Int. J. Morphol.,
29(1):182-186, 2011.

Variation of the Origin of Aortic Arch Branches: In Relationship with Plates of Atheroma

Variación del Origen de las Ramas del Arco Aórtico: Relación con Placas de Ateromas

Luis A. Yeri; Jorge E. Gómez; Sergio Fontaneto & Marcia Espósito

YERI, L. A.; GÓMEZ, J. E.; FONTANETO, S. & ESPÓSITO, M. Variation of the origin of aortic arch branches: in relationship with plates of atheroma. ***Int. J. Morphol., 29(1)***:182-186, 2011.

SUMMARY: The aortic arch branches variations have called the attention of several authors, who have handled studies and classifications, both human and in different animals. The common trunk, which is between the brachiocephalic trunk and the common left carotid artery, is the most common variation. We conducted a descriptive and randomized study of the presence of the trunk mentioned before, trying to establish the possible relationship between this variation and the distribution plates of atheroma. The lumen observation makes it possible to define and check the distribution of the ostium, among the common ostium and the ones with common trunks. Regarding the plates of atheroma, it was found that there is a slight prevalence in common trunks cases, with respect to the classics (no variety) or the ones who had common ostium. In all cases, the presence of a plaque in the distal aortic arch was certified near the left subclavian artery. The knowledge of the existence of the common trunk sets up an act of academic interest, as practice interventions and diagnostic imaging and clinical work, since the presence of the common trunk might be related to the prevalence of the plates of atheroma at the level of its origin.

KEY WORDS: Aortic arch; Atheroma; Variations of the aortic arch branches.

INTRODUCTION

The origins of the aortic arch branches (AAB) have been observed for a long time; Bergman *et al*. (2008) shows a picture of a Vesalius (1543) a common trunk (CT), between the brachiocephalic trunk (BCT) and the left common carotid artery, (LCC). It constitutes the most common variation in 7 and 27 % of cases.

Some authors do not provide statistics, but they contribute with classifications. Cruveulhier (1837) mentions four groups, according to approximation, multiplication, transposition of the branches, and finally by a combination of these events, the first group belongs to the CT (Heitzmann, 1885). He schematized the possible variations (Parsons, 1902). He has studied the aortic arch branches in different animals, and has established the species to which each variety belongs (Rigaud, 1930). He observes the adaptation of the aortic arch to the dimension of the thorax, he classifies them in saggitals, which have a tendency to approximate its branches and fronts, which have a tendency to spread.

Among those authors who provide data rates, regarding the emergence of the CT, we find Adachi (1928), who highlight the presence of common trunk in 11.5% which corresponded to 10.9% (type B). That is to say, without left vertebral artery originated arch, and, to 0.6% (type D) which is added the presence of left vertebral. Williams & Edmonds, (1932) observed the arches from light, detected the presence of common ostium (CO) in 19.2%. De Garis (1938), who studied the arch in *Phitecus rhesus,* and found the CT at 11.9%; Pontes (1939) who found them at 7.7 %, explaining them as a product of an early division. Wright (1969) who mentioned that they are found at 7%; Moor (1992) at 27%. Recently Yazar *et al*. (2003) described them and were found at 10%. Suresh *et al.* (2006) who noted them in 16.6% and Nayak *et al*. (2006) in 9.66%.

Regarding the observation of the aortic arch of atheroma (Méndez *et al.*, 1998) who studied the ascending aorta by the transesophageal echocardiography, in which he

*Laboratory of Vascular Anatomy. Second Course of Anatomy. Faculty of Medicine. Universidad de Buenos Aires, Argentina.

highlights it as a thrombogenic area. Aliyu & Poon (2002) who mention, at this level, the aortic arch of atheroma lesions, which are responsible of stroke. Fujimoto *et al.* (2004) who mentions the aortic arch of atheroma formation which involved, the aortic arch and the origins of its branches. Rutherford (2006) he stressed the arch and its branches origins as a location of atherosclerosis. Van der Linden *et al.* (2007) who carried out topographies the aortic arch of atheroma in the ascending aorta and arch, by means of transesophageal echocardiography and epiaortica.

The purpose of this communication is: a) To make a positive contribution to the existing statistics of the variation of the aortic arch branches, and in particular to the presence of the CT, and b) To establish a relationship between the variation mentioned and the distribution of the aortic arch of atheroma.

MATERIAL AND METHOD

Two sets of aortic arches, in a total of 55 adult corpses fixed in formaldehide at 10% were examined. The first series (A): 35 arches. The second series (B) were 20 isolated arches. External and internal diameters of the AAB: of the ascending aorta (ASCA) and the distal aortic arch (DAA) to the left subclavian artery (LSC), using a size "Vernier Caliper" 125 x 0.02 mm were observed and measured in both variations.

In the B series, there was also an observation of the location of aortic arch of atheroma. A descriptive study was conducted and the data was processed with XLSTAT 2008 ®. The representative cases were photographed with a camera of 10 mega pixels.

For the study of light from the arc in A series, longitudinal incision was made on the bottom, through which endoluminal shaping the ostium of the AAB are observed. In the B series, excision of the anterior arch was performed, complemented by another incision on the anterior side, close to the implementation of its branches. Thus the entire surface of the aortic arch, the morphology of the ostium in the AAB and the distribution of plate of atheroma can be observed.

RESULTS

Total CT findings were in 36.4% (20/55), corresponding to the series A, 37% (13/35) and series B, 35% (7 / 20) (Figs. 1 and 2). It is noted that LCC artery, begins from the medial edge of BCT (Figs. 2 and 3).

The presence of common ostium (CO), where the holes in the BCT and LCC were contained in a larger one, was 9.09% (5/55) (Fig. 4-II).

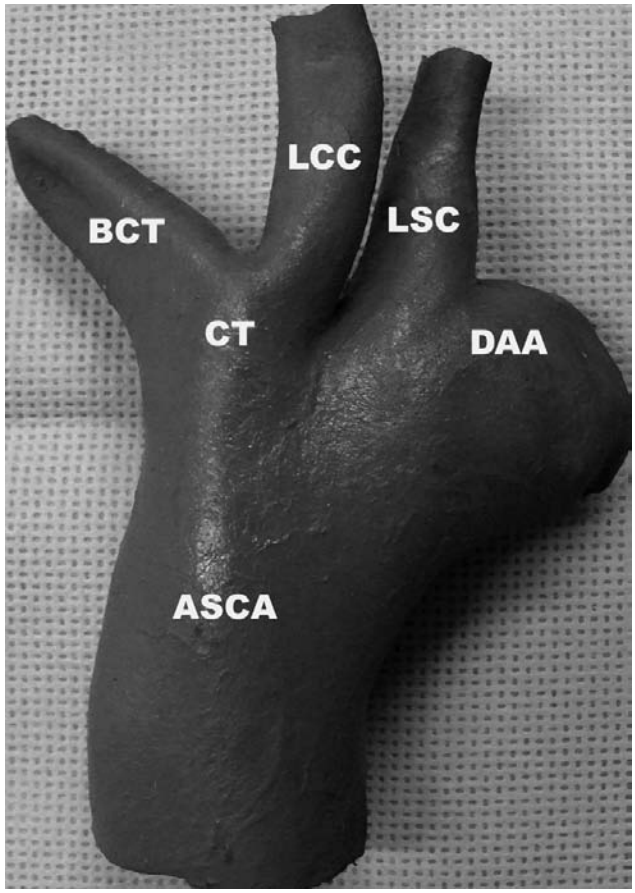

Fig 1. Previous view of the aortic arch and its branches. Presence of the common trunk (CT), brachiocephalic trunk (BCT), the left common carotid artery (LCC), left subclavian (LSC), ascending aorta (ASCA), Distal aortic arch (DAA)

Table I. External diameter (mm) of the aortic arch and its branches. Maximum diameter (Ø Max.) Minimum diameter (Ø Min) Diameter average (Avg.), Standard deviation (SD) Confidence interval (CI).

	BCT	LCC	LSC	CT	AASC	DAA
Ø Max.	20.0	14.0	17.9	26.0	38.0	29.3
Ø Min.	9.4	5.0	6.6	16.0	18.6	13.3
Ø Avg.	13.2	8.5	11.0	20.7	26.8	21
SD	3.0	1.9	2.6	2.8	5.4	4.8
C.I al 95%	12.4-14.0	8.0-9.0	10.3-11.7	19.2-22.2	24.2-29.4	18.7-23.4

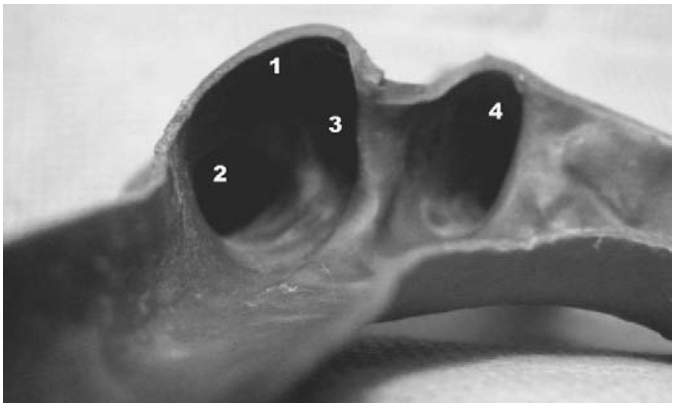

Fig 2. Luminal view. 1. Common trunk ostium, with a spur on separating high; 2. Ostium of the BCT. 3; Ostium in the LCC artery; 4. Ostium in the LSC artery.

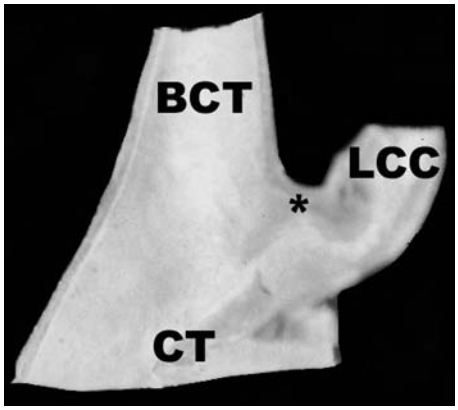

Fig 3. Coronal section of the common trunk (CT). It is observed how the LCC artery arises from the medial edge of the BCT. The ram (*) of separation is elevated to the plane of the single ostium.

Table II. Internal diameter (mm) aortic arch and its branches. Maximum diameter (Ø Max.); Minimum diameter (Ø Min); Diameter average (Avg.); Standard deviation (SD); Confidence interval (CI).

	BCT	LCC	LSC	CT	AASC	DAA
Ø Max.	19.0	12.0	17.0	23.0	31.5	24.4
Ø Min.	2.7	2.0	3.3	9.6	16.9	11.4
Ø Avg.	11.5	7.9	10.1	17.6	23.9	18.2
SD	3.0	2.3	2.9	4.1	4.5	4.0
C.I. 95%	10.7-12.3	7.2-8.5	9.3-10.9	15.6-19.6	21.7-26.1	16.3-20.1

Table III. Disposition of the aortic arch branches ostium.

Classics		34.5%	(19/55)
		30.9%	(17/55)
CT		16.4%	(9/55)
		18.2%	(10/55)

Table IV. Number and distribution of the aortic arch of atheroma.

		BCT	LCC	LSC	ARC	AASC	DAA	SUBTOT
CT	6		1	7	1	6	11	32
CH	4	2	2	6	2	1	4	21
CLASSIC		3	3	7	1	3	10	27
Total	10	5	6	20	4	10	25	80

Regarding the organization of the ostium, when CT is present, the ostium in it and the ostium of the LSC artery in 18.2%, are distant and in 16.4%, are nearby. In cases of absence of the CT, the ostium are located equidistant 30.9% (17/55) and in closed ostium in the BCT, the LSC is distant in 34.5% (19/55) of the cases (Fig. 4 and Table III).

The appearance of vertebral artery occurred in 4 cases (7.3%) with one originating from CT (1.8%).

With regard to measurements of external and internal diameters can be observed in the data Tables I and II. As aortic arch of atheroma in B series. 80 plaques in total were found, of which: 32 (40%) appeared in the arches with CT, 27 (33.5%) no change in the arches, 21(26.4) in the cases of CO.

In addition of the presence of variations were found 25 (31.3%) plaques in the DAA, 20 (25%) at the ostium of the LSC, 10 (12.5%) in the AASC, 6 (7.5%) in the ostium of LCC, 4 (5%) at the arc and 5 (6.25%) in the ostium in the BCT (Fig. 5 and Table IV).

Fig 4. Axial section of the aortic arch at the origins of its branches, luminal view. Distribution of the ostium. Normal or classic I, II common ostium at the spur of the circumference of the larger ostium, III CT, with high spur of the plane of the circumference of the larger ostium.

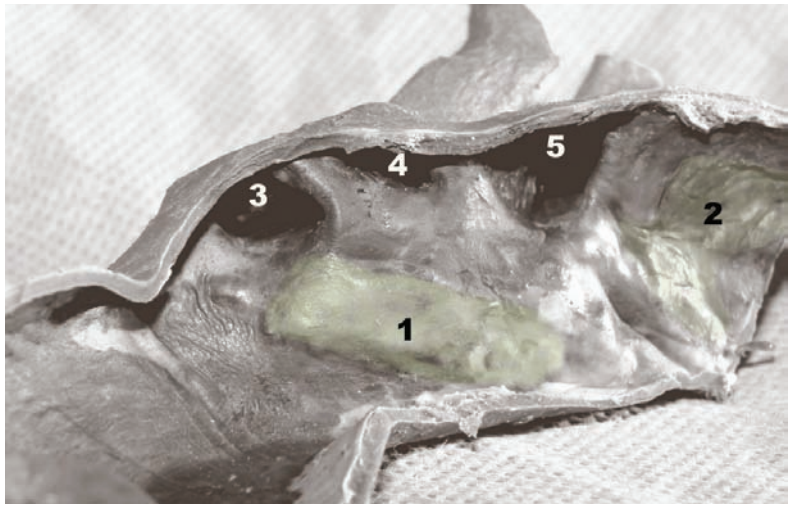

Fig 5. Luminal view. 1 and 2 the aortic arch of atheroma. 3 BCT, 4 LCC, 5 LSC.

DISCUSSION

According to our observations, the presences of the CT have a higher percentage in the total 20/55 (36.4%); as in separate series: A, 13/34 (37%) and in B, 7/20 (35%), compared to the rest of the authors (Adachi; De Garis; Nayak *et al.*; Moor; Paula Pontes; Rigaud; Suresh *et al.*; Williams; Wright; Yazar *et al*.), whose ranks range from 7% to 27%.

This difference may obey to the simple external observation and can rule out cases which appear to be mere approximations and that the lumina vision can distinguish between the two ostium content into a larger ostium and those separated ostium by a spur which is located on a high plane on the circumference of the larger ostium (Fig. 2).

We did not find a direct relationship between the presence of the CT and the saggital plane of the aortic arch, as it is stated by Rigaud, and the position of Pontes would seem more appropriate, about the CT, which is a consequence of an early division.

In the case of CO, the ram, which was mentioned before, is located in the same plane of the circle marked by the larger ostium, which contains the BCT and the LCC (Fig. 4-II).

In relation to the diameters of the AAB, AASC and DAA, our observations have given somewhat higher values than those observed by Wright, because the author will use it for fixing paraffin-conservation.

Regarding aortic arch of atheroma, 80 of them were observed in total, spread over the DAA (31.3%) at the arch (5%) and the AASC (12.5%) apart from the existence of variations. In classic cases, it was observed in one (33.5%) and in cases with a CT (40%), of which 6 / 80 (7.5%) were located at the ostium in the CT. In the case of CO, there were 21/80 (26.4%) including 4 / 80 (5%) which were located at the level of its ostium. Authors such as Mendez *et al*., Aliyu & Poon, Fujimoto *et al*. and Van der Linden *et al.* emphasized in their studies and epiaortic ultrasonic transesophageal echocardiography the aortic arch and atherosclerosis-prone area, without specifying the distributionand quantification of the plaques.

Rutherford, who emphasizes that the arch and the origins of its branches are sites of atherosclerosis seat. In our study the distribution plate at the ostium in the AAB, were observed in one (25%) in LSC; at (7.5%) in LCC; in one (6.25%) in the BCT. In the series B, the presence of CT produce hemodynamic changes; it is an observed phenomena responsible for the locations of the plates, if we compare their prevalence (7.5%) in the case of CT against (6.25%) of BCT and the (5%) of the CO. Therefore this change should be taken into account in future investigations of the aortic arch showing the formation of aortic arch of atheroma.

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RESUMEN: Las variaciones de las ramas del arco aórtico han llamado la atención de diversos autores, quienes han realizados estudios y clasificaciones, tanto en humanos, como en diferentes animales. El tronco común, entre el tronco braquiocefálico y la arteria carótida común izquierda, es la variación más frecuente. Realizamos un estudio descriptivo y randomizado de la presencia del mencionado tronco, tratando de verificar la posible relación entre dicha variación y la distribución de placas de ateroma. La observación luminal permitió precisar, entre los casos de ostios comunes y aquellos con troncos comunes, y comprobar la distribución de los ostios. En cuanto a las placas de ateroma, se observó una leve prevalencia en los casos de troncos comunes respecto de los clásicos (sin variedad) o de los que presentaron ostios comunes. En todos los casos se verificó la presencia de una placa en el arco aórtico distal, inmediato a la arteria subclavia izquierda. El conocimiento de la existencia del tronco común, constituye un hecho de interés académico, como práctico en intervencionismo, diagnóstico por imagen y la clínica. La presencia del tronco común pareciera estar relacionada con cierta prevalencia de placas de ateroma a nivel de su origen.

PALABRAS CLAVE: Arco aórtico; Placa de ateroma; Variaciones de las ramas del arco aórtico.

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Correspondence to:
Luis A. Yeri
3638 E. Zeballos street; Tower 2
Floor nº 5, Apartment 4.
Zip Code: 1872, Town: Sarandí.
Buenos Aires – ARGENTINA

Email: andresyer@yahoo.com.ar

Received: 27-08-2010
Accepted: 16-11-2010