University " Ovidius"

FACULTY OF MEDICINE

DEPARTMENT OF PRECLINICAL COURSES

MORPHOLOGY OF THE ABDOMINAL AORTA

ABSTRACT

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CONTENTS

INTRODUCTION

Cardiovascular diseases are the leading cause of death worldwide , 60% of deaths are caused by cardiovascular disease. Romania ranks 3rd statistics at European level in terms of deaths caused by cardiovascular disease, after Bulgaria and Ukraine. Cardiovascular disease mortality rates vary with age, gender , socioeconomic status , ethnicity and region . Mortality rates increase with age and are higher in males , in people with poor socioeconomic conditions . There are marked changes between countries in the world in terms of morbidity and mortality due to cardiovascular disease, which is explained by the predominance of the factors set out above, which are added to conventional risk factors such as smoking , blood pressure and blood cholesterol level . An important factor for the diagnosis in time of cardiovascular diseases is the early diagnosis , but it requires complex and expensive equipment , besides a competent staff in hospitals . Treatment to be applied to cardiovascular diseases is also expensive and must be maintained for a long time , sometimes for life. However, Romania allocates the money for nursing, about 48 euro / person / year . Thus our country lose 2.5 billion euros annually resulting in lower productivity for patients who can not work due to poor health or family members who must stay home to take care of them .

Under the tendinous arches that inserts on the vertebrae , engages lumbar vessels and communicating branches of sympathetic lumbar and thus explaining the erosion of the development of the vertebral bodies in case of posterior development of an aneurysm and sometimes, the aortic erosion by large osteophytes .

Diseases affecting the abdominal aorta play an important role in cardiovascular diseases , with a very varied picture , especially atherosclerosis, aortic occlusion , aneurysm , aortic dissection , Marfan syndrome , abdominal bifurcation occlusion (embolism and thrombosis or Leriche syndrome) .

Abdominal aortic aneurysm can be defined using any of the following four criteria : the abdominal aortic diameter more than 3 centimeters, the diameter of the abdominal aorta exceeding 1.5 times the estimated diameter for age and sex , the diameter of the abdominal aorta in relation to body surface area over 1,3 cm / m^2 , infrarenal aortic diameter / suprarenal aortic diameter over 1.2 . Abdominal aortic aneurysm is a multifactorial disease . People at risk of developing abdominal aortic aneurysm are men over 65, smokers, hypertensives , with dislipidemia, with atherosclerosis and also those with a family history of aortic aneurysm . Genetic determinism is surely proven in the pathogenesis of aortic aneurysm . Up to 28% of people wearing this diagnosis have a first degree relative diagnosed with aortic aneurysm . In addition, both the formation and

in progression of the aneurysm, a highly important role plays the inflammatory process . Abdominal aortic aneurysms are generally asymptomatic until they are broken when the main symptom is abdominal pain, which often lead to confusion of the diagnosis . Thus, if this pathology , clinical diagnosis is difficult to establish . In case of rupture of the aneurysm , the classic triad : abdominal pain , hypotension and pulsatile abdominal mass is found in more than 30 % of patients.

In the general population , the prevalence of aortic aneurysm is 2-3 %, but in the risk population, such as men over 65 years , smokers, the prevalence reaches 6-12 % . In 2006 , in the U.S. , there were 150,000 admissions with this diagnosis and were performed 35,000 aortic aneurysm surgery , the average price of such interventions is approximately $ 25,000. In case of rupture of the aneurysm , the mortality is over 90 % , over half of patients dying before reaching hospital . It is considered that aortic aneurysm rupture is ranked 15th in the world of causes of death and occurs in one in 12 people , particularly the elderly . In 2007, in the U.S., aortic aneurysm rupture was the tenth cause of death . Surgical indication arises for all symptomatic aneurysms ruptured aneurysms or if when emergency surgery is done and also for aneurysms over 5 cm in diameter , even if they are asymptomatic. The intervention consists of excision of aortic aneurysm and replacement with a Dacron prosthesis impregnated textile of collagen .

Aortic dissection is detached from the other layers , and intimal formation in the aorta of two -way traffic for the blood, the true lumen and false lumen . Blood enters the false lumen strands will not reach the other organs. In this way complications arise that may cause death : stroke and coma , myocardial infarction, mesenteric ischemia , renal failure, peripheral ischemia . In addition there is the risk of rupture of the aorta and death. If the dissection affects only the descending portion of the aorta, heart and brain are not involved and thus the medical treatment alone may be sufficient . Surgery is reserved for cases with digestive , renal and peripheral complications.

Marfan syndrome is a genetic , inherited; the connective tissue is structurally abnormal with low resistance and of particular importance in the cardiovascular abnormalities . These patients develop at a young age (just under 20 years) aneurysm of the aorta with increased risk of aortic dissection . Therefore, all patients with Marfan syndrome should be monitored periodically by echocardiography , and the indication for surgery being given even for smaller diameter of the aneurysm .

Aortic occlusion is usually caused by an embolus occlusion almost always leaves the heart . Rarely, acute occlusion may occur due to thrombosis in situ in a segment of the aorta , with severe pre-existing stenosis or plaque rupture and hemorrhage at this level. Due to the slow progression of atherosclerosis , the natural history of aortic occlusion is usually chronic and insidious . The severity of symptoms depends on the development of an adequate collateral circulation . If there is sufficient collateral blood flow , a

complete occlusion of the abdominal aorta may occur without developing symptoms of ischemia . Otherwise, this condition is a medical emergency because it threatens the viability of the lower limbs.

Aortic bifurcation embolism occurs as an acute accident conditions embolize most common being: mitral stenosis with atrial fibrillation or ventricular mural thrombi in the weeks following a myocardial infarction . Less acute thrombosis occurs endings abdominal aorta from an ulcerated plaque .

Thrombosis terminal aorta (Leriche syndrome) occurs in a narrow aortic atherosclerosis in advance the consequences of progressive occlusion of the terminal aorta in part corrected by the development of collateral circulation .

For the treatment of abdominal aortic all these conditions it is imperative to know better the normal morphology of the arteries in order to determine accurately diagnose and intervene in time to save the life of patients requiring surgery. For this, the radiologist should know as thoroughly correct anatomy of the abdominal aorta , which is why I chose the topic of my thesis its morphology .

In general part the current state of knowledge is presented , including the normal aspects of the morphology of the abdominal aorta as they are presented in the literature that I had the opportunity to consult, in classic anatomy textbooks (Paturet , Rouvière , Gray, Adachi) and recently ones (Chevrel , Kamina , Bouchet , Beauthier , Shuncke , Moore) ,in known anatomy atlases (Netter , Clemente) and many articles in journals abroad. We also consulted , anatomy textbooks published in academic medical centers in Romania and articles in medical journals in the country.

We recorded data related to morphometry (diameter and length) , raports and path of abdominal aorta, data about the characteristics at the origin of collateral branches : the side of aorta where they can be drawn , the level of the origin regarding the vertebral column , the distance between colateral branches , their size at the origin , relations with the relevant branches of the opposite side. I also presented the origin features of the terminal branches : the level and size at origin , relationships established between them and the corresponding branches of the opposite side. At the end of each chapter we have presented the general bibliography in the order of citation in the text.

In the personal part we first presented the material and methods and in the personal results chapter , we presented data obtained from the study conducted by me. For the same case we could analyze only certain anatomical aspects . At the end of each aspect , we continued discussions , the results were compared with those in the literature.

In the chapter of conclusions, we specified the main issues that are obtained

consistent or varies in relation to those mentioned in the literature or that we have not found mentioned in the literature consulted .

The last chapter includes general literature , the works consulted are listed in alphabetical order.

I was able to redeem some of the results as national and international scientific communications whose abstracts have been published in journals or volumes summaries of these events : Cluj- Napoca (2012) , Varna (2012) , Magdeburg (2013) , Timisoara (2013) , Lisbon (2013). I have also published two papers in full in the journal Ars Medica Tomis , journal indexed BDI and Copernicus .

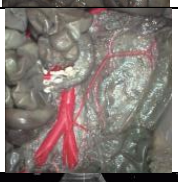
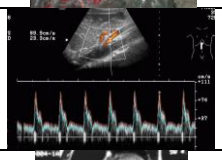
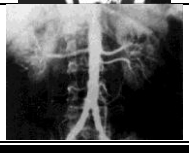
In the end thanks to the anatomy lab members of the Faculty of Medicine whose support I have continuously enjoyed and to the collegues from the Medimar Imaging Center in the Emergency County Hospital of Constanta , led by lady doctor Bardas Mariana, where I'm working and I was executing the imaging . The work could not be accomplished without the permanent and competent support of Profesor Petru Bordei , scientific leader of this thesis .

PERSONAL PART

MATERIAL AND METHOD:

My study was conducted on a total of 358 own cases , 78 of them being formolizate and fresh adult and fetal dissected human cadavers; 64 plastic injections followed by dissection or corrosion; 26 Doppler ultrasound; 16 MRI ; 46 simple angiographies ; 128 angioCT (2D and 3D reconstructions) .

Table . 1 - METHODS USED TO STUDY THE ABDOMINAL AORTA AND ITS BRANCHES.

NO.	METHOD	CASES NO	PHOTO
1.	Dissection	78	
2.	Plastic injections	64	
3.	Ultrasound echography	26	
4	MRI	16	
5.	Simple angiographies	46	

6.	**AngioCT**	**128**	
7	**Total**	**358**	

PERSONAL RESULTS:

ORIGIN OF THE ABDOMINAL AORTA REPORTED TO THE DIAPHRAGM

It has been studied in a number of 84 cases , 42 cases per each sex (50 % of cases). I found that abdominal aorta originated at the level of T10 vertebra in 37.51 % of cases .

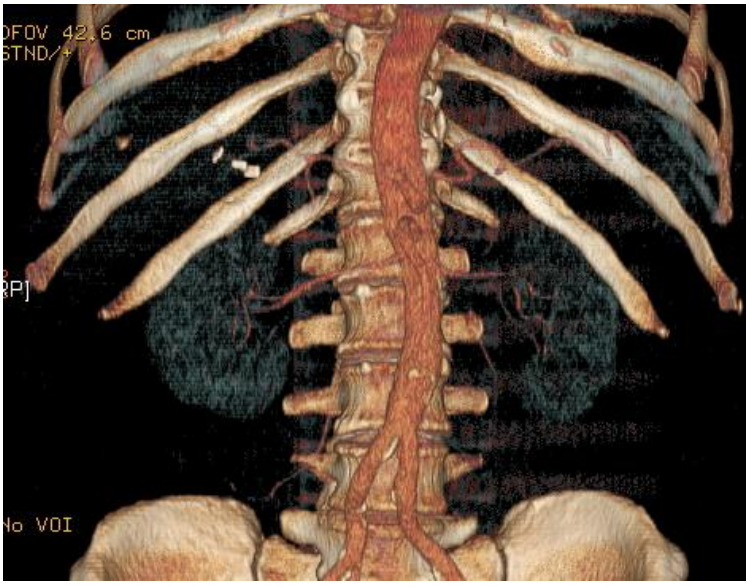


Fig . 1 - Male aortic origin of the T10 vertebra , making the whole appearance of the letter " S" italic .

Most commonly, in 52.38 % of cases , the aorta originated from T11 vertebra , and in 11.90 % of cases, abdominal aorta originated from the T12 vertebra .

Fig . 2 - Aortic origin of the T11 vertebra , making the appearance of the letter " S" italic .

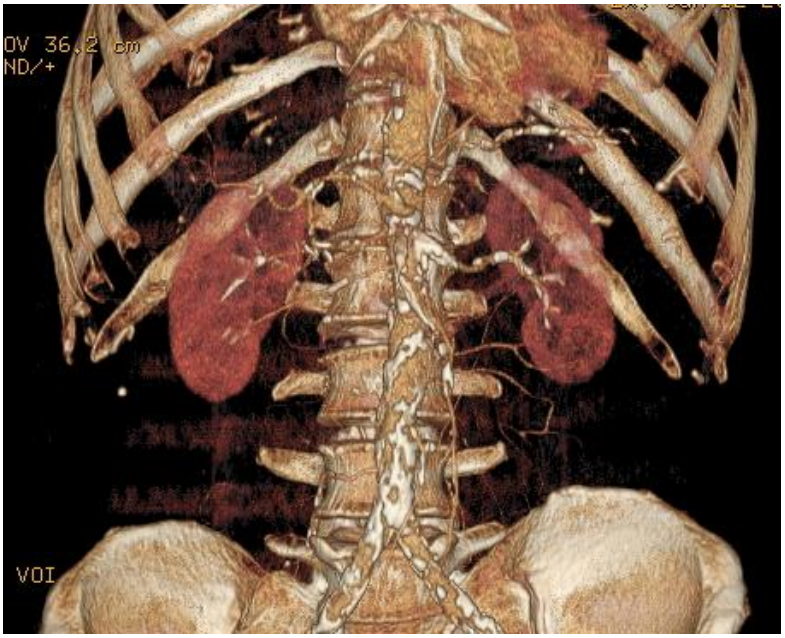


Fig . 3 - Male aortic origin of the T12 vertebra .

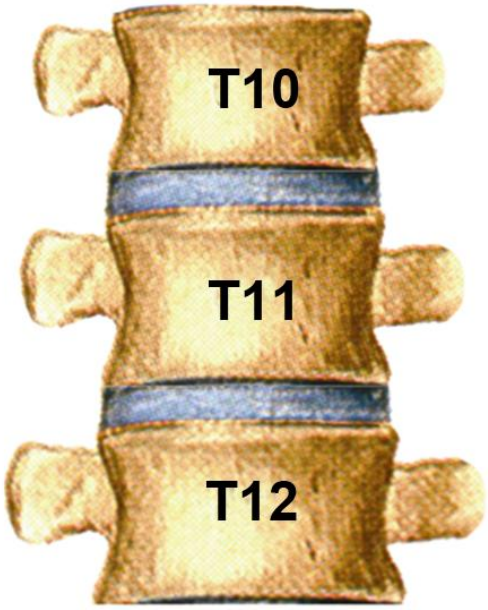


Fig . 4 - The origin of the abdominal aorta in relation to the spine.

Table . 2 - ORIGIN OF ABDOMINAL AORTA

AUTHOR	ORIGIN
Testut	T10
Rouvière	T12 inferior border
Adachi	T12 inferior border
Gray	T12 T11-T12 i.v. disc
Cormier	T12 inferior border
Magnoni	T12 inferior border
Clement	T12
Schunke	T12
Chiriac	T10-T11 i.v. disc
Personal cases	***T10:35,71%; T11:52,38%, T12:11,90%***

GENERAL APPEARANCE OF ABDOMINAL AORTA

It was studied in a total of 88 cases , describing six types :

1. to 2.70 % of cases the whole aorta described a concave curve to the left , all of them in males (9.52 % of male cases) ;

2. aorta describes a concave curve to the right , in 4 cases (5.40 % of cases) , all cases in women (12.5 % of female cases)
3. aorta describes two overlapping curves , both with concavity to the left , continuing it directly to one another , or presenting a vertical or oblique segment connecting the two curves making the appearance of the figure " 3"; this I met in 13.51 % of cases.

Fig . 5 – Abdominal aorta in males, curved with concavity to the left, next to the L2 vertebra, showing a narrowing of the diameter , at the origin of the renal arteries .

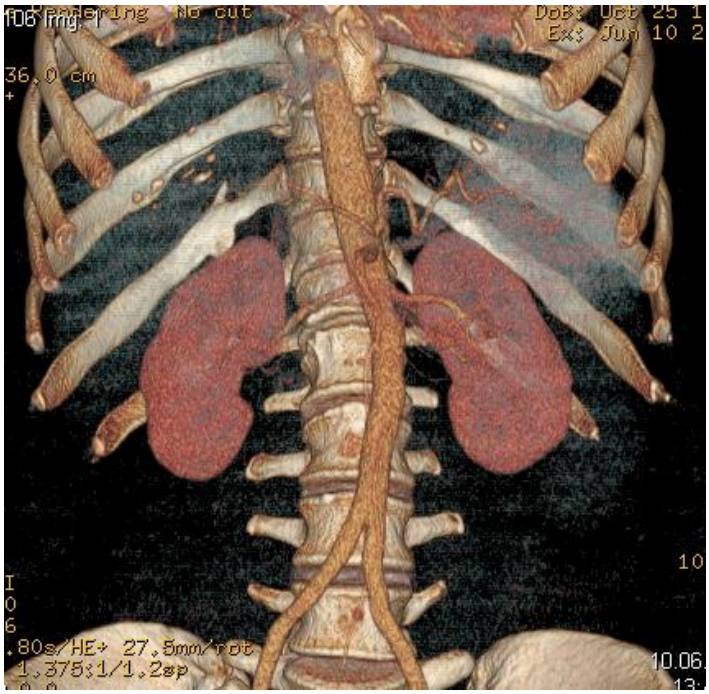


Fig . 6 - Aorta in women carrying a curve concave to the right.

Fig . 7 - Abdominal aorta in males who have two overlapping curves , both in the concavity to the left

4. aorta describes two overlapping curved , the upper one concave to the left and the lower one concave to the right , continuing directly to each other, and showing a short segment of the link , vertically or obliquely , the two curves can be equal or unequal and making aspect "S " italic; I met this in 13.51 % of cases ;

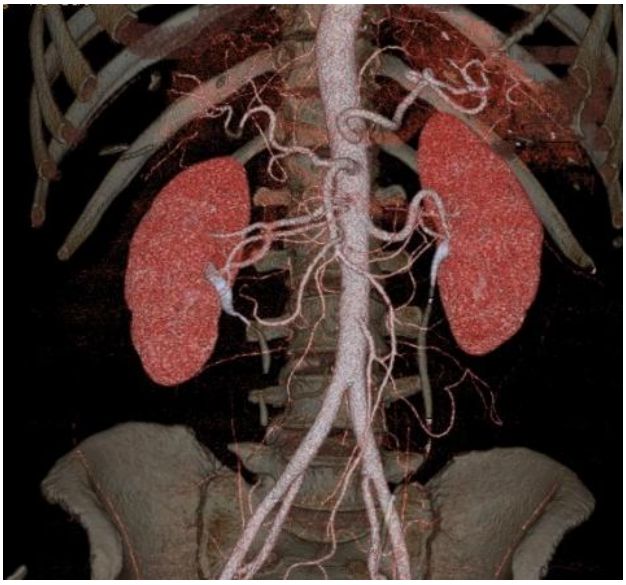


Fig . 8 - Aorta describe two curves overlapped with the concavity of the upper one to the left and of the lower one to the right, the two curves making the aspect of letter " S" italic

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5. aorta is straight vertical , located on the front of the spine, on the midline , to the left half or to the right half of it ; this I met in 18.92 % of cases ;

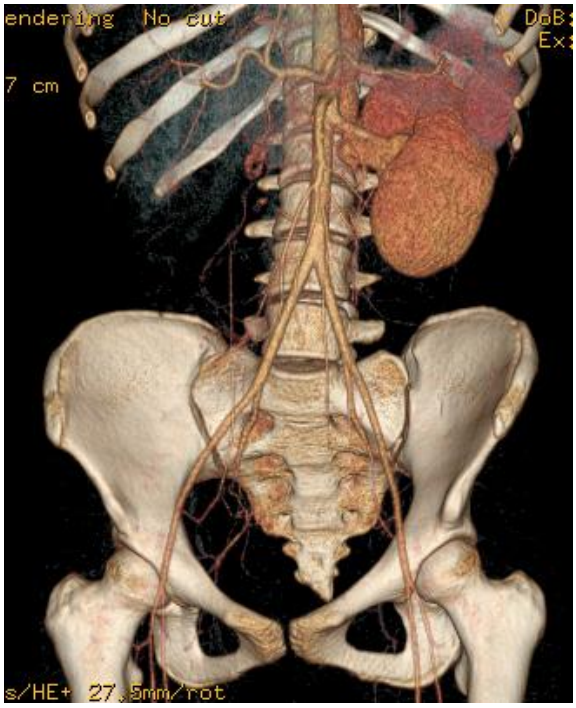

Fig . 9 Straight-vertical aorta in males . There is a marked decrease in the diameter of the left renal artery .

6. the aorta has an inferior and oblique path , obliquity is oriented supero - inferior and from the left to the right; this I met most frequently, in 32 cases (43.24 % of cases) ;

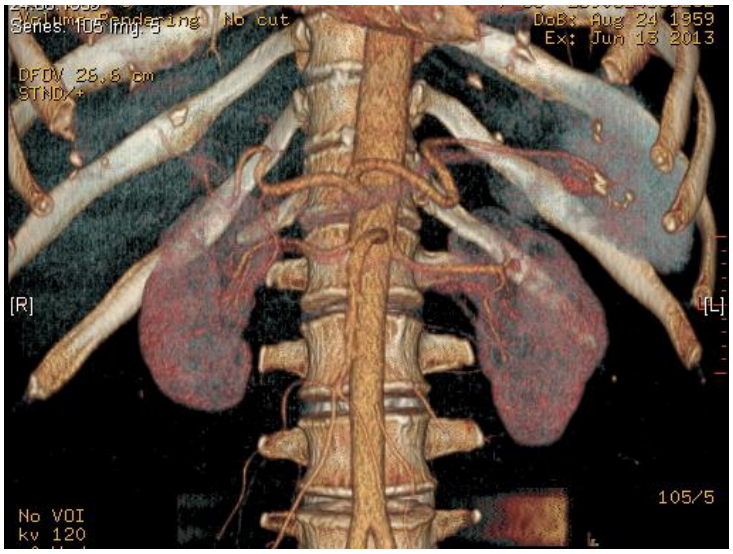

Fig . 10 - Abdominal aorta is inferior and oblique to the right , ending on the midline of the anterior spine.

TRANSVERSE DIAMETER OF ABDOMINAL AORTA

I measured the diameter in the abdominal aortic origin (subhiatal) to a total number of 65 cases , classifying it into the following groups value : between 15.8 to 17.8 mm I found in 23.08% of cases , from 18.5 to 22.5 mm in 38.46 % of cases , from 24.7 to 27.9 mm in 34.61 % of cases ; diameter 29.6 mm we found only in one case (3.85 % of cases).

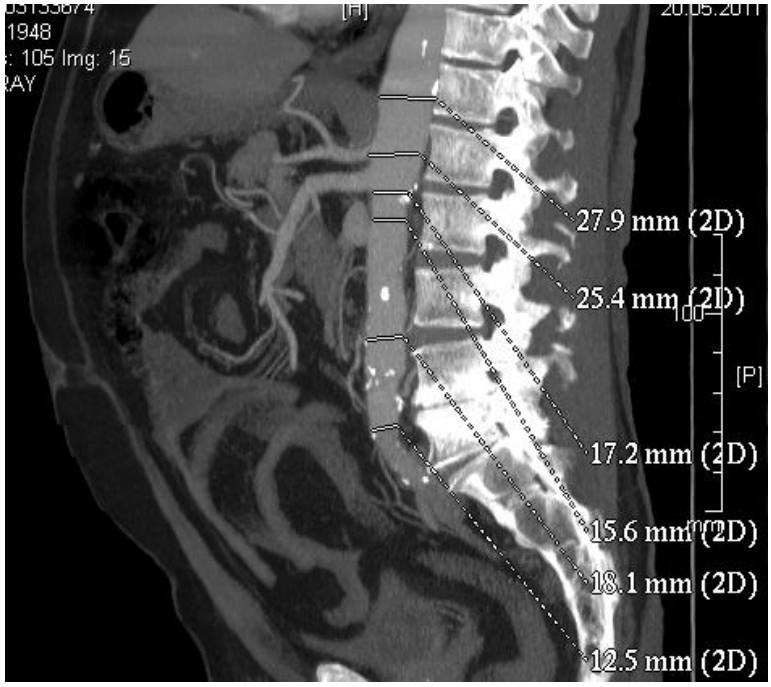

Fig . 11 - The diameter of the abdominal aorta in males . Subhiatal diameter is 27.9 mm.

We found the aortic diameter (subhiatal) in females between 14.4 to 24 mm , classifying it into the following groups value : between 14.4 to 17.8 mm I found in 35.90 % of cases) between 18.4 to 19.6 mm in 30.77 % of cases) from 20 to 22.7 mm in 30.77 % of cases , diameter 24 mm we found only in one case (2.56 % of cases).

The aortic diameter in the celiac trunk was measured on a total of 61 cases in males and I found it between 16.4 to 27.6 mm: between 16.4 to 19.3 mm I found in 36.36 % of cases , from 20.7 to 25.4 mm in 45.45 % of cases , from 26.3 to 27.6 mm in 18.18 % of cases.

In females the celiac trunk aortic diameter we found between 9.3 to 21.5 mm: 9 mm I met in one case (2.56 % of cases), between 14.7 to 16 , 9 mm I found in 41.03 % of cases , from 18.3 to 19.9 mm in 46.15 % of cases , from 20.2 to 21.5 mm in 10.26 % of cases.

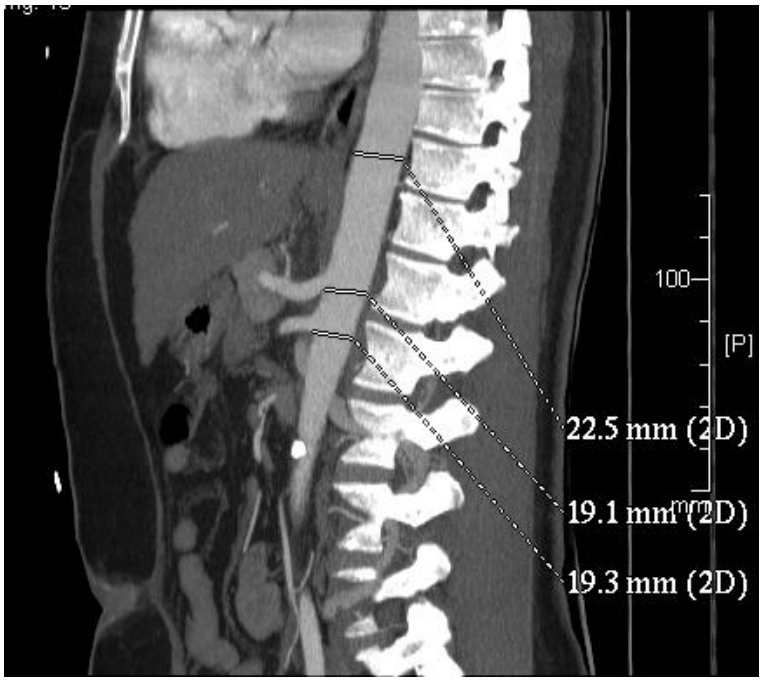

Fig . 12 -

Aortic diameter in the superior mesenteric artery we measured to a total of 66 cases in males and I found it between 15.4 to 27.2 mm : between 14.4 to 18.8 mm we found in 55.55 % of cases , from 19.8 to 23.3 mm in 25.93 % of cases , from 27.1 to 27.3 mm in 18.52 % of cases.

In females the superior mesenteric artery diameter we found between 8.7 to 20 mm: diameter 8.7 mm I met only in one case (2.56% of cases) , between 12.2 to 16.9 mm in 46.15 % of cases , from 17.1 to 19.3 mm in 47,93 % of cases , diameter 20 mm I met only in one case , 2, 56 % of the cases.

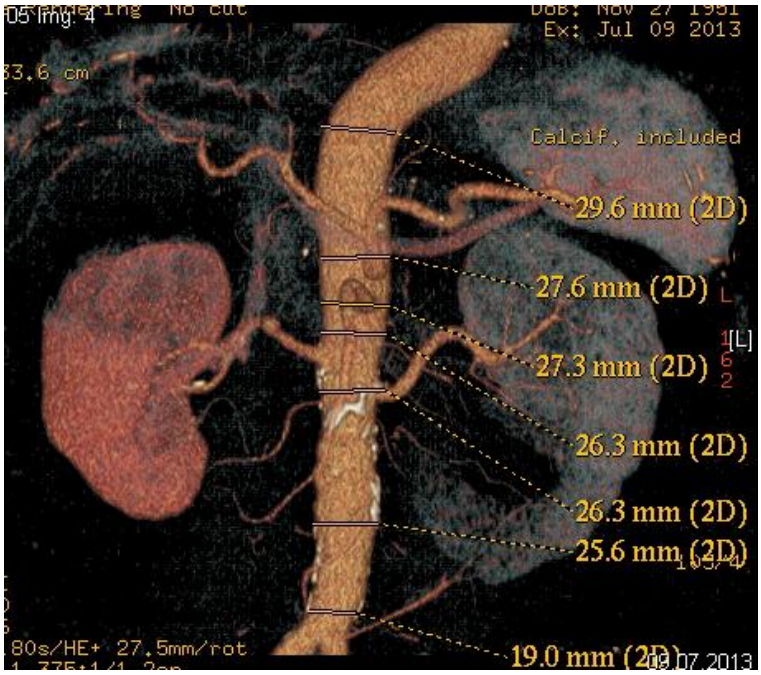

Fig . 13 - The diameter of the abdominal aorta in males . Superior mesenteric artery diameter is 27.3 mm.

Aortic diameter in renal arteries we measured to a total of 58 cases in males and I found it between 14.2 to 26.3 mm : between 14.2 to 16.3 mm we found 44.44 % of the time , from 18.2 to 23 mm in 40.91 % of the time , between 26.3 mm in one case , 4.54 % of cases.

In women diameter in renal arteries we found between 9.3 to 18.8 mm : between 9.3 to 10.4 mm I found in 5.56 % of cases , between 12.8 to 14 9 mm in 44.44 % of cases , from 15.1 to 17.7 mm I found in 47.22 % of cases , the diameter of 18.8 mm I met only in one case , two , 78 % of the cases.

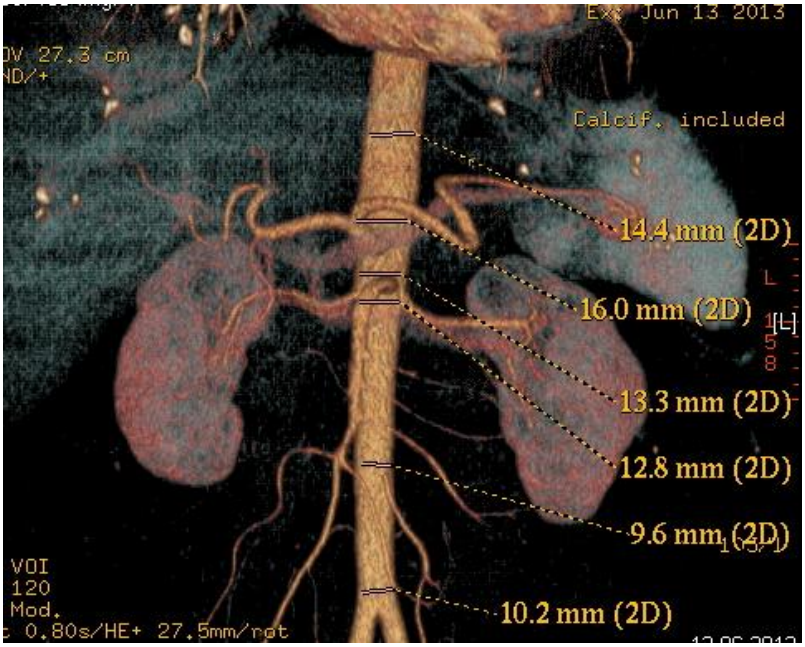

Fig . 14 - The diameter of the abdominal aorta in women . Aortic diameter renal arteries is 12.8 mm.

Aortic diameter at the level of the inferior mesenteric artery we measured to a total of 62 cases in males and I found it between 11.3 to 25.6 mm : between 11.3 to 13.7 mm we found in 8 cases (33.33 % of cases) between 14.1 to 15.1 mm in 8 cases (33.33 % of cases) between 17.6 to 19.9 mm in 7 cases (29.17 % of cases) , diameter 25.6 mm I found in one case (4.17% of cases).

In women inferior mesenteric artery diameter we found between 6.7 to 17.1 mm: diameter by 6.7 mm in I found only one case (2.63 % of cases) between I found 9.2 to 11.7 mm in 31.58 % of cases , from 12.1 to 13.8 mm in 49.47 % of cases , from 14 to 16.9 mm we found in 23 68% of cases , the diameter of 17.4 mm I met only in one case , 2.63 % of cases.

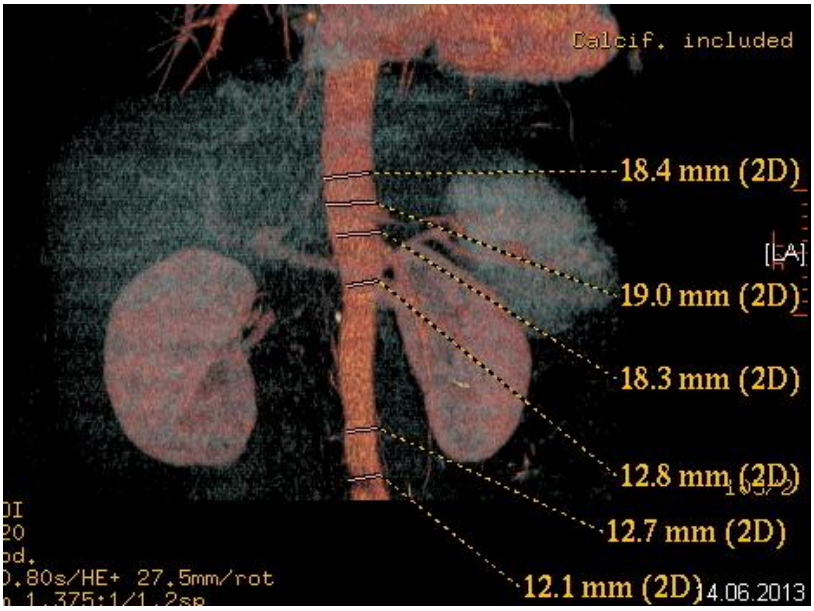

Fig . 15 - The diameter of the abdominal aorta in women . Aortic diameter at the level of the inferior mesenteric artery is 12.7 mm.

Diameter above the terminal bifurcation of the abdominal aorta I measured to a total of 71 cases in males and I found it between 9.5 to 19 mm diameter: 9.5 mm we found only a single case , 3.45 % of cases , from 10.6 to 12.5 mm I found in 27.59 % of cases , from 13.2 to 15.9 mm (58.62 % of cases , between 18 from 0.3 to 19 mm in 10.34 % of the time.

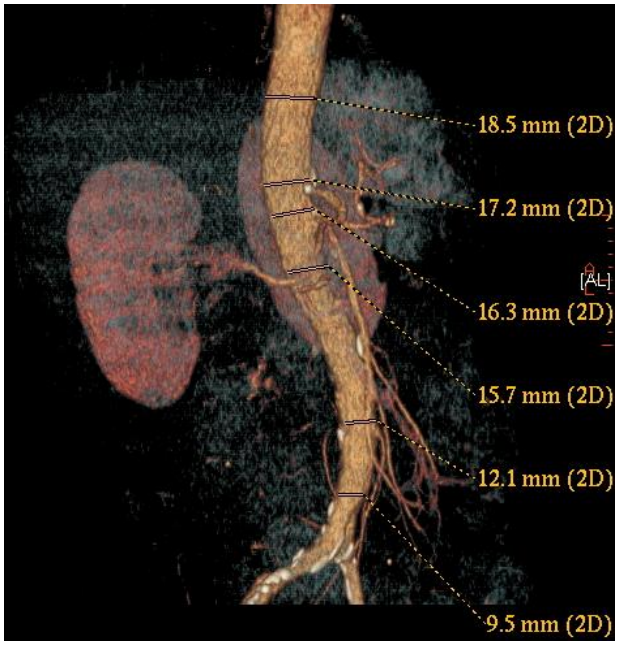

Fig . 16 - The diameter of the abdominal aorta in males . Diameter is 9.5 mm above the aortic bifurcation .

In female aortic diameter over its terminal bifurcation we found between 5 to 16.9 mm : diameter of 5 mm and 7.5 mm we found each one only one case (2.38 % of cases for each diameter) from 9.7 to 10.8 mm I found in 35.71 % of cases , from 11.2 to 12.1 mm in 38.09 % of cases , from 13.4 to 14 , 8 mm I found in 19.05% of cases ; diameter 16.9 mm I met only in one case (2.38% of cases).

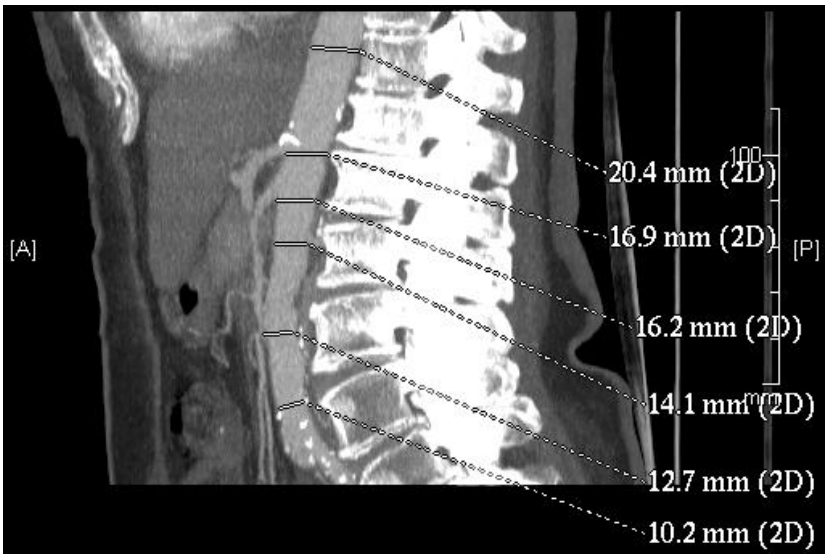

Fig . 17 - The diameter of the abdominal aorta in women . Aortic diameter is 10.2 mm above the terminal bifurcation.

We compared the transverse diameter of the aorta at different levels in relation to the origin of the collateral arterial trunks , to assess which level is most obvious decreased in size .

The difference in size of abdominal aortic diameter at its origin and size of the celiac trunk I found from 0.9 to 4 mm in males and from 0.3 to 3.5 mm in females.

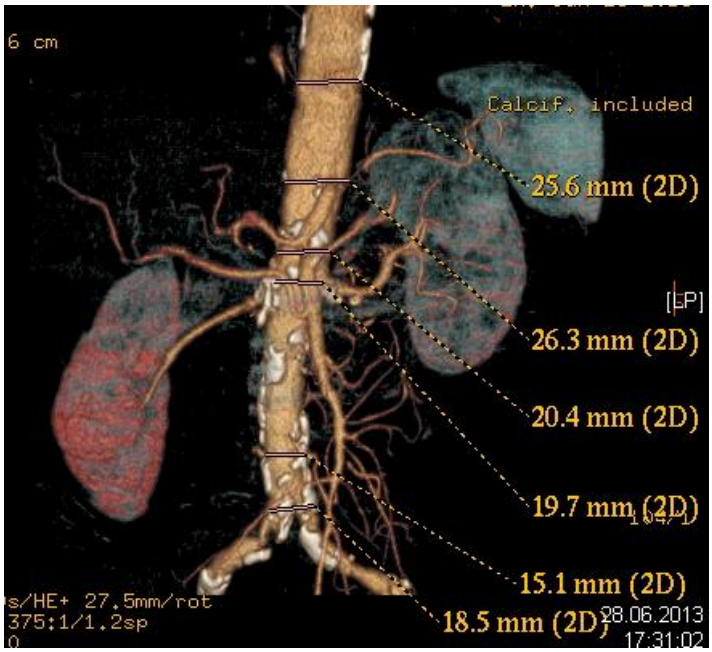

Fig . 18 - Transverse diameter of the abdominal aorta at the celiac trunk is 0.7 mm larger than the diameter of the aortic origin (males) .

In 36.84 % of the aorta in females, we found that the celiac trunk diameter was 0.5-1.6 mm greater than the diameter of the aortic origin.

The difference in size of abdominal aortic diameter at the origin of the celiac trunk and the caliber of the superior mesenteric artery origin we found in males from 0.3 to 5.9 mm.

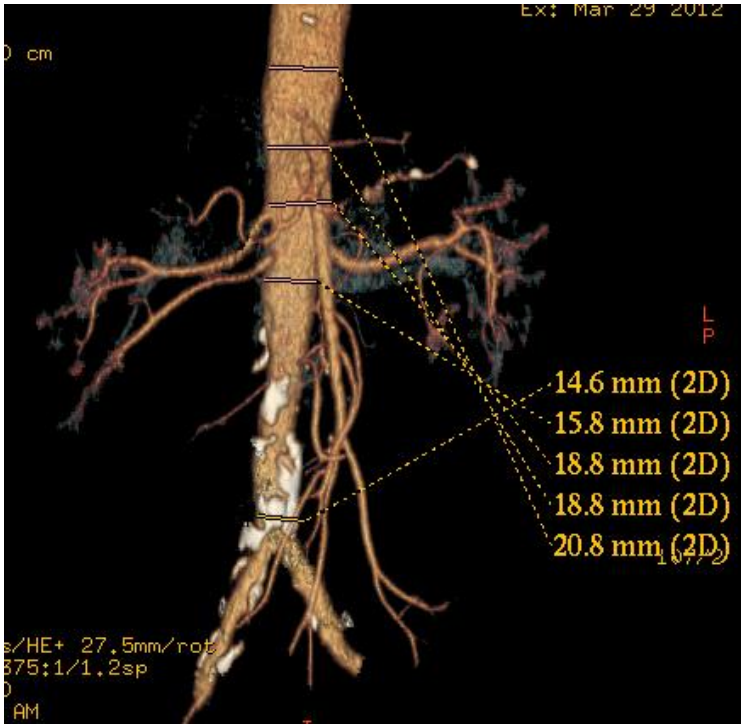

Fig . 19 -Transverse diameter of the abdominal aorta to the superior mesenteric artery is 2 mm lesser than the diameter at the origin of the celiac trunk (males) .

In one case (4.54 % of males aorta) I found that mesenteric artery diameter was 1.9 mm larger than the diameter of the aorta at the origin of the celiac trunk .

In females we found a small caliber in mesenteric artery with 0.2 to 5.2 mm. In 4 cases (10% of female aorta) I found that the superior mesenteric artery diameter was 0.2-0.5 mm greater than the diameter of the aorta at the origin of the celiac trunk .

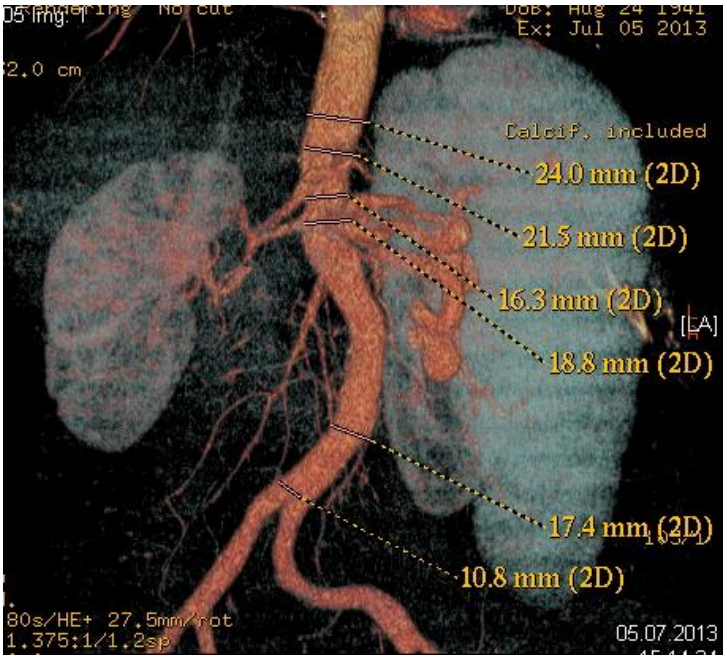

Fig . 20 - Transverse diameter of the abdominal aorta to the superior mesenteric artery is 5.2 mm smaller than the diameter in the origin of the celiac trunk (females) .

In 5 cases (12.5 % of female aorta) the transverse diameter of the abdominal aorta to the superior mesenteric artery was equal to the origin of the celiac trunk diameter .

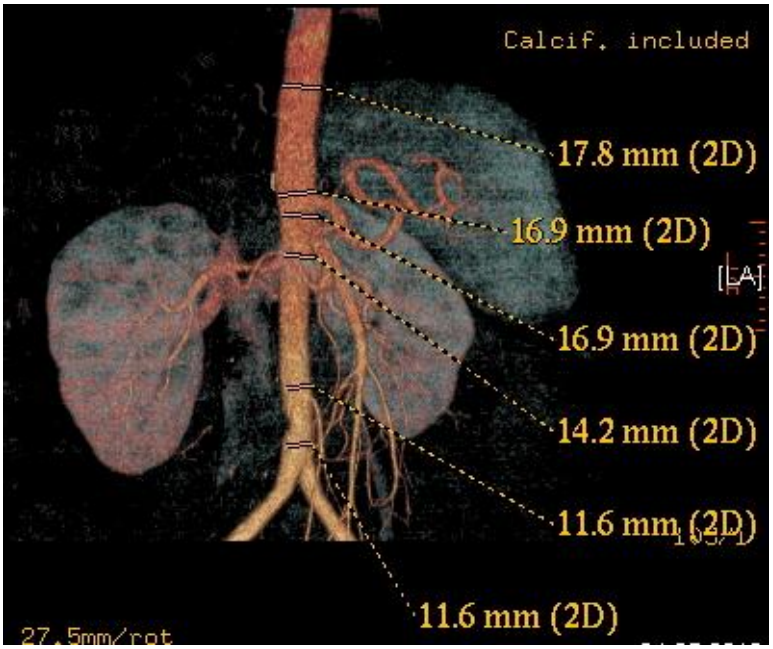

Fig . 21 - Transverse diameter of the abdominal aorta in the superior mesenteric artery is equal to aortic diameter in the origin of the celiac trunk (females) .

The difference in size between the abdominal aortic diameter at the origin of the superior mesenteric artery and at the origin of the renal artery caliber in males was 0.5 to 4.6 mm.

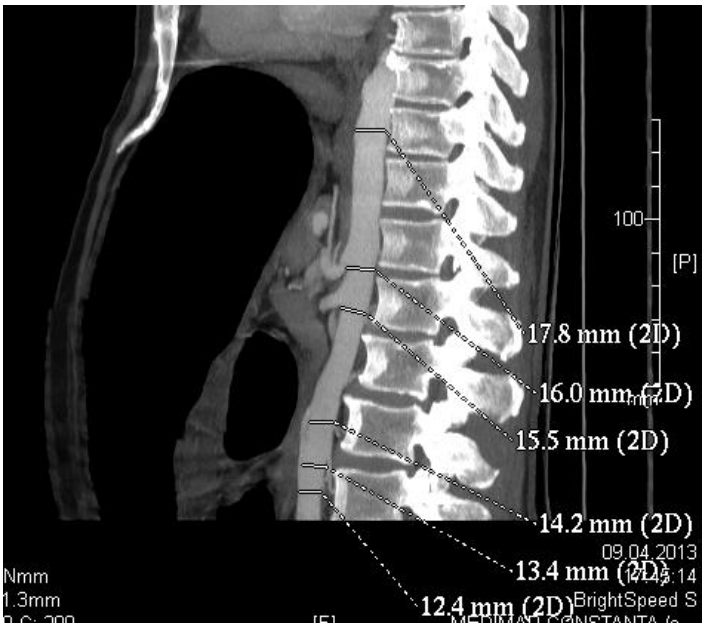

Fig . 22 - Transverse diameter of the abdominal aorta at the renal artery is 2.5 mm smaller than the diameter of the aorta at the superior mesenteric artery (male) .

In one case (4.76 % of males aorta) transverse diameter of the abdominal aorta at the renal arteries was 1.9 mm greater than the diameter of the superior mesenteric artery.

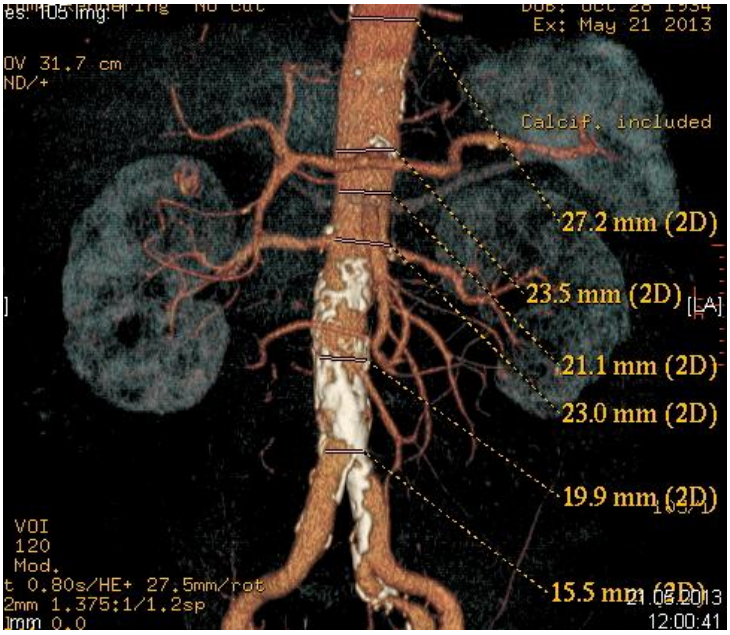

Fig . 23 - Transverse diameter of the abdominal aorta at the renal arteries is 1.9 mm greater than the diameter of the aorta at the superior mesenteric artery (male) .

The females I found a size smaller from 0.5 to 5.5 mm.

In one case (3.23 % of females aorta) transverse diameter of the abdominal aorta at the renal arteries was greater than the diameter of the superior mesenteric artery with 2.5 mm.

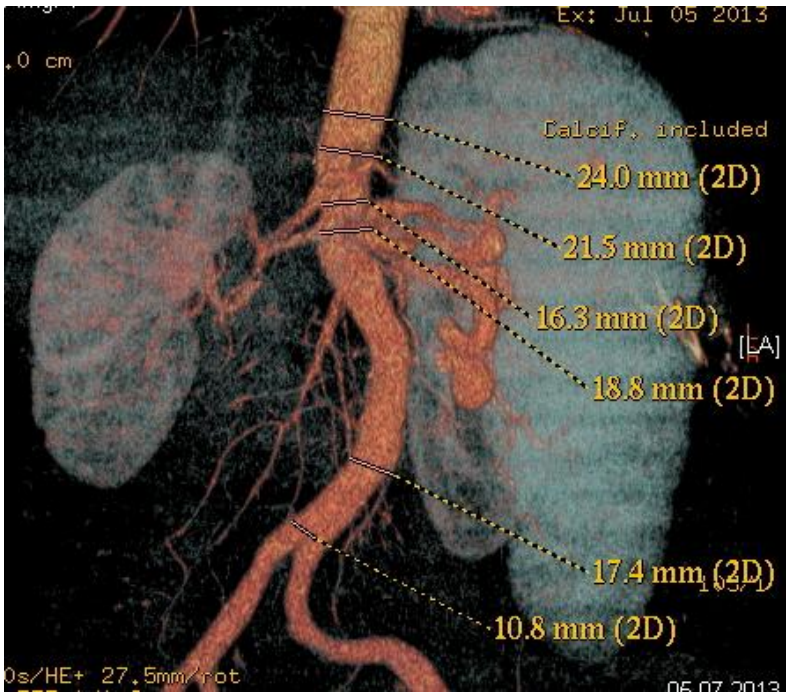

Fig . 24 - Transverse diameter of the abdominal aorta at the renal arteries is 2.5 mm greater than the diameter of the aorta at the superior mesenteric artery (females) .

The difference in size of abdominal aortic diameter at the renal artery origin and size in the inferior mesenteric artery origin in males was 0.7 to 4.2 mm.

In one case (5.56 % in males aorta) transverse diameter of the abdominal aorta at the renal artery was smaller than the diameter of the inferior mesenteric artery with 2.5 mm.

In females we found a small caliber inferior mesenteric artery with 0.1 to 3.6 mm. In one case (3.34 % in females aorta) transverse diameter of the abdominal aorta at the renal artery was smaller than the aortic diameter in the inferior mesenteric artery with 0.5 mm.

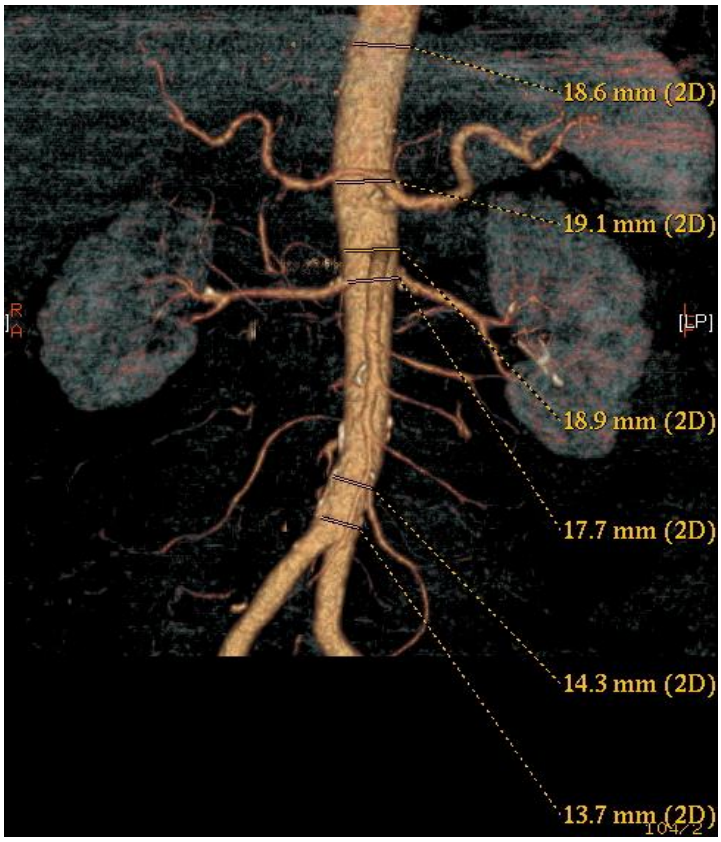

Fig . 25 - Transverse diameter of the abdominal aorta at the renal arteries is 3.4 mm greater than the aortic diameter in the inferior mesenteric artery (females) .

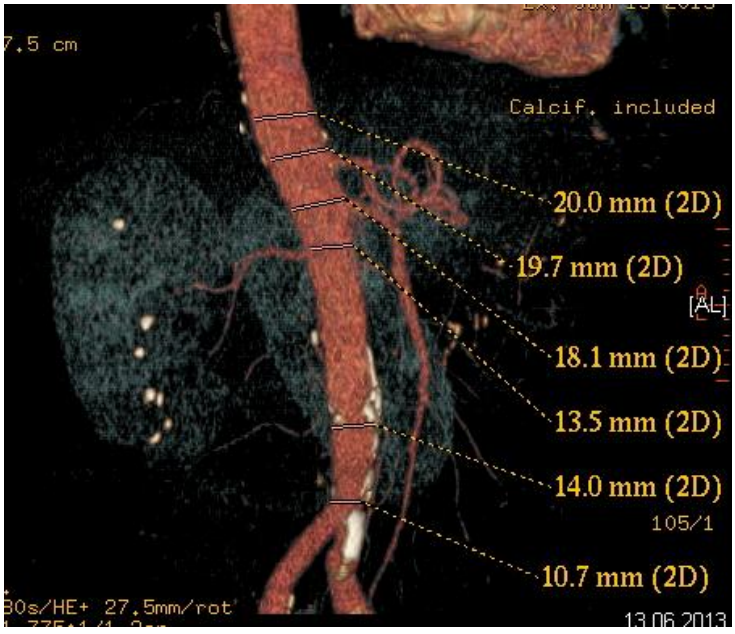

Fig . 26 - Transverse diameter of the abdominal aorta at the renal artery is 0.5 mm smaller than the aortic diameter in the inferior mesenteric artery (females) .

The difference in size of abdominal aortic diameter at the origin at the inferior mesenteric artery and the terminal bifurcation of the aorta size in males was 0.7 to 6.6 mm: in 4 cases the size was bigger than the terminal bifurcation of the inferior mesenteric artery with 0.7 to 3.4 mm , and in two cases the two sizes were equal (8.33 % of males aorta) .

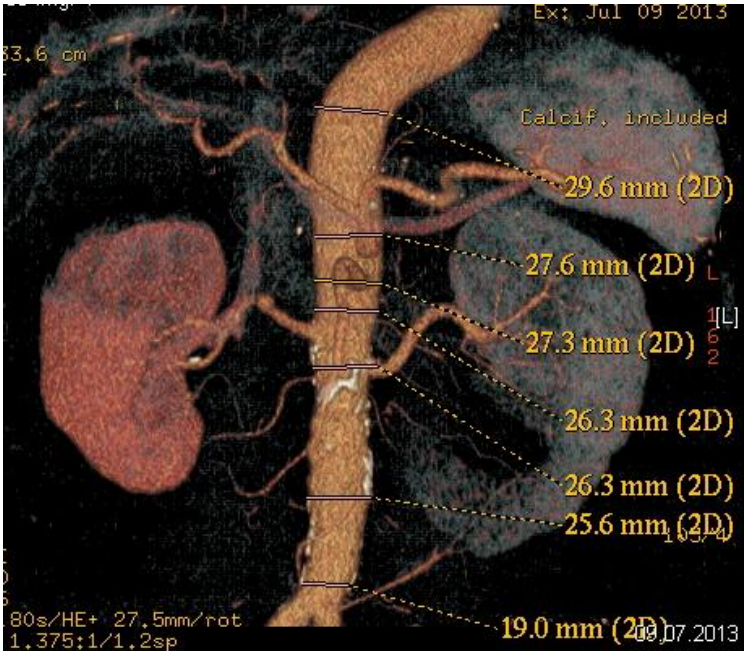

Fig . 27 - Transverse diameter of the abdominal aorta at the level of the inferior mesenteric artery is 6.6 mm larger than the diameter in the aortic bifurcation (male) .

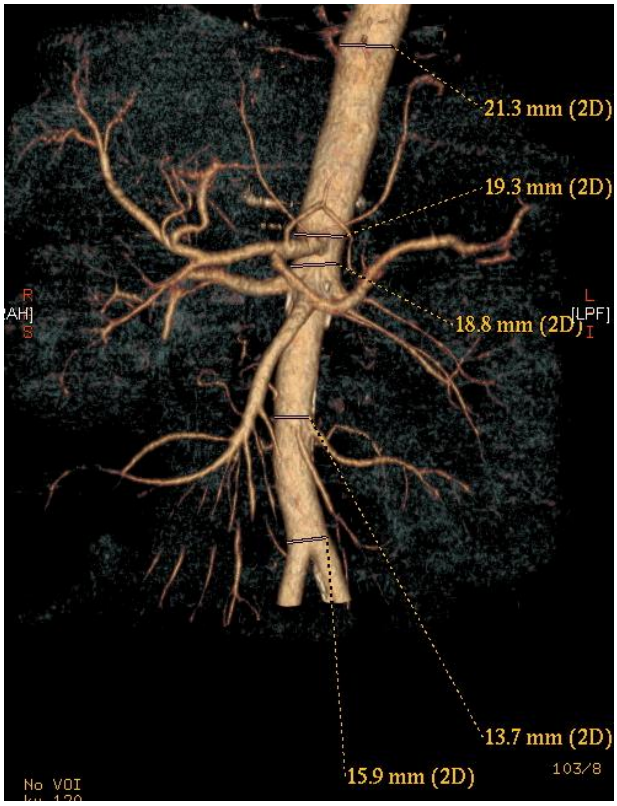

Fig . 28 - Transverse diameter of the abdominal aorta at the level of the inferior mesenteric artery is 2.3 mm smaller than the diameter in the aortic bifurcation at its terminals (male) .

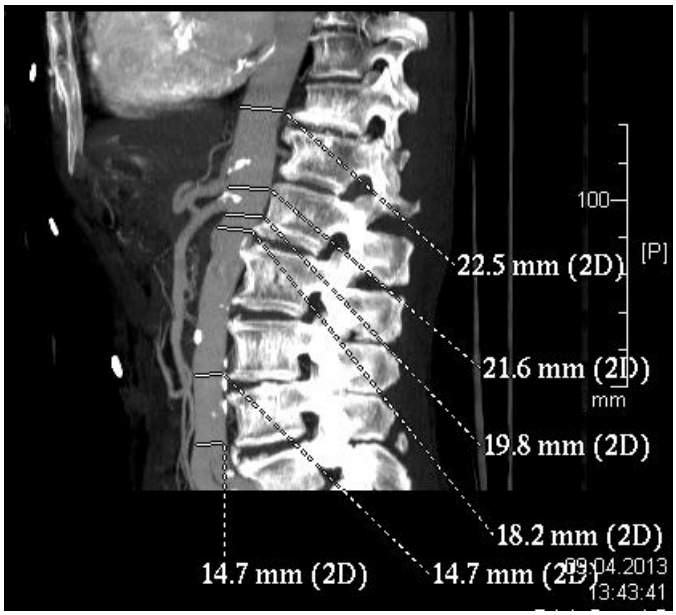

Fig . 29 - Transverse diameter of the abdominal aorta at the level of the inferior mesenteric artery is equal to the diameter of the aortic bifurcation at its terminals (male) .

In females we found a higher caliber in the inferior mesenteric artery with 0.5 to 6.6 mm.

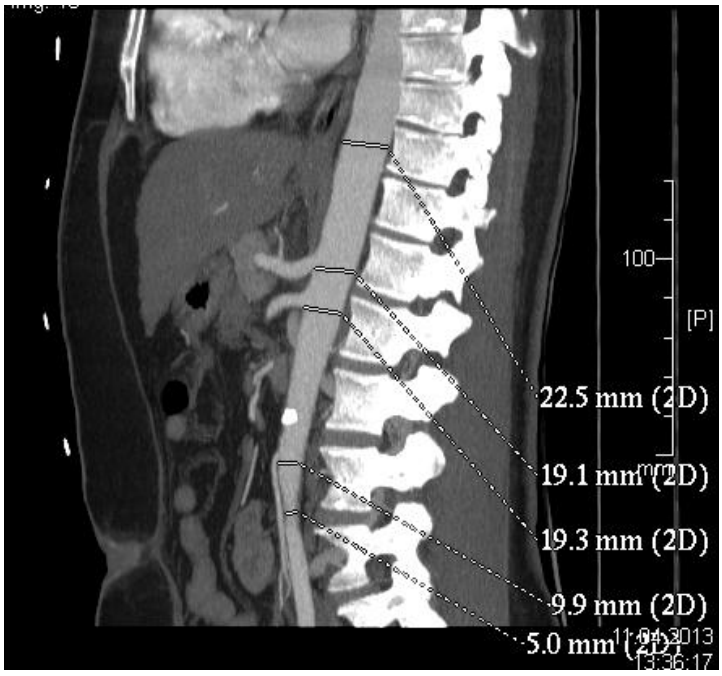

Fig . 30 - Transverse diameter of the abdominal aorta at the level of the inferior mesenteric artery is 4.9 mm greater than the aortic diameter in its terminal bifurcation (females) .

In 21.05 % of females aorta size was larger than in the terminal bifurcation of the inferior mesenteric artery with 0.4 to 1.8 mm , and in 10.53 % of females aorta those two sizes were equal .

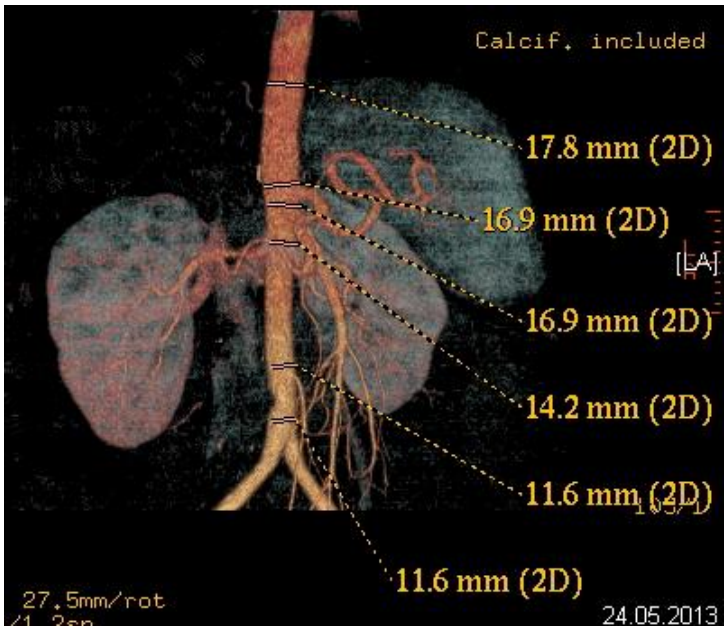

Fig . 31 - Transverse diameter of the abdominal aorta at the level of the inferior mesenteric artery is equal to the aortic diameter at the level of its terminal bifurcations (females) .

From the above it follows that the origin of the renal arteries in the abdominal aorta in males has reduced its transverse diameter at several levels , as follows: from its origin (subhiatal) and celiac trunk size was reduced from 0.9 to 4 mm in 87.5 % of cases; between the celiac trunk and superior mesenteric artery was reduced from 0.3 to 0.9 mm in 50 % of cases and from 2 to 3.7 mm in 40.91 % of cases, so there is a reduction in size from 0.3 to 3.7 mm in 90.91 % of cases; between the superior mesenteric and renal arteries in 90.48 % of cases there was a reduction in size of 0.5-2.5 mm; between the renal arteries and artery inferior mesenteric in 88.89 % of cases there was a decrease in the size of 0.7 to 3.6 mm; between the inferior mesenteric artery and the aorta between the terminal bifurcation was a decrease in the size of 0.7 to 3.7 mm in 58 , 33 % of the cases.

In males I encountered an equal aortic diameter only in 8.33% of cases (2 cases) over and underlying the inferior mesenteric artery .

Abdominal aorta in women has reduced its transverse diameter smaller than in males , except for the interval between the renal arteries and the inferior mesenteric artery , where in 96.66 % of cases there was a decrease in diameter of 0.5 to 3.6 mm. In other cases the differences are small : thus, between its origin (subhiatal) and celiac trunk size was reduced with 0.3 to 3.5 mm in 63.15 % of cases , between the celiac trunk and superior mesenteric artery was reduced with 0.2 to 2.7 mm in 72.5 % of cases ,

between the superior mesenteric and renal arteries in 80.64 % of cases there was a reduction in the size of 0.5 to 2.7 mm, between the inferior mesenteric artery and aortic terminal bifurcation was decreased in size with 0.5 to 3.5 mm in 63.16 % of cases.

In females I met a more frequently increased aortic diameter at the underlying artery : thus, between the origin of the abdominal aorta and the celiac trunk origin in 36.84 % of cases, with 0.5-1.6 mm ; between the celiac trunk and the superior mesenteric artery in 10% of cases, but, however, with differences smaller than 0.2-0.5 mm, between the inferior mesenteric artery and terminal bifurcation in 21.05 % of cases with 0.4-1.8 mm. On the other intervals we encountered only single cases , which is insignificant as percentage .

The females I met an aortic diameter equal at two levels: over and underlying the superior mesenteric artery in 12.5 % of cases (5 cases) and in 10.53 % of cases (4 cases) over and underlying the inferior mesenteric artery .

These percentage differences may be explained by the small number of cases measured to some levels or perhaps by diameter measuring error . Respective diameters increases were not due to the existence of arterial aneurysm or at most to the an onset of the disease.

(1.2) says that there is a significant reduction in size of the abdominal aorta at the level of vertebra L4 or L4 -L5 intervertebral disc , so at or below the inferior mesenteric artery origin . Or , I found that only in females an area where the diameter is largely reduced , which is located below the renal arteries , in the other cases being a progressive reduction of aortic diameter when issuing its branches , as approaching its completion . So , reducing the size of the aorta is not fast due to the emergence of very large collateral branches , as stated Chiriac , but it is graded according to its level, the measured diameters depending on the size of the distance between the origins of the collateral branches of the abdominal aorta .

TERMINAL BRANCH OF THE AORTA . THE ORIGIN OF THE COMMON ILLIAC ARTERIES

In relation to the vertebral column , the origin of the common iliac arteries (aortic bifurcation) was studied in 96 cases , of which 69 males (71.88 % of cases) and 27 female (28.12 % of cases) . We found the origin of the common iliac arteries to lumbar spine , being between the middle third of L3 vertebra and L5 vertebra lower third.

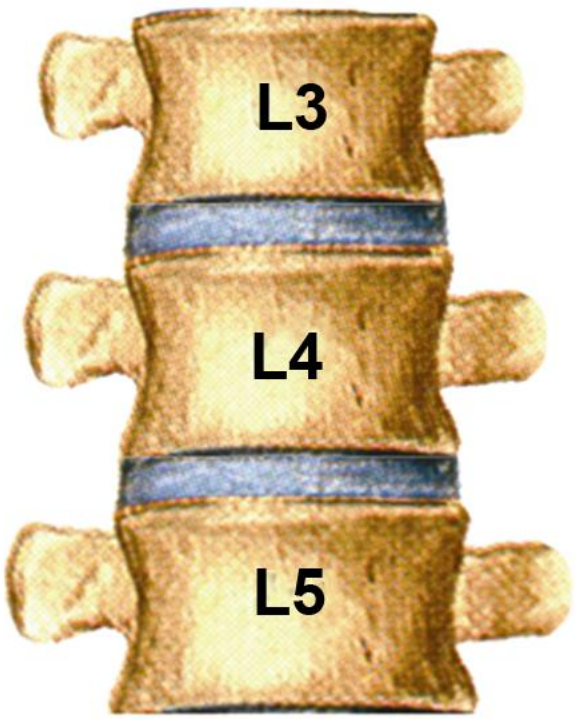

Fig . 32 - The origin of the common iliac arteries in relation to the spine.

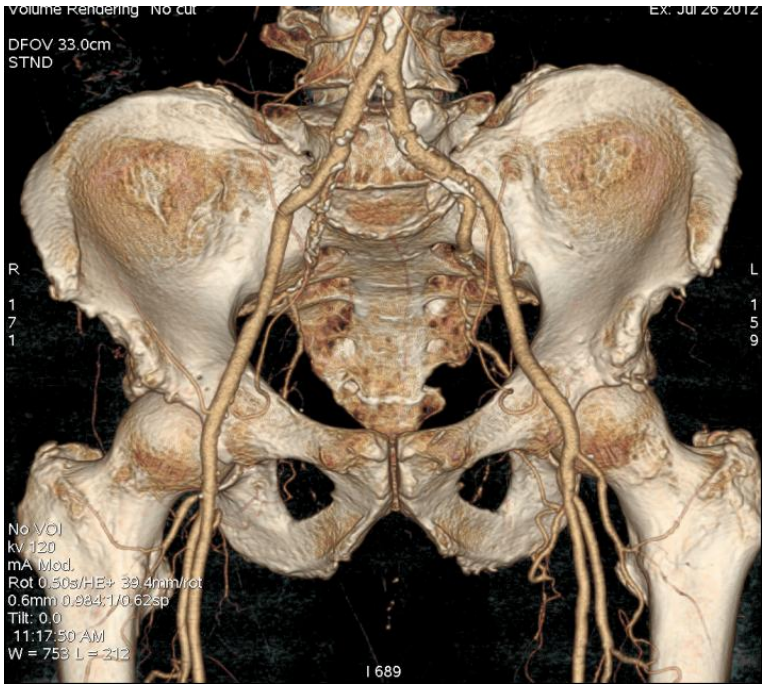

Fig . 33 - The origin of the common iliac arteries in the lower third of L4 vertebra, mid-vertebral line .

Table . 3 - The bifurcation of the aorta reported in the spinal column

AUTHOR	AORTIC BIFURCATION
Paturet	Inferior border of L4 vertebra (70%)
Testut	Inferior border of L4 vertebra
Rouvière	Inferior border of L4 vertebra
Gray	L4 vertebra
Moore	L4-L5 intervertebral disc
Krause	L4 vertebra
Chiriac	L4-L5 intervertebral disc

CONCLUSIONS

The origin of the abdominal aorta at the aortic hiatus is located between vertebrae T10-T12 , the most common being the T11 vertebra , its anterior side being abdominal, while its posterior side being still thoracic . Although most authors give as position the front of the spine, on its left side reaching the midline only at the level of the terminal bifurcation , I found it most commonly inferior and oblique to the left , often beyond the left flank of the column, not all, but only in its different parts . As a whole , from the origin to termination , abdominal aorta makes various characteristic forms: letter " S" italic, number 3, straight vertical, straight oblique , or various combinations of paths that make the abdominal aorta to present multiple route options . Wavy path of the aorta , presenting one or two curves , to the right or to the left , or in combination, is more common than straight path .

Physiologically , the caliber of the abdominal aorta decreases progressively as its collateral arteries birth , logically the size reduction would be higher by more voluminous collateral issue , as it happens in the origin of the celiac trunk and superior mesenteric artery . Decreased aortic diameter sometimes more reduced beneath the renal arteries origin , refutes the assertion of the authors, who claim the opposite. Although , the subdiaphragmatic aorta does not issue any voluminous branch till the celiac trunk, it presents a size reduction greater than to the other levels measured. The existence of differences in addition to the aortic diameter in the underlying level is more commonly in

women and is likely to be due to traction exerted in carrying CT scan , pathological conditions or errors of interpretation of the image. Equal sizes between two levels we encountered in both sexes than only between inferior mesenteric artery and the terminal bifurcation of the aorta , but in females we encountered also between the celiac trunk and superior mesenteric artery. At the level between the renal arteries and the inferior mesenteric artery I also found a reduction in frequency reductions over 2 mm.

There are discussions about the ending of the abdominal aorta , some authors considering only two terminal branches , others stating as terminal branch also the middle sacral artery . Thus, (1.2) , believes that the vertebra L4 or L4 -L5 intervertebral disc , aorta, noticeably thinner because of the numerous branches issued, ends with three branches : an artery middle , smaller , the median sacral artery and two lateral branches , relatively very large , the two common iliac arteries . In reality, as demonstrated by comparative anatomy , middle sacral artery is the continuation of the aorta , suffering atrophy parallel to the one the vertebral segments , sacrum and coccyx , above which it is situated . Its mode of distribution confirms the homology of the middle sacral artery to the sacro – coccygeal or caudal aorta of tailed mammals . Consequently , the two common iliac arteries are simple collateral branches of the aorta .

In fact, since the middle sacral artery is very thin compared with the size of the two common iliac arteries , abdominal aorta appears to bifurcate , bifurcation presenting the letter Y looks back (3). Since the middle sacral artery originates on the back of the aorta above the aortic bifurcation , I think it is more correct to consider that the aorta ends by bifurcation , opinion supported by (4).

After (5) in case of high emergence celiac trunk in relation to the aortic hiatus of the diaphragm , it can be compressed into the front , which is clearly visible on profile aortographies , radiologists comparing it with an " ax- cut " . This should be the origin of the syndrome known to clinicians that is given by the arcuate ligament , which may be responsible for gastrointestinal ischemic events .

In terms of size of celiac trunk , we found relatively low frequency of celiac trunk short, in most cases presenting a medium or high terminal branch , which is of special importance for surgery , favoring interventions and ligatures in this area.

I found that there is a connection between celiac trunk length and size of its terminal branches , noting that in cases where the hepatic artery caliber is equal to the splenic artery , the terminal branch was high or medium .

Knowledge of morphological variants of celiac trunk is particularly important for the surgeons to carry liver segmentectomies and liver transplantation , for example the existence of an additional hepatic artery with the origin off the celiac trunk , raising

particular problems . Technical difficulties operators are available also in case of an additional splenic artery for intervention at this organ.

The large variability of collateral and terminal branches of the celiac trunk and also the possibility of its absence , when the arterial branches can be drawn directly from the aorta , presents a great morphological interest , but especially surgical, forcefully imposing the mandatory execution of an abdominal aortography before surgical intervention at this level.

The importance of celiac trunk brunchs is shown also by (6) , who studied the distribution of pressure over 120 liver grafts taken from brain dead patients . He appreciates the opportunitys of vascular division in case of combined liver -pancreas procurement . The existence of a right hepatic artery originating from the superior mesenteric artery , requires conservation of superios mesenteric artery together with the liver graft, pancreas should be taken with celiac trunk and its branches . The presence of a left hepatic artery originating from the celiac trunk , requires its preservation with graft liver , pancreas being taken with the superior mesenteric artery and splenic artery .

(7.8) says that a mezenterico – celiac blood deviation , whose cause can be very varied : cirrhosis , liver tumors , may meet frequently with celiac trunk stenosis . (9) consider celiac trunk stenosis may be the mechanical cause of pancreatico-duodenal artery aneurysms, because of increased arterial flow in these areas and because of blood flow disorders . This theory was first advanced by Sutton in 1973 (cited by 9) and that this etiology should be sought systematically , as in these cases therapeutic choise should be modified . It makes that aneurysm exclusion is necessarily accompanied by aortic reimplantation of the celiac trunk , otherwise hepatic blood supply stop occuring .

Knowing the normal morphology of the superior mesenteric artery and its branches , and especially this kind of deviation in proportion of 32% , has a major importance especially in surgical practice of hemicolectomy , segmental colectomy , plasty of the esophagus with ileo-colic loop or isoperistaltic transverse colic loop.

Equaly important from a surgical point of view is the terminal ileum irrigation because the surgeon is interested in right hemicolectomy practice , when the ileo-colic artery is sacrified . This entails the resection of last ileal ansa . Anastomosis between the two branches (ileal and colic) of the ileo-colic artery exists in 76 % of cases and denies the poor vascularity reputation of ileocecal region . It provides continuity between the right paracolic arch and the arteries along the small intestine .

Generally ,in the higher part of the mezenterial bowel , intestinal arteries branch *dichotomically* (resulting in a kind of overall vascularization that some authors refer to it and which *archiform*, but (11) considers it a *concentrated* type , and others a *continuous* type) , and otherwise *monopodic* , branches of unequal size giving rise to collaterals, also unequal in size , creating types of radial vascularization , segmental or "in bouquet " .

Ultrasound and echo- Doppler exam have a great diagnostic value , being practiced before angiography and detecting stenosis and flow changes in the celiac trunk and superior mesenteric artery . Angiography revealed changes in the superior and inferior mesenteric artery , and stenosis or especially narrowing of mesenteric artery branches .

Mesenteric thrombosis occur at the most proximal level of the superior mesenteric artery , before the middle colic detachment . At 1 or 2 cm of its origin there is a cone-shaped termination of the superior mesenteric artery and the development of collateral circulation is the evidence of stenotic lesions of long duration. Non-obstructive mesenteric ischemia produces characteristic arteriographic appearance of segmental mesenteric vasospasm, with a relatively normal appearance of the main trunk of the superior mesenteric artery .

Additional renal arteries originating from the aorta , is one of the most common vascular variants in the kidney and is much more common than the existence of additional renal veins , approximately in the ratio of 1/8 . Polar arteries originating from the aorta can be damaged during mobilization or other surgical maneuvers on the pole of the kidney and a very important aspect is that the upper polar artery gives rise to inferior adrenal artery and the inferior artery gives rise to gonadal arteries, aspects that must be considered regard to conservative renal surgery . During conservative renal surgery interventions, beside bleeding and loss of renal parenchyma , arterial injuries have as a serious consequence a segmental ischemia followed by hypertension . The presence of additional renal artery in renal transplantation increases complexity, because kidney showing additional renal arteries are responsible for a significant failure more important than those with a single renal artery . For these reasons an assessment of kidney arterial vascularization is obligatory and should precede each kidney sample and each kidney surgery in order to identify any pressure variation (12, 13). Imaging examination should also be performed prior nephrectomy involving primary renal artery ligation , the existence of additional renal arteries may be responsible for a failure of vascular control , for example if a kidney tumor extirpation (14,15,16,17, 18,19,20) .

Lower polar artery originating from the abdominal aorta are involved in the mechanism producing hydronephrosis (14,15,21,22) , often presenting retroureteral paths , raising

the ureter and thus making a curvature which hinders the normal flow of urine . This curvature is important when crossing occurs at levels where the ureter is already narrowed : the pelvic - ureteric junction level or in case of ectopic kidney or ptosis, or in case of ectopic artery, low in the iliac ureter .

Retroureteral path of the renal artery is also linked to the origin of the aorta artery , which is located on the posterior side of the aorta , and sometimes on the side of it. Also, we should not neglect the role of double or triple renal arteries in renal transplantation (12,14,16,19,20,23,24) .

Gonadal artery renal artery origin is of particular importance for renal surgery in performing partial or total nephrectomy and renal transplantation , potentially compromising the gonadic vascularization , especially when gonadal artery, originating from the renal artery, is unique and there is not a second gonadal artery originating from the aorta or other blood source (20,21,22,23,24,25) . *Therefore, gonadal artery be preserved with great care to prevent vascular glandular disorder , because it represents the main arterial source of gonad .*

Knowing the normal morphology of the inferior mesenteric vessels and their branches and especially the variants that these vascular systems can present is of great importance not only for morphologist and radiologist , but also in the practice of surgery for hemicolectomy , segmental colectomy , plasty of the esophagus with ileo-colic loop or isoperistaltic colic loop .

*(*26) states*: " Any change in the parameters of the organization, structuring and operation of the subsystem side inevitably lead to lower blood pressure with ischemic colitis installation . Organizing macroscopic distribution system is structured on the basis of branches colic vessels with relatively well-defined parietal regions with available quantitative and qualitative provision , the same distribution remaining within the intraparietal territory in the microcirculatory level . "*

Even if the ransverse colon vasculature is considered almost entirely dependent of branches of the superior mesenteric artery , often is provided in a higher percentage of the inferior mesenteric artery , either by a right branch of the left colic artery or through a medium colic artery with the origin in the inferior mesenteric artery or left colic artery. Any disruption in the morphophisiology of the common iliac vessels can lead to functional disturbances in the supplied organic territories, requiring medical intervention , most often surgery. Given the relatively high frequency of the pathology of these vessels (atherosclerosis, stenosis , aneurysms , thrombosis) , it is absolutely necessary to know the normal anatomy of these vessels and angiographic examination must immediately preceed surgery. Compared with other vascular sectors, regarding the iliac vessels, the informations provided by the literature or on the internet, are

relatively poor . Considering that the middle sacral artery originates on the back of the aorta above the aortic bifurcation , I think it is more correct to consider that aorta ends by bifurcation , opinion supported also by (4,6,27) .

In relation artery / vein may occur iliac vein compression syndrome or May- Thurner syndrome produced by compression of the left common iliac vein by the right common iliac artery , during the passage of the vein under the artery, to form the inferior cavae vein (28) . This compression increases the risk of deep vein thrombosis (DVT) , the formation of a blood clot may partially or completely block blood flow through the vein. There is a risk of blood clot rupture and its circulation to the pulmonary vessels , causing a pulmonary embolism , which is fatal (29). The importance of the study results from the use of iliac vessels for various surgical treatments : the right common iliac in renal transplantation and the external and especially the internal iliac artery for embolization in the treatment of abdominal aortic aneurysm (31). In the literature is cited possible origin of other arteries - which usually originate from other sources pressure : renal, middle colic, umbilical, obturatory and circumflex iliac and even inferior mesenteric artery - in the iliac arteries (1,2,4 , 6,27,32,30,33,34) .

Different percentages in existing literature, regarding the frequency of the different morphological celiac trunk and its branches , determined some authors (11,12,13,14) to assume the existence of characteristics related to geographic and human race. He came to these conclusions after a study of 400 cadavers , finding differences, sometimes significant , between the celiac trunk of Europeans and Americans (white race) and the Vietnamese (yellow race) .

I entirely agree with the author and add the vascular and nervous variability , would depend in the same area also on some environmental factors that act during organogenesis . This would explain the morphological differences seen in the population of the same geographical area at different time periods . Also the large statistical differences between authors, depend on the total number of cases and are due to personal and different criteria to assess the collateral branches of the abdominal aorta detachment .

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