“OVIDIUS” UNIVERSITY OF CONSTANTA
DOCTORAL SCHOOL OF MEDICINE

SUBCLAVIAN ARTERY MORPHOLOGY

SUMMARY OF DOCTORAL THESIS

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INTRODUCTION

It is a fundamental medical scientific research study, knowing the fact that without fundamental research, that means knowledge, there cannot be any applicative research. The studies have an important role in the development of the investigations and the new therapies, while the results obtained after the studies serve as a term of assessment of the vascular modifications (morphometry, ramifications, and trajectory) present in different organic diseases, especially at the level of the cervical or the cerebral region and to the upper limb.

PURPOSE OF THE PAPER

Considering that the information about subclavian arteries is quite poor, I proposed myself to approach aspects regarding the origin of the arteries in report with the vicinity bone benchmarks (vertebral column, ribs, sternoclavicular joint), to describe the trajectory of the two subclavian arteries from the level of their origin and until the continuation with the axillar arteries, insisting upon the curvature they describe especially at the cervical level, describing the forms that are realized by the arteries , be it alone (in the case of the left subclavian artery), or together with the brachiocephalic trunk where from it stems (in the case of the right subclavian artery). I decided to describe at length the exo and endovascular morphometry of the subclavian arteries at the level of the arterial trunk, from more points of view: according to the sex, by comparison of right/left, by comparison with the other branches of the aortic arch. I studied the collateral branches from the point of view of the level of their origin from the subclavian trunk, the morphometry (exo and as much as possible endoarterial), the trajectory, especially at the level of the vertebral arteries, the inferior thyroid and the internal thoracic. I sought to describe the arterial variants presented by the collateral branches, especially the arterial trunks that they can form at the origin.

I sought to describe at length the cases of the right subclavian arteries with retroesophagean trajectory that I met, an subclavian vascular anomaly that can present more morphological variants and which though presents a quite reduced frequency, has a special clinical importance.

The thesis begins with the first chapter, „Introduction", where are described the reasons of the selection as Thesis study topic and purpose of the work , while the insufficiently debated aspects or even those unexplored in the specialty literature are exposed.

In the next chapter are treated the aspects of the current stage of knowledge on the subclavian arteries in the specialty literature, the classic literature (Testut, Rouvière, Paturet, Gray) and the up to date literature (Chevrel, Bouchet, Kamina, Moore), as well as in articles, older or more recent (even from 2019), published in specialty magazines.

The personal part of the work begins with the chapter „ Material and working methods", where are also mentioned the

authorizations obtained by the entitled factors in the realization of this study (The management of the imaging Centre, the informed consent of the subject to whom angiography CT was performed and the head of the anatomy discipline).

Further I describe the obtained results, the end of each morphological aspect, the results being compared with the results described in the Romanian and international literature regarding this subject, high lightening the evidenced similarities and differences. All these are sustained by personal images, graphics and conclusive tables.

The chapter of the conclusions, where are specified the most important aspects of this study, chapter that is followed by the „Originality of the study" where are exposed the realizations obtained by the signaling of some aspects less treated or even non signaled in the consulted literature.

In the chapter „Annexes" are attached the certificates obtained related to the required authorizations for the realization of the study, and in the chapter „ General Bibliography" is presented in alphabetical order the consulted literature, at the end of each chapter being mentioned the selective bibliography in the order of the quotation in the text.

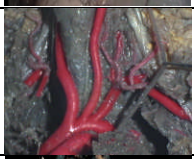
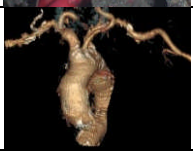
I mention that the personal results where exploited by the publication of two articles „in extenso": one „Anatomical Considerations of the Ostium of the Subclavian Artery" in „Ars Medica Tomitana", 2018, 24 (2): 108-113: the second article in extensor was published in the **Revista Română de Anatomie (Romanian Magazine of Anatomy)** functional and clinic, macro and microscopic and Anthropology, No 2, 2019: 112-118: ""**R**ight subclavian arteries with retroesophageal traiect".

I also presented a communication at the "100^{e} Congrès de l'Association des Morphologistes", published in Livres des résumés, 22-24 mars, 2018, 121.

MATERIAL AND WORKING METHODS

My study was performed on a number of 151 cases, among which 54 cases by dissection, only a number of 14cases by injection of plastic mass and a number of 83 cases represented by angiography.

TABLE No1 . WORKING METHODS USED FOR THE STUDY OF THE SUBCLAVIAN ARTERIES

No	METHOD	No. CASES	PHOTO
1.	Dissection	54	
2.	Injection of plastic	14	
3.	Angiography	83	
	Total	151	

The dissection was performed on formalinized human corpses and on anatomical pieces (prepared heart-lung, aortic arches with long arterial pedicel) existing in the human anatomy lab at the Faculty of Medicine of the „Ovidius" University of Constanta, while at the same lab where performed and the injections with plastic mass, having the written consent of the Dean and the Head of Discipline to use the existent material base.

For the injection of the plastic mass, that was performed on fresh organs, I used Technovit 7143, of German production, by injection, while the anatomical pieces were dissected and photographed.

The angiographies that I had the possibility to examine were represented by only three cases of simple angiography, existent in the anatomy lab, while the rest of 80 cases were angiography CT

coming from the Center of Medical Imagistics Medimar, that serves the Clinical Emergency Hospital "Sfântul Apostol Andrei" of of Constanta (Company "Medimar imagistic service Ltd"). The CT angiographies were performed on computer tomography GE LightSpeed VCT64 Slice CT. For the study of the angiographies I had the consent of the general manager of the imagistic center, Mrs dr. Bărdaş Mariana, to consult the existent archive in the clinic that she keeps and manages. Not all the studied anatomical benchmarks were followed on the same number of cases, the 83 angiographies representing 266 images, from which 6 are simple angiographies (2,26% of the cases) and 266 images are angiography CT (97,74% of the cases).

For the names of the subclavian arteries and their branches, I used as a guide the Terminologia Anatomica (International Anatomical Terminology), issued on 1998 by the Federative Committee on Anatomical Terminology.

The morphology of the subclavian arteries was observed from more aspects :

- the level of origin of each artery in relation to the vertebral column, with the ribs and the sternoclavicular joint, as well as in comparison with the left side;
- the angle formed at the origin by each subclavian artery with the aortic arch, respectively with the corresponding common carotid artery, as well as the angle formed by the collateral branches (especially the vertebral artery) with the artery at the origin;
- at the level of angiography CT I observed the morphometry of each subclavian artery (exo and endoarterial diameter), aspects that I observed and in comparison of the right/left; I also observed and the level of the detachment of the collateral branches in relation to their origin at the aortic arch or at the brachiocephalic trunk, as well as the distance between the origins of the collateral branches;
- the morphology of the collateral branches of the subclavian arteries was described, insisting mainly upon the vertebral arteries, the inferior thyroid and the internal thoracic;
- among the anomalies of the subclavian arteries, were observed and described the cases of right subclavian arteries with retroesophagean trajectory.

The benchmarks recorded by angiography CT were observed according to the sex and in comparison of the right/left, as well as in relation to the other branches of the aortic arch.

RESULTS

THE ORIGIN OF THE SUBCLAVIAN ARTERIES

The level of the origin of the right subclavian arteries in relation to the corresponding sternoclavicular joint and the vertebral column was studied on just 17 cases. The artery is detached from the posterior brachiocephalic trunk of the sternoclavicular joint, at different levels, most frequently at the middle and inferior level, that corresponds at the posterior with the middle or the inferior half of the first thoracic vertebra, until the level of the intervertebral disc T1-T2.

Fig. 12. The right subclavian artery has its origin at the posterior half of the right sternoclavicular joint that corresponds to the posterior of the intervertebral disc C7-T1 (male)

Fig. 13. The right subclavian artery has its origin superomedial to the corresponding sternoclavicular joint, (male subject). At the posterior it corresponds to the superior half of the vertebra C7.

In a single case (5,88% of the cases) the bifurcation of the brachiocephalic trunk was present superomedial to the sternocondroclavicular joint that is at cervical level, corresponding at the posterior to the middle and the superior half, until the vicinity of the intervertebral disc C7-C6.

On a total number of 59 cases, 30 cases of male subjects (50,85% of the cases) and 29 cases of female subjects(49,15% of the cases), I measured the value of the angle formed by the bifurcation of the brachiocephalic trunk, finding it between 8-90^{o}. In 14 cases (23,73% of the cases) the angle was between 8-20^{o}, the value of 8^{o} found in a single case (1,69% of the cases). In 8 cases (13,56% of the cases) the angle was between 21-31^{o}, in 10 cases (16,95% of the cases) the value of the angle was between 32-40^{o}, respectively 45-59^{o}, in another 8 cases (13, 56% of the cases) the angle was between 60-63^{o}, respectively 70-79^{o} and only in a single case (1,69% of the cases) the angle was 90^{o}.

Fig. 18. The angle of bifurcation of the brachiocephalic trunk is 12o (male subject).

THE ORIGIN OF THE LEFT SUBCLAVIAN ARTERY

The origin of the left subclavian artery at the level of the aortic arch was localized in three zones: at the level of the left half of the arch, at its middle and at the superior part of the descendent segment of the aortic arch. The most frequent, in 54 cases (56,25% of the cases), the left subclavian artery had its origin at the *left half of the horizontal portion of the aortic arch,* at variable distance in

relation to its middle or the descendent portion of the aortic arch. In 22 de cases (22,92% of the cases) the origin of the artery was situated at the level of the *middle of the horizontal portion of the aortic arch***,** while in 20 de cases (20,83% of the cases) the origin of the artery was situated at the superior part of the descendent segment of the aortic arch.

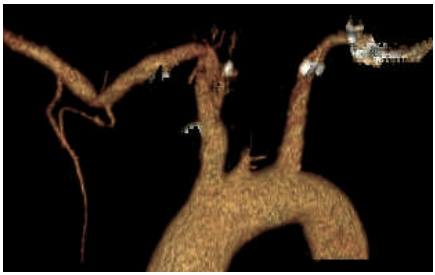


Fig. 21. The left subclavian has its origin at the left half of the horizontal segment of the aortic arch, at distance from the left common carotid..

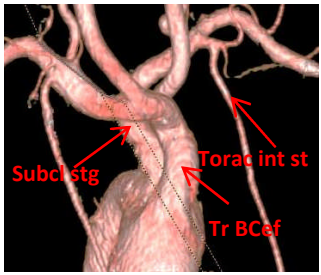


Fig. 22.The origin of the left subclavian artery is at the half of the horizontal portion of the aortic arch (male subject)

The angle formed at the origin by the left subclavian artery with the right versant of the aortic arch, was studied on 84 cases, from which 58 cases of male subjects (69,05% of the cases) and 26 cases of female subjects (30,95% of the cases), finding it between 90-138°. Considering the value of this angle, I found the following ranking:

- 90-100° 47 cases (55,95% of the cases);
- 108-119° 17 cases (30,24% of the cases);
- 126-138° 20 cases(23,81% of the cases).

THE MORPHOMETRY OF THE SUBCLAVIAN ARTERIES

The caliber of the two subclavian arteries was measured both exo and endoarterial at the level of the arterial trunks and their collateral branches.

At the level of the right subclavian artery the external diameter was determined on a number of 51 cases, among which 24 cases of male subjects (47,06% of the cases) and 27 cases of female subjects (52,94% of the cases). I found it between 5,7-12,1 mm and between the extreme values there is a difference of 6,7 mm.

Fig. 41The diameter of the right subclavian artery 9,5 mm, diameter of brachiocephalic trunk 14,4mm (masculin gender)

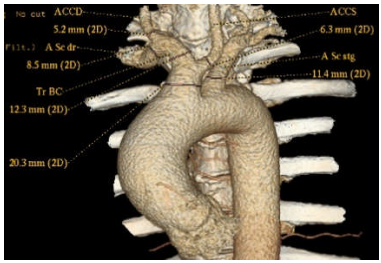


Fig. 42External diameter of right subclavian artery is 8,5mm,being larger than diameter of right common carotid which is 3,3mm smaller than diameter of the left subclavian artery by 2,9mm. The diameter of the left subclavian is larger than the diameter of left common carotid by 5,1mm. (feminin gender)

TABLE No.2 EXTERNAL DIAMETER OF RIGHT SUBCLAVIAN ARTERY

AUTHOR	**S.Cl.Dr**/mm
Paturet	9-10
Kamina	9-10
Bouchet	9-10
Manole	masc: 4,30-10,10 fem: 5,70-7,50
Personal Cases	***masc: 5,90-11,40 mm fem:5,70-12,10 mm***

At the level of left subclavian artery the external diameter was determined on a number of 66 cases, 35 of which were in male (53,03% of cases) and 31 in female(46,97% of cases),were found

between 5,2-13,1,the difference between the extreme values was 7,9mm.

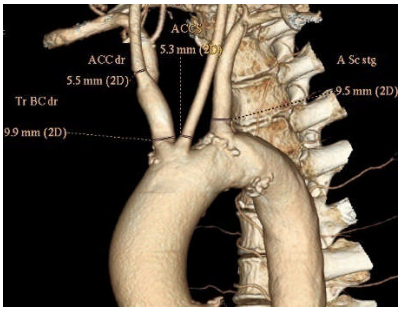


Fig. 43. The external diameter of left subclavian artery is 9,5mm, redused than the diameter of brachiocephalic trunk by 0,4mm and greater than left common carotid by 4,2mm (masculin gender)

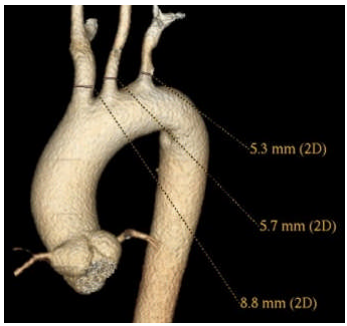


Fig. 44The external diameter of the left subclavian artery is 5,3mm, redused than the diameter of brachiocephalic trunk by 3,5mm and than left common carotid's by 0,4mm (feminin gender)

TABLE No3. EXTERNAL DIAMETER OF LEFT SUBCLAVIAN ARTERY

AUTHOR	**S.Cl.St.**/mm
Paturet	9-10
Kamina	9-10
Bouchet	9-10
Shin Young	10,6
Aboulhoda	masc: 15,50-19,68 fem: 8,91-18,71
Gorun	10
Manole	masc: 7,7-12,8 fem: 5,3-10
Malik	masc: 6,6-13,2 fem: 6,9-11,4
Personal cases	***masc: 5,7-13,1 fem: 5,2-10,6***

TABLE No4 EXTERNAL MORPHOMETRY COMPARING RIGHT/LEFT SUBCLAVIAN ARTERY.

AUTHOR	**S.Cl.St.**/mm	S.Cl.Dr./mm	Differencesmm
Paturet	9-10	9-10	0
Kamina	9-10	9-10	0
Bouchet	9-10	9-10	0
Manole	M: 7,7-12,8 F: 5,3-10	M: 4,3-10,1 F: 5,7-7,5	M: 2,7-3,4 F: 0,4-2,5
Personal cases.	***M: 5,7-13,1 F: 5,2-10,6***	***M: 5,9-11,4 F:5,7-12,1***	***M:0,2-1,7 F: 0,5-1,5***

Observing ***the decrease of the value of the diameter as the distance from the origin of the subclavicular artery increases***, I found that from the origin to the middle of the artery the smallest decrease is found in the female sex, at the level of the right subclavicular artery, the decrease in diameter being, in average, 0.60 mm, and at the level of the left subclavicular artery, the decrease in diameter being, in average, 1.95 mm. In the male sex, the progressive decrease of the diameter up to the middle of the subclavicular artery averaged 2.40 mm in both subclavicular arteries.

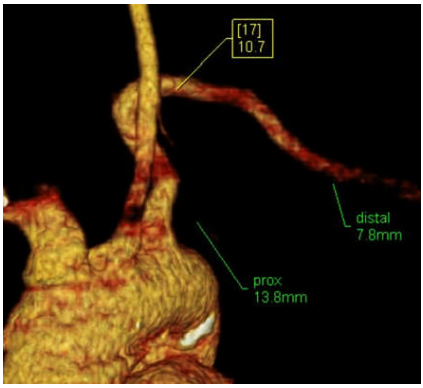


Fig. 46. The left subclavicular artery, at its origin is larger in diameter by 3.1 mm and larger by 6 mm than the female terminal diameter).

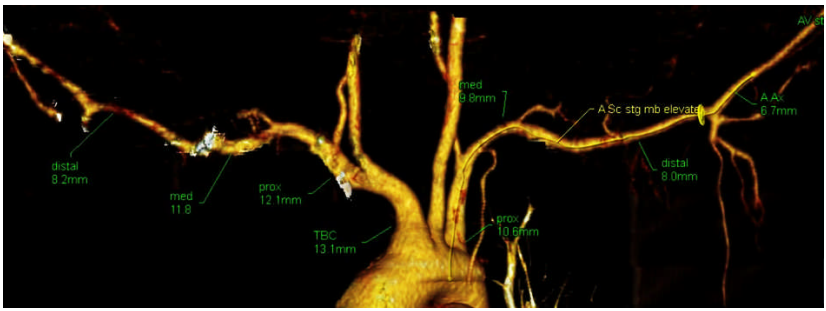


Fig. 47. The brachiocephalic trunk has a diameter of 13.1 mm; the right subclavicular artery has at its origin a diameter of 13.1 mm, in the middle, of 12.8 mm and at its end, of 8.2 mm; the right subclavicular artery has at its origin a diameter of 10.6 mm, in the middle,of 9.8 mm and at its end, of 8.0 mm (female).

ENDOARTERIAL MORPHOMETRY

I observed the horizontal and vertical diameters at the level of the aortic ostiums of the subclavicular arteries (right and left) according to sex, comparing between them the values of the two diameters (horizontal and vertical), as well as of the two parts of the body and the diameters of the aortic ostiums of the brachiocephalic trunk and the left common carotid artery.

THE DIAMETERS OF THE ENDOAORTIC OSTIUMS OF THE LEFT SUBCLAVICULAR ARTERY

There were observed 44 cases, of which 18 were male (40.91% of cases) and 26 were female (59.09% of cases). I found that ***the horizontal diameter*** was between 3.9-14.6 mm and that between the extreme values existed a difference of 10.7 mm.

Fig. 58. The horizontal diameter of the left subclavian artery is 9,6 mm , oval with the big transverse axel , with a hair like aspect with the top to the right.The vertical diameter is 9,0 mm , oval ,with the biggest axel vertically.The greatest horizontal diameter is 6,0 mm greater then the vertical (male).

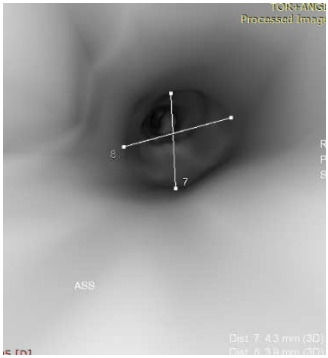


Fig. 59. The left sublavian artery has a horizontal diameter of 3,9 mm , while the vertical of 4,3 mm , it is oval with the great axel having superior oblique orientation to the left , the vertical diameter is greater then the horizontal by 0,4 mm (female).

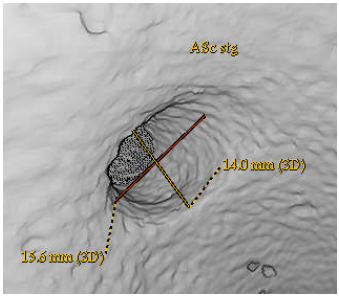


Fig. 60. The ostium of the left subclavian has a vertical diameter of 14,0 mm ,while the horizontal diameter of 15,6 mm . The ostium has an oval form with the great axel orientation being inferolateral to the left . The horizontal diameter is 1,6 mm greater then the vertical (female).

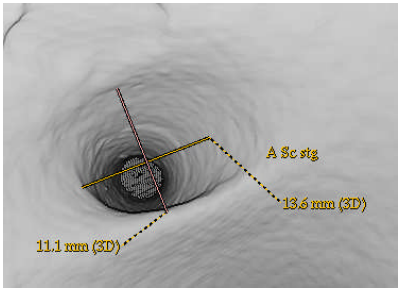


Fig. 61. The vertical entoarterial diameter of the left subclavian artery is 11,1 mm , while the horizontal one is 13,6 mm. The arterial ostium is oval with the great axel oriented superolateraly to the left , the horizontal diameter is 2,5 mm greater than the vertical (male).

It was found the ***vertical diameter*** between 4,3-14,0mm. Between the extreme values exists the difference of 9,7mm.

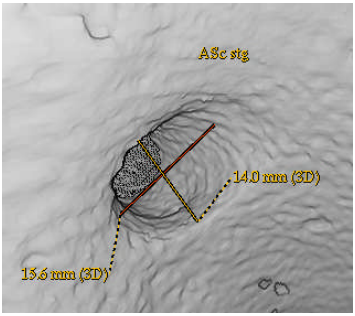


Fig. 62. The vertical endoarterial diameter of the left subclavian artery is 15,6mm and the horizontal 14,0mm (females)

The endoaortic ostium diameter of the right subclavian artery was studied in 35 cases,11 of them were male (31,43% of cases) and 24 of them were female (68,57% of cases). The horizontal diameter was found between 5,9-11,3mm, there was a difference of 5,4mm between the extreme values.

Fig. 63 Right subclavian artery. The horizontal diameter is 7,0mm, oval with the great axle slightly oblique superiorly to the left. The vertical diameter is 7.8mm being greater than the horizontal by 0,8mm (in males)

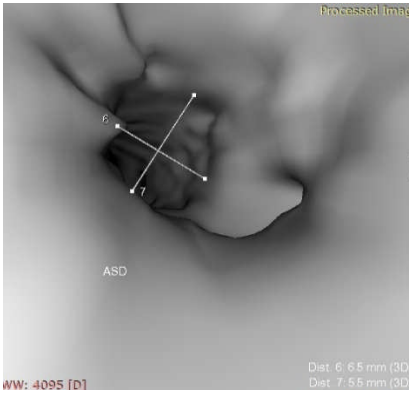


Fig. 64 Right subclavian artery. The horizontal diameter is 6,5mm, the ostiumis oval with the great axle inferiorly and left. Vertical diameter is 5,5mm with the horizontal diameter being greater than the vertical by 1,0mm (in females)

The vertical diameter was found between 5,2-11,9mm, between the extreme values exists the difference of 6,7mm.

Fig. 65. Right subclavicular artery. The vertical diameter is 9.7 mm and the horizontal diameter 11.2 mm, being larger by 1.5 mm (male).

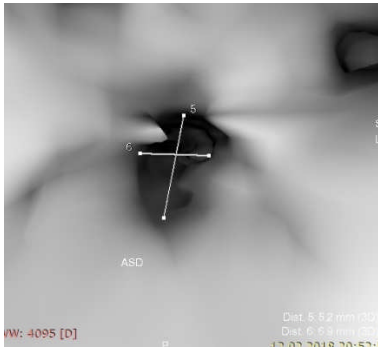


Fig. 66. Right subclavicular artery. Horizontal diameter: 6.9 mm, the ostium is oval, with the large transverse axis; vertical diameter: 5.2 mm, the horizontal diameter being 1.7 mm larger than the vertical diameter (female).

COLLATERAL BRANCHES AND TRUNKS OF SUBCLAVICULAR ARTERIES

THE VERTEBRAL ARTERY

I found two origins of the left vertebral artery: from the left subclavicular artery and for the right subclavicular artery, I found its origin only from the brachiocephalic trunk, either through the brachiocephalic trunk or from its base, before its bifurcation, sometimes the brachycephalic trunk giving rise to the left common carotid artery, in the first case the aortic arch ending with four branches, and in the second case the brachiocephalic trunk giving rise to three branches, and the aortic arch giving rise to two branches. The vertebral artery is usually the first branch (the most medial) which detaches from the corresponding subclavicular artery, sometimes the internal thoracic artery arising at the same level as the vertebral artery, but from the upper side of the subclavicular, while the internal thoracic arises from the underside of the subclavian.

Fig. 78. Left vertebral artery with origin from aortic arch (male).

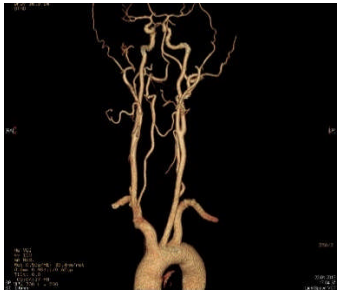


Fig. 79. Right vertebral artery has its origin at brachicephalic trunk and left vertebral artery has its origin at left common carotid .

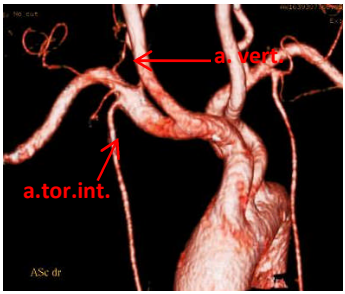


Fig. 80. Vertebral artery and internal thoracic have their origin at left subclavial in this level ,one in superior and the other one in inferior.

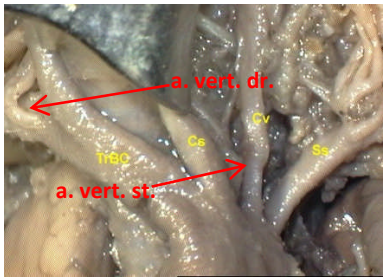


Fig. 81. Right vertebral artery comes from the anterior of subclavial ,at approximately 4-5 mm of its origin.Left subclavial has its origin at the right part of aortic arch.

The distance of the origin of the vertebral artery in relation to the origin of subclavial artery from brachiocephalic trunk ,was found between 4,0 – 25,1 mm and the left vertebral artery at a distance between 28,8 – 52,1 mm..

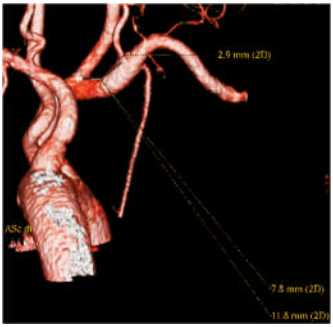


Fig. 82. The distance from the vertebral artery to the origin of the right subclavicular is 19.6 mm and the diameter of the right vertebral artery is 2.9 mm.

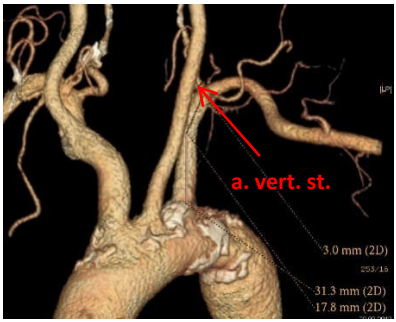


Fig. 83. The distance: origin left vertebral artery - origin left subclavicular artery is 52.1 and the diameter of the left vertebral artery is 3.0 mm (male).

From its origin, the left vertebral artery, originating in the subclavicular, is located between the left common carotid and the left subclavicular, forming with the left subclavicular an angle between 30°-70°. Intrathoracically, it can have a variable path: supero-lateral oblique, supero-medial or vertical, the arterial trunk being rectilinear or corrugated, sometimes describing a curve with the medial concavity, having an ascending path up to the level of the vertebral foramen C6, being engaged from this level in the transversal channel. The left vertebral artery may originate in the ascending part of the artery, in the cervical part, or even at the level between the two segments.

Fig. 84. The left vertebral artery originates from the border between the two segments of the left subclavicular artery. The common thyro-cervical-scapular trunk.

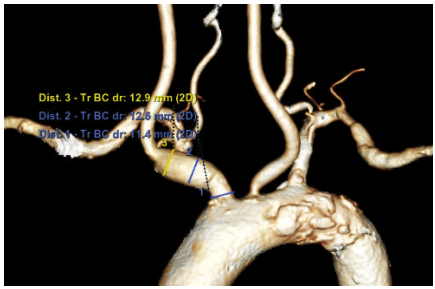


Fig. 85. The right vertebral has its origin above the origin of the right subclavicular. The left subclavicular originates in the intrathoracic segment of the subclavicular.

When the left vertebral artery has its origin in the aortic arch, sometimes the origin in the convexity of the aortic arch can be located halfway between the left subclavian and the left common carotid, so that the left vertebral artery represents the bisector of the angle between the two arteries, forming angles equal to 25-30°.

The right vertebral artery, in relation to the level of its origin in the subclavian, makes with the brachiocephalic trunk an angle between 52-90°, having the same paths as the left vertebral arteries.

The external diameter of the vertebral artery was found to be somewhat larger on the left side, between 1.8-2.9 mm, while the right vertebral artery presented an external diameter between 2.0-3.5 mm. According to [Kamina], "the left vertebral artery is larger than the right one, with an average size of 4 mm". According to [Iancu] "the vertebral artery represents the most voluminous branch of the subclavicular artery".

I found that the horizontal endoarterial diameter at the level of the left vertebral artery was between 3.8-6.2 mm and the vertical one, between 5.4-7.6 mm.

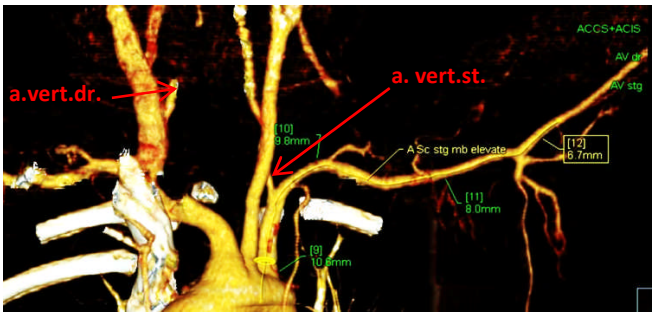


Fig. 86. The right vertebral artery makes with the subclavicular an 81° angle. The right subclavicular makes the curve from the origin, with the right inferior-lateral concavity, having next a wavy path. The left vertebral artery makes with the subclavicular an 69° angle. Both vertebral arteries have a retrocarotid path (female).

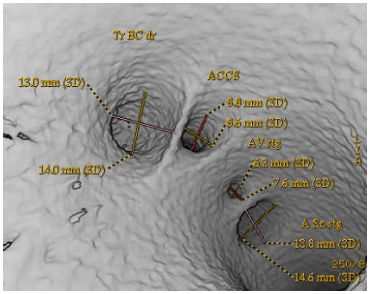


Fig. 87. The horizontal diameter of the left vertebral artery is 7,6 mm which represents 58,46% of the horizontal diameter of brachiocephalic arterial trunk and 55,07% of the horizontal diameter of left subclavial artery.The vertical diameter of left vertebral artery is 6,2 mm.

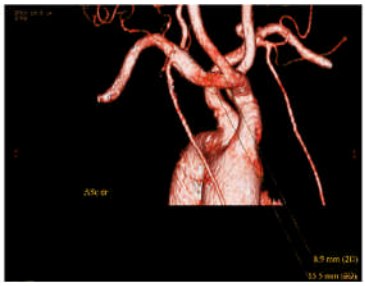


Fig. 89. The distance from the origin of the vertebral artery to the origin of the right subclavial artery is 24,4 mm.Right vertebral artery forms with subclavial artery an angle of 90º (male).

It was found that vertebral artery always enters in the tranverse canal at the level of C6 vertebra.

TABLE NR. 9. VERTEBRAL'S ARTERY ORIGIN FROM THE AORTIC ARCH.

AUTHOR	PERCENTAGE
Nelson	4,1%
Suzuki	4.1%
Lippert	6,9%
Young Shin	8%
Yamaky	5,8%
Epstein	până la 14,80%
Matula	2,5%
Elif	5,1%
Moore	5%
Manole	2,19%
Aboulhouda	5%
PERSONAL CASES	***7,14***

[Adomnicăi] states that most studies report a prevalence of the vertebral artery between 3% and 8%, but he estimates that the frequency can reach up to 14.8%, being higher in the female sex.

I found out that ***the origin of the vertebral artery*** from the aortic arch is being found in a fairly high percentage, as can be seen in the table above.

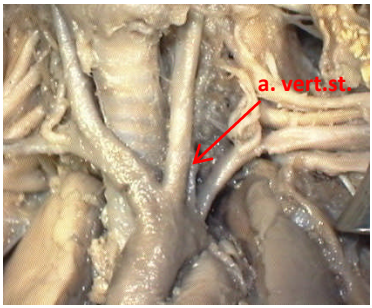


Fig. 95. Left vertebral artery with origin in the aortic arch (male).

INTERNAL THORACIC ARTERY

It usually represents the second branch of the subclavian artery, having its origin immediately laterally to the vertebral artery, but from the level of the lower side of the subclavicular artery.

The place of the origin of the internal thoracic artery in relation to the other collateral branches of the subclavicular can be very variable, being found on the left side at a distance between 40.3-50.6 mm and between 31.6-39.8 mm on the right side, depending on the origin of the respective subclavicular artery. In relation to the inferior thyroid artery, the internal thoracic artery can have its origin medially or laterally, and sometimes the origin of the left internal thoracic artery may be located at the level of the continuation of the intrathoracic portion with the cervical portion of the artery. Rarely, the origin of the internal thoracic artery can be located at the same level as the origin of the vertebral artery, an aspect that I encountered on the right side.

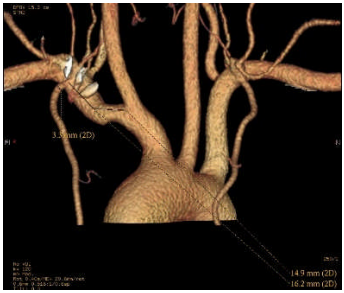


Fig. 96 Right internal thoracic artery has its origin at the inferior side of subclavianl , laterally is originated from the superior side of the vertebral artery.The distance from the origin of the left internal thoracic artery from the otigin of the right subclavianl is 31,1 mm , while the diameter of the artery is 3,3 mm(male).

Fig. 97. Left internal thoracic artery arises laterally from the inferior thyroid artery and the origin of the right internal thoracic artery is higher (male).

Fig. 99The distance between the origin of the left internal thoracic and the left subclavianl is 41,6 mm , while the diameter of left internal thoracic is 2.6 mm (male).

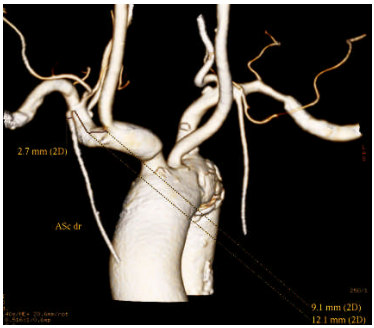


Fig. 100. Right internal thoracic artery has a caliber of 2,7 mm , distance of the origin of right subclavian to the origin of internal thoracic is 21,2 mm (male)

The diameter of internal thoracic artery was found that is between 1,9 – 3,3 mm in the right side and 2,1 – 2,8 in the left side.

CERVICAL ARTERIES

Even if exists cervical artery , independed is not exist in anatomic nomenclature .

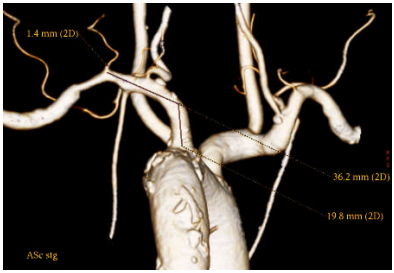


Fig. 102. The distance between the origin of the left ascending cervical artery and the origin of the subclavian artery is 56 mm , and the diameter of the left ascending cervical artery is 1,4 mm (male).

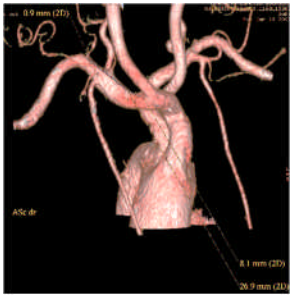


Fig. 103. The distance between the origin of the right ascending cervical artery and the origin of the subclavian artery is 40 mm and the diameter of the left ascending cervical is 0,9 mm (female).

I found only one case in which the origin of left ascending cervical artery was at the level of the asortic arch between the origin of the left common carotid and the origin of left subclavian artery.

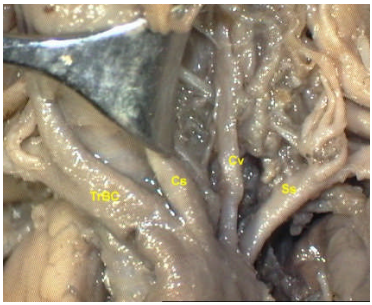


Fig. 104. Left ascending cervical artery with origin from aortic arch.

When the origin of the ascending cervical artery was from a thyrocervical trunk or cervical rib, the distance of the origin of

the trunk was closer to the origin of the subclavicular artery, on the right side being between 18.0-20.0 mm and on the left side between 47.0-49.8 mm and the trunk diameter was between 2.7-4.5 mm.

At the level of the right ascending cervical artery I encountered both the smallest value and the highest value of the diameter, the difference between the extreme values of the diameters being 2.0 mm at the level of the right ascending cervical artery and 1.0 mm at the level of the left ascending cervical artery.

The diameter of the transverse cervical artery is usually smaller, finding it on the right side between 0.9-1.9 mm and on the left side being between 0.8-1.3 mm.

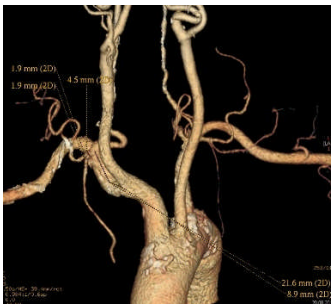


Fig. 105. The distance of the origin of the thoracic-cervical trunk is 21.6 8.9 mm, and its diameter is 4.5 mm; the internal thoracic diameter is 1.9 mm and the cervical diameter is also 1.9 mm.

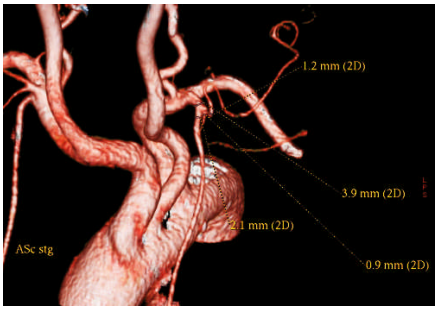


Fig. 106. Thoraco-cervico-intercostal trunk with a diameter of 3.9 mm; the left internal thoracical has a diameter of 2.1 mm; the diameter of the supreme intercostal is 0.9 mm and the diameter of the transverse cervical is 1.2 mm.

LOWER THYROID ARTERY

In relation to the other branches of the subclavicular artery, the origin of the inferior thyroid artery is found usually laterally to the vertebral artery, medially or laterally to the internal thoracic artery (but on the upper side of the subclavicular), medially or laterally to the ascending cervical artery. The left inferior thyroid artery is very rarely detached at the level of the vertical portion of the subclavicular artery, rarely at the level of the continuation of the vertical portion

with the cervical one and most commonly at the level of the cervical portion of the subclavian.

I found that the distance of the origin of the inferior thyroid artery from the origin of the left subclavicular artery was between 40.9-52.2 mm, and the distance of the origin of the inferior thyroid artery from the origin of the right subclavicular artery, between 21.9-29.6 mm.

Fig. 110. The distance from the origin of the inferior right thyroid artery to the origin of the subclavicular is 24.4 mm. Supreme right bicervical-intercostal trunk (male).

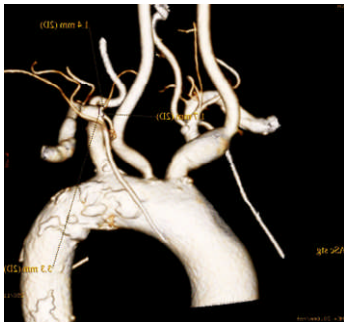


Fig. 111. Left subclavicular artery: supreme thyroid-intercostal trunk, 3.3 mm in diameter; the inferior thyroid has 1.4 mm, and the intercostal supreme 1,7 mm.

The diameter of the right inferior thyroid artery when it has its sole origin from the subclavian, I found it to be between 1.1-1.7 mm, and in the lower left thyroid artery I found it larger, being between 1.8-2.6 mm.

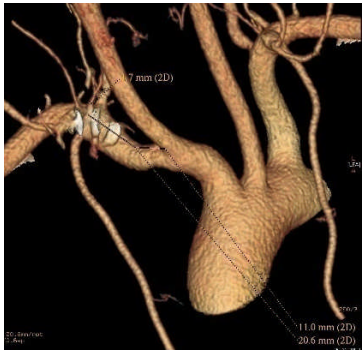


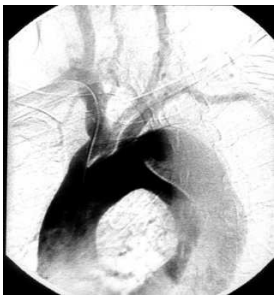
Fig. 112. The distance from the origin

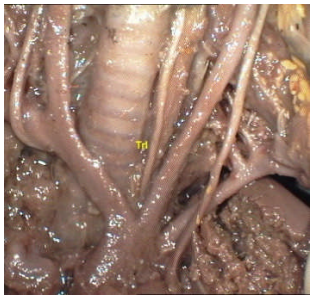
Fig. 113. The lower thyroid artery

of the right subclavicular- to the origin of the inferior thyroid is 31.6 mm; the diameter of the right inferior thyroid artery is 1.7 mm.

originating in the brachiocephalic trunk.

In 8 cases (6.95% of cases) I found the origin of the inferior thyroid artery in other arteries than the subclavicular artery (thyroidea ima artery), in 3 cases having origin in the brachiocephalic trunk (2.61% of cases) and in 5 cases (4.35% of cases) having origin in the aortic arch.





SUBCLAVICULAR RIGHT ARTERIES WITH RETROESOFAGIAN PATH

I found 6 cases of aberrant right subclavicular arteries (with retroesophageal path), of which 4 cases on CT angiography, 2 cases in adult women (both aged 49) and 2 cases in adult males (one 63 years old and the other 75 years old), the CT angiographies being performed on a GE LightSpeed VCT64 Slice CT scanner. The other 2 cases were discovered by dissection, one on a formalined male fetus, aged 9 months and the second case on a formalined corpse, of unspecified age.

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Fig. 116. First person, female, 49 years old, anterior view.

Fig. 118. The second case, female ,anterior view.

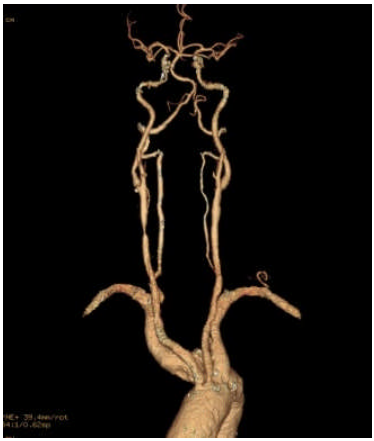

Fig. 120. The third case , male , 63 years old.

Fig. 122. Male , 75 years old , left lateral view.

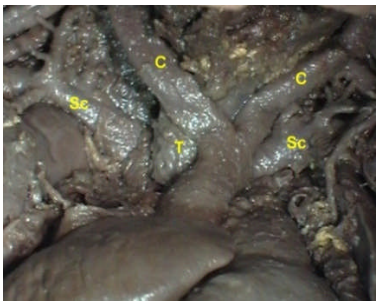

Fig. 125. Retroesophageal trajectory of right subclavian artery , right common carotid having pretracheal trajectory .

Fig 126. Retroesofageal trajectory of right subclavian artery, the origin of bicarotidian trunk being situated laterally left of the trachea.

TABLE NR. 10. FREQUENCY OF THE RIGHT SUBCLAVIAN ARTERY WITH RETROESOPHAGEAL TRAJECTORY. CONCLUSION

AUTHOR	PERCENTAGE%	DIFFERENCE
Nelson	0,52	+3,45
Elif	0,7	+5,21
Suzuki	1,4	+2,57
Lippert	1,0	+2,97
Yamaky	5,8	-1,83
Spielvogel	1,4	+2,57
Wakabayashi	0,5-2,0	+(1,97-3,47)
Natsis	0,1-4,0	(-0,03)(+3,87)
Matula	2,5	+,47

Bell	0,5-2,0	+(1,97-3,47)
Park	1,0	+2,97
Almenar Garcia	1,0	+2,97
Sakalihassan	0,4-1,4	+(2,57-3,57)
Reinshagen	4,0	-0,03
Manole	2,19	+1,78
PERSONAL RESULTS	*3,97*	

CONCLUSIONS

The morphology of the subclavicular arteries is very complex and very debatable, because there are differences, sometimes noticeable, in terms of the number of the branches, their origin and their morphometry, all being different from one author to another, not being consistent even with the last anatomical terminology, the one of 1988. The number and the order of the collateral branches of the subclavicular arteries cannot be specified, as they may differ from one individual to another, which is why a universally valid general scheme cannot be realized, as can be done in other arterial sectors.

There is no symmetry between the artery and the left subclavian collateral branches with the right subclavicular ones. Also, there is no concordance between the number and the type of the common arterial trunks that are formed between the collateral branches of the subclavicular arteries, which are not the same at both subclavicular arteries. Anatomical terminology and some authors describe only two arterial trunks, thyrocervical and costocervical. Other authors [Lippert, Bouchet], especially the classical ones [Testut, Rouviére, Paturet] as well as the Romanian authors, describe between 4 and 8 arterial trunks, the most variants being described by Lippert, who specifies (fact that I found out by myself), that in the formation of the arterial trunks participates most frequently the inferior thyroid artery (in 85% of cases), and less frequently, the internal thoracic and vertebral arteries (in 10% of cases).

The presence of atherosclerotic plaques at the level of the vertebral artery has a clinical importance in the movements of the vertebral column, which can lead to the detachment of an embolus, resulting in cerebral vessel infarction. The vertebral artery is vulnerable at the atlantoaxial level giving rise to a compromised blood flow, with the risk of a possible cerebrovascular accident [Cagnie].

This is also the case of the right subclavicular artery with retroesophageal path, which according to most authors is asymptomatic, being able to present disorders only in association with other anomalies: they had infections of the recurrent respiratory tract, dyspnea, stridor, obstructive emphysema, following compression exercised at the level of the cross of the clavicle with the esophagus and the trachea.

The anomaly could also have a racial character, occurring more frequently among blacks (36%), followed by Caucasians (16%), and in a small study, the Japanese found it only in men in a percent of 1%.

Its common origin is frequently associated with retroesophageal subclavicular arteries.

The abnormal presence of the aortic arch vessels has a considerable impact on the aortic arch reconstruction techniques and brain protection methods when the graft technique is carried out to perform a total arch replacement, an accurate preoperative diagnosis being very important in selecting an appropriate surgical strategy in patients with anomalies of the aortic arch vessels, and the morphometric results are very useful in designing the aortic stent.

Anatomical variations and morphometric data provide important information, especially for patients undergoing aortic endovascular intervention, mainly in choosing the size, the shape and the type of the angiographic catheters and the devices to be delivered.

ORIGINALITY OF THE WORK

• Establishing the morphological characteristics of the subclavian arteries through several working methods, the morphometry (exo and endoarterial) being determined only by angioCT.
• The endoarterial morphometry performed in the last years is less commonly found in the literature, and I performed it both on the subclavian artery trunk and on its collateral branches, which is very useful in the design of the aortic stent.
• Bilateral comparison right / left and according to sex of the morphometry of the subclavicular arteries.
• The description of a much larger number of arterial trunks than the anatomical terminology describes and some arterial trunks not indicated or reported of a small number of authors.
• Description of a relatively large number of retro-oesophageal right subclavian arteries (6 cases),which some authors describing in articles published in well-quoted magazines, even a single case.
• I mention the two cases of retroesophageal arteries with bicarotidial trunk and in particular the only case of a successful retrohephageal artery with a straight vertebral artery originating in the aortic arch, a variant it was found only in [Wang].
• I also mention the only case I discovered of the left vertebral artery with its origin in the left common carotid artery.
• The large number of vertebral arteries with origin in the aortic arch, my percentage (7.14% of cases) being the highest in relation to the cases described in the literature that I had the opportunity to consult.

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