question mark is higher, tighter, with the ascending and descending branches close to each other, the upper convexity of the arch being accentuated. According to [Garcier], "the diameter of the ascending aorta must not be more than 1 – 1.5 times larger than that of the descending aorta, the diameter of the aorta varying widely with age. Thus, it increases in the first 30 years of life, remains approximately constant, up to the age of 55, then growing gradually."

[Benachebou] also mentions that "men have a slightly larger diameter than women and that the measurements carried out on both sexes have shown that the aorta increases in diameter with age, at all measurement levels".

[Moor] holds that "the shape of the aortic arch also depends on the morphological type of the subject, in the case of the sagittal type subject, the aortic arch being narrower and situated in an almost sagittal plane, and in the case of the frontal subject being wider and situated in a more

frontal plane, this aspect being common to most cases". This was also my observation in the undertaken study.

[Grande] considered that "there is a connection between the origin of the branches and the diameter of the aortic arch, the calibre difference of the aortic arch between the beginning of the first branch and the one of the last branch reaching up to 11 mm"; I have found that the difference in the diameter of the aortic arch between the first branch and its last collateral branch is up to 9.9 mm for males and 8.5 mm for females. [Grande] also holds that "between the arterial branches starting from the ascending segment of the aortic arch (according to him, accounting for 61% of the total number of cases) and those starting from the horizontal segment (according to him, accounting for 39% of the total number of cases), there are differences in calibre", which was previously mentioned by [Testut], "the relative calibre of the arterial branches of the aortic arch depending on the position of their origin in the aortic arch: at the level of the arches whose branches started from the horizontal segment, the first branch is the widest, and when the branches started from the ascending segment, the widest was the third branch". I also found this aspect, but I found the origin of one or at the most two branches of the aortic arch at the level of the ascending aorta to be in a lower percentage than [Grande]. I also found that the left common carotid artery has a lower calibre when it starts from the brachiocephalic trunk, than in the cases when its origins are in the aortic arch, and in the case of the left subclavian artery, its calibre is frequently larger when it starts from the horizontal segment of the aortic arch than when its starts from the descending segment of the aortic arch, or, very rarely, when it starts at the level of the proximal segment of the descending aorta.

[Vega] holds that "the pathology of the thoracic aorta, especially the aneurysm of this artery, registered an increase of the number of cases in the last decades of the 20th century, and surgical success depends strongly on the precise knowledge of its morphology, in order to be able to obtain competitive results for its treatment, thus lowering the risks which may arise in the surgical treatment and thus lowering mortality".

For [Isselbacher], "the size of the aneurysm is the main indicator for the reparation of asymptomatic aneurysms, currently existing reasonable

consensus regarding the diameter of the aneurysm which requires surgical intervention, the results of the studies suggesting that a surgical intervention is not advisable, in most cases, for asymptomatic aneurysms with the diameter less than 5.5 cm".

[Sevastik] mentions that "the rapports of the aorta with the corresponding vertebrae are important, the rotation or the anterior or posterior movement of the spine engendering a movement of the aorta along the left margin of the spine, with the probability of the increase the length of the posterior intercostal arteries".

[Porto da Roca], following a study undertaken on posterior intercostal aortic arteries, recommends that "thoracentesis techniques adequately take into consideration the dimension of the arteries and of the collateral branches of the intercostal arteries, in order to avoid injury, and recommends to use the smallest intercostal spaces possible, preferably the intercostal spaces 6, 7 or 8, and the incision to be made as close to the medio axillar line as possible, these criteria being compulsory to be applied in any technical limitations and being taken into account from case to case".

[Porto da Roca] holds that "the results obtained from different studies also differ in function of the work method used, existing differences between the results obtained through echography, MRI, CT or transesophageal echocardiography, which is why the comparison of the results to each other have resulted in considerable differences".

I am adding that the differences between the obtained results are also due to other causes, such as: the number of cases considered in the study, the geographic area in which the study was carried out (there are differences between ethnicities), the period of time in which the study was undertaken, and in the case of the comparison of the results on sexes, I would recommend an appropriate number of cases for each sex. In the case of imagistic studies, I believe the following have a high importance: the incidence under which the images are taken, the performance of the equipment and, not the least, the experience of the specialist.